



How Artificial Intelligence Will Transform Airports and Customer Experience.

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CONTENTS

02

Executive Summary

03

Aviation Industry Overview

05

Current State of AI in Aviation

07

Opportunities

09

AI-driven innovation at
Airports at each touch point

12

Use Cases

16

Role of Airport Operators in
Adopting AI and Change
Management Approaches for
Successful AI Execution for
all the Stakeholders

21

Challenges to address

24

Case studies

28

Conclusion - Why Airports will
take a lead in adopting AI



EXECUTIVE SUMMARY:

BY NAGA SATYANARAYANA VP

The world has certainly shifted to a digital realm, and customer experience stands as the critical driving force behind this change. Businesses must aggressively adopt technology to provide a seamless digital experience that meets their customers' needs. In the digital age, outstanding customer experience is not just optional but also essential for survival and success.

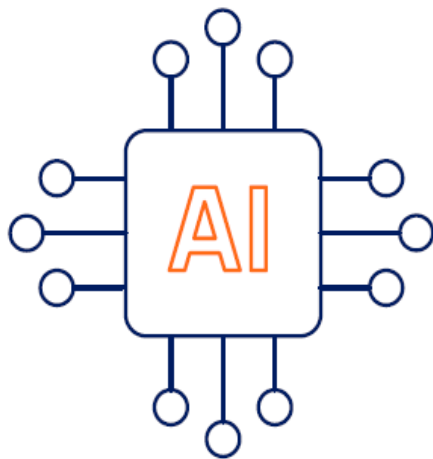
Artificial Intelligence (AI) is rapidly transforming various industries. Aviation is no exception by any measure. In fact, the use of AI creates new business opportunities and optimises operations for the aviation sector. One distinct area where AI has the most potential is in enhancing customer experience, both at the airports and during flights. AI can also greatly improve airport operations, resulting in quicker shifts in the turnaround times for routine-dependent tasks. Operational

efficiency, enhanced passenger experience, and bolstered security are the three pillars where AI could bring significant transformation.

At a fundamental level, the key issue is first to understand the various available technologies and, second, to identify practical applications that can yield tangible benefits. To achieve this, airports must enhance their internal technological capabilities. This paper explores the opportunities and challenges associated with airports adopting Artificial Intelligence and related technologies to improve the overall passenger experience and regulatory and ethical considerations, sustainability, and environmental impact.

We also examine the role of airport operators in equipping themselves with these next-generation technologies while ensuring the protection of passengers' private data and safely managing the information needed to create enjoyable experiences.

Like with any emerging technological environment, AI systems have their own set of unique challenges that must be addressed.



We are discussing the below topics in this whitepaper:

- ❖ Current trends in the aviation industry
- ❖ A broad overview of the market for AI in the Aviation industry
- ❖ Business opportunities with the adoption of AI technologies in airports
- ❖ AI-driven innovation within the airport industry
- ❖ A framework for successful AI integration in airports and identifying the relevant stakeholders
- ❖ Passengers and airport operators use cases and findings that are tailored to their needs
- ❖ AI system's challenges to address

“We will not see complete substitution. Digital is an additional complexity - it does not mean complete substitution of manual processes.”

INDUSTRY OVERVIEW:

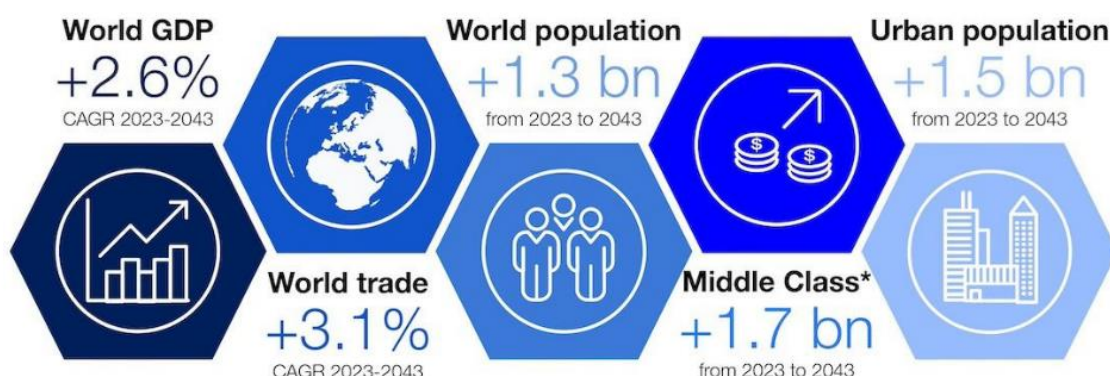
The overview of the aviation industry

The Global Aviation Market is projected to be valued at USD 333.96 billion in 2024 and is expected to grow to USD 396.15 billion by 2029, with a compound annual growth rate (CAGR) of 2.87% during this period.

The COVID-19 pandemic had a significant impact on the aviation market, and its effects are likely to continue throughout the forecast period. In the commercial sector, passenger traffic experienced a sharp decline in 2020 and 2021. However, by 2022, the aviation industry started to recover and is slowly returning to pre-COVID-19 levels. The current estimate for 2024 anticipates global passenger volume to be around 9.5 billion, which is 104% increase compared to 2019 level and reflects a 10% year-on-year (YoY) growth from 2023.

According to the International Air Transport Association (IATA), global passenger numbers are expected to nearly double by 2037, reaching 8.2 billion annually. This makes investing in technology for efficient passenger processing and capacity management at airports essential. Technology usage remains prevalent at various stages of the travel journey, with 90% of passengers utilising technology for booking and heavily relying on mobile devices for reservations, wait times and onboard activities. Additionally, 64% of passengers consider shorter waiting times at the airport to be the most critical factor in the travel process, and technology can play a key role in achieving this objective.

GDP, trade, and population growth are the main drivers of air traffic growth



Picture source: S&P Global Airbus GMF

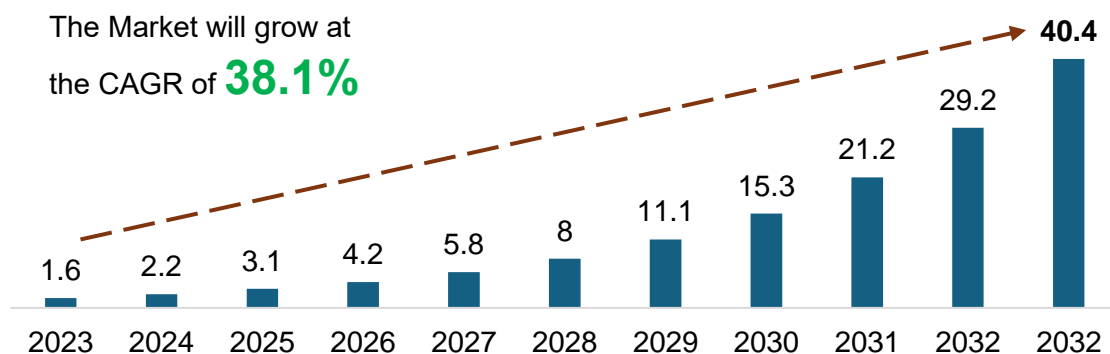
CURRENT STATE OF AI IN AVIATION:



The Global Artificial Intelligence in Aviation Market is projected to grow from USD 1.61 Billion in 2023 to USD 40.04 by 2033, exhibiting a compound annual growth rate (CAGR) of 38.1%. This growth is driven by the rising use of pattern recognition, auto-scheduling, targeted advertising, and customer feedback analysis to enhance the flight experience,

as well as the increasing implementation of artificial intelligence for efficient and seamless check-in processes, among other factors.

Global AI in Aviation Market Size (USD Billion)



source: AI in Aviation; www.market.us

AI integration in aviation is not just a futuristic concept; it is a current reality that is reshaping the landscape of air travel and operations. Initially, AI was used in air travel through automated check-in kiosks and chatbots. The transition from manual processes to digital and AI-driven solutions has significantly enhanced operational efficiency and passenger experiences. Digital technology has empowered airlines to offer more personalized services, improve communications, and boost overall passenger satisfaction. Today, AI solutions such as predictive maintenance, smart power management, and dynamic flight planning are being used to tailor passenger experiences and automate customer service. This approach enables pre-emptive action, cutting costs associated with unexpected downtime.

AI is also advancing sustainability efforts. By optimising flight routes, speeds, and altitudes, AI helps reduce fuel consumption, contributing to environmental goals. Emissions monitoring is another area where AI provides airlines with the tools to track and manage carbon output, allowing them to meet regulatory standards for sustainability.

The current state of AI in aviation is rapidly evolving, with airlines, airports, and regulatory bodies increasingly adopting AI technologies to enhance safety, efficiency, and customer satisfaction. Ongoing collaborations between technology providers and aviation stakeholders indicate that the future of AI in air travel is not only promising but also essential for the next era of the industry.

Below is a pictorial representation of the current state adoption of AI in the aviation industry.

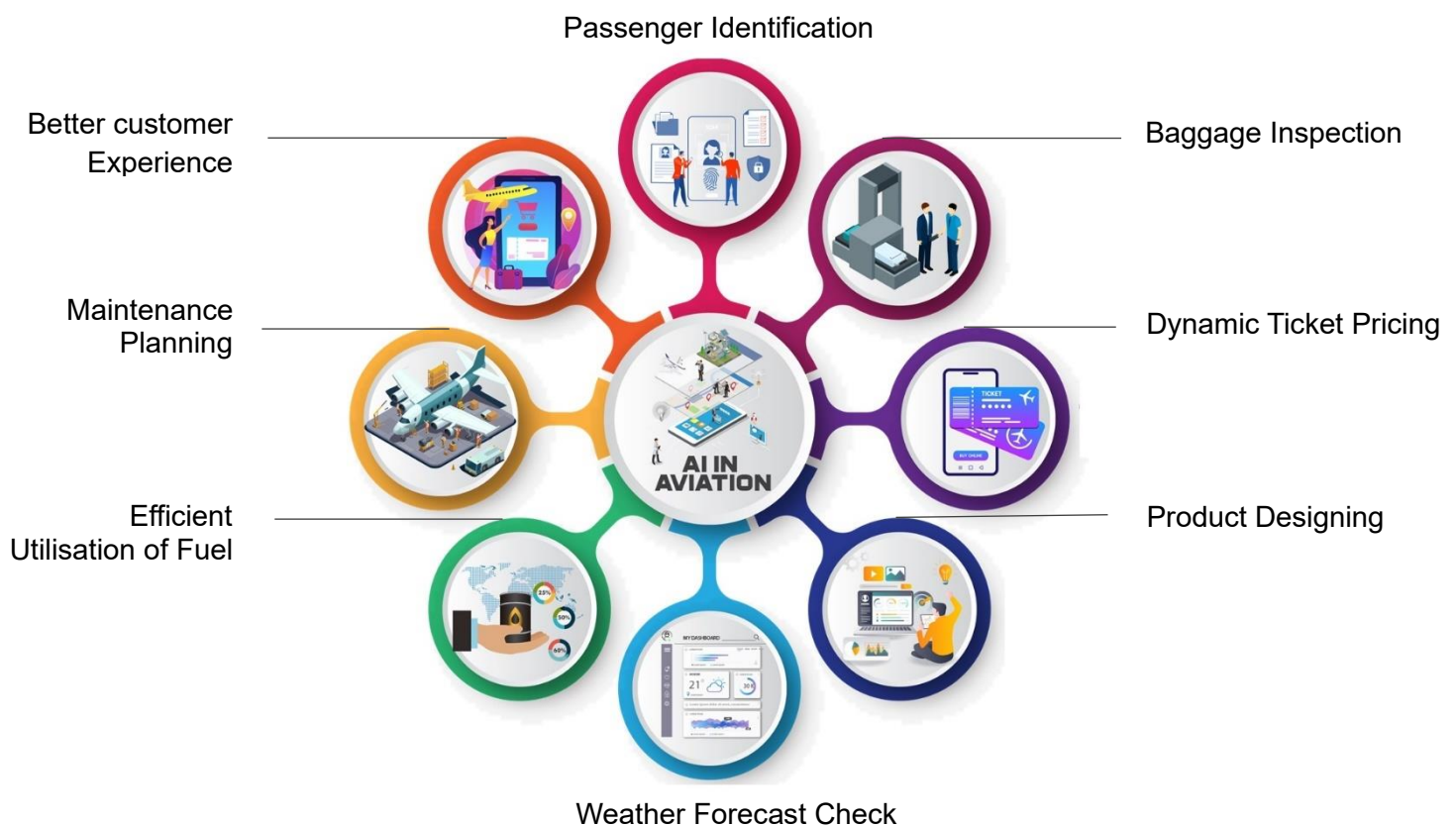
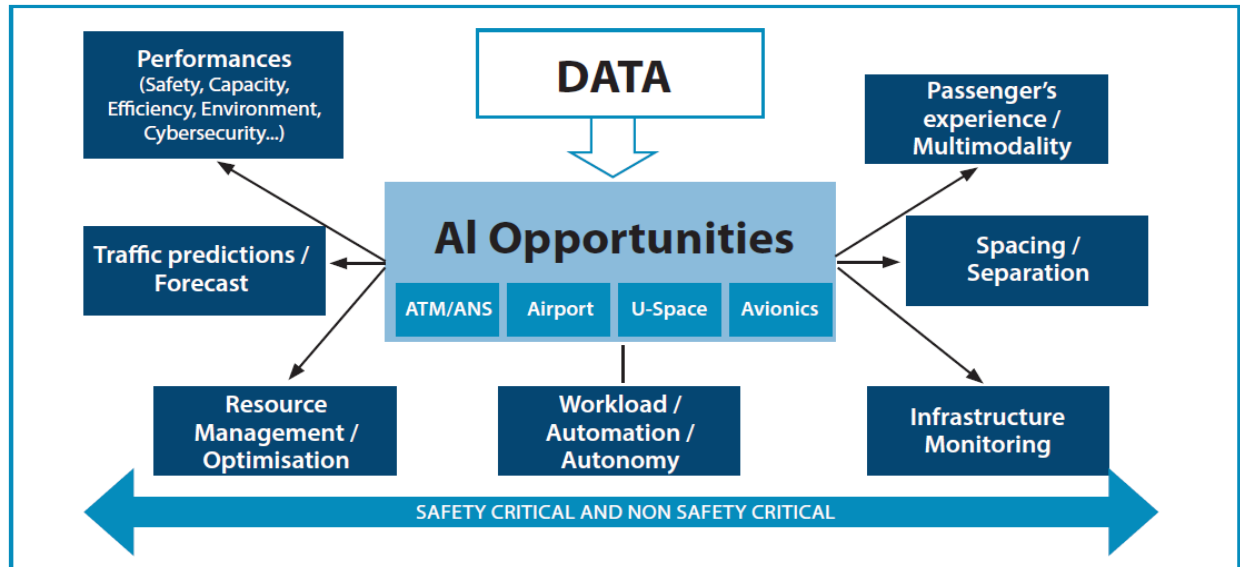


Image source: turilytix.ai/ai-in-aviation

BUSINESS OPPORTUNITIES FOR AI ADOPTION IN AIRPORTS:



ICAO:- Euro control 2020

Enhanced Passenger Experience:

Passenger experience can be enhanced using AI by providing personalised services in areas such as multi-modal, multi-lingual, baggage handling, shopping, food & dining, efficient navigation within the airport, etc. Virtual assistants are one way that the passenger journey can be significantly improved.

drop facility that uses facial recognition to allow passengers to drop off their bags without scanning a boarding pass.

AI-powered systems can automate routine tasks, freeing up human operators to focus on more complex decision-making. This can lead to increased efficiency, workload automation, and Safety.

Improved Operational Efficiency:

Airports can improve their operational efficiency through predictive maintenance, optimised resource allocation, and security enhancement using technologies such as Machine Learning and Data Mining. For example, BLR Airport has a self-baggage

Cost Reduction:

Reduction of operational costs is a direct benefit of improved operational efficiency and AI can help reduce operational costs through optimising resource management, including personnel, aircraft, energy optimisation, process automation, and

reduced downtime. For example, adopting AI-powered predictive maintenance significantly reduces operational costs by analysing vast amounts of real-time sensor data from airport equipment. AI algorithms can accurately predict potential failures before they occur.

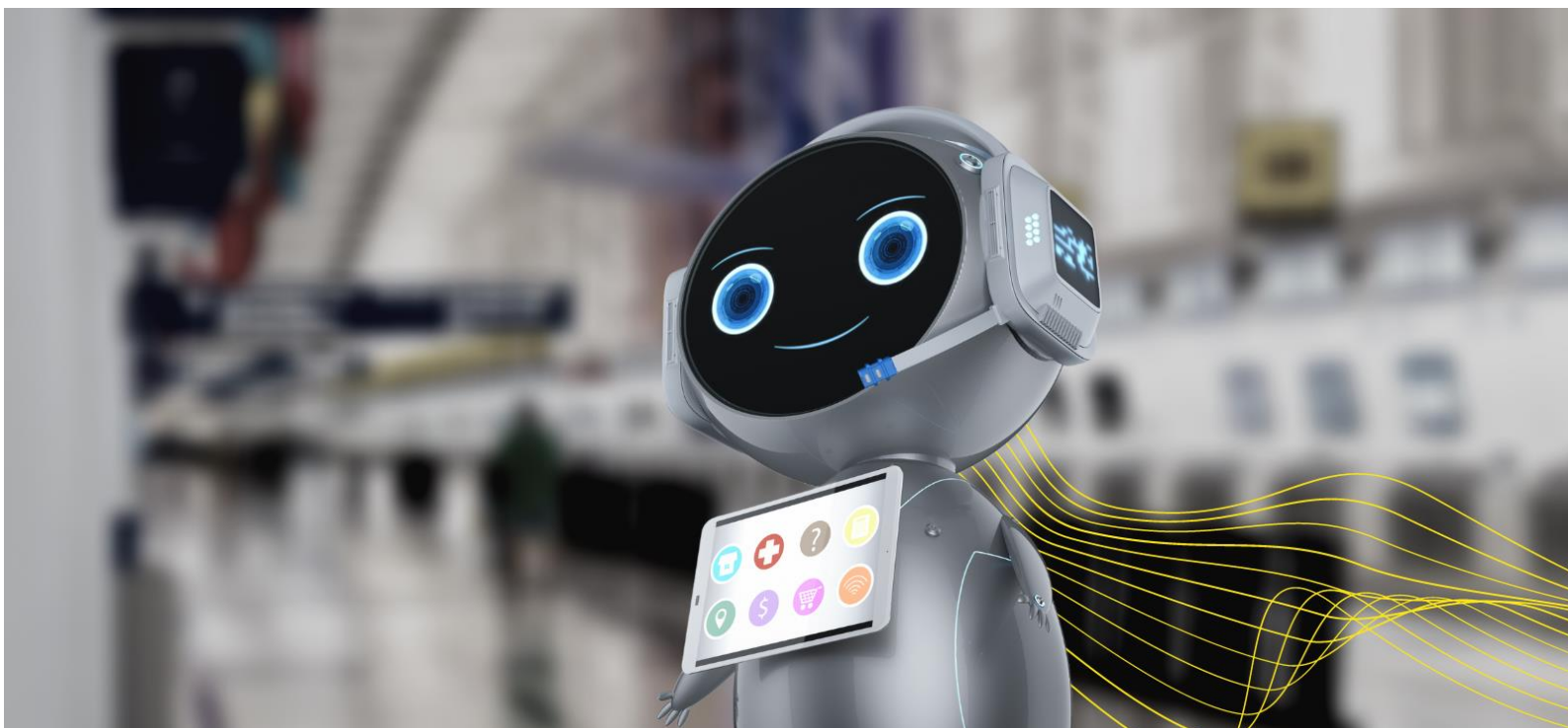
Revenue Management:

AI-powered systems significantly streamline operations and analyse the real-time demand and supply data by adjusting prices for retail, food, and beverages outlets. It predicts the seasonal fluctuations demand to optimise prices accordingly. It can also optimise the inventory

management levels for retail and food, reduces waste and maximise the revenue.

Innovation and Competitive Advantage:

Leveraging advanced AI technologies such as GenAI-based Chatbots, Natural Language Processing, and neural networks can enable new business models in the aviation industry and help deliver innovative experiences to passengers thus providing the airports a competitive edge.



AI-DRIVEN INNOVATION AT AIRPORTS AT EACH TOUCH POINT:



Touchpoints where AI can enhance the customer service experience	AI-driven innovation	Course of action
Pre-Travel Guidance	<ol style="list-style-type: none"> 1. AI Chatbots on Websites and Apps 2. Personalised Travel Assistant 	<p>Travellers interact with AI chatbots to learn airport procedures, parking requirements, and check-in times. For example, a chatbot can guide them on the necessary documents for international flights, answer security protocol questions, or offer packing tips.</p> <p>A virtual assistant can deliver reminders personalised to the itinerary via email or app alerts, such as, "Your flight departs in 3 hours! Remember to check in online." It may also give the passenger some specific information about what to expect at the airport by using the passenger's historical travel data.</p>
Flight Status Updates	<ol style="list-style-type: none"> 1. Real-Time Notifications 	<p>For first-time travellers, AI analyses the flight schedule and sends updates about changes, delays, or cancellations making them prepared for it. For example, alert passengers to come earlier for screening if a flight is anticipated to be busy. The BLR Airport app (BLR Pulse) provides real-time notifications for passengers at Kempegowda International Airport in Bengaluru.</p>

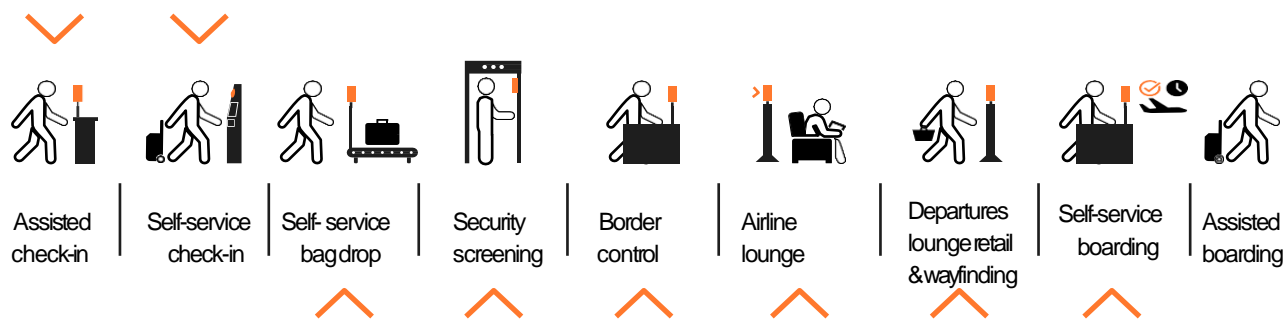
Arriving at the Airport	<ol style="list-style-type: none"> 1. Arrival Assistance 2. Smart Entry Points 3. Facial Recognition 	<p>While entering the airport, AI-assisted sign boards or digital displays can guide the passengers on where to go for check-in, baggage drop and security, based on their flight details. Using the airport app application with the Wayfinder feature will help passengers navigate the airport and find their way around.</p> <p>First-time travellers can utilise facial recognition technology at entry points, enabling a smooth entry without needing to show tickets or IDs multiple times. For example, Digi Yatra is one such app. Passengers can use their face to enter without the need to show their ticket and IDs multiple times.</p>
Check-In Support	<ol style="list-style-type: none"> 1. Self-Service Kiosks with AI Guidance 2. Baggage Drop Automation 	<p>With AI present at kiosks passengers who use airport apps can be assisted with step-by-step instructions, e.g., assistance with checking in, or printing a boarding pass, and baggage tags, etc., reducing anxiety and confusion.</p> <p>Self-baggage drop facilities will guide the process of baggage drop while performing the process in the background.</p>
Security and Boarding	<ol style="list-style-type: none"> 1. Security Checkpoint Assistance 2. Real-Time Wait Time Information 3. Interactive Kiosks 	<p>AI can provide updates on average wait times at security checkpoints through apps and digital screens, helping first-time travellers decide the best time to queue.</p> <p>Kiosks strategically placed adjacent to security checkpoints can provide information on which items require a separate removal/scan, alleviating anxiety about security processes.</p>
Wayfinding Navigation	<ol style="list-style-type: none"> 1. AI-Powered Mobile Navigation Apps 2. Augmented Reality Features 	<p>Passengers can use the airport app which provides live navigation assistance, showing the fastest routes to security checks, boarding gates, and lounge areas. This is particularly helpful for travellers who may feel disoriented in unfamiliar environments.</p>

Customer Service Integration	<ol style="list-style-type: none"> 1. Virtual Assistants at Information Counters 2. Feedback Channels 	<p>AI-powered virtual assistants can also provide real-time updates on flight status, airport amenities, and facilities including lounge, restrooms, and restaurant information for travellers. For example, Qatar Airways introduced the second generation of holographic virtual human cabin crew to assist its passengers in designing curated travel experiences.</p> <p>Apart from that, the AI tools can gather feedback through a mobile application from travellers so the airport staff can instantly address any issues to improve the overall customer experience.</p>
Personalized Boarding Notifications	<ol style="list-style-type: none"> 1. AI-Driven Notifications 	<p>Once at the gate, AI can send personalized notifications to travellers regarding boarding times, procedures, and any last-minute changes using the Flight Information Display System (FIDS) on the airport app. This ensures newcomers are up-to-date and feel confident about their boarding process.</p>
Emergency Assistance	<ol style="list-style-type: none"> 1. AI Chatbots for On-Demand Help 	<p>Once AI has gained this information, it can alert travellers with personalized notifications on when to board and where to go as well as any last-minute changes. This makes sure that first-time travellers stay informed and have confidence in making their way onboard.</p> <p>First-time travellers facing anything unusual, maybe an emergency, can flash AI chatbots on their mobile like mindless bots to fetch the nearest airport staff.</p>

USE CASES:

The smooth and uninterrupted travel experience for passengers at each touchpoint throughout the airport.

“Digital has become an essential element of the airport brand.”



Passenger Use case

1. Journey of a First-time Traveller with GenAI Platform Touchpoints

Context - A senior citizen is planning to visit his grandchildren in New Delhi for the festival season. Although the person has been to New Delhi a few times earlier, this would be their first time traveling via an airline.

Needs – The person has never been to an airport earlier and is not familiar with the processes involved in various aspects of a flight journey including check-in, boarding, baggage collection, etc. The passenger also has arthritis, making it difficult for them to walk long distances, so they need assistance at the airport. Also, the person is not well-versed in the English language, and prefers assistance in Kannada which is their native language.

Touch Points	Reaching the Airport	Terminal Entrance and Security	Check-in and Lounge	Gates and Boarding
Situation	Passenger needs to be informed about the flight schedule so that they can plan to reach the airport well ahead of time.	Passenger feels anxious about the security screening process. They are worried about the scanners and the long queues. Also, not fully aware of the documents required to enter the airport.	Passenger wants to check in the luggage and find a quiet place to relax before the flight.	By the time of boarding, passenger needs to reach the correct gate.

Opportunities & Needs

- | | | | |
|---|---|--|--|
| <p>The person is a first-time air traveller.</p> <ul style="list-style-type: none"> Needs a trustworthy partner to reach the airport. Assistance will be provided to help the passenger arrive at the right terminal. Assistance with carrying baggage from the vehicle drop-off area to the departure gate. | <ul style="list-style-type: none"> Awareness of security protocols at the airport. Knowledge of documents to be carried. Expedited security screening for entry. | <ul style="list-style-type: none"> Easy and simple check-in process. Assistance with baggage drop at the check-in counter. Details about available lounges at the terminal. Priority reservation for elderly citizens at the lounge. | <ul style="list-style-type: none"> Up-to-date information about the gates. Navigation to the correct gate. Provision to board via priority queue. |
|---|---|--|--|

Enhancing Customer experience through GenAI

<p>Through Machine learning, passenger is offered a range of options, including the most suitable modes of transportation, lowest fares, and most comfortable journey, aggregated data from various cab vendors shared with the Airport. Customer Service team can also arrange for ground staff to assist with wheelchair and luggage for passenger based on current and predicted resource allocation mechanisms.</p>	<p>Through Machine learning algorithms to fetch the passenger data with airline system integration. Airport Customer service team will guide and register passenger details with DigiYatra so that the entry and security screening are smooth and seamless.</p>	<p>Customer Service team can complete web check-in before the arrival of the passenger at the airport. The system then accesses a database of stored passenger information and uses machine learning to quickly identify the passenger and check them in for their flight without the need for manual verification. Lounge reservations can be made automatically on behalf of the passenger CX team that guides the traveller to the lounge using an in-built navigation system.</p>	<p>Timely reminders to the passenger about boarding time based on real-time information about flight schedules in Kannada. Navigation directions to the correct gate for boarding. Instructions include natural language directions in passenger's native language. After boarding the plane, the in-flight map guides the passenger to their designated seat.</p>
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Airport Operator Use case

2. Airport operations team readiness using GenAI Platform deployed at Touchpoints

Context – AI-powered airport operations team readiness, to provide real-time insights and how AI can help the airport management.

Touch Points	Pre- Arrival	Terminal Entrance and Security	Check-in and Lounge	Gates and Boarding
Situation	<ul style="list-style-type: none"> • Inconsistent staffing levels leading to operational bottlenecks • Difficulty in predicting peak passenger traffic • Inefficient resource allocation 	<ul style="list-style-type: none"> • Long Security queues and wait times • Inefficient baggage screening processes • Potential security risk 	<ul style="list-style-type: none"> • Long check-in queues • Inefficient baggage drop-off • Limited lounge capacity and suboptimal resource allocation 	<ul style="list-style-type: none"> • Delayed boarding processes • Optimize gate utilization • Minimize delays and disruptions
Opportunities & Needs	<ul style="list-style-type: none"> • Optimize staffing levels based on real-time passenger data • Proactively address potential issues before passenger numbers increase • Improve resource utilization 	<ul style="list-style-type: none"> • Streamline security screening processes • Reduce wait times and improve passenger flow • Enhance security measures 	<ul style="list-style-type: none"> • Reduce check-in time and enhance passenger experience • Optimize lounge capacity and service offerings • Provide personalised services and recommendations 	<ul style="list-style-type: none"> • Need to streamline boarding processes • Optimise gate utilisation. • Minimize delays and disruptions.

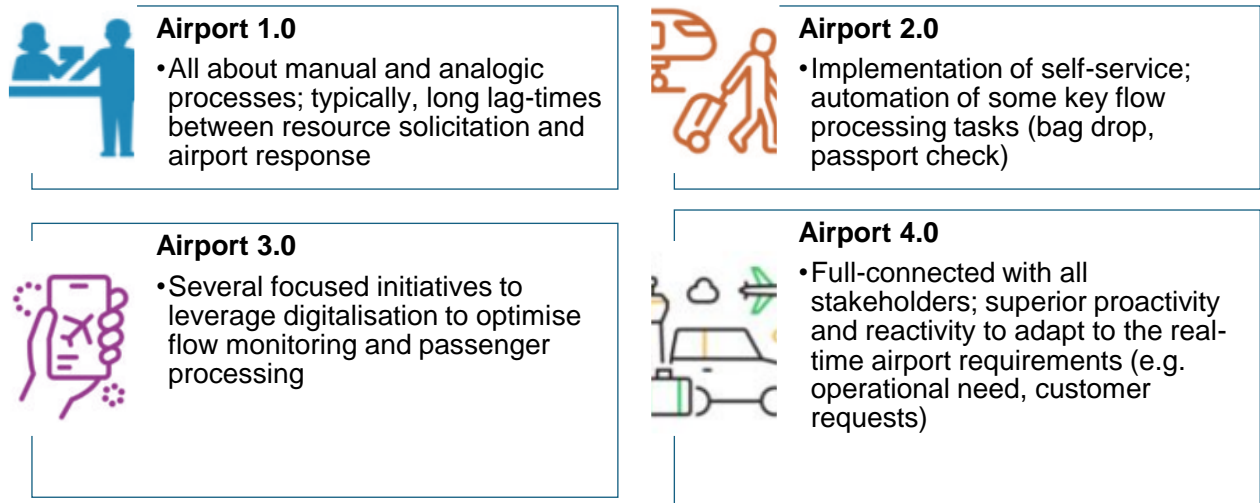
- Analysing historical data and real-time flight information to forecast passenger traffic and peak hours using predictive analytics
- Utilising AI algorithms to dynamically adjust staff levels based on predicted traffic, ensuring optimal resource allocation
- Tracking Key Performance Indicator (KPIs) like queue lengths and wait times to identify potential bottlenecks and dispatching staff accordingly
- Employing facial recognition and biometric scanners for faster and more secure passenger identification
- Using AI-powered 3D X-ray scanners to identify suspicious objects and expedite baggage screening
- Monitoring queue lengths and deploying additional resources using real-time queue management system
- Self-service kiosk for faster check-in and bag drop
- Deploying AI-powered virtual assistance to answer passenger queries and provide personalised assistance
- Using predictive analytics, forecast lounge occupancy and adjust services accordingly
- Through machine learning integration with airport stakeholders' system and social media, we can analyse and offer tailored recommendations to passengers for dining, shopping etc.
- Using real-time tracking system monitor passenger movement and identify potential bottlenecks
- Through smart gate management optimise gate allocation and boarding sequences to minimise delays and ensure smooth passenger flow
- Through predictive analytics can reduce equipment failures and schedule maintenance proactively to minimise disruptions.

ROLE OF AIRPORT OPERATORS IN ADOPTING AI ALONGSIDE OTHER AIRPORT STAKEHOLDERS:

“The role airport operators should play in adopting and transforming airports with innovative technology solutions for creating a smarter and more efficient travel experience”

Airports of all sizes are setting ambitious goals to enhance travel experiences and sustainably increase traffic. However, rapidly adapting to meet this new demand is challenging; physical expansions often have lengthy lead times, and improving staff training does not happen overnight. Additionally, airlines are continuously evolving. Airports require a new approach to move aircraft, passengers, and baggage more efficiently and predictably.

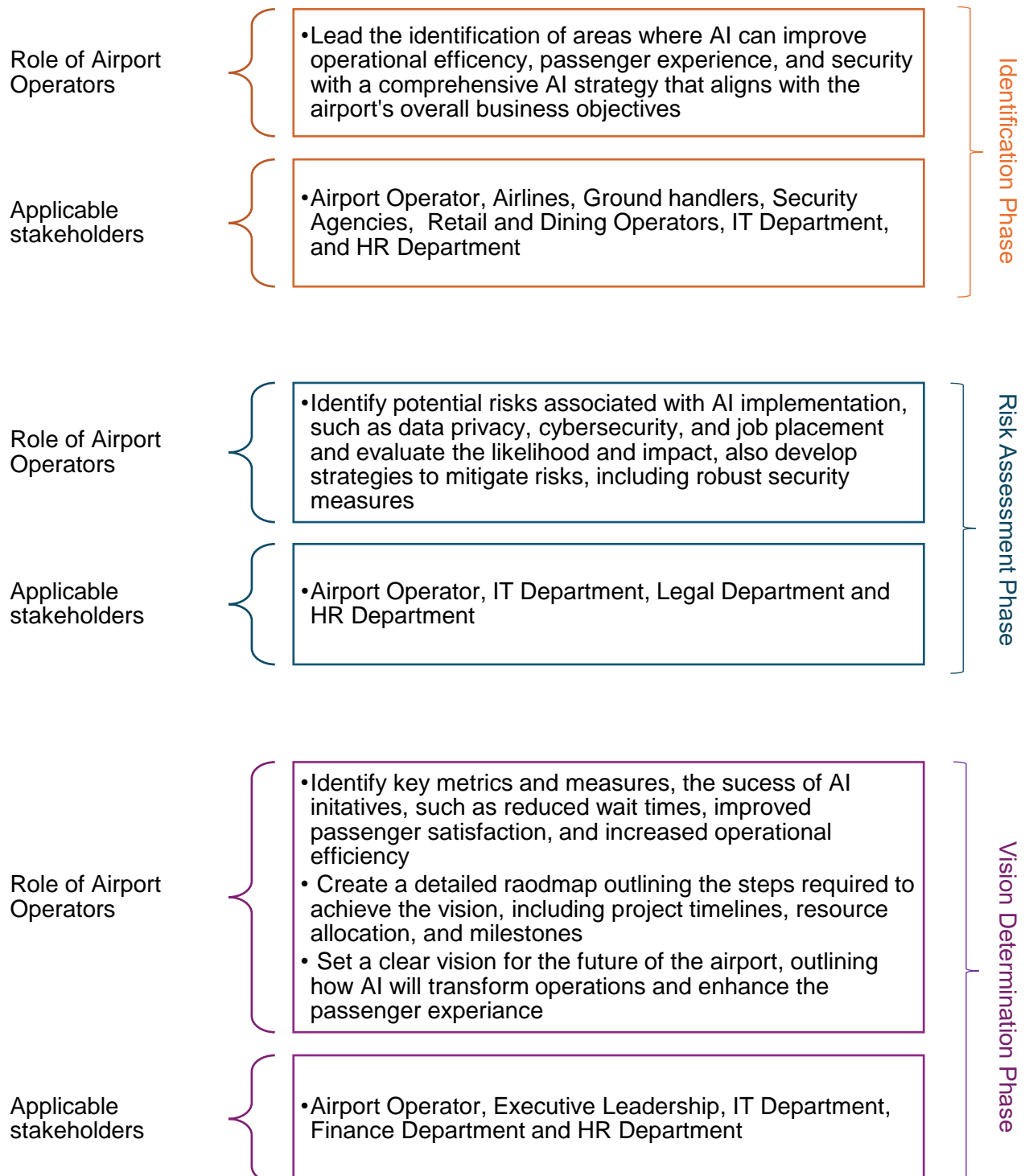
The evolution of the digitization of the airport industry is shown in terms of their level.



Airport operators are uniquely positioned to leverage AI technologies to revolutionize the passenger experience and optimize airport operations. As the aviation ecosystem's key stakeholders, they should work collaboratively to adopt AI across the industry processes.

For the transformation of terminal operations, the role of Airport Terminal Operation to Play -

Most of the routine work will be done using technology & reducing overlapping between departments with phase wise.



Change Management Approaches for Successful AI Execution for all the impacted Stakeholders

In today's rapidly growing business landscape, AI is a game-changer for organizations seeking to lead through the competition curve. However, implementing AI technologies is notoriously daunting, especially for new entrants in this field. Implementing change management tools on such a large scale can be complex and challenging. That's where artificial intelligence (AI) steps in as a powerful tool to drive successful digital transformation through effective change management.

Five Key Elements of Change Management Approaches for AI Execution:-



1. Define a Clear Vision:-

To maximize the benefits of AI, need to define a clear vision. This involves identifying the specific problems that AI can solve and setting clear goals for AI implementation. By defining a clear vision, organizations can ensure that their AI initiatives are aligned with their overall business strategy and objectives.

- a. AI strategy Goals – Outline the strategic ambitions of the AI strategy, emphasizing the ultimate goals that the company should aim to achieve
- b. Strategic initiatives – Establish a concise set of high-level initiatives that translate goals into actionable steps

Putting focus on the human for value and adoption:-

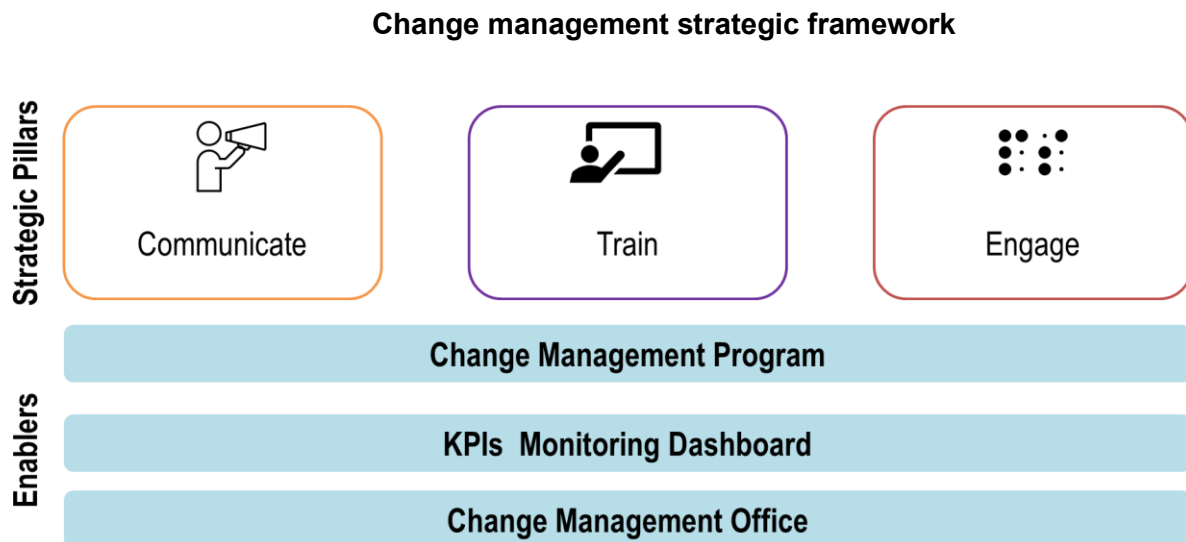
GenAI solutions augment how employees get work done, the workforce role becomes the clearest point to recognize value and monitor adoption.

Objectives and functions of Human Resources within all the units of civil aviation sector which are involved in operations collectively at both international and domestic level.

Applications of AI in aviation for resource allocation:

- ❖ Predictive staffing
- ❖ Skill based match

- ❖ Automated rostering
- ❖ Training needs identifications
- ❖ Performance analysis
- ❖ Succession planning



2. Integrate AI and change strategy:-

The next step is to integrate AI and change strategy. This involves understanding the impact AI has on the organisation's people, process, and technology, as well as having a strategy to address the impacts derived from integrating AI. In this way, through the incorporation of AI and change strategy, organisations can achieve AI initiatives effectively and sustainably.

3. Communicate Effectively:-

A further step is to communicate effectively. This can be done by informing the respective stakeholders of the advantages of AI for the employees, customers, and partners. Effective communication enables organisations to ensure that all other stakeholders involved understand and support their AI activities. The effective communication plan comprises central elements, **4W's & H (WHAT, WHERE, WHO, WHY, and HOW)** necessitating active support for the roll-out of AI strategy.

Example:- Digi Yatra (Kempegowda International Airport Bengaluru - first pilot)

Criteria	Overview
What	Digi Yatra recognition boarding system
Where	Airports across India Kempegowda International Airport Bengaluru
Who	Airports throughout India Indian Civil Aviation Industry Airports Authority of India
Passenger Process	Register at unmanned-registration kiosks at airports across India
Why	Remove redundancies, increase resource utilisation, and improve security
How	Registration kiosks at airports
Enrollment	Voluntary Digi Yatra ID enrollment
Verification of Identity	Facial recognition matching with Government of India-issued IDs (e.g., driver's license, passport, voter card, student ID, etc.).
For	Indian citizens and foreigners who travel in and out of India

4. Empower and encourage experimentation:-

The fourth step is to empower and encourage experimentation. It creates an organisational culture of experimentation and learning, where the employees are encouraged to test and learn with AI technologies. The organisation's AI initiatives will ensure that such experiments are iterative and continuously improving.

5. Establish metrics and monitoring:-

The final step is to set up metrics and monitoring. This step involves specifying clear metrics and AI success and monitoring the performance of AI initiatives over time. By establishing metrics and monitoring, organisations can ensure that their AI initiatives deliver the benefits that were expected, and if there are any issues, they can detect and address them in due time. Finally, defining the right metrics is crucial not only for AI adoption but also for triggering intervention mechanisms to sustain the AI strategy.

AI SYSTEM'S CHALLENGES TO ADDRESS:

While airports have made significant advancements recently, many challenges remain. Although a comprehensive list of specific hurdles could be extensive, the following are a few key underlying causes identified.

Data Quality:

The quality of outputs from AI systems is only as good as the quality of its inputs - which in this case - is data. Unfortunately, a lot of data available in real world scenarios is hardly of highest quality. Example of poor data quality include incomplete addresses, duplicate data, spelling mistakes, invalid phone numbers, etc. Proper measures such as data cleansing, data labelling and data auditing are necessary to ensure that only data of good quality is provided to the AI systems for processing. Ensuring data quality is the responsibility of the operators in collaboration with data engineers and it has to be noted that ensuring data quality involves continuous monitoring and regulations.

Data Privacy and Security:

Although it is easy to use the data readily available in the current systems to train the ML models and provide suggestions, data privacy is a topic which cannot be ignored at all. Protection of Personally Identifiable Information (PII) has to be of paramount importance when utilizing it for AI processing systems. Techniques such as data masking should be employed to make

sure that sensitive data such as PII is hidden or masked before feeding to the AI algorithms. Care must also be taken to ensure that the data is disposed of in a proper manner once it's no longer an asset for the systems. Retention of data should be undertaken with proper consent from users before using their data and regulatory frameworks need to be developed to ensure this is practised.

Bias and Fairness:

Humans are inherently biased, and the data generated by humans is not immune to such biases. Although biases are not always harmful to humans, their impact can be amplified when such biases creep into AI systems. AI systems, if not regulated to discard bias, can combine these biased data in many unimaginable ways to produce outputs. Common biases include race, ethnicity, gender, etc. When such biased data is used in generative AI systems, results can turn out to be morally incorrect and can also cause unrest in the society.

Technical Limitations:

Integration of AI technologies demands sophisticated hardware and software

knowledge that can pose challenges to the industries adopting them. Personnel training and continuous learning have to be the foundational pillars for a successful transition to this new era.

Ethical Considerations:

Rise of generative AI has opened a lot of avenues for immense potential in making human life better. But along with that there is also a rise in ethical concerns related to these systems. Techniques such as AI based image generation and video generation raise serious concerns about intellectual property and ownership rights. AI systems such as interactive prompts can also provide suggestions based on user questions and this can lead to dangerous and unintended scenarios. Proper regulatory frameworks and standards should be enforced while implementing such systems to prevent any misuse.

Interoperability:





Integrating AI systems with existing airport infrastructure can be complex and can present itself with its own set of challenges given the diverse hardware and software systems that are currently in use in airports. Providing seamless connectivity among these systems involves coordination among various teams, vendors, and stakeholders.






Talent Shortage:

Successful adoption of AI technologies requires specialized skill sets in understanding the data requirements for the AI tools, data engineering aspects such as data quality, data masking, data ingestion, etc for which there is currently a huge shortage in the market. Airports need to upskill their staff with such technologies by enhancing their training curricula and partner with the IT industry to impart this crucial knowledge. Periodic revision of training material to be on par with emerging areas such as Prompt Engineering must also be made mandatory.

Some of the technology solutions are already addressing many core challenges at existing airports today. Some of the solutions are expected to be implemented over a longer, or much longer, time horizon.

Technology solutions making airports smarter today:-

Operations-related areas technological innovations	 Capacity & congestion	 Operational efficiency	 Focus on sustainability	 Workforce shortages
	AI-based swift & efficient allocation of gates and counters to airlines.	AI-based smart windows for automatic adjustment of natural light.	Real-time passenger flow monitoring for HVAC, climate & light control using IoT.	Robotics and drones for maintenance and cleaning tasks, reducing manual labor.
	AI-based improved runway slot adherence.	AI-enabled predictive maintenance of airport assets.	Harmful gas detection to improve air quality using IoT.	Smart robots patrolling to track unauthorized people.
	Computer vision-enabled passenger movement congestion analysis	Digital Twin for operation optimization.	AI/ML predicting water usage patterns and identifying recyclables.	AI-powered chatbots and assistants.

Passenger-related areas technological innovations	 Flight Delays	 Customer experience	 Accessibility & transportation	 Baggage loss	 Amenities & facilities
	Smartphone apps offering personalized go-to- gate reminders.	Smartphone apps enabling virtual queuing	Parking assistance robots to reduce average parking time	Reusable RFID tags on baggage for paperless tracking	QR code and contactless option for order placement and payment
	Passenger navigation via Augmented Reality (AR).	Walk-through contactless immigration	Electric passenger shuttles, catering, trucks etc.	Smart luggage tag to notify passengers of luggage arrival at carousel	Retina scans, finger vein scans and facial recognition for lounge access, shopping, etc.
	Biometric authentication for passenger identification, luggage check-in, custom clearance.	Humanoid robots offering passengers assistance / language translation.	Autonomous wheelchairs	Smart kiosks that track finger movement for check-in, bag drops, etc.	5G connected autonomous robots, vehicles and mobility equipment to support passengers

CASE STUDY: INDUSTRY BEST PRACTICES

Let's explore real-world case studies demonstrating the power of AI in airport management:

1. Automated Baggage Handling at Tokyo Narita Airport

Tokyo's Narita International Airport has been a leader in airport innovation. In 2021, the airport introduced an AI-powered baggage handling system to automate the sorting and transportation of passenger luggage.

Powered by computer vision and deep learning algorithms, the system employs intelligent cameras to identify and track each bag as it moves through the terminal. This technology enables dynamic, real-time routing and load balancing, which helps reduce bottlenecks and improves overall baggage handling efficiency.

The results have been outstanding: Narita Airport has experienced a 25% reduction in mishandled bags and a 15% improvement in overall baggage processing times. Equally important, the AI system has allowed staff to concentrate on higher-value customer service tasks thus enhancing the passenger experience.



Picture - Tokyo's Narita International Airport - self-service bag drop

2. Predictive Maintenance at London Heathrow Airport



As one of the busiest airports in the world, London Heathrow continuously faces the challenge of maintaining its extensive infrastructure. To address this, the airport has implemented an AI-powered predictive maintenance system.

This AI system monitors the performance of crucial assets such as escalators, baggage carousels, and runway equipment. By analyzing sensor data and maintenance logs, the system can accurately predict when a component is likely to fail, enabling the airport to perform targeted and proactive maintenance.

This predictive approach has produced significant results: Heathrow has achieved a 35% reduction in unplanned equipment downtime and a 20% decrease in maintenance costs. The airport's engineering team can now concentrate on more strategic priorities, knowing that the AI is diligently monitoring for potential issues.

3. Digi Yatra



Digi Yatra, an ambitious undertaking by the Ministry of Civil Aviation (MoCA), was first announced in August 2018.

Bengaluru's Kempegowda International Airport has pioneered the Digi Yatra effort from its early concept days, with pilot trials held since January 2017. It rolled out the beta version of the app in August 2022. Now it is live with seven Indian

airports to offer a Facial Recognition-based Biometric Boarding System (FRBBS).

In a significant stride toward modernizing air travel, the Indian Government introduced the DigiYatra service, revolutionizing entry procedures at airports. Launched to facilitate paperless and contactless entry, this innovative service allows passengers to embark on their journeys without the need for a physical boarding pass.

DigiYatra leverages a sophisticated Facial Recognition System (FRS) to verify passengers' identities, seamlessly linked to their boarding passes. The primary objective is to craft a delightful and memorable digital travel experience, offering a fully biometric-based self-boarding solution for a smooth flow from registration to boarding.

Benefits of DigiYatra:

- Faster movement from airport entry to boarding gate
- Seamless and paperless travel experience
- Exclusively assigned gates for faster boarding

DigiYatra is an example of true collaboration between stakeholders – airlines, airports, online travel agents, regulatory agencies, and governments.

4. IATA - One ID Concept



Using Digital Identity technologies to transform the customer experience with:

- Contactless travel through biometric enabled identification
- Digitalization of admissibility in advance of travel

Arrive at the airport **Ready to Fly**

One ID is one of IATA's ambitious projects aimed at benefiting all stakeholders, including passengers, airlines, airports, and governments. This initiative is designed to enhance the overall passenger experience from start to finish. The concept is secure, seamless, and efficient, allowing passengers to simplify their journey through a document-free process based on identity management and biometric recognition.

- ✓ This process will eliminate repetitive security checks at the airport, as passengers will not be required to physically present documents in various combinations at different touch points.
- ✓ The project suggests using face, iris, or fingerprint recognition to smoothly transport passengers from the curb to the gate.
- ✓ One ID will be one of the contributing factors that could spell the end of the legacy check-in process

Passengers	Passengers will no longer need to juggle between different documents
	With a single identification, they will be easily recognized by all service providers
	This will eliminate repetitive processes, resulting in less queuing
	Ultimately, it will enable passengers to arrive at the airport ready to fly in nearly every travel scenario
Airlines / Airports	Cost-effectiveness & efficiency for Airlines/Airports
	One ID will improve staff productivity by reducing time spent on manual ID checks
	It provides real-time visibility of where passengers are in the airport process, possibly allowing smart queuing
	Ultimately airlines will benefit from all the passenger process improvements with happy customers
Governments : Enhanced Security	One ID will enable improvements in border, aviation and airport infrastructure security
	It will help combat human trafficking and other cross-border criminal activities by reducing the possibility for individuals to cross borders under a false identity.

CONCLUSION:

Why Airports will take a lead in adopting AI

The advent of AI and the rapid growth in AI tools and technology are nudging businesses worldwide to take the next step toward an autonomous and promising future. It is imperative that airports also follow this path and equip themselves for a technologically bright horizon.

Adoption of AI by airports helps provide their passengers with an enhanced experience while streamlining operations and thereby increasing overall efficiency. With the per-capita spending income increasing steadily in the modern economy and with government initiatives to open new airports to Tier-2 cities in all major countries, more and more people are now opting for air travel for the obvious benefits of saving time and a more comfortable journey. Capturing this opportunity is of prime priority for airports, and adopting AI can provide specific airports with a competitive edge to maintain their business lead.

In the next decade, we can expect AI to be the game changer to further embed itself into every facet of airport operations. Future advancements will likely include fully automated airport systems.

- AI-powered biometric systems will become the norm, enabling seamless and secure passenger identification and boarding process.
- AI will enhance predictive analytics capabilities allowing airports to anticipate and manage passenger flows, optimize staffing, and reduce wait times.
- AI will streamline operations through automation, from baggage handling to maintenance, reducing delays and operational costs.
- AI role will play a crucial role in sustainability efforts, optimizing energy use and reducing the environmental impact of airport operations.
- Airports will become giant flying parks and ride centers, providing access to a wide range of transport options. In a decade from now, innovations such as air taxis will be emerging to provide more efficient transport to and from the airport.

A great passenger experience is enriched by technology while maintaining the human element. However, it is crucial to note that the adoption of modern technology should be undertaken with care, prioritizing data privacy and security. Only when this is achieved can passengers feel safe to travel and trust their data to be safeguarded by stakeholders. There has never been a better time to adopt technologies like AI and soar new heights.

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