Intelligent air travel

How AI and autonomous systems shape airports of the future

Artificial intelligence (AI) can redefine the way air travel and airports work. Agentic AI—capable of autonomous decision-making and action—has increased that potential. The payoff could be significant, but so is the implementation challenge.

Airport operators seek to identify risks, develop best practice, and collaborate to build and refine the autonomous airport of the future. Technology providers incorporate artificial intelligence (AI) in new collaborative approaches that will allow operators and software developers to build the airport of the future. The goal is to accelerate the adoption of AI while balancing the governance, security, and staff impacts.

For example, Amazon Web Services (AWS) has partnered with the Cities Today Institute and technology providers Zensors AI and Nvidia[1] to create an AI Adoption Alliance. This helps address data governance, legacy integration, regulation, and use-case evaluation to accelerate AI adoption in the human-centric world of airport operation.

1 https://cities-today.com/industry-teams-up-with-airports-to-advance-ai-in-aviation/

Understanding airports

Airports present a unique transformation challenge. They're complex operational machines with many interlocking parts. They have many stakeholders with overlapping areas of authority, including airlines, air-traffic management, policing, and security. They're both publicly and privately owned and are highly regulated.

"An airport is an incredibly dynamic and complex ecosystem," says Nick Woods, chief information officer at Manchester Airports Group (MAG), which operates Manchester, London Stansted, and East Midlands airports in the UK. "We describe the airport as a mini city. There's the baggage hall, departure lounge, shopping centers, and check-in areas… then the aircraft, engineering functions, security, border control, police, fire service… These are complicated systems that involve many people and operationally they add up to a Big Data challenge. AI agents give us the ability to break down those processes into the smallest composable elements and then get them to work together in a streamlined way."

There are multiple decisions involved in each element of the airport operation: AI can automate these, explains Bob Kwik, worldwide head of airports and ground transportation at AWS. "The essential thing is to work backwards from the problem you want to solve. That almost always means starting with the passenger experience or operational improvement. Identify the business value that could be unlocked, then experiment and test with new or proven technologies to find the best solution for your airport. Once you've established a positive impact, implement that technology at scale."

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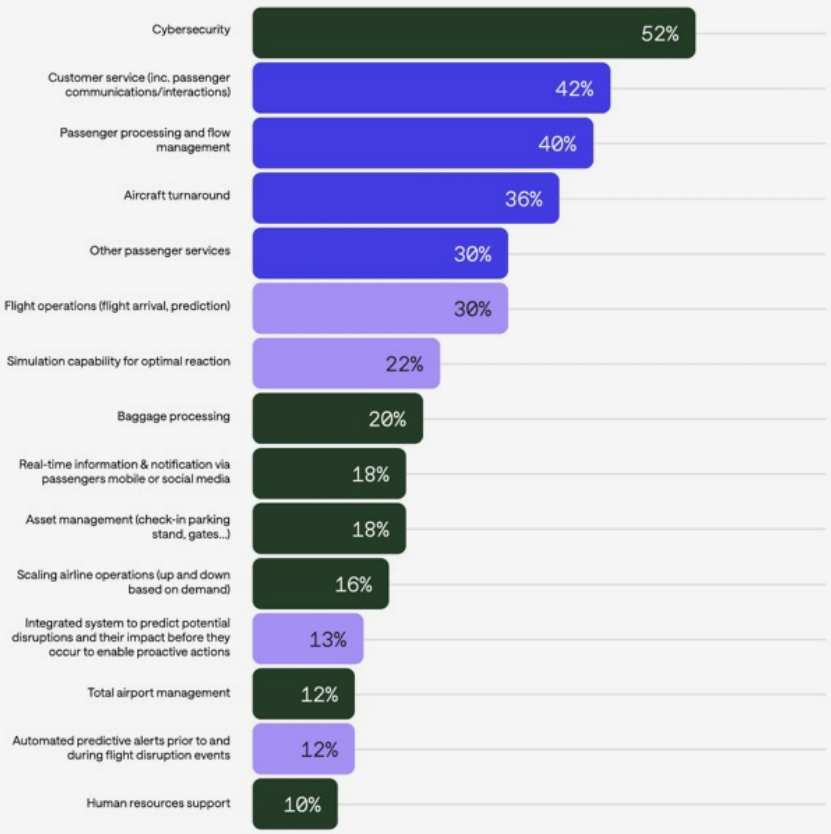
Isolate core journeys

One way to think about how AI agents can work in an airport is to link discrete events into a core journey that an AI agent can support. MAG, for example, identifies the passenger journey, the aircraft journey, and the luggage journey.

"Within these journeys, you can isolate a series of products," says Woods. "For example, check-in is a product, so is security, boarding, and even the runway and control tower. You can then identify the value drivers for those products and think about optimizing them."

Global AI in aviation use cases

In which of the following areas are you currently using artificial intelligence tools or initiatives?



Source: SITA 2024 Air Transport IT Insights

Technology for customers

Agentic AI use cases and implementations that focus on customer experience include early-warning information channels, interactive chatbots, and travel-assistance and employee assistance agents. The payoff for such investments is better management of passenger time.

"This is important for the commercial viability of airports," says Kwik. "How do you get people to shop more at airports? How do you get them to consume more food and beverages? Early adopters of agentic AI are going to create more revenue opportunities for airports."

Woods gives the example of a passenger who in the future may take an autonomous taxi to the airport. "We could combine a number of emerging technologies such as biometrics to understand who's in the vehicle so we can pre-screen and speed them through security and use robots to sort their luggage." He adds that they're also beginning to work to use AI to support luggage screening because it can help spot threats and reduce false positives faster and more accurately. These things together provide better customer service.

Real-world airport AI: customer applications

There are already customer-facing deployments of AI and agentic AI at airports worldwide. For example, enhanced chatbot assistants. Agentic AI delivers more proactive guidance based on data about the individual passenger and their current position in the passenger journey, which makes the chatbots more valuable.

Increasingly, customer-facing implementations use a hybrid approach to underlying technologies to optimize useability. For example, airport operator Aena—the world's largest operator by passenger numbers—implements its Oli passenger assistant[2] worldwide. Originally trialed at Madrid and Barcelona airports, the Oli assistant has multiple applications, such as connection assistance, travel documentation, and entertainment. It uses two AI foundational models. This combines a simple discriminative model, which responds to a set of pre-standardized passenger queries, with a generative model, which responds to more complex queries. The latter includes cases where AI detects multiple intents on the part of the user.

Airport operators are experimenting with styles of user interface and in some cases offer AI assistants that don't need a dedicated app or kiosk-based interface. Some of Aena's Oli functions can be accessed through WhatsApp, Facebook, or WeChat, so the technology can more easily be extended to airlines and non-Aena airports. Zurich airport has implemented a comparable airport assistant based entirely on third-party, commonly available communication apps including Facebook and WhatsApp.

Agentic AI enables airport-assistant applications to both respond automatically to events and utilize real-time data instead of static databases. These capabilities help passengers understand what's happening in the moment and predict what they need to do next. Airport operator Vinci—which manages more than 70 airports across 14 countries—has tested a virtual assistant powered by agentic AI at Lyon Airport in France. It has real conversational abilities and can hear, speak, and reply to complex passenger queries.

Vinci also uses AI to leverage other advanced technologies, such as biometric recognition as an alternative to travel documents. Its Vision-Box trial at Lisbon Airport[3] allows passengers to use facial recognition to check in from any location and pass through boarding channels. In India, the DigiYatra facial-recognition tool uses facial biometrics as a 'single-identity token' and is being rolled out in airports across the country. And Air Canada recently deployed a facial biometric solution[4] with 99.9 percent accuracy with **Amazon Rekognition** as the underlying technology.

2 https://www.internationalairportreview.com/video/225330/creating-a-personalised-airport-experience-for-aenas-411-million-passengers/
3 https://amadeus.com/en/newsroom/press-releases/vision-box-and-ana-aeroportos-de-portugal-sa-unveil-groundbreaking-biometric
4 https://www.passengerterminaltoday.com/features/exclusive-feature-how-is-ai-revolutionizing-airports-around-the-world.html#

Agentic AI has improved the experience that earlier chatbot generations offer, explains Woods.

"In our earlier efforts, we tried to capture as many frequently asked questions as we could, put them in a list, and if the customer asked the right question the chatbot would probably be able to answer. The difference now is that the gen AI models we use have far greater access to our data, and can enrich this with data from external sources. This includes what's happening at the airport and destination, flight schedules, and the weather. Also, you can now query the assistant in natural language and get a natural-language response. So, it becomes a true companion app for passengers."

The impact of Agentic AI technology for airports

Agentic AI is potentially a breakthrough technology to support airport operations, says Kwik. "Analytical AI is good at forecasting," he says. "But it's not so powerful in decision support in a highly complex environment where you need to ask many different stakeholders what their status is and determine what the impact could be. This is where AI agents come into play."

Woods agrees that the logic of a single AI-managed airport operation can be extended to cover many interacting factors in day-to-day operations. "Agentic AI will eventually support all our partners' interactions. If someone needs to tell us a flight is delayed, or an asset needs to be repaired, the AI agent will provide a single front door between all our stakeholders and us. The agents will figure out what needs to go where and who they need to tell."

"Take the case of a delayed departure," adds Woods. "The agent sees the stand is not going to be free. A standard optimization algorithm then determines the next-best alternative and how to replan in real time. Then other agents kick in to tell passengers they need to be at a different gate, deploy the ground handlers, and direct the fleet of autonomous wheelchairs to the incoming flight. We think we'll soon see a whole suite of AI agents able to support operations in a dynamic, responsive way."

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Real-world airport AI: operational applications

Airport operators constantly seek to improve capacity management. Airports are capital-intensive facilities and the ability to optimize capacity is limited by events that are difficult to manage—from weather to airline performance. If airports can improve the ability to forecast needs and manage the fast-changing day-to-day realities of air travel, it means immediate improvements to the bottom line.

Airport capacity utilization constantly changes. As a result, many operators have focused their AI deployments on improved forecasting for operations that may impact the duration that aircraft remain on allotted terminal stands.

For example, **Riyadh Airport and AWS** collaborated to apply AI in a predictive analytics tool to optimize baggage handling—as delays can impact aircraft wait times. The tool is also designed to reduce unforeseen system failure by up to 50 percent, and to reduce repair times by up to 60 percent, as it improves the scheduling of planned repair downtime. Heathrow Airport, meanwhile, has implemented an AI-driven predictive maintenance tool for baggage handling with **Amazon Monitron.** Brussels Airport has implemented an AI-powered passenger demand forecasting tool as part of an integrated forecasting-based Airport Operations Plan[5] designed to optimize check-in and border control, as well as baggage handling.

Some operational AI implementations have focused on the underlying causes of turnaround delay. For example, at Ljubljana Airport in Slovenia, the operator Fraport uses the ApronAI system from airport technology provider Assaia[6] to reduce aircraft turnaround delays. It assigns staff based on actual events rather than pre-planned schedules. Another implementation of ApronAI technology is in use at Gatwick Airport[7]. It reduces delays by interpreting camera data to analyze all the discrete events in an aircraft turnaround process. It then manages the airbridge, fueling, catering delivery, and push back to prevent any one part of the sequence breaking down.

As AI can function as a connective technology, it's inevitable that some AI-powered airport operations tools have combined multiple technologies. At San Sebastián Airport in Spain[8], a combination of AI, drones, and a private 5G communications network are enabling real-time detection of Foreign Object Debris (FOD) on the runway. FOD is a safety-critical issue that is time-consuming to rectify; automating object recognition saves time and improves safety.

AI's flexibility helps airport operators address several efficiency and performance issues at once, by incorporating multiple data sources that are operations-critical in a single implementation. At London's Gatwick Airport, AWS partner Veovo[9] is creating an Integrated Airport Control (IAC) System that can predict challenges as they unfold. This underlying AI function supports a Virtual Control Room, which gives airport stakeholders—including security, immigration, airlines, ground handlers, air-traffic control, and airport management—live situational awareness. This includes flight data, passenger flow and transport connectivity, and provides AI-driven operational recommendations based on historical and real-time data.

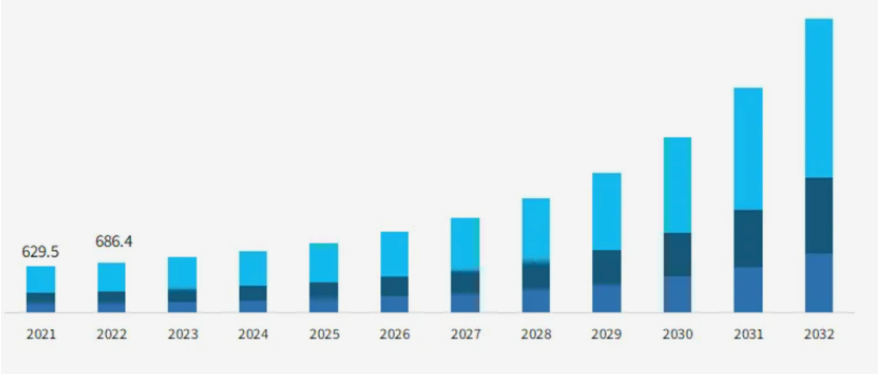
5 https://superlinear.eu/impact/superlinear-and-brussels-airport-company-revolutionize-the-airport-experience-using-ai
6 https://www.assaia.com/
7 https://aerolatinnews.com/aeropuertos/gatwick-airport-welcomes-ai-technology-to-its-apron/
8 https://www.airportsinternational.com/article/aena-uses-drones-san-sebastian
9 https://veovo.com/insights/news/gatwick-integrated-airport-control-system-aop

Airports collaborate to accelerate AI and Agentic AI impact

Building the foundational models that support AI is resource-intensive and generally done by multinational technology enterprises so that other enterprises can use these to power specific applications.

Regardless of size, airport operators have common needs. "There's a surprisingly small difference between a very big and a very small airport," says AWS's Kwik. "They all do basically the same thing, and they're all regulated in the same way. The technology needs are more or less the same. The main difference is that bigger airports often implement more granular and varied systems to manage their operations and so have more scope to try new things."

AI in aviation market size to 2032 (USD millions)



Source: Global Market Insights

There are also few competitive barriers to collaboration on technology. "Airports don't really directly compete with each other, and they're very open to collaborating," says Woods.

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> Chief information officer at Manchester Airports Group (MAG)

Multiple stakeholders can find common ground

Sharing data that used to be in siloes can improve passenger experience and airport operations.

In one example, an airport built an integrated data platform with detailed real-time data on all arriving and departing flights, gate availability, and allocations. It had to decide if sharing this with airlines could disrupt the normal flow of passengers from terminal retail areas to the gates. That could impact levels of crowding as well as revenue.

The solution is often a simple agreement between the airport and the airline on when the airline can publish the data to their passengers, for example not until 30 minutes before boarding. The airport could then vary the publishing time based on congestion in the dwell area and walking distance to the gate.

"It's a great illustration that better AI will demand improved collaboration," says Kwik. "When you look at the problem through the lens of the passenger experience and use that lens when you make decisions, you'll enable more meaningful collaboration that delivers better outcomes for all stakeholders."

Opportunity outweighs challenge

The implementation of AI in aviation is evolving fast as we progress towards a more autonomous airport. Today, technology is being used to enhance information (forecasting, predictive maintenance, resource utilization) and provide AI assistance (systems that automatically generate work orders, perform biometric identity verification, and manage incident responses). But it is moving to more fully autonomous systems. These may be discrete (such as autonomous cleaning equipment, wheelchairs, baggage tags, and computer vision-aided monitoring and maintenance systems), and increasingly they're beginning to be coordinated by AI.

Successful coordination is the greatest challenge in building the more autonomous airports in the near future, and will involve a culture of constant experimentation, testing, and collaboration. "I expect automation adoption to build gradually," says Kwik. "Systems must be safe, secure, and reliable in handling complex operations and coordinating multiple tasks, especially during delays, disruptions, and incidents."

Kwik adds that as systems will eventually start coordinating themselves, this will change the role of airport staff. Instead of reacting to situations, people will focus on forward planning and refining the underlying rules and policies that drive AI automation, using their real-world experience to continuously improve the system.

"The opportunity is to create resilient, efficient, and environmentally conscious airports through measured integration of AI technologies," says Kwik. "It's an evolution, but one that will unlock the efficiencies that operators need and the travel experience that passengers expect."

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