AIRLINE INDUSTRY

The AI Nervous System Guiding Leading Airports

By Dirk-Maarten Molenaar, Luis Ponce de León, Julien Lardet, and Robert Hjorth

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Airports worldwide face dueling challenges. In many markets, passenger volumes have surged past prepandemic levels while capacity remains strained because of labor shortages, new sustainability mandates, and delayed infrastructure projects.

Airports are launching ambitious AI and digital technology upgrades to overcome the challenges and get more out of existing infrastructure while they complete large capital projects. (See “The Challenges Airports Adopt AI to Solve.”) Despite their good intentions, many struggle to launch and scale initiatives that improve performance and create value.

The Challenges Airports Adopt AI to Solve

Airports represent critical infrastructure for economies worldwide, and demand for air travel continues to grow. Because many facilities put planned expansions on hold during the COVID pandemic, work on new terminals or runways has slipped substantially, in some cases, by years. Meanwhile, the operating environment has fundamentally changed. Costs are rising, driven by labor shortages and higher passenger expectations, and disruptions from weather and geopolitical events have become more frequent.

The current conditions have intensified long-standing challenges that hold airports back from operating at their best:

- **Planning is fragmented** across multiple stakeholders that maintain their own objectives and incentives, including airport owners, airlines, ground handlers, customs and immigration authorities, air traffic control, and other landside operators.
- **Congestion** at the curbside, security, and immigration, and other bottlenecks cascade into problems at airline gates and missed connections. When issues arise, stakeholders often act to protect their own interests rather than with the shared interests of the broader system in mind.
- **Aging infrastructure** is driving up maintenance costs while degrading service.
- **Disruptions** have become the norm, leaving airports with more irregular events and less buffer to absorb them.

By contrast, airports that are AI leaders are excelling despite the pressure. At these industry frontrunners, key stakeholders collaborate through an integrated, AI-based operations control center that serves as the airport's digital "nervous system." Much like the central nervous system governs the body, this digital nervous system collects, circulates, and shares data, acting as a single source of truth for ground and flight operations, passengers and baggage, retail, facilities

management, and aircraft movement. They also prioritize rolling out use cases that optimize capacity and make constrained assets more productive. The approach helps them maximize throughput within existing infrastructure and reduce the effects of flight disruptions, producing substantive value across the entire airport ecosystem.

Why Airports' AI Initiatives Often Fall Short

Although many airports are updating or replacing core systems, their AI initiatives often fall short. When they do, the fault typically lies not with technology but with the way it is implemented and adopted:

AI initiatives are disconnected. Airports often pursue long lists of use cases without anchoring on solving the critical small set of needle-moving business challenges and end-to-end operational flows that inherently transform how the airport operates. As a result, the use cases that are adopted lead to only incremental improvements.

Silos persist across the ecosystem. Individual airport stakeholders continue to run separate systems and don't share data. This limits transparency and prevents stakeholders from creating a real-time, shared view of operations across the entire airport ecosystem.

Decision rights are unclear. Many airports do not have a consistent, unified governance model to manage real-time trade-offs between different stakeholders.

Change management is missing. New AI and digital tools arrive, but stakeholders don't adopt the new ways of working, roles, and skills that are necessary to embed the technology into daily operations, scale solutions, transform workflows, and, ultimately, realize value.

Critical data infrastructure is limited. The pilot projects that airport stakeholders launch show promise, but solutions don't scale because there is limited reliable data infrastructure to support them.

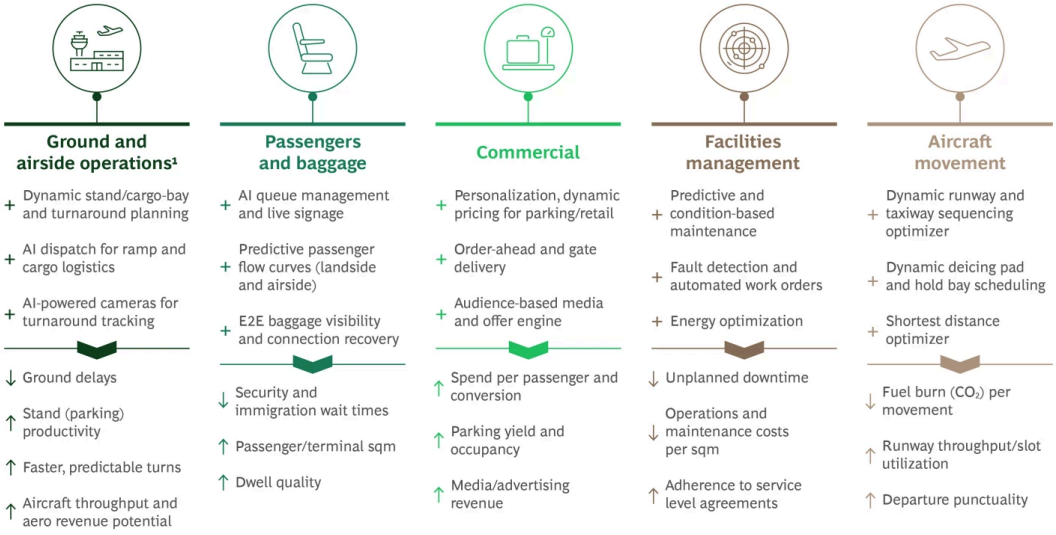
Building an AI-Enabled Airport Digital Nervous System

It's a different story with airport AI leaders. At these airports, key stakeholders collaborate on AI and digital technologies and use cases that deliver value across the ecosystem. The linchpin is the digital nervous system with a shared data layer and "single plan" operating model that sits above core systems. The system enables end-to-end orchestration across ground and airside operations, passenger and baggage flow, commercial ventures, facilities management, and aircraft movement. (See Exhibit 1.)

EXHIBIT 1

The "Digital Nervous System" of AI-Enabled Airports

A single AI plan and data source connects end-to-end flow across all airport partners



Source: BCG analysis.
Note: Sqm = square meter. E2E = end to end.
¹Ground and airside operations include cargo operations.

By facilitating decisions in real time, the system improves operational performance and commercial outcomes. For instance, by analyzing shared passenger data and using predictive intelligence, airports, airlines, and customs officials could do a better job of staffing international customs and immigration checkpoints. This would help people get through inspections faster, which could increase the time they have to visit airport shops, and improve the percentage of those who make connecting flights.

Three reinforcing capabilities allow for these optimizations:

A Shared Operational Picture. All partners agree to share relevant data and use common operating processes that, when combined, create a unified picture of airport operations. By collaborating, organization leaders and frontline teams see the same live data on queues, gates, aircraft movements, assets, and staffing—all of which improves their ability to respond effectively when situations develop.

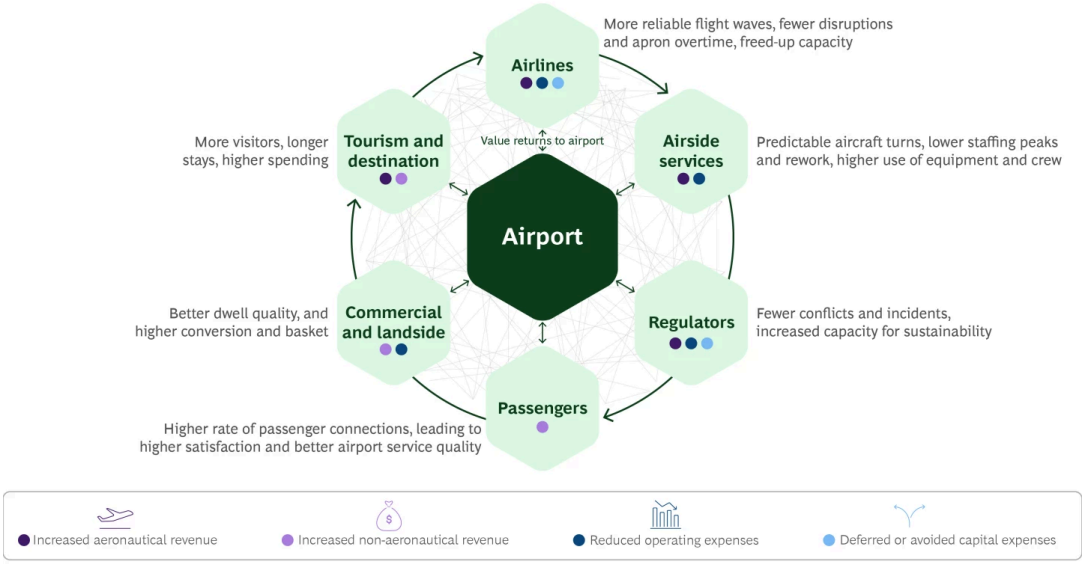
Predictive Intelligence. AI-based forecasting models crunch data from all airport ecosystem partners to analyze the likelihood of congestion, missed connections, and equipment failures; the possibility that those situations could create network-wide delays; and how long it could take to get operations back on track. Predictive intelligence is embedded into daily planning and control-room routines, helping teams prepare for future challenges at a time when demand patterns have become increasingly more volatile and less predictable. In addition, predictive intelligence also allows for better commercial planning of passenger flows, pop-up shops, and other retail offers.

Integrated Decision Making. Leaders bring stakeholders together in a digital airport operations control center—an APOC or AOCC—where stakeholders translate shared data and predictive intelligence into coordinated action. Partners use the center to align decision rights, escalation paths, and cadences for taking integrated decision making from planning to real-time execution. It's also the source for decisions about gate assignments, aircraft parking, staffing, baggage belt allocation and movement for connecting flights, as well as responses to disruptions that affect system-wide performance.

The improvements these optimizations lead to affect four distinct value pools: increased aeronautical revenue; increased non-aeronautical revenue; reduced operating expenses; and deferred or avoided capital expenses. (See Exhibit 2.) For airports that have dealt with constrained capacity for years, every percentage point of improvement they can create in these value pools is growth that does not require new infrastructure.

EXHIBIT 2

How AI Leaders Create Value Throughout the Ecosystem



Sources: Airport and airline annual reports; BCG analysis.

Airport AI Success Stories

In addition to the core system, airport leaders prioritize launching a small set of mission-critical AI and digital use cases and invest in the data, governance, and operating routines needed to scale them across the ecosystem. (See Exhibit 3.)

Airports that take this approach are seeing measurable improvements in reliability, throughput, and commercial performance along with adoption rates that justify scaling:

Optimized Gate and Stand Allocation. A leading Nordic airport operator wanted to improve decisions about gate and stand (parking) allocation in order to increase gate utilization and boost commercial revenue. In a 10-week proof of concept (POC), the airport used AI and machine learning models to assign flights with high-value passengers to gates near retail areas. The POC showed that the solution was technically feasible and had the potential to realize significant value. It also showed that better gate and stand allocation could lead to fewer flight disruptions, better schedules for ground crew, and higher retail sales. By the end of the POC, the airport had identified an estimated $3 million in annual value potential for the airport—and significantly more for the airport ecosystem.

Dedicated Governance Structure. A major European airport hub undertaking an airport operational database rebuild created a dedicated governance structure for the project, with explicit milestones, executive accountability, and disciplined scope management. Because the database is foundational infrastructure and a mission-critical system, the program prioritized creating a minimum viable product to "keep the lights on," while designing the full database with future improvements and total airport management enablers in mind, to reduce transition risk and avoid disruptions to operations.

Single Operational Plan and Shared KPIs. A major airport introduced total airport management that united all key stakeholders under a single operational plan and shared KPIs. Today, when conflicts arise, stakeholders resolve them in daily APOC meetings where responsibilities for decision making are clear.

The multiplier effect of a successful digital nervous system extends beyond the airport. A leading Asia-Pacific airport with an AI-based digital transformation underway could see an estimated $380 million in direct benefits to the facility between 2030 and 2040 through better resource allocation, which would allow it to meet latent passenger demand. The same transformation could lead to $4.8 billion in direct benefits to airlines and other ecosystem partners by accommodating greater passenger volumes, and $12.7 billion in benefits to the local tourism industry by allowing for increased visitor flow.

Getting Started

It’s not necessary to build a full digital nervous system and data layer all at once to follow in leaders’ footsteps when launching AI and digital initiatives. Think big but start small. Begin with a clear business challenge, quantify the value at stake, and then build the minimum products, data, and enablers needed to deliver it. (See Exhibit 4.)

Align the ecosystem and financials. Focus on changes that would bring value to the ecosystem, but be clear about financing from the beginning, including which stakeholder will fund specific initiatives, how they’ll benefit, and how value will be shared. In many cases, the airport orchestrates the new capability while airlines, handlers, and other partners capture part of the benefits.

Let context guide the upgrade path. What a modernization journey looks like depends on the facility and circumstances. The needs of a growing regional airport will be markedly different from those of a major hub. Updates also depend on the challenges an airport faces, whether they are labor, runway capacity, terminal capacity, retail mix, or something else. Identify the single most critical constraint coming in the next 12 to 18 months. Define the minimum capabilities required to address it and connect success metrics to financial or operational outcomes.

Start with a single use case. Target one end-to-end operational flow to start with that will create value by solving a critical ongoing business challenge, such as gate turnaround and allocation, security queue management, or recovering from a disruption.

Build a minimum viable data foundation. Identify data-related problems such as lack of integration, fragmentation, or outdated databases, and address them systematically. Establish a shared set of definitions and an operational data model to act as the common currency for all partners. Treat this minimum viable data foundation like a product, with clear ownership and governance.

Put ownership and scaling muscle in place. Pick a stakeholder that can ensure that “one plan, one truth” happens across the ecosystem, and institute clear mechanisms for resolving conflicts when they arise. Track benefits and drive adoption so the first tool to be successfully released earns the right to scale. Recognize the value of owning AI and digital capabilities in house and invest in building and strengthening them.

The airports building digital nervous systems are not waiting for perfect conditions or unlimited budgets. They are starting with one high-value operational flow, proving the model works, and expanding from there. The question, now, is whether airports will shape that transformation—or be shaped by it.

Authors

Dirk-Maarten Molenaar

Managing Director & Senior Partner
Amsterdam

Luis Ponce de León

Managing Director & Partner
Dubai

Julien Lardet

Managing Director & Partner
Amsterdam

Robert Hjorth

Managing Director & Partner
Oslo

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