ACI EUROPE

AIRPORTS COUNCIL INTERNATIONAL



AIRPORT INNOVATION HANDBOOK

Guidelines for Setting Up Innovative Processes and Managing Transformative Projects



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1. EXECUTIVE SUMMARY

Welcome to the ACI EUROPE Innovation Handbook.

Innovation is more than a buzzword. It touches every element of airport operations – from physical infrastructure, to processes such as security and accessibility, to the people at the heart of aviation: staff and passengers alike.

It is clear that airports are prioritising innovation – in a survey of over 20 European airports conducted for this Handbook, 85% of airports have a dedicated innovation team, and 60% have a dedicated innovation budget[1]. But what is innovation? How do we define it? What is the theory behind it, and how do we turn it from an intangible concept to a concrete plan for an airport to enhance and transform their own operations?

The answers to those questions, and more, are within this Handbook. This Handbook consolidates three years of collaborative work by ACI EUROPE's Innovation & Technology Forum, giving airports a practical, end-to-end framework for turning real operational challenges into innovation, supported by industry evidence, proven use cases and clear guidance on the organisational, regulatory and ecosystem conditions required for deployment. Above all, this Handbook shows that innovation is – at its heart – about transformation. It also demonstrates the role that ACI EUROPE, and the ACI EUROPE Innovation & Technology Forum, plays in ensuring that transformation is available to airports of any and all sizes, locations, and contexts.

For airports, it provides a catalogue of successful case studies alongside an essential oversight of how innovation is implemented by peers across Europe, designed to inspire and enhance your own operations. For policymakers, it showcases the predictable, proportionate, and future-ready conditions you can create to unlock Europe's competitiveness. For the industry as a whole, it showcases **what is working**, **what is needed**, and **what is to come**.

Regardless of your role within the industry, by the end of this handbook, you'll have gained a clear understanding of how to identify, organise, test and scale airport innovation – and the practical conditions needed to turn ideas into lasting operational impact.

Your Role in Innovation

Airport executives	Innovation and operational leaders	Policymakers and industry institutions
• Embed innovation in the airport's core strategy. • Provide visible C-level sponsorship. • Secure ownership and funding for successful scale-up.	• Begin with clearly defined operational challenges. • Agree on KPIs and scaling criteria before the pilot. • Involve operations, IT, procurement, safety, legal, and affected employees early.	• Create predictable and technology-neutral regulation. • Simplify standardisation, certification, and cross-border data exchange. • Provide accessible funding and regulatory testing environments.

[1] Annex 1: Survey: The Innovation Engine Across European Airports

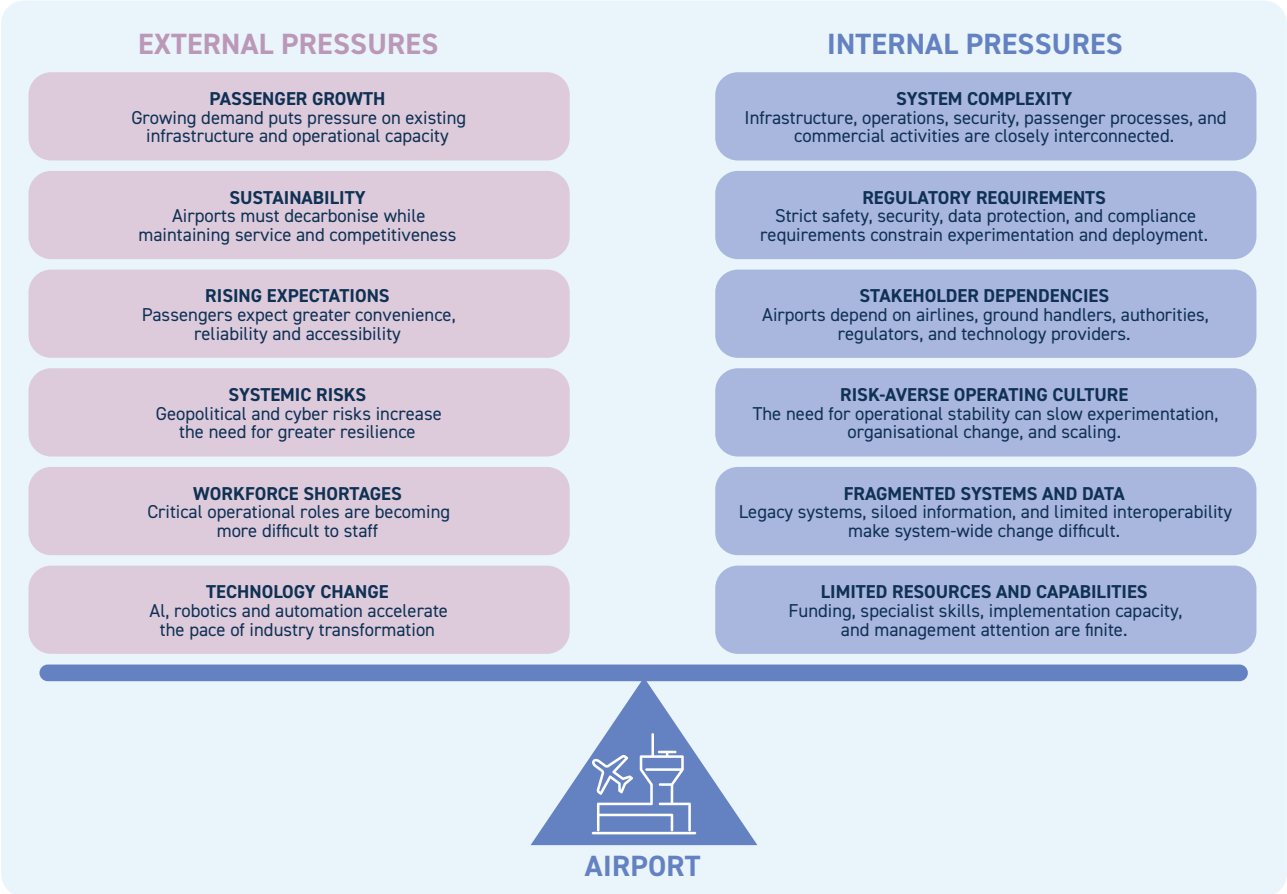
2. SETTING THE SCENE: WHY INNOVATION IS NO LONGER OPTIONAL

2.1 The Changing Role of Airport Operators

Airports face growing demand, workforce shortages, sustainability requirements, operational complexity, and rapid technological change. At the same time, their role is evolving from infrastructure management towards the orchestration of interconnected transport and service ecosystems. Innovation is becoming a core capability for maintaining operational resilience, competitiveness, and long-term relevance. Structured, challenge-driven innovation embedded into daily operations bridges the gap between increasing demands and limited resources. Success depends on innovating collaboratively as an industry, not in isolation.

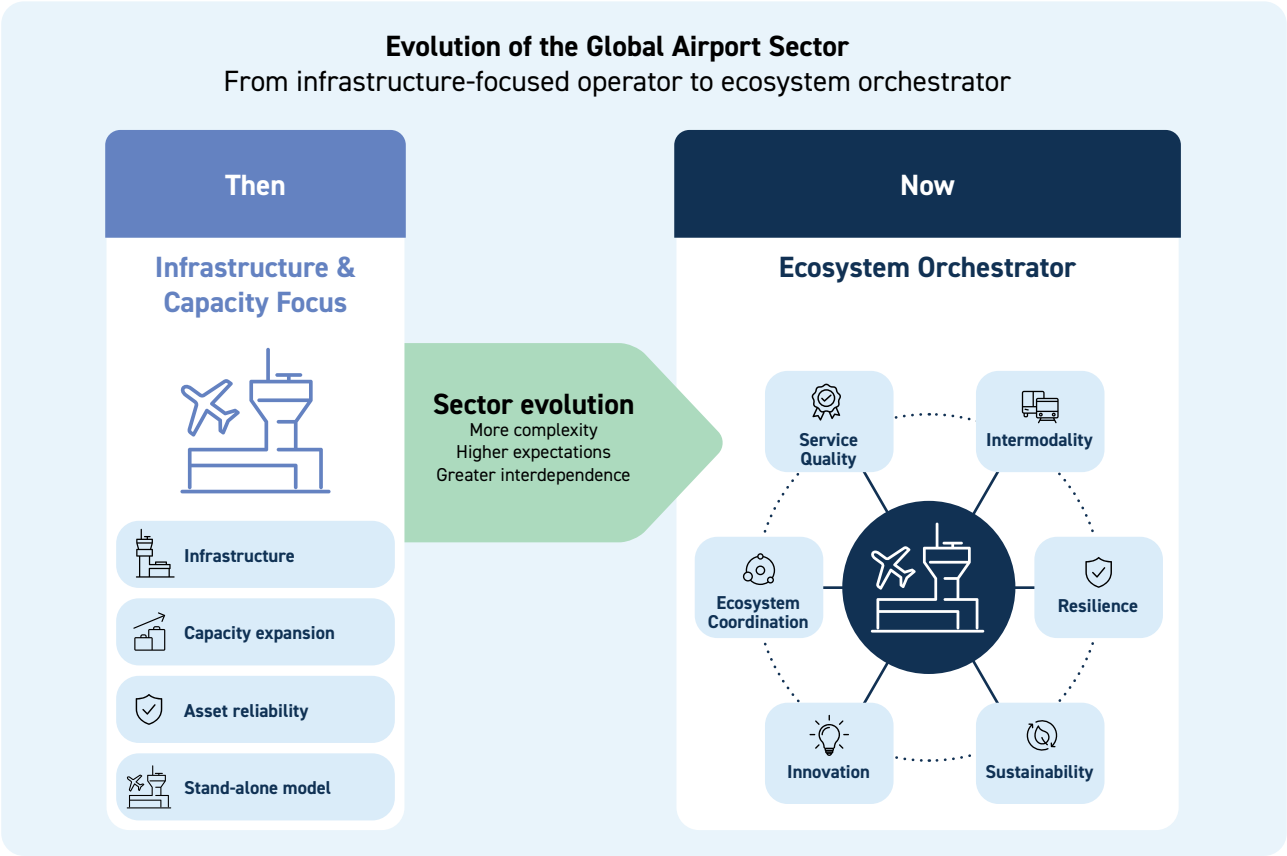
Passenger traffic has surpassed 2019 pre-pandemic levels: in 2025, Europe's airports welcomed an additional 100 million passengers for a record of 2.6 billion passengers.[2] This structural growth, combined with rising customer expectations, tighter regulatory requirements, and growing workforce shortages in operationally critical roles, is fundamentally reshaping the conditions under which airports must innovate.

External pressures increase the need for transformation, whilst internal constraints limit the speed and scale of responses. These pressures and constraints are illustrated in the table below.



[2] https://www.aci-europe.org/press-release/579-2025-all-about-traffic-resilience-as-europe-s-airports-welcomed-an-additional-100-million-passengers.html

The role of airports, too, is expanding. Airports have evolved from stand-alone infrastructure operators into orchestrators of complex, service-oriented, and multi-stakeholder ecosystems – as shown in the diagram below:



> Therefore, **innovation is no longer optional**: it is becoming a **defining capability for airports** seeking to remain competitive, operationally resilient, and strategically relevant in an accelerating environment.





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2.2 Business and Technology Opportunities

If innovation is no longer optional, then how can airports grasp the opportunity to innovate?

Airports have historically been consumers of technology. But the most forward-looking airports are not only adopting technology to solve operational problems. They are building proprietary capabilities, developing reusable platforms, and positioning themselves as active contributors to a broader technology ecosystem. As these capabilities mature, they can create value beyond the airport's own operations, by becoming replicable solutions for other airports, partners, or adjacent mobility ecosystems. A central question is therefore how to capture the strategic and commercial value that innovation creates.

While innovation is not only about technology, new trends and developments within technology are expanding opportunities for airports to innovate. The ACI EUROPE Innovation & Technology Forum has identified four primary areas of opportunity that will define the next wave of airport innovation, explored further within this Handbook:

OPPORTUNITY AREA	DESCRIPTION
AUTOMATION	End-to-end process automation across passenger flows, baggage handling, maintenance, and airside operations, reducing manual effort, increasing consistency, and improving throughput in time-critical environments.
ARTIFICIAL INTELLIGENCE	Agentic AI systems that anticipate bottlenecks, support dynamic decisions, and coordinate operational responses, including congestion prediction, gate allocation, resource deployment, and closed-loop process optimisation.
ROBOTICS	Robotic systems for baggage handling, cleaning, inspection, perimeter monitoring, passenger assistance, surveillance and maintenance in airside and operationally sensitive environments.
DIGITAL CAPABILITIES	Platforms, operational intelligence, and data-driven capabilities that can be standardised, scaled, and commercialised beyond the airport itself, from cybersecurity to reusable digital infrastructure.

What sets apart these areas is their scalability and adaptability at scale. In this sense, every capability an airport builds to solve its own operational problem has the potential to become a product. This change in thinking helps a company see internal innovation as an investment in research and development (R&D), rather than just a cost. It helps the business grow and supports continuous innovation.

2.3 The Innovation Imperative: Closing the Gap

These pages are designed as a printable resource for airport innovators to understand the 'bigger picture' at play: it can be referred to throughout your innovation journey, from identifying operational challenges and evaluating potential solutions to measuring their impact.

Airports face both growing demand and constrained operational capacity: this requires structured, challenge-driven innovation that turns ambition into tested, practical solutions with measurable impact at scale. The questions below should remain at the forefront of your mind throughout your innovation journey, as well as the principles below them.

Key Questions Before Starting Innovation

- What problems are we solving?
- Who benefits & how do we measure success?
- Is it scaled beyond a pilot?
- Do we have the conditions to scale?
- What if we do nothing?

Principles defining high-performing airport innovation:

Start with the challenge, not the technology
Effective innovation is challenge oriented. Define the operational challenges that matter most, from throughput and safety to sustainability and workforce productivity. Start with real needs, not technology trends, to ensure strategic alignment and stakeholder buy-in.

Move beyond pilots: build pathways to scale
Too many pilots remain isolated because integration, ownership, and scalability were not considered upfront. Plan for scale from the outset. Successful implementation requires clear ownership, reliable data, integration readiness, regulatory clarity, sustainable funding, and workforce acceptance.

OPERATIONAL CHALLENGE	SOLUTION SOURCING	PILOT	OPERATIONAL HANDOVER	SCALE
☑ Clear owner and need		☑ Defined KPIs and criteria	☑ Budget and IT responsibility	☑ Replication across airports



Focus on value and measurable impact

Judge innovation by outcomes, not activities. Define measurable impact across five dimensions:

- **Operational:** Turnaround times, punctuality, throughput, and capacity
- **Financial:** Unit costs, revenue diversification and cost per passenger
- **Environmental:** Emissions, energy use and waste
- **Experience:** Passenger satisfaction, waiting times and accessibility
- **Workforce:** Working conditions, manual effort, and engagement

Match metrics to maturity: use early indicators such as problem validation, stakeholder commitment, data readiness and adoption to guide decisions; track measurable outcomes as solutions scale.

Build a culture of learning and adaptation

A culture of learning and adaptation does not emerge automatically; it has to be deliberately built and continuously reinforced. Make experimentation part of everyday operations. Give teams time and permission to test ideas, involve operational staff early, share lessons from failure, and recognise constructive challenge. Leadership commitment, dedicated resources, cross-functional teams, and hands-on training help embed this culture. A culture that punishes failure, rewards only operational certainty, and treats every deviation from the standard process as a risk will kill innovation before it has a chance to prove its value.

Enable the sustainable transition
Use innovation to advance decarbonisation, resource efficiency and social responsibility. From energy-efficient infrastructure and AI-optimised ground operations to autonomous mobility and circular models, connecting the green and digital transitions can deliver long-term environmental value and near-term operational gains.

Innovate as an industry, not in isolation
Collaborate on shared challenges through joint pilots, benchmarking, and knowledge exchange. This reduces duplicated effort, shares costs, and accelerates learning. A coordinated industry voice also strengthens engagement with regulators and technology providers. ACI's Innovation community helps enable this collaboration.

Innovation enables airports to close the gap between expectations and reality. The airports that lead the next decade are those that treat innovation as a strategic discipline: challenge-driven, impact-focused, scalable, culturally embedded, and pursued together as an industry.



3. ACI EUROPE'S PERSPECTIVE ON INNOVATION

*This chapter seeks to create an **essential basis for an airport to begin their innovation journey**: with a clear definition of what innovation is – and isn't – in the airport context; how an airport's relationship with innovation changes based on context and size; ACI EUROPE's role in fostering innovation; and a definitive set of principles for airport innovation.*

3.1 Definition of Innovation in the Airport Context

Before we continue, it is essential to set a clear definition of airport innovation.

> Innovation refers to the **introduction of new ideas, technologies, processes, products, or services that enhance efficiency, safety, security, sustainability, and the passenger experience**.

In the context of airports, innovation is not solely about adopting cutting-edge technology but also about rethinking how airports operate, engage with communities, and respond to industry challenges. It is also not only about inventing products or ideas. Effective innovation is **not simply the adoption of the latest technology, nor is it technology for its own sake**. It is **not a collection of isolated pilots or experiments without a clear operational need, owner, or pathway to scale**. And it is **not the sole responsibility of a central innovation team; it requires active involvement from the business units, people, and partners who will ultimately deliver and use the solution**. In practice, **airport innovation is therefore also defined by how it is delivered**.

Innovation is not about inventing everything from scratch; it is about finding and adopting the right solutions. Airports rarely have the time or resources to develop their own technologies when solutions may already exist in the market. The role of the innovation team is to **stay close to the market, understand emerging technologies and proven solutions, gather needs and challenges from operational teams**, and **connect these to the right providers through procurement and implementation**. For airport leaders, this means building teams with market knowledge, operational understanding, and the ability to translate needs into solutions – not necessarily hiring inventors. The value of innovation lies in identifying what works, adapting it to the airport's context, and bringing it into operation at scale.

Airport innovation in practice cuts across almost every objective, field, and stakeholder – making tracking and ensuring efficiency often complex and unwieldy:

- **Premises:** sustainable infrastructure, energy hubs, and physical environment design.
- **Processes:** automation, security, baggage handling, airside turnaround, landside accessibility, border control, and many more.
- **People:** staff training and continuous learning, passenger experience design, and organisational capability development.

This Handbook proposes three practical workstreams in Chapter 5, covering premises, processes, people, and application areas of each.

High-performing airport operators increasingly organise innovation around two process dimensions: how solutions are sourced and validated, and how successful pilots are transitioned into operational ownership. This shifts innovation from isolated experimentation towards a repeatable capability that connects operational demand, external solutions, and scalable deployment.

- **Demand-driven sourcing** starts with concrete operational needs rather than broad technology scouting. Business units define specific pain points, whilst the innovation function identifies, tests, and validates solutions with a credible path to deployment. This Venture Clienting logic treats pilots as structured commercial and operational validations, with clear go/no-go criteria from the outset.

- **Pilot-to-scale handover** is equally critical. The innovation team may facilitate or fund early validation, but the business unit must co-define requirements, validate KPIs, and commit to owning the solution if the pilot succeeds. This makes innovation a shared organisational capability rather than the responsibility of a central team alone.



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3.2 Who can innovate, and where?

A key value of this Handbook is that all airports can innovate.

Good innovation is bespoke: uniquely crafted around an airport's specific operational context, size, and location. But where does an airport begin if all innovation strategies are unique?

Regional Airports as Testbeds for Innovation

Regional airports offer a controlled environment for testing and refining new ideas, technologies, and practices at an early stage. Their contained operational scale and flexible access to infrastructure enable:

- **Faster feedback loops:** All stakeholders on the platform are closely integrated into the innovation process. Feedback can therefore be incorporated quickly, and solutions refined in short iterations.
- **Controlled trials:** Simpler operational environments make regional airports well suited for trials of new technologies, allowing regional airports to act as innovation sandboxes where appropriate. Regulators also use them to test compliance approaches and industry standards under controlled conditions.



The BETA Technologies ALIA CX300 (N214BT) became the first fully electric cargo aircraft to visit Ostend-Bruges Airport during a demonstration tour across the Benelux.

Major Hubs as Living Laboratories

Major hubs offer a high-impact environment for testing and validating new solutions at scale. They handle hundreds of flights and more than 100,000 passengers per day in a regulated, multi-stakeholder setting. This combination of scale and complexity enables:

- **Real-time experimentation at scale:** Hubs operate under continuous coordination across airlines, ground handlers, authorities, service providers and airport teams. Solutions can therefore be tested under full operational load and across the entire stakeholder chain.
- **Validation under operational pressure:** For start-ups and technology partners, hubs provide a testing environment that few other industries can offer. Solutions proven here have demonstrated their robustness and scalability.

Thinking outside the (airport) box

External innovation platforms can be just as valuable as internal R&D. Airports that act as innovation platforms partner with start-ups, universities, and R&D centres, typically to improve passenger experience, resource efficiency and operational resilience. Airport-based accelerators and incubators are becoming more common, giving early-stage companies space to test prototypes, gather user feedback and refine their offerings. Those that succeed gain a clear strategic advantage: they become more attractive to technology partners and academic collaborators, and they can build new non-aeronautical revenue streams by hosting innovation business communities at or around the airport. Continuous transformation is becoming the defining condition of the sector.

Innovate Together, Learn from Each Other

ACI EUROPE's innovation work is broad and far-reaching, with active involvement across a wide range of areas, projects, and initiatives. It inspires members by creating visibility for emerging trends, successful use cases, and new partners through the ACI Airports Innovate conference, the ACI EUROPE Innovation & Technology Forum, and cooperation with institutional and industry actors such as the EUROCONTROL Innovation Hub, SESAR 3 Joint Undertaking, and Clean Aviation Joint Undertaking. ACI EUROPE enables collaboration by bringing airports together to share use cases, develop common approaches, and initiate joint research or demonstration projects, including those suitable for European funding. It informs and advocates by helping members understand funding opportunities, regulatory developments, and technology-related policy implications, whilst representing the airport operator perspective in relevant industry and institutional discussions. Finally, it supports deployment by helping airport operators move promising innovations from experimentation into operating models, so that new solutions improve efficiency, passenger experience, staff wellbeing, and long-term resilience.

In particular, ACI EUROPE's Innovation & Technology Forum fulfils several roles. It serves as a peer-to-peer exchange for innovation projects. It also acts as a marketplace that connects its members with airports outside the Forum and enables them to share experiences. In addition, it works as a think tank for advocacy on innovation policymaking and funding opportunities. Finally, the Forum helps airports bring their innovation needs to the market more collectively. It does so by developing common specifications for innovation applications, which in turn limits the number of change requests. This allows airports to act more strongly in the market without necessarily teaming up in a single tender. Instead of reacting to solutions developed without a clear understanding of their requirements, they can state their needs clearly upfront.

Collaborative networks such as Airports4Innovation also operationalise this principle at industry scale: rather than each member airport running parallel pilots on identical challenges, the network coordinates joint start-up calls, shares PoC outcomes transparently, and collectively accelerates the validation of solutions that any member can then adapt and deploy. The key condition for replicability is documentation discipline: a pilot that does not capture its assumptions, its KPIs, and its failure modes cannot be transferred. It becomes institutional knowledge for one airport rather than industry knowledge for all.



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3.3 Guiding Principles for Airport Innovation

Section 2.3 sets out the practical principles that guide individual innovation initiatives. At an organisational level, these principles need to be supported by strategic commitment, clear governance, and collaboration across the airport industry. Below, find the next steps to ensure that innovation is approached strategically, translated into practical action, and ultimately delivers lasting value.

ACI EUROPE's five guiding principles for airport innovation

Strategic Embedding
Innovation must be embedded in the airport operator's core strategy, not treated as a collection of disconnected projects. It should inform decisions across the operating model, investment priorities and long-term business planning. As sustainability increasingly becomes a licence to operate, innovation is essential to delivering decarbonisation while maintaining operational performance, competitiveness, and business continuity. Without a broader commitment to innovation, sustainability efforts alone will not secure an airport's future relevance.

Design for Scalability
Scalability should be considered from the outset, with a clear pathway from testing to operational implementation. This means involving the business units responsible for adoption, assessing integration requirements early and establishing the ownership and resources needed for deployment. Solutions should be evaluated not only on whether they work in a pilot, but also on whether they can be integrated into daily operations and deliver value at scale.

Replication as a Force Multiplier
Airports face many of the same challenges, creating opportunities to adapt proven solutions rather than start from scratch. Replication can reduce development costs, shorten implementation timelines and limit duplicated effort. To make this possible, airports need to document pilot objectives, assumptions, performance indicators and lessons learned, including what did not work. This turns individual project experience into knowledge that other airports can use and adapt to their own operational contexts.

Collaboration Across the Industry
Airport innovation benefits from active collaboration between operators, technology providers, start-ups, research institutions, regulators, and industry partners. Sharing challenges, evidence and experience helps airports identify relevant solutions, coordinate testing, and accelerate adoption. Through its innovation activities and member network, ACI EUROPE can facilitate these connections, support knowledge exchange, and help develop common approaches to challenges that extend beyond individual airports.

Align Innovation with Long-Term Investment Priorities
Innovation portfolios should reflect the forces shaping the sector's future, including decarbonisation, energy transition, digitalisation, resilience, security, and infrastructure modernisation. European policy frameworks and funding mechanisms can create opportunities to support these priorities. While not every innovation project needs to fit a specific funding programme, understanding the wider investment and regulatory landscape helps airports prioritise initiatives, identify potential funding and direct resources towards solutions that support long-term strategic objectives.

Ultimately, airport innovation requires more than promising ideas or successful pilots. It depends on leadership commitment, the ability to implement and replicate solutions, and an industry-wide approach to shared challenges. By connecting strategic priorities with practical delivery and collective learning, airports can accelerate innovation and maximise its value across the aviation ecosystem.

4. THE THEORY BEHIND INNOVATION

Airports structure their innovation efforts along several complementary dimensions. Understanding these dimensions, and how leading European airports apply them, is **essential for any airport seeking to build or mature its innovation capability**. This chapter examines four dimensions: organisational placement, degree of openness, sources of innovation, and strategic intent. Before turning to the empirical evidence, it sets out the theoretical foundations behind these dimensions, drawing on four decades of management research on how organisations create, absorb, and diffuse innovation.

4.1 Theoretical Foundations of Innovation Management

Innovation management research provides a useful basis for understanding how organisations, including airport operators, structure innovation efforts, select partners, and build the capabilities needed to translate external knowledge into operational value. Four theoretical pillars are particularly relevant in the airport context: Open Innovation, Absorptive Capacity, Organisational Ambidexterity, and Innovation Ecosystems.

CONCEPT	WHAT IT TELLS AIRPORTS	REFERENCES
Open Innovation	Explains how airports combine internal capabilities with external ideas and solutions – by deliberately managing knowledge flows, combining internal expertise with external ideas, and using multiple pathways to develop and commercialise innovation	Chesbrough (2003)
Absorptive Capacity	Highlights the capabilities required to evaluate, adapt, and apply external knowledge: absorptive capacity being an organisation's ability to recognise the value of external knowledge, assimilate it, and apply it effectively	Cohen and Levinthal (1990)
Organisational Ambidexterity	Addresses how airports can balance operational reliability with experimentation and renewal – this dual requirement is organisational ambidexterity; the ability to pursue exploration and exploitation simultaneously	O'Reilly and Tushman (2004)
Innovation Ecosystems	The success of an innovation depends not only on the focal organisation, but rather, broadens the perspective to the partners, dependencies, and governance arrangements that shape implementation. Airports cannot control every actor in the ecosystem, but they can create the governance, shared roadmaps, data arrangements, and joint success criteria needed to move innovations from fragmented pilots to operational deployment	Adner (2006)

Together, these four perspectives provide the analytical foundation for the dimensions examined in this chapter and help explain how airports organise innovation, engage external actors, and translate new solutions into operational value.

4.2 Organisational Placement: Centralised vs. Decentralised vs. Hybrid

Where does innovation sit in your ecosystem? Where innovation is structurally located within an airport organisation is not merely an administrative choice: it is a strategic signal. Organisational design theory identifies three canonical archetypes, each reflecting different assumptions about where strategic decision-making is located, how knowledge flows, and who is accountable for outcomes:

DIMENSION	CENTRALISED ONE CENTRAL INNOVATION UNIT	HYBRID / FEDERATED CENTRAL DIRECTION, LOCAL OWNERSHIP	DECENTRALISED INNOVATION WITHIN BUSINESS UNITS
Strategic control	**HIGH** Central unit sets the agenda	**BALANCED** Central strategy, local execution	**LOW** Distributed across divisions
Speed to pilot	**MODERATE** Central approval required	**FAST** Lean process, business-unit ownership	**FAST** Autonomous business-unit decisions
Duplication risk	**LOW** Central coordination prevents overlap	**LOW** Central function acts as knowledge broker	**HIGH** Limited visibility across units
Business-unit buy-in	**MODERATE** Risk of disconnection from operations	**HIGH** Embedded champions, central support	**HIGH** Strong grassroots ownership
Scalability	**HIGH** Shared infrastructure and methods	**HIGH** Replicable framework, distributed reach	**LOW** Uneven maturity across units
Best airport fit	**SINGLE-CAMPUS OPERATORS** Clear central governance	**COMPLEX AIRPORT OPERATORS** Strategic consistency + operational ownership	**HIGHLY FEDERATED GROUPS** Strong local autonomy

Most leading airports are moving towards **hybrid models**: a lean central team sets direction and provides methods, whilst embedded innovation champions keep execution close to operational needs. **Discover two case studies of these hybrid models below to understand how this is applied in airport practice**.

CASE STUDY: ADR Innovation Model

Aeroporti di Roma (ADR), a Mundys Group company operating Rome Fiumicino and Rome Ciampino airports, offers a compelling example of a **hybrid open innovation** model, which combines centralised strategic governance with broad collaboration across employees, start-ups, corporate partners, airports, and venture capital.

ADR views Rome Fiumicino not merely as a transit facility but as a living Smart City and industrial testbed, where advanced technologies can be tested, validated, and scaled into real airport operations in support of green infrastructure, net-zero targets, operational excellence, and passenger experience.
The model rests on four pillars. First, internal engagement: an Innovation Cabin Crew of 26 champions distributed across business units mentors start-ups and aligns pilots with operational needs, whilst the ADR Hangar Program, a Call4Ideas launched in 2024, engaged 460 colleagues and gathered 108 ideas across its first two editions.

Second, the Innovation Hub and Acceleration Program, centred around "Runway to the Future" and ADR's Innovation Hub located inside Terminal 1.

Through Runway to the Future, ADR has delivered 43 Proofs of Concept, converting approximately 50% of them into commercial deployment (ADR internal data, 2024–2026), a conversion rate well above the levels commonly reported for corporate open-innovation programmes. Third, Strategic Partnerships, which connect ADR with leading innovation stakeholders worldwide. A key example is Airports for Innovation (A4I), the alliance co-founded by ADR and Aena, which today brings together ten airport operators representing approximately 800 million passengers annually and launched the airport industry's first Joint Call4Start-ups in 2024.

Fourth, ADR Ventures, the company's corporate venture capital vehicle, which invests in growth-stage companies across vertical SaaS, passenger experience, smart city infrastructure, and sustainability, enabling ADR to gain early access to emerging technologies and innovation trends.
Together, these four pillars create a repeatable and scalable open innovation platform that transforms a traditional infrastructure operator into an active orchestrator of innovation across the global airport ecosystem.



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CASE STUDY: The Aena Innovation Model

Aena, the world's largest airport operator by passenger traffic, illustrates the hybrid model in practice across a network of 46 airports and two heliports in Spain, together with international airports in the United Kingdom, Brazil, Mexico, and Jamaica. Given the scale and diversity of this network, Aena defines innovation strategy centrally whilst carrying out implementation locally. Innovation is led by the Innovation and Customer Experience Directorate at corporate headquarters, which sets the strategy, identifies priority areas, coordinates initiatives, and ensures alignment with wider corporate objectives; individual airports test, pilot, and deploy solutions according to their operational realities, guided by the central team. The strategy is periodically refreshed and tied to the company's strategic plan, defining innovation priorities, the technologies to be rolled out across the network, and the resources required to deliver them.

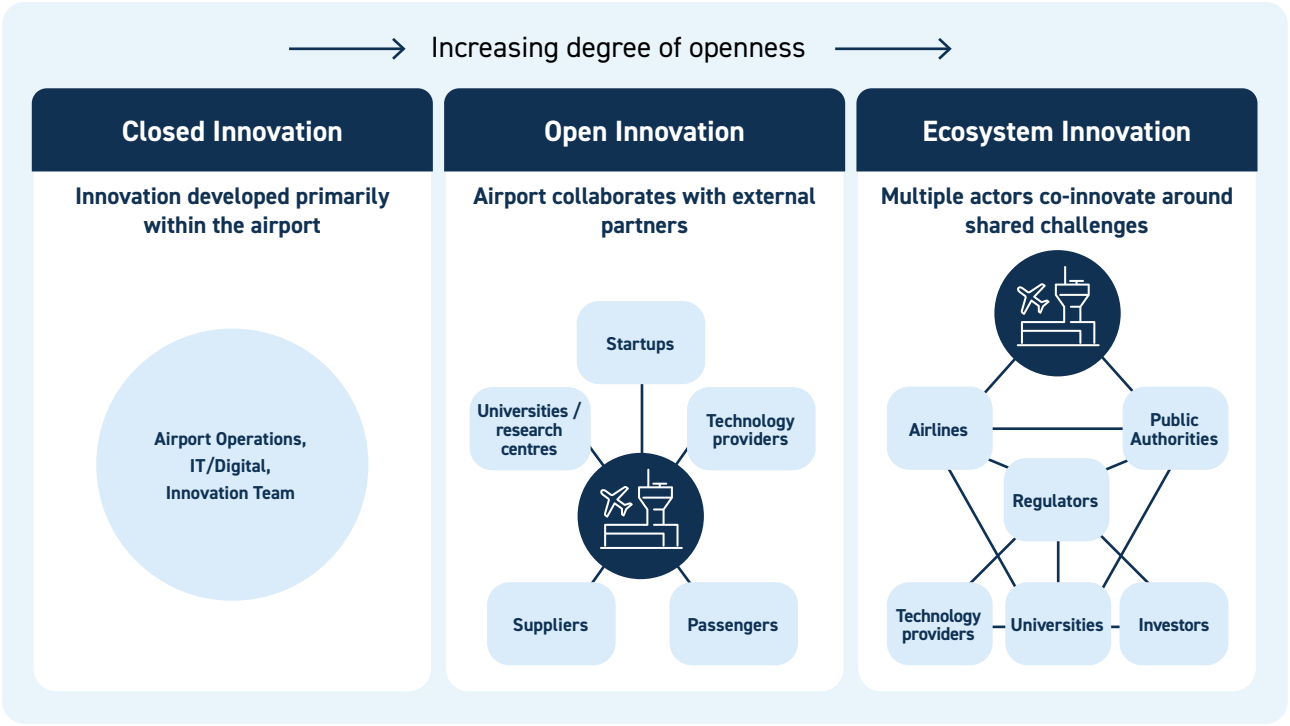
To strengthen collaboration with the wider ecosystem, Aena runs four complementary programmes: i) Aena Ventures, an open-innovation programme that identifies, pilots, and scales solutions from start-ups addressing airport challenges; ii) INNOVA, a corporate intrapreneurship programme through which employees propose, develop, and validate new ideas; iii) Airports for Innovation (A4I), an international alliance of leading airport operators promoting collaborative innovation, knowledge sharing, and joint pilots; and iv) a Technology Surveillance Team responsible for technology scouting, trend monitoring, and the management of national and European innovation funding. This combination of centralised strategic governance, local implementation, employee-driven innovation, start-up collaboration, and international partnerships allows Aena to balance strategic consistency with operational flexibility, blending internal, open, and ecosystem innovation into a single scalable framework.



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4.3 How Airports Source Innovation

What is the right degree of innovation openness for your airport context?



MODEL	STRENGTHS	WEAKNESSES
Closed Innovation	High control over IP and data; strong confidentiality	Limited external perspective; higher costs; slower development
Open Innovation	Wider access to ideas and expertise; shared risk/cost; faster adoption	Greater coordination complexity; less direct control
Ecosystem Innovation	Broadest collaboration; shared capabilities, knowledge, and risk; supports system-wide solutions	Highest coordination and dependency across stakeholders

Innovation in airports depends not only on the degree of openness, but on the ability to mobilise three complementary sources of knowledge and capability:

- **Internal capabilities:** operational knowledge, technical expertise, digital competence, and the organisational capacity to identify needs, define use cases, and embed new solutions.
- **External sourcing:** deliberate engagement with start-ups, established suppliers, technology firms, universities, and organisations in adjacent industries.
- **Partnerships as co-development mechanisms:** settings in which airports and other actors jointly shape innovation through shared resources, shared learning, and shared risk.

Airports operationalise these sources through structured programmes: intrapreneurship initiatives, start-up accelerator programmes, open innovation challenges, academic and research partnerships, and passenger co-creation initiatives.

Three Design Principles for Airport Innovation Leaders

- Establish a dedicated team with C-level visibility. Reporting directly to the CEO enables broader mandates, stronger governance, and greater ability to mobilise resources across organisational boundaries.
- Design for handoff, not ownership. The central innovation team's role is catalytic, not operational. Its primary success metric is the volume and quality of innovations that transition into business-unit-owned operations.
- Embed distributed capability through innovation champions. The hub-and-spoke model works when named individuals within business units participate in the innovation process and act as first points of contact for need identification and pilot co-design.



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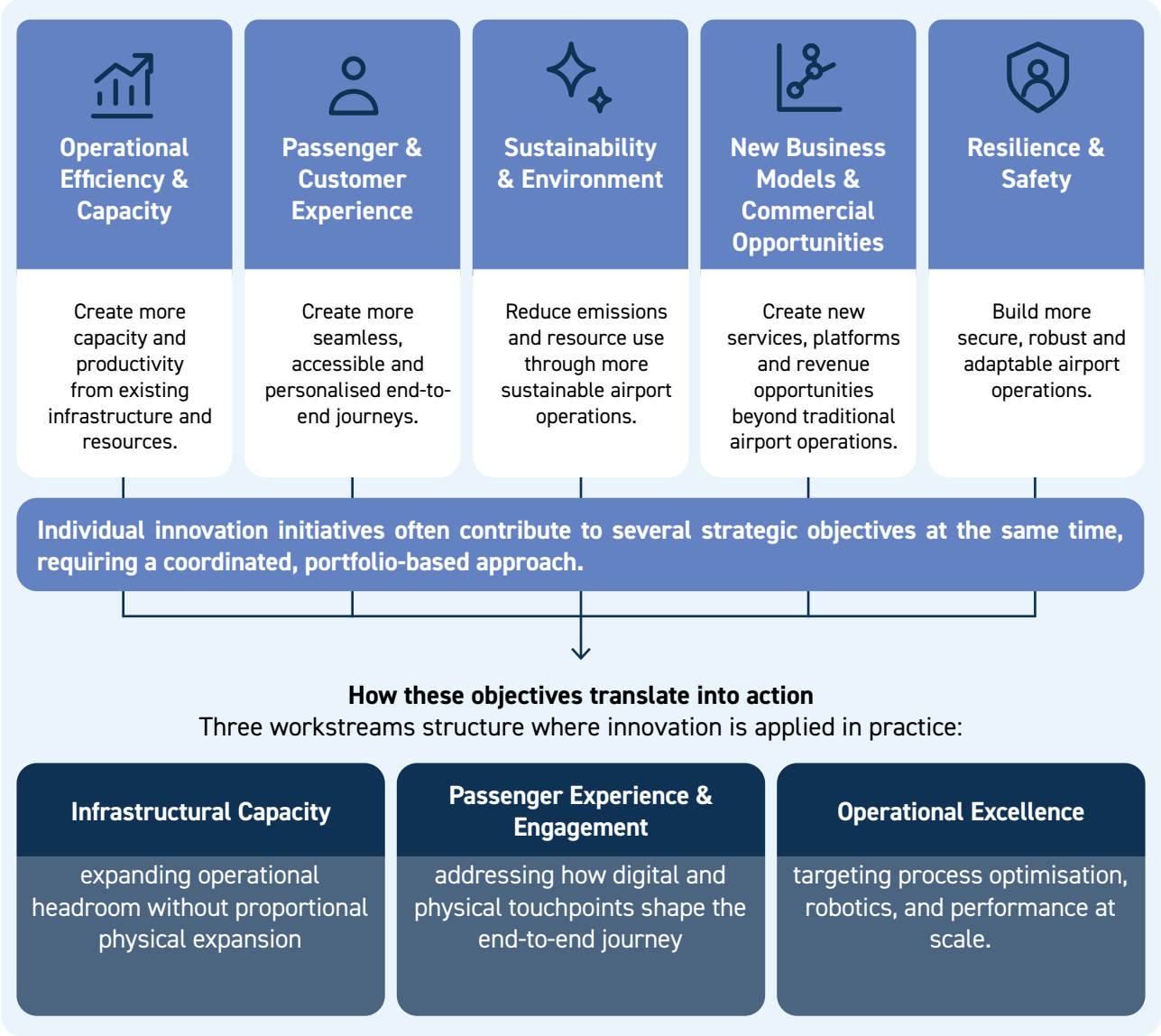


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5. KEY INNOVATION WORKSTREAMS

Utilising the previous chapters, you should now have a clear idea of what theory and approaches can benefit your own operational context, as well as the Guiding Principles to keep your innovation journey efficiently on track. This chapter translates **that strong strategic foundation into practice**.

Regardless of the organisational model or source of innovation, your efforts must translate into tangible, implementable actions. Therefore, this Handbook translates universal airport goals into **three key workstreams** that enable an efficient and coordinated approach, avoiding duplication of efforts. The logic behind this categorisation can be seen below.



Together, these workstreams provide a practical, evidence-based view of where airport innovation is being deployed today and where it is heading. In this chapter, we explore how innovation manifests in practice in each workstream – defining the challenge, opportunities for innovation, successful case studies, and recurring barriers/limitations unveiled during this research.

5.1 Infrastructural Capacity

5.1.1 The Challenge

The widening gap between demand and available airport capacity is becoming a defining strategic constraint for the aviation sector. Infrastructure cannot expand as fast as demand: new runways and terminals require complex planning, environmental assessment, stakeholder consultation, regulatory approval, financing, and construction, often extending delivery timelines to 15–20 years or more – when increased capacity is needed today.

The resulting impact of demand outweighing supply extends beyond airport operations: constrained capacity reduces connectivity, weakens service reliability, increases cost pressure, and limits the economic contribution aviation makes to the regions it serves.

The management implication is clear: **airports need a dual capacity strategy**. Long-term infrastructure investment must continue, but it must be complemented by measures that increase the effective throughput of existing assets within the current planning cycle. Innovation is therefore not a substitute for infrastructure expansion; it is the critical bridge between demand growth and the point at which new physical capacity becomes available.

But if latent capacity exists, why is it not fully utilised? The table below illustrates the main obstacles blocking optimisation.

Fragmented Data	Core systems operate in silos with limited real-time integration.	OPERATIONAL EFFECT **Interdependent airport processes cannot be optimised in real time.**
Manual Turnaround Management	Radio communication, checklists and manual reporting remain widespread.	OPERATIONAL EFFECT **Small delays cascade across gates, schedules and resources.** *10 min delay can propagate across the schedule*
Limited Autonomy & Connectivity	Autonomous GSE and connected airside operations remain in early deployment.	OPERATIONAL EFFECT **Potential throughput gains remain largely unrealised.**
Workforce Constraints	30-40% of the experienced airport workforce is approaching retirement globally.	OPERATIONAL EFFECT **Growing traffic meets shrinking operational capacity.**
Regulatory & Environmental Constraints	Slot rules, ATM capacity, noise limits, curfews and emissions restrictions constrain operations.	OPERATIONAL EFFECT **Potential throughput gains remain largely unrealised.**

The result: a structural performance gap

DEMAND		INFRASTRUCTURE		OPERATIONS
+3-5% annually	VERSUS	**Expansion measured in decades**	+	**Still fragmented and partly manual**

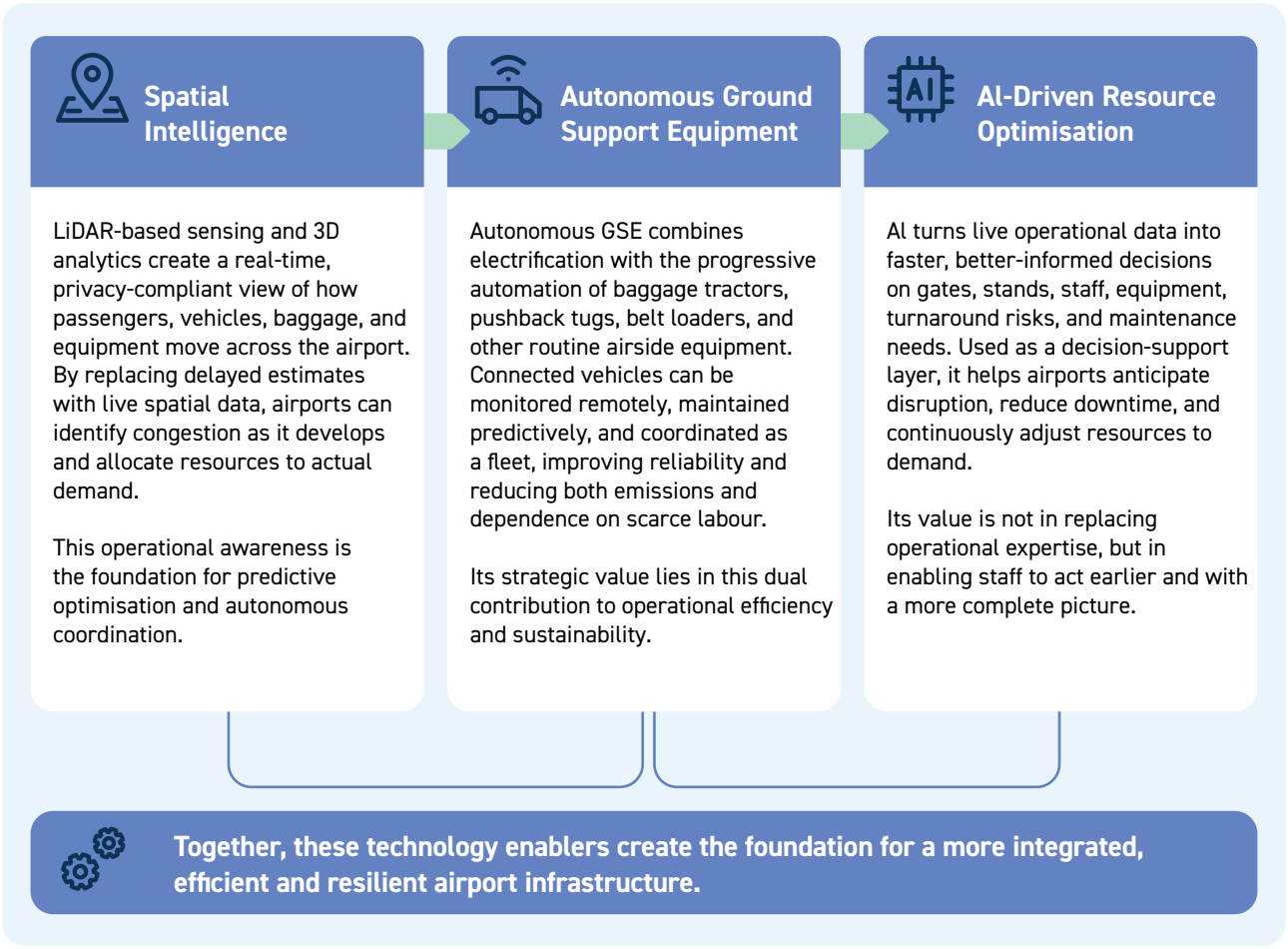
Current operating models cannot close the gap between growing demand and constrained capacity.

5.1.2 Innovation Opportunities

The future of infrastructural capacity lies in managing existing assets more intelligently, combining real-time awareness, predictive decision-making, and increasing automated operations.

The shared ambition of leading operators of constrained airports is the **self-optimising airport infrastructure**: a physical and operational environment in which the throughput of existing assets is continuously maximised through real-time data, predictive intelligence, and increasing levels of automation, without requiring proportional physical expansion. In this vision, **capacity is no longer fixed by concrete and steel alone**; it becomes a function of how precisely and dynamically the airport manages what it already has.

ACI EUROPE has identified three **key technology enablers** that define the pathway from the current fragmented state to the integrated, self-optimising airport infrastructure. They are interdependent, and their value compounds when deployed in combination.



5.1.3 Case Studies

The individual use cases referenced below, with their partners, maturity levels, and quantified results, are consolidated in Annex 2: Full Use Case Register.

The use cases submitted by Forum members show a clear shift from isolated technology pilots towards integrated, data-driven approaches to increasing effective capacity. Four recurring patterns emerge: **operational intelligence, phased automation, intelligent inspection, and targeted workflow optimisation**.

Pattern 1 – Data-driven operational intelligence

WHAT IT DOES	WHY IT MATTERS	WHAT THE EVIDENCE SHOWS	LESSONS LEARNED
Digital and AI-enabled systems create a more accurate, real-time picture of aircraft, passenger, and operational flows, replacing manual observation with shared operational data.	Better visibility enables airports to identify bottlenecks earlier, improve turnaround planning, allocate resources more effectively and make better use of existing infrastructure.	Aena's AI-powered turnaround monitoring and ADR's ApronAI at Fiumicino demonstrate the move from manual event logging to automated, shared turnaround data. Prague Airport has taken the next step, using machine learning to predict TOBT for all flights, whilst ADR's Aeroficial Intelligence platform extends operational awareness across airspace, runways, and taxiways. ADR's LiDAR deployment at FCO similarly demonstrates how real-time passenger-flow data can support capacity management whilst maintaining a privacy-by-design approach. Copenhagen Airports, Munich Airport and Heathrow are adopting Smarter Airports' AIRHART as an Airport Operations Orchestration Platform, integrating systems and real-time data to create shared situational awareness and enable AI-supported decision-making across airport operations.	The critical enablers are not the sensors or algorithms alone, but reliable data foundations, system integration and orchestration, formal data-sharing agreements, and clear operational ownership. Data creates value only when it is connected to the people and systems able to act on it.

Pattern 2 – Phased automation and platform-based autonomy

WHAT IT DOES	WHY IT MATTERS	WHAT THE EVIDENCE SHOWS	LESSONS LEARNED
Airports are progressively automating physical assets and vehicles, moving from remote operation towards higher levels of autonomy rather than attempting full automation in a single step.	This approach can reduce staffing requirements, improve resource utilisation, increase consistency and support more resilient operations without requiring proportional infrastructure expansion.	Aena's Passenger Boarding Bridge programme illustrates a staged progression from local remote control to off-site control and automated operation, with 129 bridges now managed through three control centres at Madrid-Barajas. Avinor's autonomous snowplough programme demonstrates the same principle at larger scale: remote-supervised vehicles have reduced crew requirements from eight drivers to one or two supervisors whilst delivering high clearing capacity. Zurich Airport successfully operates an autonomous staff shuttle pilot airside without a safety driver on board and monitored remotely. Munich Airport, meanwhile, is deploying autonomous freight transport. SEA Milan's autonomous shuttle at Malpensa will extend the model to landside mobility.	The evidence points to phased deployment, early stakeholder engagement, regulatory readiness, and an integrated control architecture as the key conditions for success. The Avinor example also shows that platform-based fleet coordination can create considerably more value than standalone vehicle autonomy.

Pattern 3 – Intelligent inspection and predictive maintenance

WHAT IT DOES	WHY IT MATTERS	WHAT THE EVIDENCE SHOWS	LESSONS LEARNED
Drones, robotics, computer vision and AI are shifting inspection from periodic manual checks towards continuous, data-driven monitoring of infrastructure and assets.	The objective is not simply to automate inspection, but to generate consistent, machine-readable data that supports earlier intervention, predictive maintenance, better reporting, and reduced exposure of staff to hazardous environments.	Aena's drone programme is now operational across multiple airports for perimeter, runway, and infrastructure inspections. Avinor's Roboxi programme combines FOD detection, runway inspection and wildlife monitoring in a single autonomous platform, whilst Milan Linate Airport's application uses AI to identify infrastructure defects from photographs and generate standardised reports. ADR's Buildots pilot applies AI to infrastructure condition and construction monitoring, demonstrating how one data architecture can support multiple maintenance and asset-management use cases.	Regulation, operational integration, and data quality are the binding constraints. Solutions also need to be designed with operational staff from the outset and connected to existing maintenance and operational management systems.

Pattern 4 – Targeted interventions in existing workflows

WHAT IT DOES	WHY IT MATTERS	WHAT THE EVIDENCE SHOWS	LESSONS LEARNED
Some of the most practical innovations improve a specific operational step without requiring wholesale redesign of the surrounding process.	Targeted interventions can deliver measurable operational or workforce benefits with relatively limited investment, whilst also creating a pathway towards broader process transformation.	Zurich Airport's Visual Bag Trace pilot reduced average bag-search time by approximately 60% by integrating image recognition into an existing handheld workflow. Its Power Stow Rollertrack Conveyor addresses the ergonomic burden of baggage handling by reducing manual handling distance, whilst SEA Milan Airport's Smart Cargo City pilot applies real-time monitoring to cargo flows to improve forecasting and reduce congestion. Avinor's winter de-icing AI provides a further example of a focused decision-support application, targeting a 10–20% reduction in chemical use.	These examples show that integration into existing workflows, careful pilot sizing and early involvement of users are essential. A technically effective solution can still fail to create value if it adds complexity, does not fit the operating process, or attempts to scale beyond what the business case can initially support.

5.2 Passenger Experience & Engagement

5.2.1 The Challenge

The passenger journey is the part of air travel that travellers experience most directly and closely associate with the airport – with direct implications for service quality, operational performance, accessibility, and commercial value. Therefore, the strategic ambition for airports is a seamless, predictable, and inclusive journey, personalised where appropriate. Achieving this requires coordinated processes, reliable operational data, consistent information across channels, intuitive physical and digital services, and effective collaboration among airports, airlines, ground handlers, authorities, transport providers, and commercial partners. As a result, passenger experience is a field that could naturally benefit from innovative solutions. However, passenger-facing innovation has progressed unevenly across three maturity levels:

OPERATIONAL Conversational services	TRANSITIONING Sensing and prediction	EARLY Personalisation and physical autonomy
Automated assistants and contact services increasingly operate as permanent, multilingual service channels with defined ownership, service levels, and operating costs.	These capabilities are technically mature but scale only where insights are linked to clear decision rights and operational responses.	These services remain less mature because they require stronger evidence on consent, liability, accessibility, and passenger acceptance.

The result is an industry that has become better at responding to passengers, but not yet consistently better at anticipating their needs. Information remains largely reactive, services are often uniform, and the journey is still managed as a sequence of individual touchpoints rather than as an integrated end-to-end experience.



5.2.2 Innovation Opportunities

Technology can enhance the transition to a more personalised, seamless, and inclusive passenger experience. Digital identity and biometrics reduce friction at controlled touchpoints; sensing and analytics improve visibility of queues and passenger flows; automation and robotics support mobility and service delivery; and AI provides a cross-cutting layer for prediction, communication, personalisation, and increasingly autonomous service execution. The graphic below summarises the main AI capabilities relevant to passenger-facing services.



The following sections show how Forum member airports are addressing these challenges in practice and which barriers still prevent individual solutions from becoming dependable end-to-end services.

5.2.3 Case Studies

The individual use cases referenced below, with their partners, maturity levels, and quantified results, are consolidated in Annex 2: Full Use Case Register.

The use cases submitted by ACI EUROPE Innovation & Technology Forum member airports show passenger-experience innovation is broadly shifting from channel-by-channel digitisation towards an integrated, data-driven service layer that anticipates passenger needs rather than simply responding to them.

Pattern 1 – AI-driven customer service and passenger communication

WHAT IT DOES	WHY IT MATTERS	WHAT THE EVIDENCE SHOWS	LESSONS LEARNED
Generative AI is increasingly being used to provide 24/7 multilingual passenger information and support, whilst newer agentic systems are beginning to move from answering questions to taking actions on behalf of passengers.	AI can reduce call-centre and information-desk workload, improve service availability and response times, and scale support without requiring proportional increases in staffing.	Berlin Brandenburg Airport's AI call centre BERry has replaced its third-party call centre, whilst Athens International Airport and Rome Fiumicino have deployed live AI assistants supporting passenger enquiries. Munich Airport also implemented a chatbot service both for flight-related and parking customer questions. Prague has combined GenAI with verified operational data, whilst ADR's ADRYX uses multi-agent orchestration to handle complex, multilingual passenger requests	The key requirements are a reliable central knowledge base, authoritative operational data, continuous content and accuracy management, clear governance and quality assurance, and human escalation for complex cases. The evidence also shows that AI architecture needs to balance generative flexibility with deterministic reliability.

Pattern 2 – Real-time operational information for the passenger

WHAT IT DOES	WHY IT MATTERS	WHAT THE EVIDENCE SHOWS	LESSONS LEARNED
Operational data is increasingly being converted into real-time, actionable information that allows passengers to respond to changing conditions during their journey.	Giving passengers accurate information earlier can reduce uncertainty, prevent unnecessary queuing and crowding, and improve the experience during delays or disruption.	Athens International Airport is scaling predictive delay and disruption management, whilst ADR's Smart Boarding provides live boarding status directly to passengers' smartphones without requiring an app. The latter demonstrates how a relatively simple digital intervention can simultaneously improve passenger convenience, reduce gate crowding and create additional commercial dwell time.	These services depend on reliable cross-stakeholder data, integration with core airport systems and disciplined pilot-to-scale deployment. Accessibility also matters: solutions should minimise friction and work across a diverse passenger population.

Pattern 3 – Queue, flow, and landside monitoring

WHAT IT DOES	WHY IT MATTERS	WHAT THE EVIDENCE SHOWS	LESSONS LEARNED
Computer vision, LiDAR, sensors, and predictive analytics are being used to monitor passenger and vehicle flows, identify congestion, and increasingly move from observation towards active queue and resource management.	Better flow intelligence can reduce waiting and walking times, optimise lane and resource allocation, improve terminal capacity, and provide a clearer understanding of how passengers move through the airport.	Aena is piloting dynamic security-queue management at Ibiza, whilst Athens International Airport is combining computer vision, predictive analytics and IoT to manage queues and passenger flows. Geneva Airport has used computer vision to analyse Kiss & Fly vehicle flows and saturation, whilst the LiDAR deployment by ADR provides a complementary terminal-wide spatial-intelligence capability.	The main requirements are accurate and continuous data, appropriate sensor positioning, integration with operational processes and careful management of privacy and GDPR requirements. Flow monitoring creates limited value unless the resulting intelligence leads to an actual change in resources, processes, or passenger management.

Pattern 4 – Personalisation, navigation, and door-to-door journeys

WHAT IT DOES	WHY IT MATTERS	WHAT THE EVIDENCE SHOWS	LESSONS LEARNED
AI is being used to personalise services and offers, improve navigation, and extend journey support beyond the terminal into connected air, rail, and other transport modes.	These services can make journeys more seamless, reduce passenger stress and missed connections, and create opportunities for additional non-aeronautical revenue.	Athens International Airport is testing AI-driven recommendations for services and offers, location-aware wayfinding and TravelWise, a SESAR JU project which explores AI-enabled optimisation across air, rail, and maritime journeys. The examples demonstrate the potential to move from airport information provision towards contextual, end-to-end journey support.	Personalisation requires strong consent and privacy management, whilst navigation depends on accurate positioning data. Intermodal services introduce a further challenge: value depends on data sharing and coordination across multiple organisations beyond the airport itself.

Pattern 5 – Physical service automation and inclusive mobility

WHAT IT DOES	WHY IT MATTERS	WHAT THE EVIDENCE SHOWS	LESSONS LEARNED
Robotics and autonomous mobility are being introduced into passenger-facing environments to support staff, automate repetitive tasks, and improve independence for passengers requiring assistance.	These solutions can reduce physical workload, improve staff productivity, support service continuity, and create more independent and accessible passenger journeys.	Prague Airport uses autonomous robots to transport used dishes within the terminal, reducing repetitive staff movement, whilst ADR has tested autonomous wheelchairs for passengers with reduced mobility at FCO. The wheelchair trial showed stronger passenger acceptance than anticipated, demonstrating the importance of testing assumptions in real operational environments. Munich Airport has carried out successful trials with snack delivery, customer service, and cleaning robots.	Successful deployment depends on fitting the technology into existing workflows, designing the service with operational teams and users, and providing appropriate training and support. For autonomous passenger services, the next challenge is moving from individual devices towards coordinated fleet management and reliable service availability.

5.3 Operational Excellence

5.3.1 The Challenge

Operational excellence is the airport's ability to deliver safe, reliable, and cost-efficient services through resilient processes, effective workforce deployment, and secure digital operations. This must be done without weakening safety, accountability, or workforce sustainability: a difficult balancing act, made increasingly complex as physical capacity lags passenger demand.

Unlike infrastructural capacity, this workstream does not primarily address physical throughput; unlike passenger experience, its primary outcome is not the passenger-facing journey. It focuses on the **internal capabilities that allow the airport and its partners to operate efficiently, securely, and resiliently**.

Airports face four interdependent operational-excellence challenges that affect both frontline operations and enterprise functions:

Ground handling cost and workforce sustainability	Enterprise productivity and knowledge continuity	Cybersecurity and ecosystem resilience	Scaling robotics and digital tools
Two distinct pressures are shaping ground handling across Europe. First, labour costs are rising as sector-wide agreements increasingly limit competition on employment terms and lock in wage growth ahead of the pace of automation. Second, physically demanding tasks such as baggage handling create ergonomic, safety, and compliance obligations independent of labour shortages. Together, these trends strengthen the case for dispatch optimisation, automation, and robotic lifting assistance, not only as productivity measures but also as tools to improve workforce sustainability.	Internal functions such as HR, finance, procurement, dispatching, and knowledge management remain fragmented and often rely on manual workflows. Unlike operational disruptions, their inefficiencies rarely appear on performance dashboards, making investment cases more difficult despite potentially comparable returns. At the same time, demographic change increases the urgency of preserving institutional knowledge and reducing dependence on individual expertise before large parts of today's workforce retire.	Cybersecurity has evolved from a back-office IT topic into a board-level operational risk. Airports increasingly depend on shared third-party platforms and service providers, meaning resilience can no longer be assessed solely within the airport itself. Growing convergence of IT and operational technology further expands the attack surface, while regulatory frameworks such as NIS2 and aviation-specific Part-IS requirements are increasing accountability across the sector. As a result, identity, access, supplier, and resilience management are becoming strategic priorities alongside traditional cybersecurity controls.	Robotics adoption is expanding across activities such as ground handling, cleaning, inspection, and staff transport, but most deployments still remain isolated pilots rather than coordinated programmes. The main constraints are typically workflow integration, operational variability, staff acceptance, training, and change management rather than the underlying technology itself. The same applies to enterprise AI, where success depends less on model performance than on whether organisations can embed new tools into daily work and ensure employees perceive them as reducing rather than adding complexity.

Overall, airports face the challenge of turning fragmented initiatives into scalable programmes that combine workforce sustainability, productivity, technology adoption, and operational resilience.

5.3.2 Innovation Opportunities

Whilst this workstream presents many challenges, it also presents many accompanying solutions – with the primary beneficiaries the organisation and its workforce. Passengers benefit indirectly through more stable operations and fewer disruptions. Key technology enablers include:

- **Ground Handling Dispatching and Decision Intelligence:** Real-time software determines who performs which task, where, and with what equipment. Fraport's Intelligence Dispatching Agent supports next-generation dispatch at Frankfurt, whilst LuRAI feeds computer-vision baggage data into operational decisions. The economic logic is clear: where labour is the largest and fastest growing operating cost, improving its deployment creates greater leverage than only monitoring its output.

- **Ground Handling and Facility Robotics:** Robotics supports tasks that are difficult to staff or physically demanding, addressing workforce scarcity, ergonomics, and compliance rather than throughput. Schiphol's Cobot Lift assists with loose baggage; Frankfurt and Munich use autonomous cleaning robots with digital activity records; Zurich is piloting an autonomous airside staff shuttle; and ADR and Stuttgart have tested cleaning and baggage-handling robots. Across these cases, robotics augments labour in internal operations rather than serving passenger-facing or capacity objectives.

- **Enterprise AI and the Digital Workplace:** Large language models and retrieval-based co-pilots are moving into office-based knowledge work. Fraport's programme illustrates a structured approach: AI@OPS for operations, AI@Workplace for office staff, and AI@Basics for governance, ethics, and communication, including the internal FraportGPT assistant.

- **Cybersecurity and OT/IT Convergence Resilience:** As baggage systems, GSE telematics, building management, and access control increasingly share networks and vendors with conventional IT, the attack surface expands. EU Implementing Regulation 2023/203, applicable from 2026, adds aviation-specific information-security requirements alongside NIS2. Leading responses include AI-based anomaly detection, zero-trust architectures, and centralised threat intelligence, with several Forum members already reporting live deployments. The main constraint, however, is identity and access governance across airlines, handlers, and vendors beyond any airport's full control, as the September 2025 MUSE incident demonstrated.



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5.3.3 Case Studies

The individual use cases referenced below, with their partners, maturity levels, and quantified results, are consolidated in Annex 2: Full Use Case Register.

The use cases mapped to the Operational Excellence workstream show a clear shift towards using AI and robotics to improve workforce productivity, safety, security, and organisational resilience. **Three application domains emerge: AI co-pilots for knowledge work and operational decision-making; AI-based monitoring for safety, security, and cyber resilience; and robotics for physically demanding, repetitive or hazardous tasks**. The individual use cases, with their maturity levels and results, are consolidated in Annex 2, Full Use Case Register.

Pattern 1 – AI co-pilots for knowledge work and operations

WHAT IT DOES	WHY IT MATTERS	WHAT THE EVIDENCE SHOWS	LESSONS LEARNED
AI co-pilots use large language models, enterprise data and operational analytics to help employees retrieve information, generate content, support decisions, and respond more quickly to operational events.	These tools can reduce manual effort and search time, improve knowledge reuse and decision-making, and help airports preserve and make better use of organisational knowledge.	Athens International Airport has piloted an internal corporate AI co-pilot using LLMs, Retrieval-Augmented Generation and enterprise data, delivering faster document creation, improved knowledge access and reduced manual effort. ATH is also exploring an Airport Digital Assistant that would extend the concept into live operations, providing operational insights, alerts, and recommendations across airport systems.	The main requirements are reliable data, access controls, accuracy validation, governance and change management. For operational applications in particular, employee trust and adoption are as important as the technical performance of the AI itself.

Pattern 2 – AI for safety, security, and cyber resilience

WHAT IT DOES	WHY IT MATTERS	WHAT THE EVIDENCE SHOWS	LESSONS LEARNED
AI and computer vision are increasingly being used to detect risks, anomalies, and threats across both physical and digital airport environments	These capabilities can improve situational awareness, strengthen safety and compliance, automate elements of threat detection and response, and increase resilience as airport IT and operational technology become more interconnected.	ATH is piloting computer-vision and edge-AI monitoring to detect safety and security risks in real time, whilst its AI-driven cybersecurity platform is already live, using machine-learning-based anomaly detection to identify and mitigate cyber threats across airport systems. Computer vision is also increasingly being used to optimize aircraft turnarounds. Several airport operators including FCO, Aena, BER or MUC deployed AI-based turnaround monitoring. Together, these examples show how AI is becoming an operational layer for both physical and digital resilience rather than a standalone technology experiment.	The evidence points to three requirements: design infrastructure and workflows to accommodate robotics from the outset; involve operational staff closely in testing and change management; and integrate robot-generated data into existing operational and maintenance systems. The technology may work in isolation, but value is created only when the robot becomes part of the operating model

Pattern 3 – Robotics for physically demanding and repetitive tasks

WHAT IT DOES	WHY IT MATTERS	WHAT THE EVIDENCE SHOWS	LESSONS LEARNED
Robotics is being applied to tasks where work is physically demanding, repetitive, hazardous, or difficult to staff reliably, including baggage handling, cleaning, and airside inspection.	The objective is not simply to replace labour, but to reduce physical strain, improve consistency and safety, increase workforce productivity, and allow employees to focus on tasks that require human judgement and interaction.	ADR has tested autonomous robotics at Rome Fiumicino across several different tasks. Its Azalea Robotics PoC demonstrated autonomous baggage identification, grasping and cart loading in a live airport environment, highlighting the importance of reliable perception across varied real-world conditions; its Loki Robotics cleaning PoC showed that high-dexterity tasks such as bathroom cleaning are substantially harder to automate and that operational scheduling and staff acceptance are critical; and its Guimu Robot inspection PoC demonstrated the potential of autonomous 2D/3D imaging to generate more consistent data for predictive maintenance across a 20,000 m² runway area. The Digital Testbed Air Cargo, led by Fraunhofer IML, is advancing autonomous robotics for air cargo handling at different German airports such as Frankfurt, Cologne, Leipzig, and Munich.	The evidence points to three requirements: design infrastructure and workflows to accommodate robotics from the outset; involve operational staff closely in testing and change management; and integrate robot-generated data into existing operational and maintenance systems. The technology may work in isolation, but value is created only when the robot becomes part of the operating model.



6. INNOVATION POLICY RECOMMENDATIONS

The case studies throughout this Handbook have shown the necessity of a solid foundation on which to begin work. However, this foundation is not based on the airport alone: the regulatory and policy environment plays an equally fundamental role to the success of any innovation. Even where solutions are technically mature and operationally proven, unclear regulation, fragmented standards, lengthy approval processes, limited interoperability and constrained access to funding can prevent innovation from moving beyond the pilot stage.

For this reason, creating the conditions for innovation externally is just as important as developing innovation itself. The main aim of regulation, standardisation, and certification should be to enable innovation and provide clear safeguards, without becoming the dominant constraint on innovation itself. A reliable and future-oriented policy and regulatory framework can reduce barriers to deployment, support investment, and enable solutions that have been validated in one airport or jurisdiction to be replicated across Europe. This chapter therefore sets out recommendations for regulators, policymakers, and European institutions to help create the conditions in which airport innovation can move from experimentation to operational scale.

6.1 What Airports Need From the Policy Environment

This high-level framework establishes four key principles that regulators and policymakers should consider as essential when implementing any innovation-focused regulation:

- **Future-proof:** Any legislation that might eventually be proposed should be 'future-proofed' in that it should not lock in, or be predicated on, today's existing technologies, business models, or processes. Any pertinent legislation should not protect existing models or try to foresee everything that the private sector might develop at the expense of future innovation in the domain.

- **Proportionate and technology-neutral:** Innovation only needs to be regulated if it is needed for safety, security, and interoperability. Regulation should be technology agnostic and technology non-descriptive.

- **Mutual recognition for faster validation:** If regulation of a certain technology is available outside Europe and has proven to be reliable, no new European or national initiatives need to be launched but the regulatory, standardisation or certification framework can be copied or, at the most, adapted to existing European regulation. Similarly, within Europe, if regulation of a certain technology is available in one of the member states or affiliated states and has proven to be reliable and validated also in another state or on EU level, no new European or national initiatives need to be launched. We would support, in the aviation sector, a European homologation procedure inspired by what exists in the automotive sector (Regulation (EU) 2018/858), as well as regulatory sandboxes, as foreseen in the draft European Innovation Act. Hong Kong's regulations and code of practice for autonomous-vehicle pilots, as well as Singapore's sandbox-based approach and ongoing development of a broader legal framework, show how authorities can enable controlled testing while maintaining safety and accountability.

- **Interoperable by design:** Existing regulations should be adapted to make cross border exchange of data and intelligence possible for all stakeholders in aviation.

What this means for airports

- When assessing an innovation opportunity, airports should ask four questions: Is the regulatory pathway clear? Can the solution be validated quickly? Can approval or evidence be recognised elsewhere? And can the solution operate across the wider airport ecosystem?

6.2 The Role of International Institutions

Innovation exists, and acts, within a complex aviation ecosystem – and should also be considered in light of the sector's major investment, sustainability, and operational imperatives.

A variety of international institutions exist, and have a direct impact, on aviation innovation: the European Commission, the SESAR Joint Undertaking, EASA, EUROCAE, as well as legislation such as the Innovation Act and funding mechanisms such as the European Competitiveness Fund.

Across the innovation examples in this Handbook, the same policy barriers recur: regulatory uncertainty, fragmented certification and standards, limited interoperability, and difficulty accessing funding for deployment. These barriers are not specific to one technology or one airport; they affect the ability of airports to move proven solutions from testing into regular operations and to replicate them across borders.

Where Chapter 6.1 addresses what airports need, Chapter 6.2 explains **where policy intervention matters most**.

6.2.1 Regulation and approval

Relevant Institutions: European Commission | EASA | national aviation authorities

A predictable (and consistent and adaptable) policy environment is key for attracting European and third-party investment. Regulation needs to aim to introduce good oversight, rather than managing a market that is dynamic by definition, while simplifying and streamlining regulatory convergence between jurisdictions.

To restore European competitiveness, regulation should align with real market dynamics. This means oversight recalibrated to support the economic processes that drive innovation and, after deployment, increased productivity. The European Aviation Safety Agency (EASA) has a significant role to play here. A critical activity for EASA is to ensure that activities have regulations ready on time. EASA should be proactive and make sure that resources are available to make technical regulations for large scale demonstrations or testing. Without this, innovation is considerably slowed down.



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6.2.2 Standards and Certification

Relevant Institutions: EASA | EUROCAE | European Commission

Standards and certification can determine whether an innovation moves from a successful pilot to a deployable product. For airports, the priority is to shorten the path from validation to market uptake, ensure that operational stakeholders are properly represented in standardisation, and enable validated approaches to be recognised across jurisdictions.

The European Organisation for Civil Aviation Equipment (EUROCAE) has an important role in reducing the time to market (from TRL6 to TRL9) so that the industry then can swiftly adapt their product for market uptake. This Handbook recommends the EUROCAE standardisation process be restructured as such:

1. The EUROCAE drafting groups (officially known as Working Groups; expert committees that develop aviation standards and guidance documents) work on a full-time basis for the entire duration; with two or three stakeholder consultations to strengthen the standardisation content.

2. The drafting groups could be further incorporated with deployment support (currently the SESAR Deployment and Infrastructure Partnership, fulfilling the role of SESAR Deployment Manager) so that the prioritisation is aligned with the deployment dates in the upcoming CP2.

3. The contribution of the operational stakeholders (that are not in a cost recovery financial situation) could be remunerated, as well as the contribution of the deployment support unit.

The Draghi Report highlighted the potential of researchers and innovation in Europe. Still, we are largely failing to translate innovation into commercialisation (or deployment as a synonym). Procurement – both public and private – needs to be more innovation-friendly, and we need better policies to attract and retain talent. We support regulatory sandboxes as a useful concept, together with other regulatory novelties that tackle the problem of lead times to deployment. However, these novelties should shorten the lead time to market, avoiding additional lead time.

6.2.3 Funding and Investment

Relevant Streams: MFF 2028-2034 | European Competitiveness Fund | Horizon Europe | SESAR Joint Undertaking

Aviation contributes to nearly all European policies: if we want our European aviation critical infrastructure sector and the aeronautical sector to be even more competitive, we must make all relevant funding mechanisms accessible for all partners in the aviation industry.

The upcoming **Multi-Annual Financial Framework 2028-203**4 presents dual use as a key element in the upcoming strategy. Airports are on the forefront of dual use of critical infrastructure; however, we strongly recommend against introducing percentages of existing dual use as, in case of conflict, we need to be able to mobilise all critical aviation infrastructure.

Co-funding programmes, be it national or European, accelerate innovation in several ways: de-risking high-risk R&D programmes that allow pursuing disruptive deep-tech projects that airport operators normally deem too risky, enhancing cross-border collaboration among airport operators by sharing technological know-how, and bridging local and EU funds. For instance, the SESAR project allows, for those airports that have some research & development resources, to team up with research institutions and universities to conduct exploratory research (TRL 0-2) and be at the forefront of emerging possibilities.

ACI EUROPE also offers a service to members for the participation in European calls for proposals that are funded. As ACI EUROPE seeks to facilitate the access of the members to European funding programmes in a collective way, this service brings together different initiatives of airport operators for the same funding call and repackages them as a joint airport operators' proposal that gains magnitude in investment amount – ensuring the cross-border cooperation dimension is easily reached. Further information is available from the ACI EUROPE Secretariat.

We welcome the ambition of the EC, through the **European Competitiveness Fund**, to address the financing and investment gap in the latter stages of innovation (acceleration). Whilst helpful, there is still not enough money in the industry for the ideal timely investment and implementation of all the different regulatory and investment challenges that airport operators are facing. Horizon Europe should fund most of the research and innovation work so that the other windows of the European Competitiveness Fund can be used for funding upstream activities in the implementation phase.

Aviation and airports must have access to more windows of the European Competitiveness Fund, including:

- **The Clean Transition and Industrial Decarbonisation Window:** Airport operators tick most of the main objectives of the investment window, by promoting the uptake of decarbonisation technologies, renewable and clean energy solutions; the development, resilience, integration and digitalisation of the energy and transport infrastructures and systems; and by boosting smart mobility, sustainable alternative fuels, sustainable blue economy, energy efficiency.

- **The Digital Leadership Window:** Airports are achieving leadership in digital and AI technologies, technological sovereignty by building resilient digital ecosystems and ensuring a high level of cybersecurity, enabling the power of digital for businesses and citizens, and supporting the digital transformation and interoperability of public and private sectors.

- **The Resilience, Security, Defence and Space Window:** Although not specifically mentioned in the objectives, the dual use of airports also in the policy framework of civil military mobility should be considered.

ACI EUROPE works on a European level, with our members, to share airport operators' concerns and investments within the work programmes of the European Competitiveness Fund.

SESAR post-2027

- **ACI EUROPE considers it essential** for the post-2027 SESAR framework to maintain strong operational-stakeholder involvement, protect support for deployment and operational benefits, and keep R&I linked to operational benefits. ACI EUROPE supports the continuation of a Joint Undertaking, governance reflecting investment contributions, and continuation of the current SESAR deployment and R&I operating models as far as possible.

6.3 Regulation in Action: Policy Examples

To demonstrate the complex relationship between technology, innovation and regulation, this Handbook showcases two areas of strategic importance for the airport industry: biometric passenger processing and autonomous airside mobility.

Both rely on technologies that are increasingly mature and already being trialled or deployed in live airport environments, but their wider adoption depends on clear, proportionate, and harmonised rules covering fundamental rights, safety, cybersecurity, liability, and interoperability.

For airports, the priority is therefore not simply to enable innovation, but to create predictable pathways from controlled trials to responsible deployment at scale. The following paragraphs set out the current state of play and ACI EUROPE's recommendations for engagement with regulators in each area.

Biometrics:

The Challenge:

The deployment of biometric passenger-processing solutions at European airports is being constrained by legal uncertainty and divergent interpretations of GDPR requirements, limiting airports' ability to improve passenger facilitation, strengthen process reliability, and manage growing traffic within existing infrastructure and workforce constraints.

ACI EUROPE Recommends:

- aligning GDPR terminology with the biometric definitions established under the AI Act
- explicitly enabling voluntary, consent-based verification whilst preserving a non-biometric alternative
- recognising that both decentralised and appropriately secured centralised architectures can provide robust data protection

The Objective:

A harmonised European approach would reduce divergent national enforcement, provide greater investment certainty, and enable airports to deploy biometric solutions responsibly whilst safeguarding passengers' fundamental rights.

Autonomous Airside Mobility:

The Challenge:

Autonomous airside mobility has the potential to improve safety, reliability, workforce productivity, and environmental performance, but deployment is constrained by fragmented technical, operational, cybersecurity, liability, and insurance requirements at European level.

ACI EUROPE recommends:

- immediately establishing a clear framework for trials and progressive deployment in the style of Hong Kong/Singapore's sandbox-based approach and ongoing development of a broader legal framework. European and national regulators should draw on these established approaches, adapt them to the airport environment, and create a common pathway from supervised trials to regular Level 4 operations.

- harmonised trial requirements, mutual recognition of validated test results, and common specifications for vehicle interfaces, remote supervision, data exchange, liability, and insurance.

The Objective:

These efforts would shorten deployment timelines, reduce duplicated approval efforts, and support interoperable autonomous operations across European airports.



7. CONCLUSIONS

This Handbook has taken readers through the full journey of airport innovation. The evidence shows a clear conclusion: **technology is no longer the principal constraint on airport innovation**. This Handbook demonstrates that solutions that expand effective capacity, improve the passenger journey, and strengthen operational performance are already commercially available and, in many cases, deployed within the European airport network. Yet **regulation and organisational culture remain the most frequently cited barriers to scale.** This is where airport innovation either begins to create lasting value or fizzles out.

What now? For airport operators, three priorities follow. Make innovation a shared organisational capability, treat data infrastructure as a strategic prerequisite, and design for scale from the outset. For regulators and policymakers, the task is equally concrete. Predictable, proportionate, and technology-neutral frameworks, combined with recognition of approaches already validated in other jurisdictions, would materially shorten that pathway without weakening safeguards. Funding should likewise be accessible to airport operators in their role as critical infrastructure managers across the clean transition, digital leadership, and resilience agendas, with requirements proportionate to the scale and risk of the investment.

For airports, the next step is to take the challenges in front of them, apply the principles set out in this Handbook and build the pathway to scale from the outset. For policymakers and regulators, create the conditions that allow that innovation to move from experimentation to deployment.

ACI EUROPE's Innovation and Technology Forum stands ready to support both airports and policymakers – with this handbook establishing a common baseline for that work.

The handbook ends here; but the work has only just begun.



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8. ANNEX & BEST PRACTICES

This annex consolidates insights from the ACI EUROPE Innovation & Technology Forum Member Survey (Q1 2026, n = 20 European airports) and selected best practices submitted by member airports.

Annex 1. Survey Summary: The Innovation Engine Across European Airports

The survey was conducted among ACI EUROPE Innovation & Technology Forum member airports in Q1 2026. It covered organisational placement, innovation models, ecosystem engagement, success metrics, pain points, funding models, and cultural programmes. Key aggregate findings:

Dimension	Key Finding	Data Point	% of Respondents
Dedicated Team	Vast majority have a dedicated Innovation Team	17 out of 20	85%
Org. Placement	Two dominant models: CEO-level vs. IT/Digital	6 CEO + 6 IT/Digital	33% each
Innovation Focus	Balanced portfolio is the prevailing approach	8 out of 19	42%
Innovation Model	Venture Clienting is the dominant model	10 out of 19	53%
Ecosystem	University/Research partnerships are the #1 channel	15 out of 20	75%
KPIs	Operational KPIs lead as primary success metric	14 out of 19	74%
#1 Pain Point	Regulatory/Compliance hurdles	10 out of 18	56%
#2 Pain Point	Internal culture / Resistance to change	9 out of 18	50%
Funding	Dedicated Innovation Budget (CAPEX/OPEX) is standard	12 out of 20	60%

Detailed Breakdown: Innovation Models

Model	Count	% of Respondents
Venture Clienting (pain-point driven scouting → PoC)	10	53%
Innovation Lab / Living Lab (Open Calls → scale-up)	7	37%
Investment-Led / Corporate Venture Capital	1	5%
Intrapreneurship (internal programmes / hackathons)	1	5%

Detailed Breakdown: Pain Points in Scaling

Pain Point	Count	% of Respondents
Regulatory / Compliance hurdles	10	56%
Internal culture / Resistance to change	9	50%
Budget constraints	7	39%
Integration with legacy IT systems	7	39%

Qualitative Insights: Pilot-to-Scale Transition Patterns

Theme	Pattern Observed Across Respondents
Ownership of scale-up	Business Units own the industrialisation; Innovation team hands off formally after PoC success
Stage-gate governance	Multiple airports use structured stage-gate or RACI frameworks with formal approval milestones
Key bottleneck	Budget approval and IT integration are the most cited hurdles in the pilot-to-scale transition
Procurement timing	Several airports involve Procurement from PoC initiation; others bring them in only at the scale-up stage



Annex 2. Full Use Case Register

This register consolidates all use cases submitted by ACI EUROPE Innovation & Technology Forum member airports. It provides a comprehensive overview of innovation activity across the network, spanning passenger experience, operations, infrastructure, sustainability, and safety & security.

Use Case	Domain	Description	Objective / Value	Technology	Maturity Level	Best Practice (Airport)	Key Results	Impact / Limitations
Smart Queue Management	Passenger Experience / Landside Operations	AI-supported dynamic management of security queues using real-time demand	Reduce waiting and walking times; improve efficiency	Computer vision, real-time analytics	Pilot	Ibiza Airport (Aena)	Adaptive queue length (33–212m)	Automated queue management, improved efficiency
LiDAR Passenger Flow Monitoring	Operations / Capacity Management	LiDAR-based 3D tracking of passenger flows	Accurate flow measurement, congestion detection	LiDAR, spatial analytics	Pilot	Málaga & Alicante (Aena)	High-precision tracking	Data-driven capacity planning
Computer Vision Monitoring (Kiss & Fly)	Landside / Traffic	Video analytics for vehicle & passenger flows; AI computer-vision monitoring of Kiss & Fly vehicle flows, usage patterns (e.g. average presence time) and saturation situations	Optimise traffic, commercial insights	Computer vision (Wintics); uses existing cameras, integrated into VMS	PoC finalised (go-live targeted early 2027)	Geneva Airport	Vehicle counts, dwell times; >98.5% data accuracy; flexible KPIs	Fast deployment, setup dependent; camera positioning key; continuous accuracy verification (audits, quality management) required
AI Consumer Testing	Commercial / Strategy	Synthetic personas for market testing	Faster research, reduce bias	Generative AI	Concept	Geneva Airport	Behaviour insights	Not yet validated
Internal Corporate AI Co-pilot	Enterprise Operations	AI assistant integrated with enterprise data enabling employees to retrieve information, generate content, and support decision-making	Increase workforce productivity; reduce search time; enhance knowledge reuse and decision support	LLMs, RAG, enterprise data integration, Co-pilot platforms	Pilot → Scaling	ATH Airport	Faster document creation, improved knowledge access, reduced manual effort	Data governance, access control, accuracy validation, change management
Smart Queue Management & Flow Prediction	Passenger Experience / Landside Operations	AI-supported dynamic prediction and management of queues and passenger flows using real-time and historical data	Reduce waiting times; improve passenger experience and throughput	Computer vision, predictive analytics, IoT sensors	Pilot → Scaling	ATH Airport	Reduced congestion, optimised lane allocation	Dependent on data quality, GDPR constraints
AI Passenger Flow Monitoring (LiDAR / CV)	Operations / Capacity Management	Real-time monitoring of passenger movements using sensors and AI analytics	Accurate flow measurement and congestion detection	LiDAR, computer vision, spatial analytics	Pilot	ATH Airport	High-precision tracking and flow insights	Infrastructure cost and integration complexity
Airport Digital Assistant (AI Ops Co-pilot)	Airport Operations	AI assistant providing operational insights, alerts, and recommendations across airport systems	Improve decision-making speed and operational efficiency	AI/ML models, big data analytics, cloud	Concept → Pilot	ATH Airport	Faster response to disruptions	Adoption and trust challenges

Use Case	Domain	Description	Objective / Value	Technology	Maturity Level	Best Practice (Airport)	Key Results	Impact / Limitations
AI Chatbot → Agentic Passenger Assistant (Philos)	Customer Service / Passenger Communication	Conversational AI evolving into agentic assistant with memory, personalisation, and reasoning	Improve service quality, automate passenger support	LLMs, NLP, generative AI	Live → Expanding	ATH Airport	Increased self-service and engagement	Requires governance and QA mechanisms
Personalised Passenger Services &	Passenger Experience / Commercial	AI-driven personalisation of services, offers, and journey guidance based on context	Enhance passenger experience and increase non-aeronautical revenue	Recommendation engines, data analytics	Pilot	ATH Airport	Improved retail conversion and satisfaction	Data privacy and consent management
Location-Aware & Wayfinding AI Services	Passenger Experience / Navigation	Context-aware AI providing real-time navigation and location-based information to passengers	Improve passenger orientation and reduce stress	Mobile apps, indoor positioning, AI decisioning	Pilot	ATH Airport	Reduced missed flights, smoother journey	Accuracy limitations in indoor positioning
Predictive Delay & Disruption Management	Passenger Experience / Operations	AI predicts disruptions and supports proactive passenger communication and recovery actions	Improve predictability and passenger communication	Predictive analytics, AODB/eAOP integration	Pilot → Scaling	ATH Airport	Reduced disruption impact on passengers	Depends on cross-stakeholder data sharing
Intermodal Journey Optimisation (TravelWise)	Mobility / Passenger Experience	AI orchestration of passenger journeys across air, rail, and maritime through data sharing	Optimise door-to-door passenger experience	Data platforms, AI optimisation models	Pilot (EU project)	ATH Airport	Improved coordination and journey continuity	High ecosystem complexity
Computer Vision Safety & Security Monitoring	Safety / Security	AI-based real-time monitoring of airside and terminal environments to detect risks and anomalies	Enhance safety, compliance, and situational awareness	Computer vision, edge AI	Pilot	ATH Airport	Improved detection of incidents	High implementation cost, false positives
AI-driven Cybersecurity (Unified Threat Platform)	Cybersecurity	AI-enabled detection and mitigation of cyber threats across airport systems	Strengthen resilience and automate response	ML-based anomaly detection	Live	ATH Airport	Automated threat detection and response	Requires system integration and governance
Generative AI Passenger Communication	Customer Service	AI-powered voice/chat agents providing real-time passenger support and information	Reduce operational cost, enhance service availability	Generative AI, NLP, voice AI	Live → Expanding	ATH Airport	Improved response times, reduced workload	Requires QA and monitoring
AI-Powered Virtual Assistant	Passenger Experience / Digital Services	Automated passenger support across the journey: flight info, navigation, F&B, parking, lounge, Fast Track, entertainment, and baggage query resolution. Available via multiple digital channels with Generative AI.	Reduce call centre workload; improve passenger experience across the journey	Generative AI, NLP, multi-channel integration	Operational (network-wide)	Aena	7M+ unique users; 99% response automation rate	Sustained investment in unanswered-query review required to maintain performance

Use Case	Domain	Description	Objective / Value	Technology	Maturity Level	Best Practice (Airport)	Key Results	Impact / Limitations
Remote & Automated Passenger Boarding Bridges	Infrastructural Capacity / Ground Operations	Remote and automated operation of Passenger Boarding Bridges from centralised control centres, reducing the need for dedicated on-site operators. Validated at Seville, Vigo, and Madrid-Barajas (129 bridges, 3 control centres).	Reduce staffing requirements; improve resource utilisation; enable scalable bridge management	Automation, remote control systems, robotics	Operational (scaling across network)	Aena	Centralised management of 129 bridges at MAD; validated remote and automated docking	Phased approach essential; multi-stakeholder engagement (airlines, handlers, safety authorities) critical from day one
AI Turnaround Monitoring (Video Analytics)	Infrastructural Capacity / Ground Operations	AI-powered video analytics automatically detecting and timestamping turnaround events using CCTV and dedicated cameras. Monitors ground handling milestones and provides near-real-time performance data.	Increase operational visibility; identify bottlenecks; enable data-driven turnaround management	Computer vision, AI analytics, CCTV integration	Pilot → Scaling (MAD, BCN, PMI)	AENA	Automated timestamping across stands; bottleneck identification; performance benchmarking	Camera positioning is critical; stand-by-stand AI calibration required; data-sharing agreements needed for full value
Drone-Based Airside Inspections & Surveillance	Infrastructural Capacity / Safety & Security	Autonomous drone-in-a-box for perimeter surveillance, runway marking/lighting inspection, and infrastructure inspection. Pre-programmed flights, automatic reporting, on-demand surveillance.	Automate inspection cycles; improve coverage and consistency; reduce manual exposure to airside hazards	Drone-in-a-box, autonomous navigation, computer vision	Operational (multiple airports)	Aena	~10 km perimeter coverage; multiple inspection use cases on a single platform	Operational approval for autonomous recurrent flights within controlled airspace is the primary constraint
Autonomous Snowplough Operations	Infrastructural Capacity / Winter Operations	Driverless snowplough vehicles (RS600) keeping runways and taxiways free of snow at Oslo Gardermoen using a cloud-based fleet control platform (YASP). Reduces operator requirement from 8 to 1–2 supervisors per operation.	Reduce labour dependency in critical winter operations; improve consistency; lower emissions	Autonomous driving, cloud fleet management (YASP), IoT	Advanced Pilot (scaling toward full autonomy)	Avinor	Clearance capacity ~357,500 m²/hour; 8→1–2 supervisors per operation; reduced chemical usage	Platform-based autonomy (YASP) essential: standalone vehicle autonomy without fleet integration captures only partial value
AI De-Icing Chemical Optimisation	Infrastructural Capacity / Winter Operations	AI decision-support model integrating sensor data (temperature, precipitation, contamination) and historical usage to recommend optimal de-icing chemical dosage for runway supervisors.	Reduce chemical use by 10–20%; lower environmental impact; support supervisor decision-making	AI/ML, IoT sensors, predictive analytics	Early Development / PoC	Avinor	10–20% chemical reduction targeted; first internal AI model developed	Data quality and sensor infrastructure are binding constraints; AI model development is secondary to data foundation
Autonomous Runway Inspection Robot (Roboxi)	Infrastructural Capacity / Airside Operations	Modular self-driving electric robot detecting FOD, inspecting runway lights and surface conditions, deterring birds. GPS-tagged real-time reporting and automated maintenance work order generation.	Automate airside inspections; reduce personnel exposure; enable predictive maintenance	Autonomous robotics, computer vision, cloud data platform	R&D / Testing	Avinor (Stavanger + Alta)	Parallel detection of FOD, lighting faults, surface damage, bird activity in a single pass	Close collaboration with operational staff from day one is essential for solution relevance and adoption

Use Case	Domain	Description	Objective / Value	Technology	Maturity Level	Best Practice (Airport)	Key Results	Impact / Limitations
International Test Arena for Zero-Emission Aviation	Operational Excellence / Sustainability	National airport-based test arena enabling safe testing, validation, and operational integration of zero- and low-emission aircraft and AAM technologies in real airport and airspace environments.	Accelerate deployment of sustainable aviation technologies; reduce implementation risk; build operational knowledge	Real airport infrastructure, regulatory sandbox, stakeholder coordination	Pilot (operational	Avinor / CAA Norway	Electric aircraft demonstrations (Bergen–Stavanger); fast charger installations; NOK 50M state funding allocated	Long-term stakeholder commitment and regulatory co-design are prerequisites; modular governance structure designed for replication across European aviation authorities
Cargo Flow Monitoring: Smart Cargo City	Infrastructural Capacity / Cargo Operations	Monitoring of truck and driver flows within Malpensa cargo city (warehouses and external areas) to improve forecasting, reduce congestion, and enable objective stakeholder performance tracking.	Improve cargo throughput forecasting; reduce congestion; enable objective performance monitoring	IoT, process monitoring, data analytics	Pilot	SEA Milano (MXP)	Improved inbound/ outbound flow visibility; foundation for objective stakeholder KPI tracking	Scope the pilot to a manageable zone first; full cargo city coverage from day one is not operationally or economically viable
AI Automatic Queue Management System	Passenger Experience / Security Operations	System automatically redirecting passengers to the most efficient security lane using automatic gates, monitors, and sensors. Real-time and live monitoring with AI lane balancing.	Minimise waiting times; optimise machine load; avoid bottlenecks	AI, automatic gates, real-time sensors	Pilot ongoing	SEA Milano (LIN)	Passenger flow balanced across lanes; bottlenecks reduced; divesting station utilisation improved	Human management of queues causes significant imbalance; information to passengers is never sufficient: invest in signage alongside the system
S.M.A.R.T. Mobility: Autonomous Inter-Terminal Shuttle	Infrastructural Capacity / Landside Operations	Autonomous driving shuttle connecting Terminal 1 and Terminal 2 at Malpensa, providing passenger transport without dedicated drivers and testing AV technology in an airport landside environment.	Provide additional transfer capacity during peak hours; test AV technology in airport landside environment	Autonomous driving, sensor fusion	Pilot	SEA Milano (MXP)	Autonomous inter-terminal transfer validated; AV technology proven in landside airport environment	Regulatory framework must be studied well in advance; top management commitment from day one is non-negotiable
AI Structural Infrastructure Inspection	Infrastructural Capacity / Asset Management	Mobile app enabling inspectors to automatically detect and categorise defects (cracks, surface damage) from on-site photographs. AI processes images and generates standardised inspection reports.	Reduce inspection time; reduce subjectivity; standardise defect reporting	Computer vision, AI image recognition, mobile app	Pilot → Operational	SEA Milano (LIN)	Significant time reduction in inspection and reporting; standardised, machine-readable defect records	Inspector engagement from day one is the primary success factor: a technically excellent tool that inspectors resist delivers no value
AI Chiller Optimisation	Operational Excellence / Sustainability	AI solution optimising chiller usage based on sensor data from terminal areas and HVAC units, reducing energy consumption and environmental impact.	Reduce energy cost; lower environmental impact; optimise HVAC utilisation	AI, IoT sensors, HVAC integration	PoC	SEA Milano (MXP)	Energy savings and emissions reduction achieved; usage patterns identified	Savings can only be quantified at end of PoC; pay-per-saving model recommended for PoC phase

Use Case	Domain	Description	Objective / Value	Technology	Maturity Level	Best Practice (Airport)	Key Results	Impact / Limitations
AI Call Center 'BERry'	Customer Service / Passenger Experience	Fully automated AI-powered call centre replacing the conventional airport call centre. Operates 24/7 in five languages with instant scalability to handle peak call volumes.	Eliminate third-party call centre costs; improve service availability and multilingual coverage	Generative AI, NLP, voice AI (Kinova & Parloa)	Live (since Q3 2025)	BER Airport	Call centre fully replaced; 24/7 multilingual service delivered; third-party costs eliminated	Passenger satisfaction stable; complaint topics shifted; central knowledge base is a prerequisite, best established before AI deployment
Visual Bag Trace: AI-Assisted Baggage Search	Infrastructural Capacity / Ground Operations	Automatic photography of bags during sorting, linked to bag tag. Image displayed in existing handheld application during offload search to enable faster visual identification of target bag.	Reduce bag search time; improve turnaround reliability; support handlers in time-critical situations	Computer vision, AI image matching, handheld integration	Pilot (~9 months)	Zurich Airport	~60% average reduction in bag search time in initial tests	Integration into existing handheld tools is essential: a standalone app would not achieve operational uptake; physical retrieval effort unchanged
Power Stow Rollertrack: Assisted Baggage Offloading	Infrastructural Capacity / Ground Operations	Belt loader extension into aircraft hold transporting bags closer to the operator, reducing manual lifting distance and physical strain during bulk baggage offloading.	Reduce physical strain; improve working conditions; potentially accelerate offloading	Mechanical conveyor, ergonomic equipment	Operational Testing (3 months)	Zurich Airport	Reduced back strain and improved ergonomics validated	Time savings dependent on aircraft type and operational context; change management and hands-on training are essential for adoption
Next-Generation Baggage Trolley (Wägeli Concept)	Operational Excellence / Ground Operations	Upgrade to standard baggage trolley with integrated roller conveyor, reducing manual lifting between trolley and conveyor belt. Functional prototypes developed and tested.	Improve handler ergonomics; reduce repetitive lifting without replacing existing trolley fleet	Ergonomic engineering, roller conveyor integration	Prototype (stopped: viability gap)	Zurich Airport	Ergonomic benefit and faster offloading validated through structured innovation process	Viability must be assessed earlier: desirability and feasibility alone are insufficient; retrofitting fleet cost proved economically unviable despite validated ergonomic benefit
ApronAI Turnaround Management	Infrastructural Capacity / Ground Operations	AI computer-vision monitoring of all aircraft turnaround activities across 57 gates, giving real-time visibility of ground-handling milestones and more accurate Predictive Off-Block Time (POBT).	Reduce departure delays; improve A-CDM and POBT accuracy	Computer vision, AI analytics	Operational (57 gates live; scaling)	ADR (Italy)	~6-min average YoY reduction in departure delays; est. €18.8M annual savings potential	First Runway to the Future PoC to reach full airport-wide deployment; needs data-sharing agreements with all stakeholders
LiDAR Spatial Intelligence: Passenger Flow (Outsight)	Operations / Capacity Management	Large-scale 3D LiDAR 'Physical AI' platform across Schengen common-use areas providing real-time passenger flow, queue, and congestion data with privacy-by-design anonymous point clouds.	Real-time passenger-flow visibility; agile resource allocation	3D LiDAR, spatial analytics	Large-scale operational (2026)	ADR (Italy)	End-to-end real-time view across Schengen areas; foundation for predictive operations	LiDAR resolves GDPR constraint of camera systems; value requires integration with operational systems

Use Case	Domain	Description	Objective / Value	Technology	Maturity Level	Best Practice (Airport)	Key Results	Impact / Limitations
Aeroficial Intelligence: Runway & Taxiway Monitoring	Infrastructural Capacity / Airside Operations	AI platform tracking aircraft movements across airspace, runways, and taxiways in real time, feeding a runway-throughput and ground-movement dashboard integrated into the APOC.	Improve airside operational awareness and runway throughput	AI analytics, real-time tracking	Operational (FCO, APOC)	ADR (Italy)	Real-time runway throughput monitoring live; integrated with A-CDM sequencing	Complementary to ApronAI; requires formalised ATC/A-CDM data-sharing protocols
Buildots: Infrastructure & Construction Monitoring	Infrastructural Capacity / Asset Management	AI software detecting anomalies and predicting failures in airport equipment and infrastructure, also monitoring construction-site progress, safety compliance and deviation from plan.	Enable predictive maintenance and infrastructure reliability	AI, computer vision, predictive analytics	Pilot (3rd Call for Start-ups)	ADR (Italy)	Anomaly detection and failure prediction validated in pilot; proactive AI maintenance alerts	Value scales with historical data quality; one platform serves both maintenance and construction
AI Virtual Assistant 'ADRYX'	Passenger Experience / Digital Services	GenAI-powered digital companion (AWS Amazon Bedrock, multi-agent orchestration; Storm Reply) on WhatsApp and adr.it serving all departing passengers with flight, parking, transport, baggage, and personalised guidance.	Reduce information-desk workload; 24/7 multilingual support	Generative AI, multi-agent LLMs (Amazon Bedrock)	Operational (launched Oct 2025)	ADR (Italy)	4 information desks decommissioned; 24/7 multilingual support live to ~50M pax	Requires ongoing knowledge-base maintenance; multi-agent orchestration needed at hub scale
Smart Boarding: Real-Time Boarding Status (ZestIOT)	Passenger Experience / Operations	Real-time boarding-status monitoring giving passengers live gate status on their smartphone via QR code, letting them dwell in retail/lounge areas until boarding is genuinely underway.	Reduce gate crowding; support commercial dwell time	IoT, real-time analytics	Operational (gate area E11–E24)	ADR (Italy)	Live in E11–E24 following successful pilot; integrated with Digiport platform	Bounded gate-area scope enables managed industrialisation before full rollout
WHILL Autonomous Wheelchair for PRMs	Passenger Experience / Mobility	Autonomous self-driving chairs transporting passengers with reduced mobility to their gate using smart obstacle-avoidance sensors; embedded into ADR Assistance core operations.	Improve PRM autonomy, comfort, and safety	Autonomous driving, sensor fusion	PoC completed (4 chairs tested from Mar 2025 to Mar 2026)	ADR (Italy)	4 chairs tested in live operations; strong acceptance among avg-age-66 PRM cohort (~500k PRM pax/yr)	One of the first European operational deployments; next challenge is fleet dispatch optimisation
Loki Robotics: Autonomous Cleaning Robot	Operational Excellence / Ground Operations	Autonomous bathroom/surface cleaning robot trained via a VR+AI methodology to replicate human cleaning movements in the specific terminal environment.	Automate cleaning; maintain quality and consistency	Autonomous robotics, VR+AI training	PoC completed	ADR (Italy)	PoC completed; cleaning quality and time results collected internally	Must integrate with terminal schedules; staff acceptance and change management are prerequisites
Azalea Robotics: Autonomous Baggage Handling	Operational Excellence / Ground Operations	Autonomous mobile cobot with robotic arm identifying bags via cameras and AI, determining grasp orientation, and loading them onto carts, with an AI safety-stop for shared human-robot working.	Automate baggage handling with high safety standards	Autonomous robotics, computer vision, AI	PoC completed	ADR (Italy)	Autonomous identification, grasping and cart-loading demonstrated; AI safety-stop validated	Bag identification across varied sizes is a key challenge; BRS/sortation integration required

Use Case	Domain	Description	Objective / Value	Technology	Maturity Level	Best Practice (Airport)	Key Results	Impact / Limitations
Guimu Robot: Autonomous Pavement Inspection	Operational Excellence / Airside Operations	Autonomous robot navigating airside surfaces to assess runway/taxiway pavement health, acquiring 2D/3D imagery and analytics to identify cracks, deterioration, and subsurface anomalies for predictive maintenance.	Automate airside pavement inspection; enable predictive maintenance	Autonomous robotics, 2D/3D imaging, analytics	PoC (20,000 m² runway trial)	ADR (Italy)	20,000 m² trial completed; pavement-health analytics delivered	Requires strict airside safety coordination; maintenance-system integration is key implementation step
Auto TOBT, ML-Based Target Off-Block Time Prediction	Infrastructural Capacity / Turnaround Operations	Machine-learning-based automated prediction of Target Off-Block Time (TOBT) for all flights, replacing manual expert predictions; backbone of turnaround planning and operations.	Improve TOBT accuracy; optimise planning of operational capacity; eliminate manual TOBT inputs	Machine learning, A-CDM data (internal development)	Operational (fully integrated, used daily)	Prague Airport	More accurate than manual expert predictions; minimal TOBT discrepancy; reduced FTE for turnaround management; shorter turnaround times; manual TOBT inputs fully eliminated	Requires a reliable data baseline and strong data quality (ensured via the A-CDM standard)
AI Assistant for Passengers (WhatsApp)	Passenger Experience / Digital Services	GenAI-powered but deterministic chatbot integrated into WhatsApp providing real-time updates, information-oriented conversations, and trigger-based reminders (openings, boarding, other journey milestones).	24/7 passenger support; reduce workload of the telephone information service	Generative AI, deterministic source integration, WhatsApp (Born Digital)	Operational (launched Dec 2025; further features planned)	Prague Airport	24/7 multilingual passenger support live; real-time information validation; reduced telephone information-service workload	Continuous verification of answer accuracy and incident management for inaccurate outputs required; data governance and handover to human operators for complex queries
AI Integration to Telephone Helpdesks	Customer Service / Incident Management	AI features on incoming calls: sentiment analysis to determine urgency and auto-flag potential security incidents; automatic transcription, information sharing between operational personnel, and automatic ticket creation and assignment.	Faster incident handling; prioritisation of urgent and security-relevant calls	Generative AI, sentiment analysis, automatic transcription (ASC Technologies)	Pilot ongoing (launched Jun 2026; further features planned)	Prague Airport	20 to 30% increase in incident resolution speed	GenAI features must be paired with tagging and reporting functions and embedded natively into current applications
Autonomous Dish Collection Robots	Passenger Experience / Terminal Services	Autonomous service robots collecting used dishes from passenger dining areas and transporting them to designated collection points, navigating the terminal, and avoiding obstacles.	Remove repetitive, physically demanding tasks from staff; increase productivity; improve cleanliness and table turnover	Autonomous mobile robotics, obstacle avoidance (Bettaroe Robotics)	Operational (used daily)	Prague Airport	Reduced staff time on dish transportation and lower physical workload; robotic capacity scalable with demand without process redesign	Requires environment mapping, defined collection points and integration into staff workflows; most value when supporting rather than replacing staff

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ACI EUROPE is the European region of Airports Council International (ACI), the only professional association of airport operators.

ACI EUROPE represents over 600 airports in 55 countries. Our members facilitate over 95% of commercial air traffic in Europe. Air transport supports 14 million jobs, generating €851 billion in European economic activity (5% of GDP). In response to the Climate Emergency, in June 2019 our members committed to achieving Net Zero carbon emissions for operations under their control by 2050, without offsetting.

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