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Optimising the airside:

Efficiency,
coordination
and capacity

Conference report:

**Airside &
operations**

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Executive summary:

The last frontier of airport performance

The terminal gets the attention. The airside gets the results.

Across two dozen sessions at PTE World Conference 2026, operational leaders examined a shared reality: the airside – the apron, the stand, the taxiway, the baggage belt, the cargo shed – remains the least digitised, most labour-dependent, and highest-leverage domain in aviation. And capacity headroom is increasingly constrained.

Heathrow is optimising for three to five seconds per arriving aircraft across 240,000 annual arrivals. Schiphol is processing 70 million passengers through a terminal designed for 30 million. Lufthansa has two autonomous tugs running a single two-kilometre route in Frankfurt, and treats this as an early milestone. The industry's most advanced baggage messaging standard was designed in the 1980s. Airlines pay more than \$1 billion a year to use it.

The sessions revealed seven structural truths that will define airside operations for the next decade:

- 1. The capacity ceiling is measured in seconds, not square metres.** Heathrow's demand-capacity balancing runs 52,000 computations per flight to shave single-digit seconds off each arrival. When two runways serve 84 million passengers, every second is structural.
- 2. Electrification is as much an infrastructure challenge as a sustainability initiative.** Schiphol needs 1.6 megawatts just to charge 25 pushback trucks in one zone – and the vehicles do not even use the same voltage.
- 3. Autonomy on the ramp exists, but has not yet scaled.** Level 4 autonomous tugs are operating. But the taxiway crossing problem, the trolley coupling problem, and the 10,000-person change management problem at a single hub mean deployment is measured in units, not fleets.
- 4. The turnaround is aviation's highest-leverage minute.** Over 40% of delay originates from the turnaround process. Vancouver is targeting a 25% capacity improvement without building anything. The weapon is data, not concrete.
- 5. Baggage handling carries a billion-dollar legacy cost.** Teletype messaging from the 1980s costs airlines over \$1 billion annually. Passengers with AirTags know more about their luggage than the airline does. Thirty to forty percent of damage claims are fraudulent because the industry cannot photograph a bag at check-in.
- 6. Demand-capacity balancing is moving from weeks to months.** Schiphol's Airport Operations Plan now classifies days 180 days in advance, pre-positioning resources before the schedule is even finalised.
- 7. Cargo is the strategic asset airports still treat as a back-office function.** Schiphol screens 85% of cargo off-airport. Fraport is building 4-to-8-hour predictive models. The cargo community platform is where the next wave of airside intelligence will be built.

What follows is not a summary of what was said. It is an argument about what it means.

1. When three seconds per aircraft is all that remains

Heathrow handles 84 million passengers on two runways – comparable air traffic movements to Amsterdam, which has six. A landing or takeoff occurs every 45 seconds. The operation delivers 1,350 ATMs per day within approximately 14-15 square kilometres of land.

Everything that was low-hanging fruit was addressed years ago. What remains is the regime of incremental optimisation, and it is more sophisticated than most of the industry realises.

The toolset behind those seconds is formidable. Time-based separation, operational since 2015, has reduced headwind delays by approximately 60% and adds 2-4 additional movements per hour in strong headwind conditions. Pairwise wake vortex separation – using specific leader/follower aircraft pair data across more than 300 aircraft types – is now operational, yielding further capacity gains that would be invisible to anyone not watching the radar screen. Pre-sequencing begins up to 390-400 nautical miles out, with cross-border agreements establishing arrival order before aircraft even reach UK airspace.

The demand-capacity balancing engine runs 52,000 computations per flight, generating predicted in-block and off-block times fed directly into Eurocontrol's network management system. Target Time of Arrival trials, ongoing since 2019 for short-haul and recently extended to long-haul, represent a conceptual shift: from ATC-imposed flow control to airline-cooperative schedule management, where airlines choose to meet a target time rather than being regulated into it.

The NATS/Heathrow partnership – where ATC sits physically inside the Airport Operations Control Centre – is presented as the model for future ANSP/airport integration. Segregated runway mode operations, dictated partly by noise compliance, constrain optimal capacity sequencing. Terminal 4, south of the southern runway, creates mandatory runway crossings that inherently limit throughput. The ATC 2040 planning effort is already underway: digital towers, integrated departure management, and intelligent approach for departures.

What this means for 2030: The airports that will unlock capacity in the next decade are not the ones building new runways. They are the ones that have embedded their air navigation service provider inside operations and are treating every second of every arrival as a system-level optimisation variable. For the rest of the industry, three seconds sounds trivial. At Heathrow, it is the difference between a functioning hub and a capacity crisis.

2. Electrification: The infrastructure challenge behind the sustainability goal

The narrative around airside electrification is familiar: swap diesel for electric, install chargers, claim sustainability targets. The reality at Schiphol reveals something far more complicated.

Dennis de Cock and Ivar Bal of Schiphol and Dircens Engineering described what it actually takes to electrify one operational zone of pushback trucks. Twenty-five vehicles. Two brands – Goldhofer Phoenix at 700 volts and Trapo at 600 volts – requiring dual-voltage infrastructure. Total power demand: 1.6 megawatts for a single zone. Charging time for heavy vehicles on industrial sockets: 8-10 hours, rendering them operationally unavailable during the day.



“Each handler has a different vehicle and they all have their charging ports on another side of the vehicle – so if you don’t know which vehicle will be used, you always place the charging equipment on the wrong position.”

Ivar Bal, engineer, special airport systems, Deerns

Schiphol’s response – a distributed DC network with shared power modules, 50kW per module, and per-cabinet redundancy – is a pragmatic engineering response to current constraints. The system handles partial failures and unequal demand. But it is a workaround for a grid that cannot handle simultaneous peak charging, not a long-term solution.

The deeper insight: electrification is not primarily a sustainability project. It is also a compliance and health mandate. The Dutch labour authority requires engines off at the gate. Employee health and safety regulations are tightening. Small GSE – belt loaders, cargo tractors – was already electric. The frontier is heavy equipment: the pushback trucks that weigh tens of tonnes and operate around the clock.

What this means for 2030: Vehicle standardisation must precede infrastructure design, not follow it. Airports planning electrification without first solving the multi-vendor voltage and charging-port problem will build expensive infrastructure in the wrong locations. The grid constraint is structural, not temporary – and until airports invest in grid capacity as aggressively as they invest in chargers, the mismatch will worsen.

3. The autonomous ramp: Real, early, and facing scaling barriers



“If you look at a photo of the ramp today and compare it to one 60 years ago, actually very little has changed. And if you were to do the same with the terminal, you would see biometric gates, new baggage checking machines, mobile phones – there’s been so much change in the terminal, but on the ramp, very little.”

Stuart Holdstock, head of projects, processes - operations, Deutsche Lufthansa

The proof points are genuine. Lufthansa Cargo has a Level 4 autonomous freight tug – no safety driver – operating on a two-kilometre route in Frankfurt between two warehouses. ANA Japan achieved Level 4 autonomous cargo transport from warehouse to aircraft. Two autonomous baggage tug tests were planned for 2025 in Munich and Mallorca.

And yet the scaling barriers are not technical. They are structural. The taxiway crossing problem is the critical unsolved barrier: no autonomous vehicle currently has a certified solution for crossing active taxiways. Automatic trolley coupling is the second blocker. Until a tug can autonomously attach to and detach from bag trolleys, humans remain in the loop.

“Think of the history of the elevator. Autonomous elevator technology existed in the late 1800s and early 1900s. It wasn’t until around 1945, after a strike in New York from elevator operators, that autonomous elevators were actually adopted. Sometimes we need a forcing function.”

Stuart Holdstock, head of projects, processes - operations, Deutsche Lufthansa

Germany faces 3 million fewer available workers by 2030. Eighty percent of ramp employees have been there less than two years. The fragmented incentive structure – handling companies with contracts misaligned with airline or airport objectives – is the deeper problem. Aviation ramp is too niche for large robotics companies focused on factories and consumer markets.

CLX Engineering’s experience with autonomous docking bridges tells the same story. Two and a half years to deploy eight bridges at Atlanta, each requiring near-custom configuration due to gate geometry heterogeneity.



“The number one delay in getting the bridge on the plane – even in semi-autonomous mode – is still the operators showing up. Until you get to the full end state, you really don’t eliminate a lot of the challenges we see.”

Max Kling, lead automation technician, Delta Air Lines Inc.

What this means for 2030: The technology works. The deployment model does not. Airports waiting for a plug-and-play autonomous ramp solution will wait indefinitely. The airports that will lead are those designing for the end state – full autonomy – and layering in interim capabilities, while simultaneously solving the organisational problems that technology alone cannot address.

4. The turnaround: Aviation's highest-leverage minute



“Over 40% of delay has been originating from the turnaround process. And to fix that, there's no single party that can do it alone.”

Jeffrey Schäfer, process owner aircraft turnaround, Royal Schiphol Group

The data from IAG's digital twin makes the cost tangible. In 2025, Heathrow saw 4,337 arrival-related holding events, burning 335 tonnes of fuel across 387 hours of holding. Knock-on stand blockages added another 600 incidents and 45 tonnes of fuel. The turnaround is not just a delay problem. It is a fuel problem, an emissions problem, and a capacity problem simultaneously.

The solution emerging across multiple airports is what Vancouver's Albert calls “bytes before bricks” – using data to increase capacity before building new infrastructure. Vancouver is targeting a 25% improvement in turnaround capacity using digital tools alone.



“It's just one camera that gets all the data correct, and that's the starting point for the three of us to start improving – and nobody can argue about it anymore.”

Albert Van Veen, vice president of innovation and chief information officer, Vancouver Airport Authority

Menzies Aviation at Amsterdam achieved a 9-10% improvement in on-time performance from AI turnaround tool adoption. Berlin Brandenburg's A-CDM system, with 130,000 turnarounds feeding the AI prediction engine, now auto-feeds TOBT predictions to Eurocontrol. After one week of the automated override trial, ground handlers stopped manually overriding the AI's predictions almost entirely.



“We provided all the ground handlers at Fiumicino and the main airlines with access to the platform for free – free of charge. This fostered collaboration because we all share the same information. That's the secret recipe.”

Marco Guadalupi, head of transformation and program management, Aeroporti di Roma

Vancouver's biometric boarding reduced boarding time from 20 minutes to 17, with a target of 15 – a 25% reduction requiring one person instead of three to four. At 70% adoption, biometrics is not a passenger experience tool. It is a turnaround tool. Every minute recovered at the gate translates directly to stand throughput.

What this means for 2030: The airport that masters the turnaround will outperform airports with better terminals, better runways, and bigger budgets. The prerequisite is a single shared data source – camera-based, AI-predicted, freely shared – that eliminates the coordination gaps that have constrained ground operations for decades. Rome's decision to give away platform access for free is among the most strategically important business model decisions in this track.

5. Baggage: Aviation's underinvested innovation frontier

The numbers are striking. Airlines pay more than \$1 billion annually for teletype message exchange – a standard designed in the 1980s. One in five passengers has experienced baggage mishandling. Thirty to forty percent of damage claims are fraudulent. And when passengers started putting AirTags in their luggage, the customer often had more real-time visibility than the airline did.



“I don’t believe in this day and age that we have to pay per character for a message. And that’s something that is stifling the industry.”

Farnush Anwar, senior manager, baggage automation, IATA

The BIX standard – IATA’s internet-based replacement for teletype – is the highway. At 5% adoption, it would drive \$50 million in cost reduction. At 10%, \$110 million. A small German airport, Munster, built a fully functional ground handling app on BIX within two to three days. Connecting a new airline partner under legacy teletype takes weeks to months. BIX reduces this to minutes. IATA plans to mandate adoption, modelling the approach on the e-ticketing transition.

On the physical side, the BOOST consortium – Schiphol, Heathrow, Brussels Airport – is confronting automation with unusual candour.

Schiphol ordered 19 Koboldlift robots within four weeks of a two-week pilot. Only six were deployed in live operation before being pulled back. Brussels Airport’s AGV trial was derailed by seasonal dandelion fluff blocking sensors – a problem that took more than 10 days to diagnose. The Dutch labour inspector demanded Schiphol mechanise its entire baggage handling process within two years. Schiphol missed the deadline by at least a year.



“Automation doesn’t replace labour unless you force the system to changes. You’re forced to use the automation.”

Henrik Gulløv, CEO, Cobot Lift

Dusseldorf’s PRELUDE project revealed a subtler dimension: 50% negative passenger ratings even when actual performance metrics were good. The gap is not performance – it is transparency. The prediction model deliberately uses a biased quantile to overestimate delivery times, because passengers rate the experience higher when their bag arrives earlier than predicted. Operational psychology embedded in machine learning model selection.

What this means for 2030: Baggage is where the industry’s digital debt is most acute and most addressable. The BIX mandate will be the single largest messaging infrastructure change in aviation since e-ticketing. Airports that build automation programmes around functional requirements rather than specific vendor technology, and that treat regional airports as test centres, will mature the market faster than those attempting to solve everything at their own hubs.

6. 180 days ahead: The end of improvisation



“Schiphol is designed for 30 million passengers a year. Last year we processed almost 70 million. We used to rank number 3 in European hub passenger experience – now we rank number 8. You know why? Because we were just not looking far enough ahead.”

Pien Alberts, product innovation lead, Royal Schiphol Group

The response is the Airport Operations Plan – a demand-capacity balancing system that begins classifying operational days 180 days in advance and extends its planning horizon to three years for infrastructure decisions. It operates through day-category classifications (1 through 4), determining which KPIs are targeted: Category 4 days target 80% on-time performance; Category 1 days target 95%.

Two critical handover gates structure the cascade: D-60, where strategic preparation becomes technical preparation, and D-7, where technical preparation becomes operational execution. The system coordinates 87 airlines, four security parties, seven-plus ground handlers, and border control.



“Without early insights in demand and capacity, it’s like driving without navigation. You only react well once you’re already stuck.”

Martijn van Boven, product manager, Amsterdam Airport Schiphol

Practical applications are already proving out. When a KLM strike was planned during peak season, the tool identified the capacity shortfall far enough in advance to intervene. Scenario planning models a 20% chance of runway configuration change due to weather two weeks out. Proactive passenger time-slotting can smooth peak demand curves without building new infrastructure.

What this means for 2030: The improvisation era is over for constrained airports. Demand-capacity balancing that spans months – not hours – will separate airports that grow capacity from those that merely cope with it. The operational advantage belongs to whoever builds the shared planning infrastructure first, because the data network effects compound.

7. Hydrogen: Navigating the regulatory frontier

The electrification path for light GSE is clear. For heavy equipment – the pushback trucks and tugs that move wide-body aircraft – the question remains genuinely open.

Schiphol's hydrogen demonstration required an 800-kilogram trailer of gaseous hydrogen at 21 bars, compressed to 500 bars for faster fuelling at a dispensing pressure of 350 bars. Four potential locations were evaluated; three were rejected due to maintenance conflicts, operational distance, and a NATO Air Force One exclusion zone.



“For the final demonstration plan we had over 700 documents – from insurance papers to risk analyses, site overviews, building drawings, contracts, and training documents. You name it.”

*Wesley Teeuwisse, innovation manager, Willem de Jongh, innovation manager,
Royal Schiphol Group*

“There are not that many regulations available yet – so it’s about talking to each other and discuss the safety requirements and how to ensure safe operations.”

*Wesley Teeuwisse, innovation manager, Willem de Jongh, innovation manager,
Royal Schiphol Group*

Three future supply pathways exist. On-site electrolysis demands massive power and land – not viable at congested airports. Pipeline supply is the long-term answer but requires a demand tipping point. Trucked hydrogen works for demonstrations but does not scale. The TULIPS consortium (European subsidy programme) enabled the demonstration, underscoring that hydrogen GSE currently requires public funding to reach proof-of-concept.

The hydrogen-versus-electric debate for heavy GSE is the core unresolved question of airside decarbonisation. Hydrogen offers faster refuelling – critical for high-utilisation equipment – but infrastructure cost and regulatory complexity are orders of magnitude higher.

What this means for 2030: Hydrogen on the airside is a decade away from commercial viability, not because the technology fails but because the regulatory infrastructure does not yet exist. The 700-document demonstration is a regulatory learning exercise that maps what rules exist and who needs to align. Airports that complete these demonstrations now are building the regulatory knowledge that will become a strategic asset when hydrogen infrastructure becomes standard.

8. Cargo: The strategic asset hiding in plain sight

Cargo became essential during the pandemic and has since received less strategic focus at many airports. The sessions at PTE World Conference 2026 suggest this is a strategic error.

Schiphol screens up to 85% of cargo off-airport. The governance story is instructive: Schiphol absorbed the Cargonaut community platform not for strategic advantage but because customs required it. The platform is migrating from 40-year-old architecture to Azure DevOps Cloud with Kafka.



“When I stumbled into cargo four years ago, I had to reset my mindset. Things that are normal in the passenger world are not normal in the cargo world.”

Marco Franz, chief application architect, technology, Fraport AG

Fraport's cargo analytics platform, built over approximately ten years, connects all stakeholders through shared event timestamps across the cargo chain. Simulation models produce 4-to-8-hour forecasts of incoming cargo volumes. E-commerce growth is materially changing the type and volume of shipments, requiring dedicated analytics streams.



“It's not about making shiny dashboards. Data products with business logic in the backend – not in Power BI – is the key to serving both.”

Oliver Wohak, principal, d-fine GmbH

The next frontier for both airports is truck slot booking and machine learning forecasting integrated into community dashboards. Ground handling in cargo is still partially paper-based. Digital transformation is multi-generational.

What this means for 2030: Cargo is the domain where airside digital infrastructure will mature fastest, because the stakeholder ecosystem is smaller, the financial incentives are clearer, and the data standardisation effort is less politically charged than passenger operations. Airports that treat cargo as a data-platform opportunity will find it becomes the proving ground for predictive operations that eventually migrate to the passenger side.

The airside in 2035:

Five bets

The airside is where the real capacity battle of the next decade will be fought. Not in terminals, not in master plans, not in architectural renderings. On the ramp, in the baggage hall, at the stand, on the taxiway.

1. The second-by-second runway will replace the runway expansion debate.

Heathrow's approach – time-based separation, pairwise wake vortex, pre-sequencing 400 nautical miles out – will become the standard toolkit for constrained airports worldwide. New runways will still be built, but most capacity gains in the next decade will come from operational optimisation, not concrete.

2. The autonomous ramp will arrive unevenly.

Japan, with its proactive regulator, will lead. Europe will follow with regulatory patchwork. Airports that invested early in testing infrastructure will have a five-to-ten-year advantage.

3. Electrification will stall without grid investment.

The charger is the visible part of the transition. The grid is the invisible constraint. Airports that solve grid capacity and vehicle standardisation simultaneously will electrify. Those that install chargers first and discover the grid later will waste capital.

4. Baggage will undergo its e-ticketing moment.

IATA's BIX mandate will force the transition from 1980s teletype to internet-based messaging. The airports and airlines that adopt early will unlock cost savings, fraud reduction, and passenger transparency that late adopters will spend years catching up to.

5. Shared data will replace shared blame.

The Golden Triangle – airport, handler, airline – only works with a single source of truth. Rome gave away its platform for free. Vancouver installed cameras no party can dispute. Berlin is auto-feeding AI to Eurocontrol. The competitive moat is not data ownership. It is ecosystem alignment around shared truth.

The airside has been aviation's most underloved domain for six decades. The sessions at PTE World Conference 2026 suggest the next decade will be different – not because the technology is finally ready (it has been for years), but because the forcing functions are finally arriving. Labour shortages, regulatory mandates, grid constraints, and the sheer impossibility of building new infrastructure fast enough are converging to make optimisation not a choice but a necessity.

The airports that understood this five years ago are already measuring gains in seconds. Everyone else is still measuring in years.

Appendix: Sessions referenced

REPORT SECTION	SESSIONS
When three seconds per aircraft is all that remains	The schedule never flies: extraordinary journeys in capacity constrained environments (NATS); 180 days ahead: orchestrating the airport ecosystem by DCB (Royal Schiphol Group, Amsterdam Airport Schiphol)
Electrification is harder than anyone will admit	Electrifying airside at Amsterdam Airport Schiphol (Amsterdam Airport Schiphol, Deerns)
The autonomous ramp: Real, early, and facing scaling barriers	Introducing automation on the ramp (Deutsche Lufthansa); The Smart Ramp innovation program: reinventing ramp operations (NLMTD, IAG); Panel discussion: Transforming gate operations through autonomous docking systems (CLX Engineering, Delta Air Lines Inc., Greater Orlando Aviation Authority)
The turnaround: Aviation's highest-leverage minute	Panel discussion: Turnaround wins – how empowering the golden triangle drives real change (Royal Schiphol Group, Vancouver Airport Authority, Menzies Aviation, easyJet); Panel discussion: Harnessing AI-driven insights to optimize POBT and enhance A-CDM collaboration (Aeroporti di Roma, Centralny Port Komunikacyjny, Assaia International, Flughafen Berlin Brandenburg)
Baggage: Aviation's underinvested innovation frontier	Panel discussion: Failing forward in baggage innovation with BOOST (Brussels Airport, Royal Schiphol Group, Heathrow Airport Ltd, Cobot Lift, Vanderlande Industries); Shaping the future of baggage operations through collaboration and standardization (IATA); Enhancing passenger experience at airports through luggage delivery time prediction (Eurocontrol Innovation Hub, Düsseldorf Airport); Panel discussion: Technological evolution and Poland's new airport adaptability for a smart baggage solution (Centralny Port Komunikacyjny, Vanderlande)
180 days ahead: The end of improvisation	180 days ahead: orchestrating the airport ecosystem by DCB (Royal Schiphol Group, Amsterdam Airport Schiphol, airports)
Hydrogen: Navigating the regulatory frontier	Chances and challenges for implementing hydrogen GSE at airports (Royal Schiphol Group)
Cargo: The strategic asset hiding in plain sight	Cargo as a strategic advantage (Amsterdam Airport Schiphol, Royal Schiphol Group); Building scalable data products for air cargo operations (Fraport AG, d-fine GmbH)
Additional sessions referenced	Smart phasing at airside, aligned with ADM's finances and operations (ADM – Aéroports de Montréal, NACO, Netherlands Airport Consultants); Changi Airport advanced simulation: operational efficiencies and strategic airport planning (Changi Airport Group Singapore Pte Ltd, BNP Associates); Panel discussion: The digital airport – apron management services and surface operations (EASA, Zurich Airport Ltd, DAAV, City of Vantaa and Helsinki Uusimaa Regional Council, DFS Aviation Services, Eurocontrol, CPK Centralny Port Komunikacyjny, Five Aero); Total airside orchestration: applying digital twin insights to Munich Airport's airside operations (Smarter Airports, Munich Airport)

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