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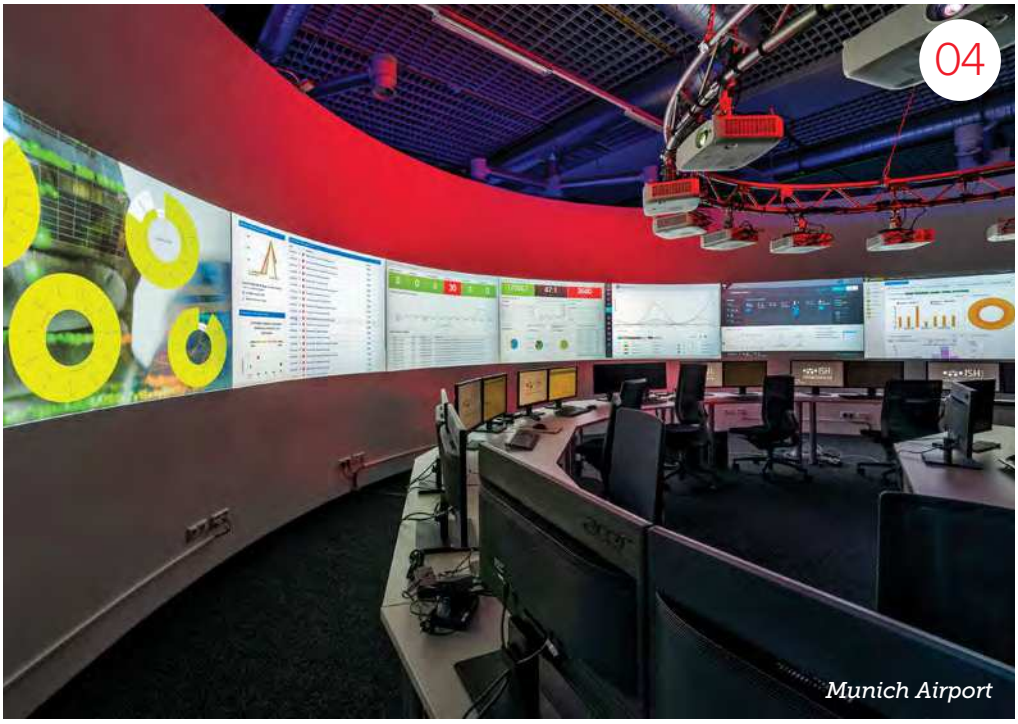
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Front cover image:
Vienna International Airport



Munich Airport

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Munich Information Security Hub describes itself as 'a unique environment where the experts of tomorrow can practice in realistic scenarios and prepare for future challenges' *Munich Airport*

Safety first

Phishing, malware, denial-of-service and ransomware have become everyday occurrences worldwide, and airports are not immune. Emma Kelly looks at how they are tackling cybercrime



Flight information displays are among the airport systems most at risk from cybercrime *SITA*

Airports – as critical infrastructure – are popular targets for cyber criminals, with an attack potentially having a major and wide-ranging impact, including operational disruption, financial losses, reputational damage and – most critically – safety implications.

Recent airport cyberattacks include a distributed denial-of-service (DDoS) attack on the websites of several German airports, where the websites were flooded with traffic, forcing them offline. Seven German airports were believed to have been targeted, among them Dusseldorf, Dortmund, Erfurt and Nuremberg.

Late last year, more than a dozen international US airports, including Atlanta Hartsfield-Jackson, Chicago O'Hare, Los Angeles and New York LaGuardia, were the victims of DDoS attacks that took down their websites. Russian cybercriminal group Killnet was believed to be behind this, acting in response to US support for Ukraine in the war with Russia.

While bringing down a website causes inconvenience, it can be relatively quickly rectified. However, it is generally a sign of something bigger to come. As Emil Sayegh, CEO of US-based IT security provider Ntirety, told *Airports International*: "While an airport's website being down is inconvenient and causes disruption, such an attack is often merely a first attempt to find weaknesses and gain entry to an airport's systems. Cyberattacks on airport systems, websites, and the entire transportation ecosystem could be just a taste of something larger than ever thought possible."

He added: "Once you understand how the ecosystems of attackers operate, you cannot eliminate the possibility that today's technology inconvenience is a Phase 1 component of a grander

attack." Hackers will test the perimeter, with weaknesses used to launch more damaging attacks, he explains.

Proactivity over reactivity

With the security landscape rapidly changing, organisations including airports need to move from "a mature level of cybersecurity towards an advanced and adaptable proactive posture," Sayegh said.

Airports have had to adapt to the changing environment and quickly. Just three years ago, 97 out of the top 100 of the world's largest airports were identified as having major security risks. Airport cybersecurity research conducted by Switzerland-based global application security company ImmuniWeb identified security risks related to vulnerable web and mobile applications, misconfigured public cloud, dark web exposure or code repositories leaks.

ImmuniWeb found that 97% of the websites contained outdated web software; 24% of the websites featured known and exploitable vulnerabilities; 15 security or privacy issues were detected per airport app on average; 66% of the airports were exposed on the dark web; and 3% of airports had unprotected public cloud with sensitive data.



Germany's Munich Airport invests 10% of its total IT budget on cybersecurity. The figure is increasing each year *Munich Airport*

Airports have responded in recent years by taking a proactive approach, committing extensive investment and resources to fight what constitutes a growing and ever-changing threat.

Cybersecurity, along with biometrics and cloud services, is the focus of airports' IT investment, according to SITA's 2022 Air Transport IT Insights, with 88% of airports questioned identifying it as an IT investment priority.

Germany's Munich Airport invests 10% of its total IT budget on cybersecurity and this figure is increasing each year, according to Florian Lesch, senior vice president IT. Prague Airport is investing up to 1% of its total airport budget in cybersecurity, according to Roman Palkovič, information security director.

"Ensuring a secure airport is Schiphol's number one priority, and this also applies to cybersecurity," said Hedzer Komduur, chief information security officer (CISO) at the Dutch airport. Cyberattacks are becoming more frequent and more sophisticated. "In our connected world, sophisticated cyberthreats are on the increase. This is a major concern for Schiphol, especially given Schiphol's reliance on increasingly



Cybersecurity is taken seriously at Schiphol, where an incident response team is prepped to take action as soon as an issue occurs *Royal Schiphol Group*



The Cyber Security Operation Centre at Prague Airport monitors internal IT systems and all operations 24/7 *Prague Airport*

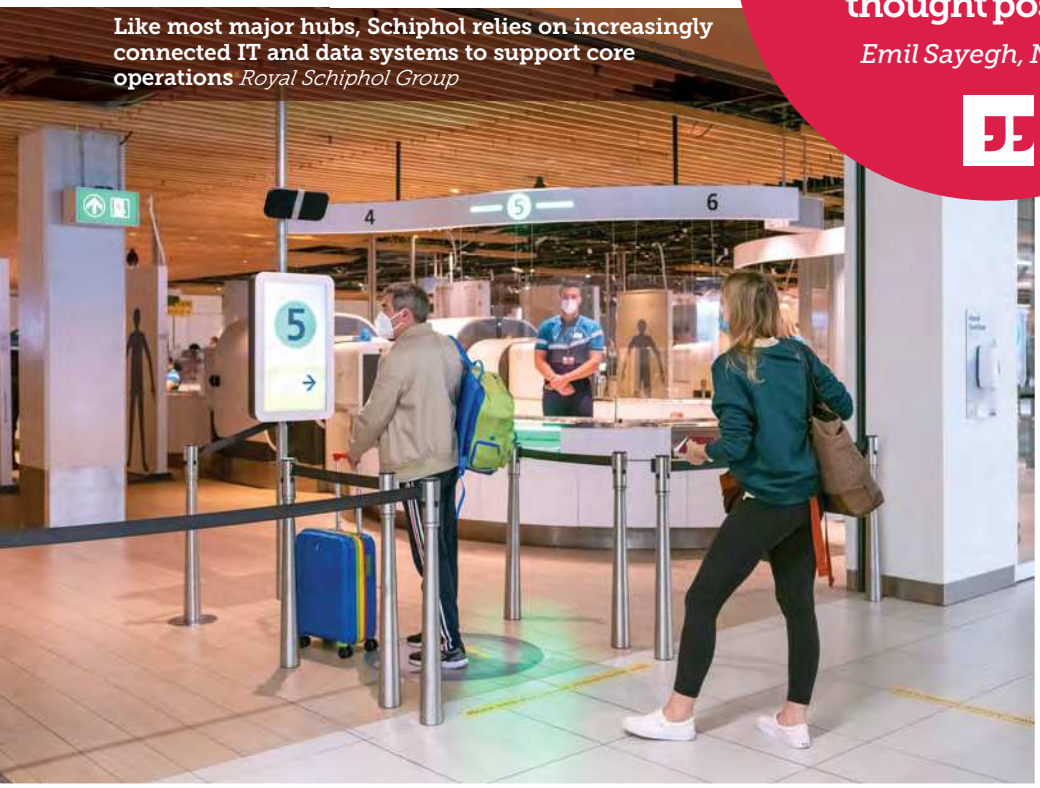
connected IT and data systems to support our core operations and, in turn, business continuity," he explained.

"We are experiencing a significant increase in both the frequency and sophistication of cyberattacks," said Prague's Palkovič. "We categorise these events based on severity and typically handle hundreds of lower-level events per day," he added.

Munich's Lesch concurred: "We're seeing an increasing number of cyberattacks. We count around 1,000 attacks per day. We also see that some attacks, apart from the 'usual noise', are becoming more targeted and sophisticated."

As highly complex environments, all aspects of airport operations can be vulnerable to attack if the right preventative measures are not implemented. "Potential entry points for cyberattacks must be protected at all levels," explained Lesch. "However, when it comes to impact, the key areas of airport operations are naturally more critical than the peripheral areas. Regarding vulnerability, systems connected to the Internet are still considered more critical. Threats are certainly changing over time. Not only in our industry, ransomware threats, including data theft and DDoS attacks, are currently the biggest concerns," he said.

> **Cyberattacks on airport systems could be just a taste of something larger than ever thought possible**
>
> *Emil Sayegh, Ntirety*



Like most major hubs, Schiphol relies on increasingly connected IT and data systems to support core operations *Royal Schiphol Group*

Airports fight back

In response to the ever-evolving cyberthreats, airports have established dedicated units to address the growing and changing threat and cybersecurity roadmaps. The Schiphol Cyber Security Centre (SCSC) is responsible for ensuring the security of the European airport's digital processes and sensitive data and information. "One of the SCSC's core functions involves 24/7 monitoring of all digital activities within the Schiphol Security Operations Centre to prevent potential cybersecurity incidents of data breaches. An incident response team is prepped to take action as soon as an issue occurs," Komduur told *Airports International*.

At Munich Airport, the Information Security Hub (ISH) is a key element of the airport's cybersecurity defences. The ISH is a competency centre focused on developing strategies for defending against cyberattacks, conducting IT security training, crisis drills and cyberattack simulation. A goal of the centre is to establish a community and encourage collaboration cybersecurity, working with others in the industry, says Lesch.

Prague Airport established a Cyber Security Operation Centre (CSOC) in 2020. The centre monitors internal IT systems and all operations 24/7. It currently employs 16, with recruitment under way to fill additional positions. Prague is investing "substantial resources" in the development of its cybersecurity team, with Europe's Network and Information Security (NIS) Directive, European Union-wide cybersecurity legislation, set to bring about significant changes to the cybersecurity landscape on the continent.



As technology becomes more sophisticated, airports are increasing their cybersecurity spend *SITA*



Munich is seeing up to 1,000 cyberattacks a day, according to Florian Lesch, senior vice president IT Munich Airport

The directive aims to achieve a high common level of cybersecurity across EU member states, which have until October 17, 2024, to make the measures national law.

Airports continually need to review and update their cyber response. Komduur said: "Schiphol intends to further develop its cybersecurity resilience in line with our ongoing digital transformation. We invest continuously in the resilience of our IT and operational technology [OT], and have set out a Cybersecurity Roadmap that will guide us in becoming even stronger in this domain."

Munich Airport also has cybersecurity developments high on its agenda this year. Lesch says the airport has analysed its existing cybersecurity organisation and is working to realign it in order to be able to address current and future challenges, as well as recruiting more cyber experts. The guiding principles are "security by design, security by default and zero trust," he added.

Prague Airport has several cybersecurity projects planned this year. "We will be focusing on the renewal and development of our technical infrastructure, including the implementation of new standards in OT. From an organisational standpoint, we will be undertaking a complete change in perspective regarding business community management, with a greater emphasis on supporting the key services of Prague Airport by re-evaluating our primary and support assets," Palkovič explained.

In addition, the airport plans to introduce a new cybersecurity education platform to increase awareness and knowledge for airport employees. Protecting its employees has been a major challenge, according to Palkovič, with the growth in phishing campaigns. "In the past, the Czech Republic had a unique position due to the complexity of the Czech language, making it easier for users to recognise generated or machine-translated text. However, modern technologies are erasing this advantage, so we now have to focus more on user education," he explained.

From the ground up

New-build airports are addressing cybersecurity many years before operations even start. Sydney's new Western Sydney (Nancy Bird Walton) Airport is not due to open until late 2026, but is taking a proactive approach to cybersecurity, aiming to create Australia's most technologically advanced airport. Cybersecurity is being addressed from the start, Maksym Szewczuk, safety and security design manager at Western Sydney Airport's project delivery partner Bechtel, told an Australian Security Industry Association Limited conference. Cybersecurity is one of the core elements of the project that will inform its construction and subsequent operation, addressed in the early stage of the design cycle and assessed through its development. The airport is working with technology company DXC Technology on cybersecurity, integration and hosting platforms to bring together more than 60 operational systems. ✈

US beefs up cybersecurity

In March, the US Transportation Security Administration (TSA) issued new cybersecurity requirements to airports and airlines as part of efforts to increase the cybersecurity resilience of critical US infrastructure.

The requirements are in response to increasing and persistent cybersecurity threats against critical infrastructure. The measures, the result of collaboration with the aviation industry, require certain TSA-regulated airport and aircraft operators to develop an approved implementation plan detailing measures they are taking to improve cybersecurity resilience and prevent disruption.

Airports and airlines are required to develop network segmentation policies and controls to ensure operational technology systems can continue to safely operate if an IT system has been compromised; create access control measures to secure and prevent unauthorised access to critical cyber systems; implement continuous monitoring and detection policies and procedures; and reduce the risk of exploitation of unpatched systems through the use of security patches and updates for operating systems, application, drivers and firmware in critical cyber systems.

The aviation sector was already required to report significant cybersecurity incidents to the US Department of Homeland Security's Cybersecurity and Infrastructure Security Agency, establish a cybersecurity point of contact, develop and adopt a cybersecurity incident response plan and complete a cybersecurity vulnerability assessment.

The move is intended to make airport and airline operations "a less lucrative target – reducing risk and raising costs for would-be attackers", said Gary Kinghorn, senior director of product marketing at Nozomi Networks, which provides cybersecurity solutions to airports and other sectors.

The aviation sector is realising that it may only be as strong as its weakest link, said Kinghorn. "The weakest link in an organisation may be a compromised cyber-physical system, broad access to a component of operations that enables remote access or unnecessary internet connectivity, or an IT system critical for business operations," he concluded.

Working together

A collaborative approach is necessary to ensure airports can mount their best possible defence. "We co-operate and share know-how with other airports on the occasion of Information Security Hub events, in working groups or during committees, such as Airports Council International or [German airport association] ADV, as well as direct exchange of information," said Munich's Lesch. Schiphol Airport works with the Dutch Government, local and international airlines, as well as air navigation service providers and other airports, participating through industry bodies including ACI Europe, Eurocontrol and ICAO, according to Komduur. Prague Airport, meanwhile, is looking to work closely with the local air navigation service provider to mount a unified defence and integrate surveillance systems.

More than 40 airports worldwide are members of the Aviation Information Sharing Analysis Center (A-ISAC), which was established to provide an aviation-focused information sharing and analysis function to help protect aviation businesses, operations and services. The centre analyses and shares information on cyberthreats, vulnerabilities and incidents, and is the primary cybersecurity communications channel for the aviation sector.



Among IT initiatives planned by Prague Airport is a new cybersecurity education platform to increase awareness and knowledge for airport employees *Prague Airport*

On an annual basis, A-ISAC surveys industry CISOs to provide a tool to benchmark their strategies, programme maturity and management of resources. The 2023 survey found that cybersecurity efforts this year are focused on protect and identify functions, with identity management the number one focus. "Your employees' corporate accounts are the doorways into your organisation's data vault and your employees' credentials are the keys," said A-ISAC. Identity management gets increasingly complex as networks expand to the cloud, become more segmented and supply chain risk is addressed, says the survey. Third-party risk and ransomware are growing concerns, according to the survey, with supply chain attacks increasing in 2022 and expected to rise again this year.

Awareness and training is a vital part of the 'protect' aspect, stressed A-ISAC: "Cybersecurity is a team sport. The job of a CISO is to get everyone on the team to understand the big picture, understand their role, own it, and to communicate with the rest of the team." **AI**

Despite being three years from opening, Western Sydney Airport is already addressing the risk of cybercrime *Western Sydney Airport*



AeroCloud

Not just another airport software vendor – we are your business partner

AeroCloud's cloud-native intelligent airport management platform is modular, scaleable and easy to use.

Our CUPPS and CUSS solutions move passengers effortlessly through the airport.

AeroCloud Optic, our passenger count and tracking software, delivers accurate, real-time footfall data from kerb to gate.

We deliver innovative answers to the complex operational challenges experienced by airports across the globe.



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An intelligent approach



In less than three years, AeroCloud has partnered with 44 customers in the UK, Europe and United States *All images: AeroCloud*



AeroCloud Systems CEO George Richardson tells Tara Craig how AI and machine learning can help airports raise their game

What is your take on the state of the airports sector today, post-COVID?

Obviously, all airports globally had to do the best that they could in line with the guidance and/or restrictions in their specific regions, so to say one region recovered better than another would be subjective. But purely from a commercial perspective, airports in the North American market were in a more advantageous position as, despite the tighter restrictions on international passengers, the domestic flights still gave them the opportunity to continue operating and they didn't lay off staff like airports did in Europe and APAC, so were commercially in a much better position post-COVID-19.

Now international travel is returning, airports worldwide are struggling to adjust to heightened demand as they navigate the challenges of staff shortages and a lack of investment due to debt incurred during the pandemic. They must invest in solutions that will enable them to make greater operational efficiencies, improve the passenger experience and boost revenue in the long term.

How can airports best harness IT?

Small to mid-sized airports often use manual processes to monitor vital information. This is slow and can deliver inaccurate information to the airport operation and management systems – skewing predictions and planning decisions. Manual processes also don't give a centralised, real-time view of what's happening across the airport, leaving any stakeholders in the dark about the current state of play beyond periodic reports. Decision-making will be made in silo, not necessarily delivering the optimum outcome.

Airports need to become data driven, so that data is in the hands of all relevant parties for real-time decision-making based on accurate insights. When AI and machine learning are added to the mix, airports can use this data to identify trends, draw lessons and predict future scenarios to inform more accurate decision-making and long-term planning.

Tell me about AeroCloud.

I founded AeroCloud with Ian Forde-Smith, our CTO, in Macclesfield in 2019. Ian had come from a long career of working with airports and I was in the process of retiring after ten years in motor racing and looking for an 'old lock, new key' style of company. After a couple of years devising potential business ideas, AeroCloud was born – an intelligent software-as-a-service (SaaS) airport management platform that allows executives and operational teams to make data-driven decisions to solve the complex challenges they face every day. In less than three years, we have partnered with 44 customers in the UK, Europe and US, with our software processing more than 150+ million passengers annually.

Is there anything you would have done differently?

There are a few things, and lessons I would give to my younger self. First, it's all about the people. As you progress post-seed funding and go on a scaling journey into Series A, the 'levelling up' process of various departments can cause a lot of friction, so you need to prepare yourself to have difficult conversations about scaling up early. Be open, honest and remain focused.

Second, at times it's crucial to remain laser-focused and not let some of the challenges of building a business distract you from the ultimate goal(s). I now like to resettle myself every month on our core principles. Setting yourself objectives and maturing the operation's function early on will enable you to focus on what you're good at.

Who or what inspires you?

Thought Machine inspires me, as its initial journey was very similar to AeroCloud's. It was trying to do something that was perceived as impossible and convince huge enterprise clients to go through a massive change of technology and move to the cloud in a very legacy-intensive industry. Our competitors also inspire me. We like to treat them with respect, but at the same time have total clarity on how to beat them.

The growth and success of AeroCloud will always be underpinned by finding the best people possible – those who are passionate about change, that share our company values and are committed to achieving the best performance as a team. A key focus for us in the last year has been hiring into our senior leadership team.

> **When we work with customers, we encourage them to tell our product team the problems they face and then collaborate with them on fixing them**

Tell me about the current AeroCloud portfolio

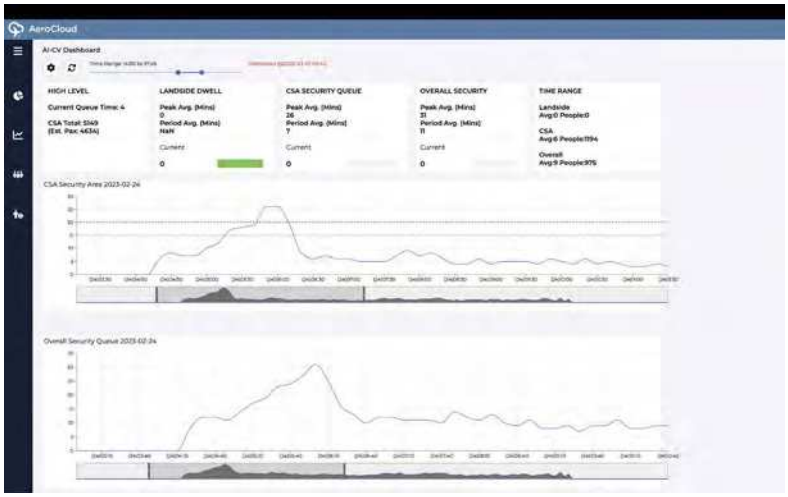
AeroCloud is the only cloud-native intelligent airport management platform on the market. It enables everything from faster passenger processing times to increased communication between stakeholders to deal with real-time fluctuations in processes to ensure that airports work better and communicate with customers.

When we first launched, we had great success penetrating the US market with our proposition of offering airports a cloud-based environment to become more data-driven, rather than relying on manual data management processes for airport management, like Excel.

For us to penetrate the European market successfully, though, we knew we had to tap into what airports in the region wanted – and that centres around common use passenger processing, self-check-in and self-bag-drop. That's why we acquired Flight Solutions in August 2022, a company well regarded in the region for its passenger processing technology. We can now offer airports a comprehensive one-stop solution for all their data and passenger journey needs.

Tell me about AeroCloud Optic

We launched AeroCloud Optic, an industry first, in March 2023. For decades, airports have trialled technologies such as Bluetooth, Wi-Fi and Lidar to solve the issue of kerb-to-gate insights. However, AeroCloud Optic is the first technology ✈



The platform is easy-to-use, scalable, and can be accessed anywhere on any device, says AeroCloud



AeroCloud's cloud-native platform uses AI and machine learning to power airport operations

capable of intelligently, anonymously and accurately tracking passengers through the entire process – from arrival to security and departures to boarding an aircraft. Our AI algorithm is the only one on the market that can re-identify passengers along their journey.

The real-time monitoring of passengers triggers alerts in response to operational bottlenecks such as extended wait times at security, which can then be immediately addressed. The AI and machine learning algorithms also enable airport staff to identify trends and predict future scenarios to inform more accurate decision-making and long-term planning. This enables better resource management and enhanced retail opportunities for concession partners.

When we work with customers, we encourage them to tell our product team the problems they face and then collaborate with them on fixing them. This is how we worked with Liverpool John Lennon Airport when trialling AeroCloud Optic. Paul Staples, the airport's operations director, has described the technology as the 'holy grail' of commercial activity, having battled for a decade to accurately track how passengers move through the terminal.



L-R: Paul Secker, Ian Forde-Smith and George Richardson take inspiration from Concorde

> Our mission is to be the largest provider of operation automation software for the small to medium-sized airport market globally

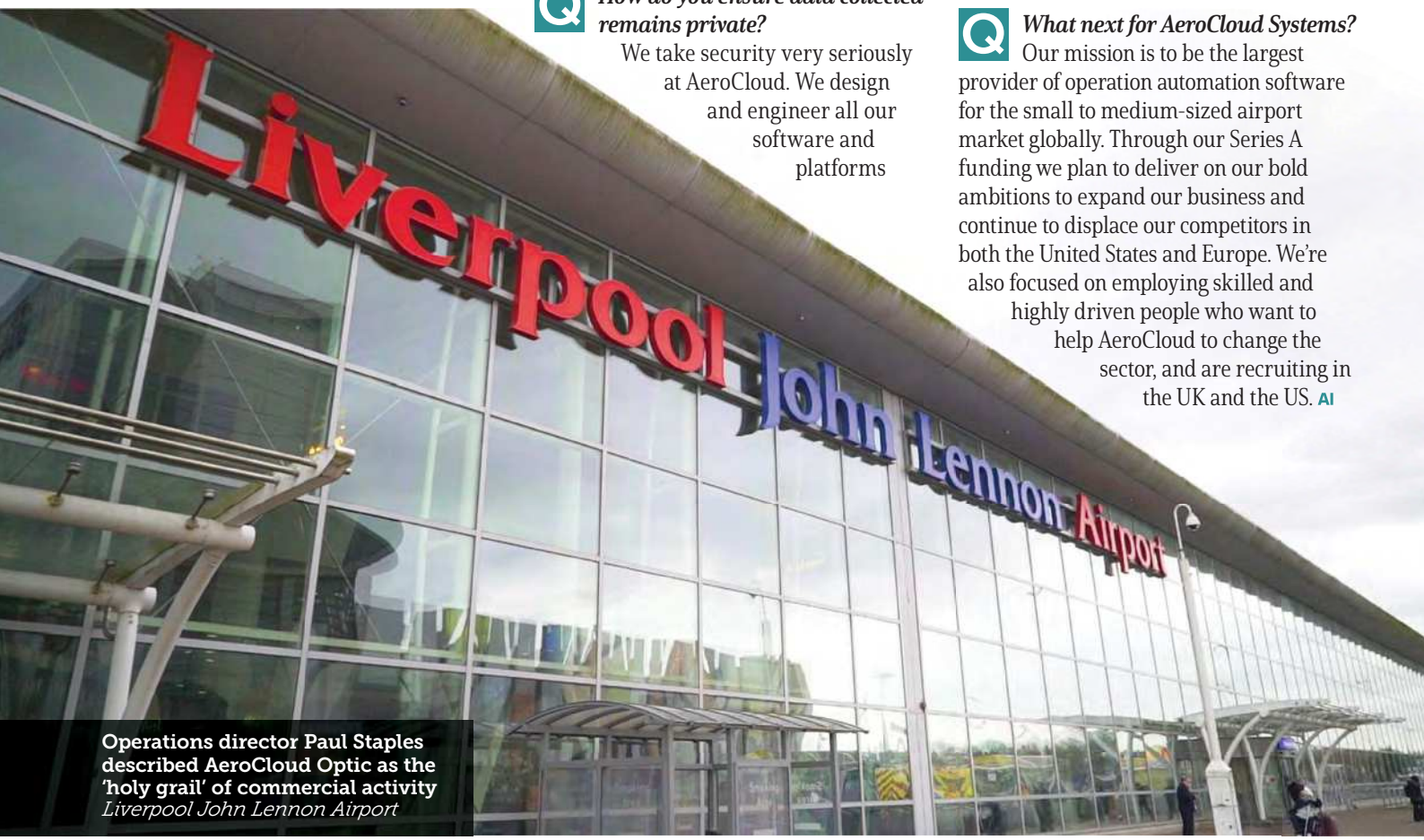
Q How do you ensure data collected remains private?

We take security very seriously at AeroCloud. We design and engineer all our software and platforms accordingly. We work with third-party specialist security companies to ensure we maintain our standards and continue to protect what we treasure the most – our customers' integrity and data.

Our computer vision technology, AeroCloud Optic, uses airports' existing CCTV infrastructure to provide aggregated, anonymised data on the flow of passengers through different zones of the airport in a GDPR-compliant way. It doesn't collect or store data at an individual level.

Q What next for AeroCloud Systems?

Our mission is to be the largest provider of operation automation software for the small to medium-sized airport market globally. Through our Series A funding we plan to deliver on our bold ambitions to expand our business and continue to displace our competitors in both the United States and Europe. We're also focused on employing skilled and highly driven people who want to help AeroCloud to change the sector, and are recruiting in the UK and the US. AI

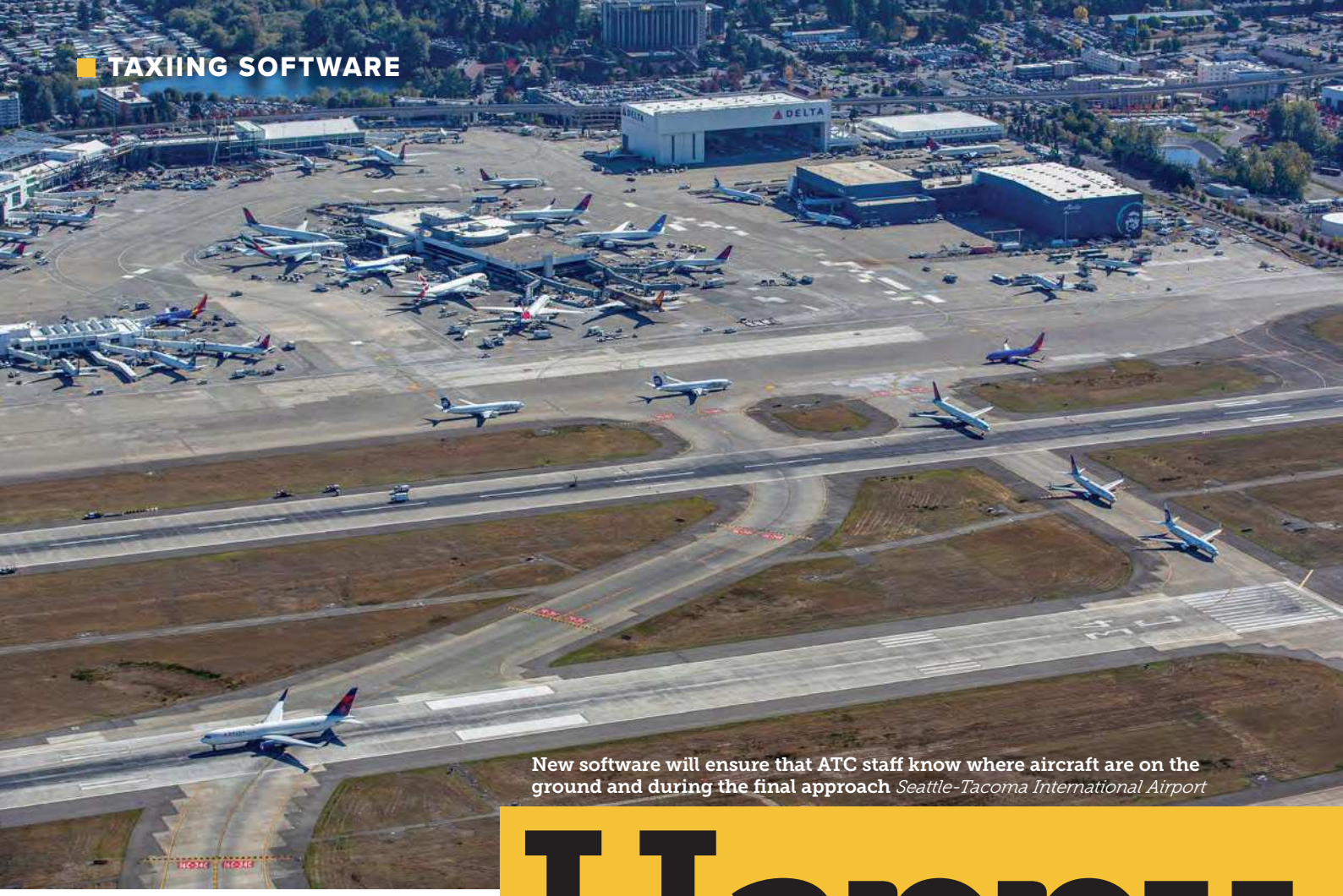


Operations director Paul Staples described AeroCloud Optic as the 'holy grail' of commercial activity
Liverpool John Lennon Airport



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New software will ensure that ATC staff know where aircraft are on the ground and during the final approach *Seattle-Tacoma International Airport*

Happy landings

FAA-backed runway safety initiatives are currently being rolled out across US airports. Mark Broadbent looks at the latest technology

Between October 2016 and the end of 2022, US airports saw 1,641 'wrong surface incidents', where aircraft unintentionally landed on taxiways rather than runways. The Federal Aviation Administration (FAA) is understandably keen to avoid these and other major safety hazards, so has introduced various solutions designed to help improve runway and taxiway safety at airports across America.

Two innovations being implemented are Airport Surface Detection Equipment – Model-X (ASDE-X) and the Airport Surface Surveillance Capability System (ASSCS), both supplied by Saab. An FAA spokesperson told *Airports International* that the agency "has completed all planned deployments" of these systems.

ASDE-X

First deployed in 2003, ASDE-X is now in operation at 35 major US airports. The technology is Saab's Advanced Surface Management, Control and Guidance System (A-SMGCS), which the manufacturer describes as "a proven, high performance and standards-compliant system [that] enhances a controller's ability to manage airport traffic in all visibility and weather conditions".

The ADE-X system fuses data from the surface surveillance radar on top of the air traffic control tower and/or radar located on a remote tower, multilateration (MLat) sensors, ASDE-3 surface movement/surveillance radars, automatic dependent surveillance-broadcast sensors and terminal automation flight plan data. It determines the position of aircraft and vehicles on the ground and aircraft on final approach. Controllers see this information on a colour display that shows moving aircraft and vehicle positions as icons overlaid on a map of the airport's runways/taxiways and approach paths. The system continuously updates the data and the resulting detailed coverage of movements enhances situational awareness –



ATAP warns ATC when a pilot has lined up their aircraft with a taxiway rather than a runway *Denver International Airport*

particularly beneficial at night or in poor visibility caused by inclement weather.

ASDE-X is also equipped with visual and aural alarms to alert controllers of possible runway incursions or incidents. The system can also track non-transponder-equipped vehicles and aircraft.

ASSC

ASSC is a similar system to ASDE-X, with controllers able to see aircraft and ground vehicles on the surface and on approach, as well as departure paths within a few miles of the airport. The system likewise fuses data from multiple sources, including radars and multilateration remote units, to provide a highly accurate display for controllers, along with the same facilities for visual and aural alerts.

The ASDE-X and ASSC alerting capabilities have been supplemented by Airport Taxiway Arrival Prediction (ATAP), which provides warnings to air traffic controllers of 'misalignment', where pilots on approach have mistakenly lined up their aircraft with a taxiway rather than the assigned runway. ATAP is enabled at all airports equipped with ASDE-X and ASSC.

SSM

In October 2019, the FAA introduced the Surface Safety Metric (SSM) to measure and report runway safety performance and more accurately identify risks to aircraft. The SSM incorporates all relevant events in the runway environment, encompassing commercial and non-commercial aircraft, vehicle and pedestrian movements, runway collisions, excursions and incursions, and other surface incidents.

The system is part of concerted action by the FAA to improve runway safety that is leading to developments on various fronts, as well as the adoption of ASDE-X and ASSC.

Status lights

Runway status lights, now operational at 20 US airports, are designed to increase situational awareness for aircrews and airport vehicle drivers. They use traffic information from surface and approach surveillance systems to illuminate red in-pavement airport lights to signal a potentially unsafe situation.

Similarly, runway entrance lights are deployed at taxiway/runway crossings and illuminate if it is unsafe to enter or cross. Take-off hold lights are deployed on the runway by the departure hold zone and illuminate red when there is an aircraft in position for departure or if the runway is occupied by another aircraft or vehicle and is unsafe for take-off.

Runway incursion mitigation

The FAA's national runway incursion mitigation (RIM) initiative identifies airport-specific risks such as unclear taxiway markings and airport signage or complex runway/taxiway layouts. The agency then works with airports to develop strategies to reduce accidents at these locations. As of March 2023, the FAA had identified 126 RIM locations at 80 airports, with mitigations introduced at 91 locations. There is an average 78% reduction in runway incursions at airports where mitigations have been applied, the FAA says.

At locations where physical changes to the runway are unfeasible, an education campaign or a 'hot spot' designation – enabling users to plan safe paths of movement – is employed.

In May 2022, the FAA standardised hot spot symbology and verbiage on airport diagrams, bringing consistency to how potential risks are displayed. The RIM programme continuously monitors locations for reoccurrence and assesses new RIM candidates.

Alerts and education

The FAA has added arrival alert notices to the charts of 12 US airports where there's a history of misalignment, using graphics to visually depict the approach hazards and language describing the risk. The Federal NOTAM System now includes automated publication of Airport Construction Notices and Automated Closure Notice diagrams.

The FAA has produced 100 site-specific 'From the Flight Deck' videos to educate and inform pilots and controllers of the risks at specific airports. These cover wrong surface landings, complex airfield geometry, hold short, wrong direction intersection take-offs and more. Additional airport videos are planned for 2023.

A Runway Safety Pilot Simulator video series assists flight instructors when teaching student pilots surface safety best practices. Supplemental web content on faa.gov includes airport-specific cautions, communications, airspace details, best practices and other pre-flight planning resources. This content is currently available for 25 airports across the NAS, with more in development. AI





The Surface Safety Metric (SSM) measures runway safety performance, helping identify risks in the runway environment *Dallas/Fort Worth International Airport*



Assaia gives airports control over turnaround operations, enabling them to predict issues and automate processes *All images: Assaia International unless stated*

A turn for the better

Assaia International's **Max M Diez** explains how AI and machine learning have the answer to the challenges posed by the turnaround

The aviation industry uses technology widely to tackle the demands of sustainability, safety and capacity. Digital solutions are essential for airports and airlines to remain operational and, looking to the future, to keep up with the predicted growth in aviation while maintaining their commitment to achieving net zero emissions.

However, one piece of the jigsaw puzzle has been missing: the turnaround. Artificial intelligence (AI) and computer vision software can be applied to the vast numbers of cameras located in and around airports to analyse footage and collect new data. By embracing a data-driven approach to turnaround management, the industry is taking a vital step towards on-time performance with fewer delays and more efficient and sustainable airports and airlines.

AI technologies are revolutionising the way we automate current processes.



Max M Diez is chief executive officer of Zurich-based aviation software specialist Assaia International

Computer vision and AI track the movements of aircraft on the apron and predict key turnaround events. The technology notifies catering companies if they are not on schedule and ensures a bridge is always available to enable passengers to disembark as soon as the aircraft parks. With autonomous catering trucks, the software can request their services at the ideal moment during the turnaround. The result is a combination of predictive analysis to make systemic changes and real-time data to manage day-to-day decision-making.

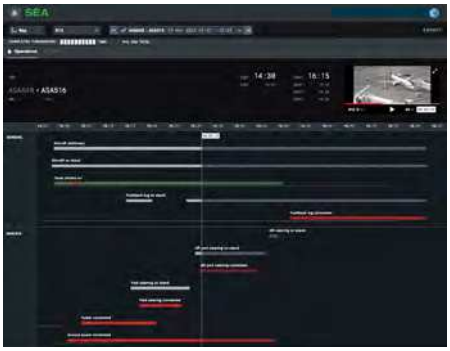
A range of tools

Assaia's mission is to use AI and computer vision to give airports and airlines full visibility of turnaround operations. By these, we mean the 45 minutes where there has hitherto been minimal scrutiny of the hundreds of tasks done by more than 75 people to park the aircraft, clean and fuel it, get the passengers off and on, and then away again on time. With our technology, we enable airlines to turn around aircraft efficiently and help airports free up gates faster. In addition to the obvious benefits to both passengers and airport operators, this also leads to significant reductions in CO_2 emissions.

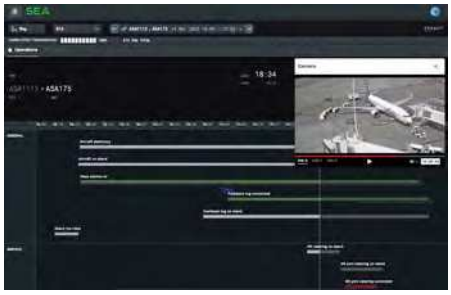
Assaia's Turnaround Control platform keeps airports running smoothly by

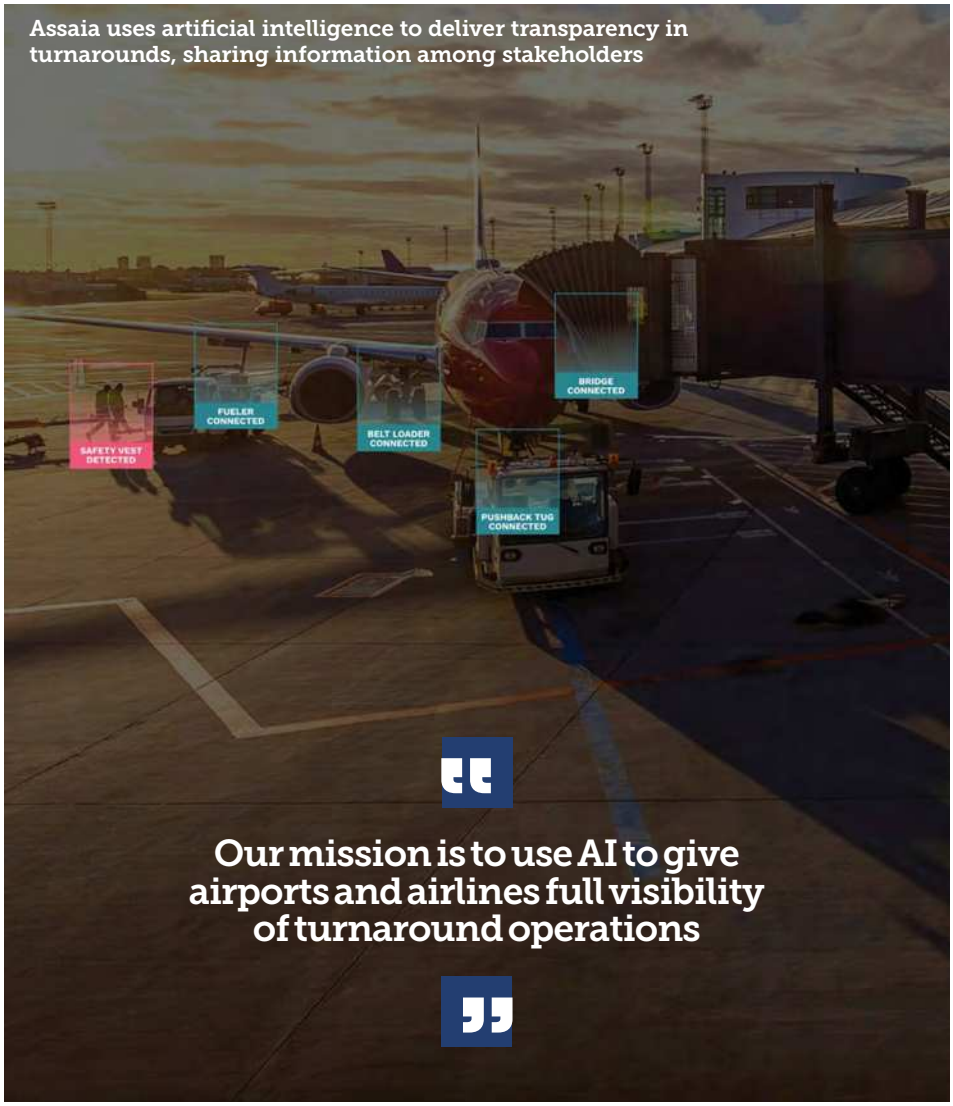


Assaia's solutions enable a faster turnaround and a safer, more sustainable airport ecosystem



Assaia's ApronAI helps improve apron safety by detecting unsafe events and foreign/misplaced objects at stands





Assaia uses artificial intelligence to deliver transparency in turnarounds, sharing information among stakeholders

Our mission is to use AI to give airports and airlines full visibility of turnaround operations

managing operations and resources in real time, with flight and weather data taken into account. We use computer vision alongside our data from millions of turnarounds across 30+ airports to provide accurate insight on when the aircraft will leave its gate (off-block time). This advanced system reduces taxi-in and average gate holding times and optimises gates for incoming flights, resulting in a streamlined traffic flow at all times.

While traffic flow is a priority, safety remains key to effective airport operations. The Assaia portfolio includes the Risk Control platform, which proactively safeguards airports and their workers by continuously monitoring the apron for unsafe behaviour. With real-time and historical safety data, staff can be trained to recognise potential threats while feeding this information into existing safety management systems, optimising airport security even further.

Assaia's APU Emissions Control provides an essential sustainability solution by monitoring auxiliary power unit (APU) usage and alerting users when APUs are not turned off in time, ensuring emissions are minimised. Furthermore, historic tracking of APU usage enables an airport's sustainability team to understand how the various airlines perform in terms of their environmental targets.

Assaia ApronAI, meanwhile, uses computer vision to detect turnaround events from airport video streams and leverages untapped operational data. The data provides real-time situational awareness and accurate predictions to enable highly efficient decision-making.

Solutions in action

Seattle-Tacoma International Airport (SEA) served 36.2 million passengers in 2021. With three runways and 89 gates, SEA has the highest passenger count per gate in North America. Its operators, therefore, need to focus on getting the most out of every gate. SEA required an innovative solution to increase its capacity, achieve real-time oversight over airside operations to ensure safety, and demonstrate it was achieving its ambitions to reach net zero by 2050.

The results of SEA's work with Assaia International have been striking: on-time-performance increased by 17% for flights managed by Assaia software, and the airport saw a reduction in average taxi-in time by almost a minute, leading to potential annual savings of more than $25m. Average excess gate holding time fell by 79% and airlines' annual kerosene costs dropped by $1m, alongside a 1,500,000kg annual reduction in CO_2 emissions.

Using Assaia's Predicted Off-block Time (POBT) platform, SEA reduced average gate holding times by nine minutes, resulting in savings of $5m. Average gate departure delays for late flights fell by 3.9 minutes, resulting in increased gate capacity. Use of POBT to optimise the arrival flow has the potential to save SEA a further $5m a year and to reduce CO_2 emissions by 7,500,000kg annually.

JFK International Air Terminal (JFKIAT) is one of the busiest terminals in the

ApronAI: taking a closer look

Assaia ApronAI uses computer vision to detect turnaround events from video streams, leveraging untapped operational data to bring efficiency, safety and sustainability to the apron.

The system can work with multiple cameras covering the same location/aircraft stand. It can be used with a wide range of cameras, including those already installed. It is common for customers to allocate up to three cameras per stand and to also install them on passenger boarding bridges to monitor boarding-specific events.

If the camera position and the layout of a series of adjacent aircraft stands are similar, it is sufficient to calibrate the system rather than for each individual stand. Assaia has found that the higher up a camera is installed, the more events can be detected. However, decisions about camera positions are dependent on which processes are most important for the customer to monitor.

The system can detect many objects on an aircraft stand and determine if the stand is clear for an aircraft to enter. It can also support the process of FOD (foreign object debris/damage) inspection, checking whether it was performed properly.

ApronAI operates within normal preference levels in adverse weather conditions such as snow, rain, fog or sandstorms and, according to Assaia, its performance at night may even be slightly better due to constant light sources on the apron.



Assaia's airline clients include Alaska Airlines and British Airways *Alaska Airlines*

New York area, with annual passenger volumes of 21 million. It serves 24 airlines and works with a range of ground handlers, resulting in a need for maximum visibility of operations between all turnaround stakeholders as they co-operate to reduce delays and ensure a safe apron environment. Assaia worked with the airport to tackle any turnaround shortcomings.

The partners saw an average reduction in ground delays of five minutes for flights managed by Assaia, resulting in potential annual cost savings of $40m across all flights. The terminal's capacity to handle additional flights with the same number of gates rose, while the percentage of occasions where the gate was clear when the aircraft arrived has increased by 25% since Assaia solutions were installed.

In addition to airports, Assaia works with airlines, among them Alaska Airlines. Its 300-strong fleet delivers passengers to more than 120 destinations, with a particular emphasis on Seattle-Tacoma International Airport, which accounts for a third of the Seattle-headquartered airline's business. With a clear ambition to be an on-time airline, Alaska Airlines needed to prevent delays, react quickly to unanticipated issues and optimise gate allocations, so each journey is seamless for their passengers.

Assaia helped Alaska Airlines reduce average ground delays for delayed flights by 3.9 minutes, equating to a 30% increase in profit per flight. It helped deliver a 17% increase in the number of flights departing on time, a 12% reduction in turnaround time and a 25% reduction in ground delay minutes.

Using Assaia's Turnaround Control, Alaska has been able to proactively prevent delays, get ahead of operational issues and improve gating allocation. The cost implications are not to be sneered at, either: four minutes less on the turnaround across the fleet can mean annual cost savings of $15m. AI

Using Assaia's POBT, Seattle-Tacoma reduced average gate holding time by nine minutes
Seattle-Tacoma International Airport





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The magic number

Thornton Tomasetti's Tyler Ranf and Jonathon Stage recommend a three-pronged structural approach when building sustainable airports. Here they explain why

Sustainability is much more than just collecting LEED points. While LEED certification provides a framework and a metric for improving efficiency and reducing a building's carbon footprint, forward-thinking firms are pushing the envelope with a three-pronged approach that greatly enhances sustainable airport design.

Designs that follow this approach focus on maximising sustainability through increasing structural efficiency, improving structural resiliency, and the creative use of materials. The progress on each of these is monitored throughout the life of the project, to stay on track with the overall goals and to provide insight and expertise for future work.



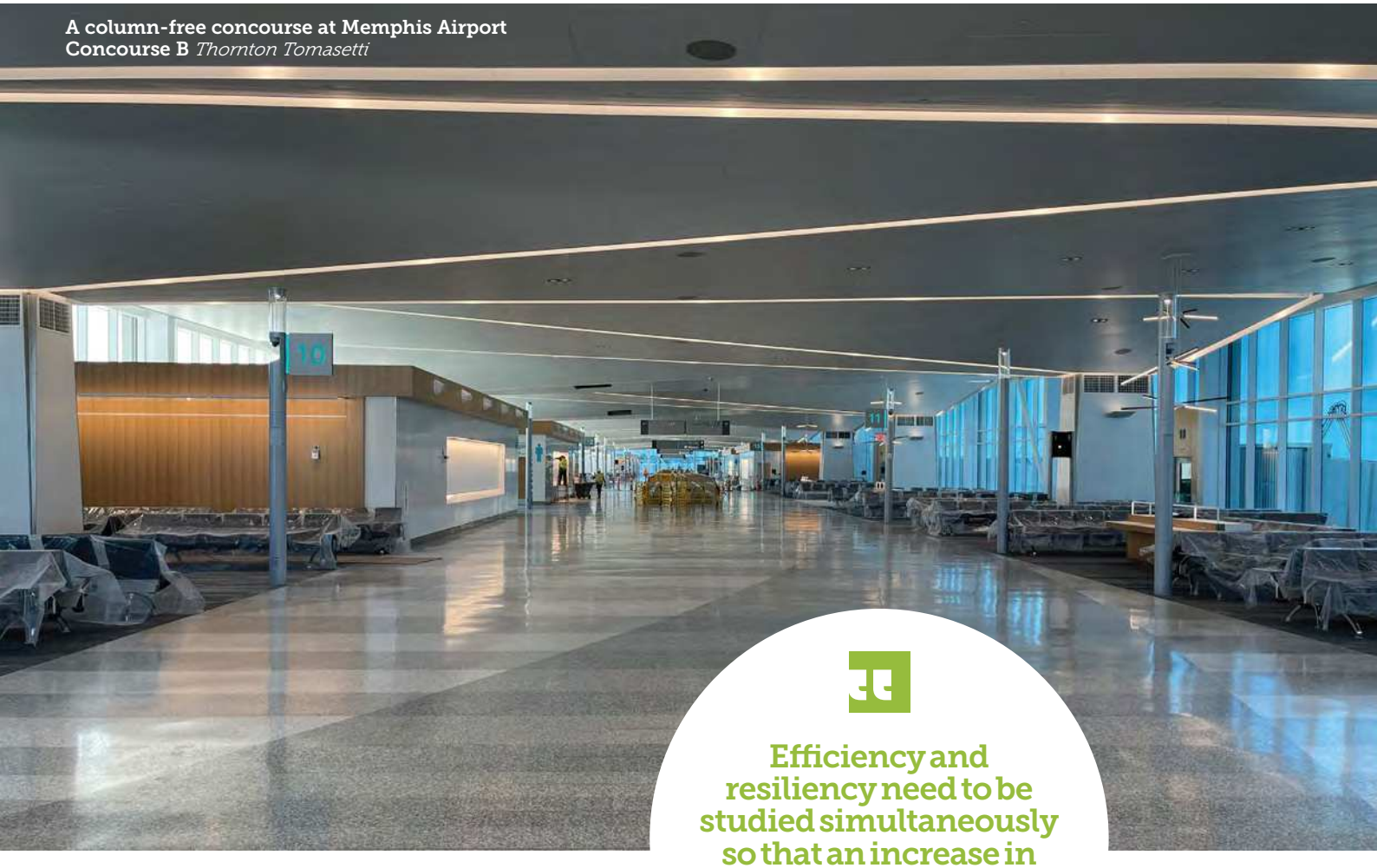
Factor one: efficiency

Structural efficiency is the first part of this process and requires smart material use. However, targeting efficiency without integrating the needs of the client and airport may lead to poor designs. The intent of the structural design should be to enhance the architectural vision by elegantly integrating its presence into the structure. To achieve this, the structure must be an early factor when establishing the project's programmatic and aesthetic goals. Early analysis provides timely data to enable the smart, sustainable, and cost-effective application of the structural system.

By being proactive, a project team can ensure the structure is efficiently designed to reduce the embodied carbon while still reflecting the goals of the client and the airport. For example, in designing a new 700,000sq ft terminal at Pittsburgh International Airport, Thornton Tomasetti conducted a comprehensive analysis of the roof design. We received the architectural BIM (building information modelling)



Efficient roof design was crucial to Pittsburgh International Airport's Terminal Modernization Program *Gensler + HDR in association with luis vidal + architects*



A column-free concourse at Memphis Airport Concourse B *Thornton Tomasetti*

> **Efficiency and resiliency need to be studied simultaneously so that an increase in one does not cause a decrease in the other**

model and worked with the architectural team of Gensler in association with luis vidal + architects to define parameters that could be modified to maintain the architectural vision while increasing the efficiency and redundancy of the roof structure. By the end of this highly collaborative process, and with the use of our parametric modelling techniques, the roof structure was lighter, performed better, and was easier to construct. The lighter roof meant smaller columns and foundations, thereby saving additional material 'downstream'.

Factor two: resiliency

Resiliency is the second key consideration in a sustainable design. Structural resiliency is a measure of the building's ability to be relevant in the future. A structure is not sustainable if it requires premature demolition or substantial modifications. Structures should be able to withstand weather and climate changes, future airport needs and trends, man-made threats and negligence, advances in technology, etc. Over the decades, we have seen numerous accounts of airport terminals and facilities being partly or completely demolished prematurely because they restrict programmatic changes, often in the spirit of creating efficiency. Therefore, efficiency and resiliency need to be studied simultaneously so that an increase in one does not cause a decrease in the other.

There are many ways of increasing resiliency. Examples of this includes encasing steel columns with concrete in critical areas and locations where there is vehicular use, to protect them from intentional or unintentional damage; designing floors for an enveloped vibration criteria to facilitate future occupancy changes; and prioritising large framing bays to minimise obstructive columns.

One way of promoting future programmatic resiliency is to design wide open spaces that are free to be changed when needed, by concentrating the necessary structure where changes are less likely to take place. In a terminal, for example, landside spaces like ticketing, bag claim, and TSA screening, and airside spaces such as concessions and circulation, are all very fluid and likely to change throughout the life of the building. Therefore, these should be designed as open, column-free areas that can easily be reprogrammed without being restricted by structure.

Conversely, often there are areas between the landside and airside that are populated by back-of-house functions, such as administration offices, mechanical rooms, restrooms, vertical circulation, etc. These areas are generally not as fluid and can accommodate a denser structure.

Our work on the Concourse B Modernization Project at Memphis International Airport is an example of how to concentrate structure in a concourse to maximise flexibility. The necessary structure was placed below the concourse, which allowed for a light and column-free structure within the programme area above it. This resulted in column-free hold rooms, concession areas, and restroom blocks, all of which can be easily adapted to meet future programmatic needs. ✈



Beacon embodied carbon calculations for more than 600 projects, including the modernisation work at Pittsburgh *Gensler + HDR in association with luis vidal + architects*

Factor three: materials

Structural material use and selection is the final prong of a design approach toward a sustainable structure. The materials selected early in a project can play a key role in its sustainability. Being creative and looking to the industry for innovative low-carbon alternatives is a great way of reducing the carbon footprint. Early in the design process of the Pittsburgh Terminal Modernization Program, Thornton Tomasetti decided to use high-strength steel columns to support the roof and high-strength concrete grade beams and slabs at the apron level to span over the existing tunnels below the building. This helped to reduce the overall structural quantities and embodied carbon.

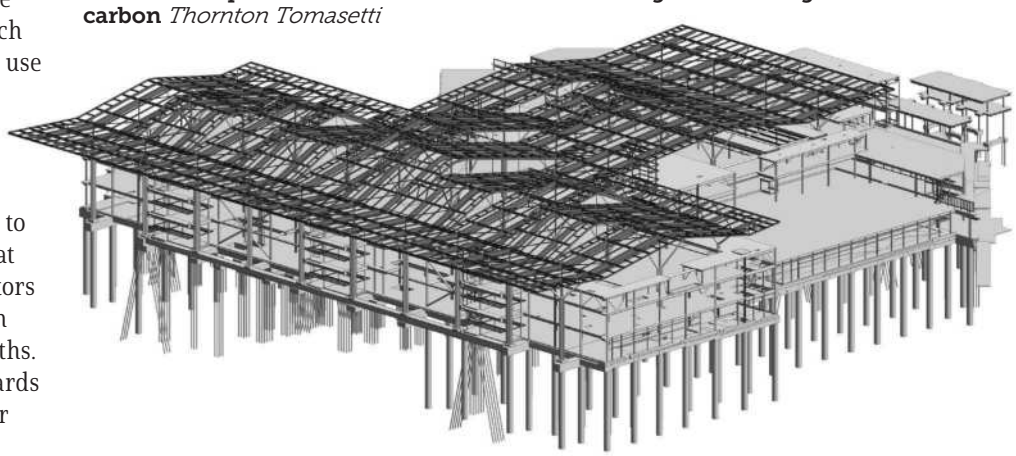
Once the design has been established, materials can be investigated for how they can best be sourced to reduce their carbon footprint. There may be an opportunity to source steel and rebar from manufacturing facilities that use more eco-friendly energy sources, such as hydropower or photovoltaics, or to use concrete products that capture and sequester carbon. When sending out construction documents for bid and procurement, it is important that specifications provide flexibility to ensure that the designer receives what is needed while enabling the contractors to creatively reduce embodied carbon based on their knowledge and strengths.

Thornton Tomasetti has shifted towards a performance-based specification for this very reason. For example, when specifying concrete, the required strength and shrinkage properties should be indicated, but the concrete subcontractor could be allowed to propose a mix that reduces the amount of cement by adjusting slump, material substitutions, age at required strength, water-cement ratio, and so on.

The ability to reduce the embodied carbon in the design process is maximised if the embodied carbon can be categorised and tracked throughout the life of the project. Thornton Tomasetti uses programmes such as Beacon, an open-source Revit plug-in that was developed by our CORE studio (a virtual incubator of ideas), to establish a structural embodied carbon baseline for each project, then tracks carbon reduction throughout the life of the project. By tracking embodied carbon for each component of the structure (floor, framing, columns, walls, foundation, etc.), the design team can determine how each project decision helps reduce embodied carbon, and where to concentrate resources to maximise reduction efforts. For example, if 30% of the embodied carbon is in the structural framing, then time should be spent investigating added efficiencies, alternate materials, or smarter specifications to minimise it.

By using the three-pronged approach of integrating efficiency, resiliency, and material use throughout the life of the project, the team can ensure that a structure is sustainable in both the short and long term. Accounting for embodied carbon throughout the life of the project enables the team to maximise this sustainability effort for the current project and provide baselines and targets for future ones. AI

CORE developed tool Beacon enables the measuring and tracking of embodied carbon *Thornton Tomasetti*



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NEW POWER generation

All images: Henderson Engineers unless stated

Henderson Engineers was responsible for the New Terminal at Kansas City International Airport. Aviation practice director James Dietz explains to Tara Craig why electricity was the airport fuel of choice

We were selected as lead engineer for the New Terminal at Kansas City International Airport (MCI) in 2017 after 75% of voters in Kansas City, Missouri, approved the project in a special election. Our brief was for the entire engineering design work. We were contracted for this by various partners, among them the Kansas City Aviation Department, Edgemoor Infrastructure & Real Estate, Skidmore, Owings & Merrill (SOM) and Clark/Weitz/Clarkson., the project's design-builder. Our scope of work covered acoustics, audio/video, electrical, fire alarm, mechanical, plumbing, technology and security building systems.

Henderson Engineers was founded in Kansas City in 1970, and while we've worked on major projects throughout the United States and internationally for the past 53 years, the New Terminal is a standout because it's in our own backyard. There's a heightened sense of pride in knowing that our project will be the front door to our hometown for decades to come.

Full electrification

At just over one million square feet, the New Terminal was the first ground-up Henderson Engineers project of its size and scale to be all-electric, minus concessions cooking. Our philosophy from the beginning was to reduce the project's operational carbon footprint and that intention from conception to completion stands out from similar systems that we have delivered on smaller projects.

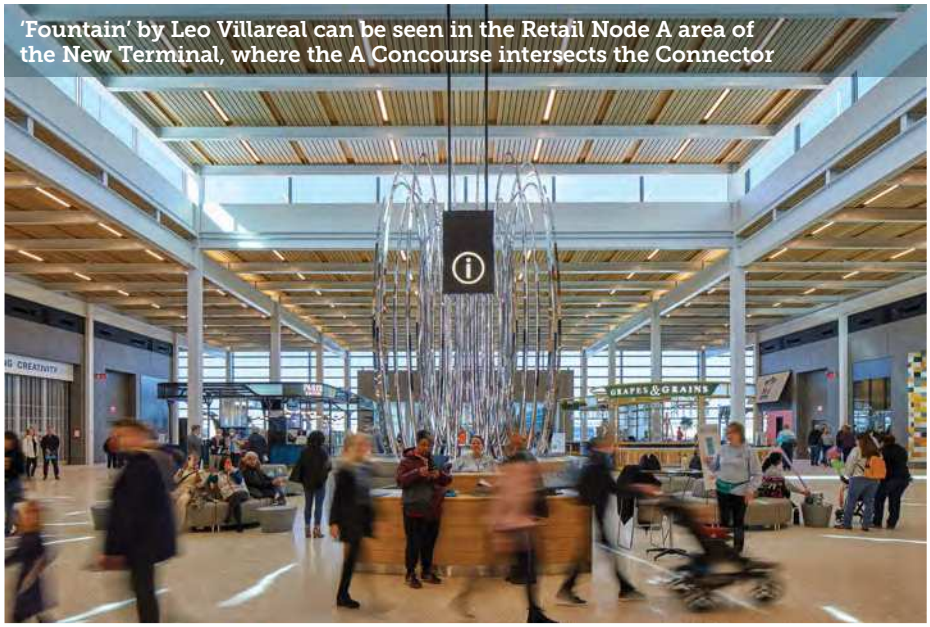
The new system powers all airport operations except for the kitchen cooking facilities. Chefs are accustomed to gas stoves as the restaurant industry standard and that shaped the feedback we received from concessionaires on the possibility of all-electric kitchens. However, that was around five years ago and the idea of full electrification is gaining steam as electric induction cooking becomes more familiar and sustainability becomes a higher priority for restaurateurs. We designed the electrical system at the New Terminal with ample capacity to make updates if desired. Because of this, the kitchen facilities could easily go all-electric further down the road, which would be as simple as capping the gas and hooking up the cooking spaces to the existing all-electric power system.

As we neared the project's completion, Henderson's in-house sustainability director conducted a comparative analysis. Based on our findings, we confidently expect that the all-electric system will avoid 92% of operational CO_2 emissions by 2050 when compared to a traditional mixed-fuel system that utilises oil, coal and other fossil fuels to power airport operations.



James Dietz is aviation practice director at Henderson Engineers

> There's a heightened sense of pride in knowing that our project will be the front door to our hometown for decades to come



'Fountain' by Leo Villareal can be seen in the Retail Node A area of the New Terminal, where the A Concourse intersects the Connector



The Henderson-designed high-efficiency chiller plant inside MCI's New Terminal

LEED explained

An initiative of the US Green Building Council (USGBC), Leadership in Energy and Environmental Design (LEED) is the most widely used green building rating system in the world.

It has been developed to provide a framework for healthy, efficient structures prioritising carbon reduction and cost-saving. LEED certification is a globally recognised symbol of sustainability achievement and, according to the USGBC, it is backed by an industry of committed organisations and individuals paving the way for market transformation.

LEED-certified buildings save money, improve efficiency, lower carbon emissions and create healthier places for people. They are critical to addressing climate change and meeting environmental, social and governance (ESG) goals, enhancing resilience and supporting more equitable communities. LEED categories can also contribute towards meeting the UN's Sustainable Development Goals, the USGBC said.

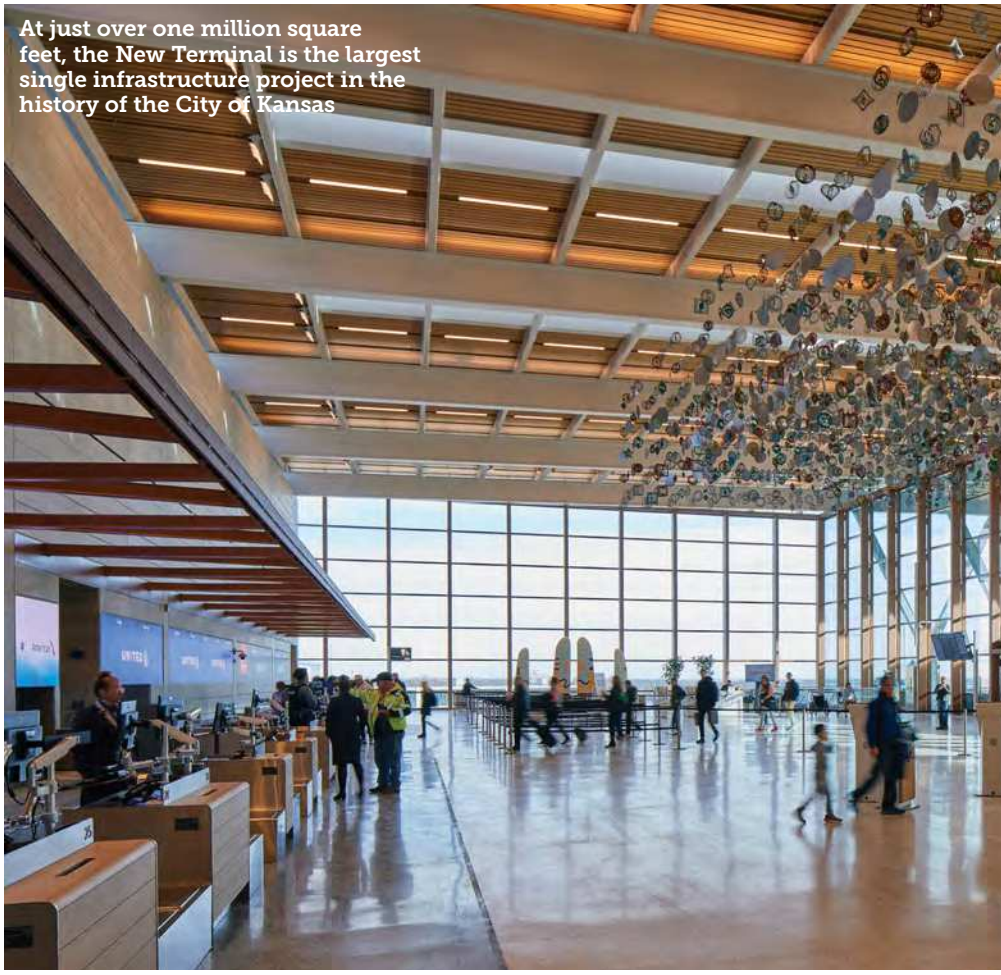
To achieve LEED certification, a project earns points by adhering to prerequisites and credits that address carbon, energy, water, waste, transportation, materials, health and indoor environment quality. Projects go through a verification and review process by Green Business Certification Inc (GBCI) and are awarded points that correspond to a level of LEED certification: Certified (40-49 points), Silver (50-59 points), Gold (60-79 points) and Platinum (80+ points).



'Molten Swing' by Soo Sunny Park uses ordinary steel frames and acrylic tiles to sculpt a malleable visual structure that changes as travellers and light flow through the space *Kansas City, Missouri, One Percent for Art Program*

Working with the Kansas City Aviation Department and its airlines, Henderson provided the specification and infrastructure for electric ground service equipment chargers





At just over one million square feet, the New Terminal is the largest single infrastructure project in the history of the City of Kansas

In addition to environmental benefits, there were also financial advantages. From a construction standpoint, mechanical equipment costs less when building and operating an all-electric facility. Further savings stemmed from not having to procure gas lines, venting and other gas-related equipment that would have otherwise been necessary.

The system itself

Design and installation of the new system didn't take any longer than would have been the case with a conventional set-up. Together with our project partners, we completed analyses and planning for what it would look like beforehand, so additional time wasn't a factor despite the unconventional approach. Any extra time went into the analysis and evaluation stage to determine which approaches worked best to meet the project's goals.

The system took up less physical space within the central utility plant due to the all-electric boilers being smaller. We also didn't have to install chimney flues, piping and exhaust systems, so there wasn't as much overhead congestion to design and construct around. In total, we estimate that we made around 20% in space savings, making it easier for personnel to manoeuvre around the boiler plant and providing more operational space for storage or making any future updates and additions.

Prior to installation, we liaised with the Kansas City Aviation Department, which owns and operates the new facility. There was education involved throughout the project regarding the advantages of going all-electric, the footprint of key components and how the department could realise the system's full potential based on what we had modelled. Electric boilers are generally easier to operate than gas boilers as they require fewer adjustments, have a lower risk of system failures and are typically more robust. These factors contributed to buy-in from key stakeholders from the beginning.

Challenges and solutions

Like any major public infrastructure project, there are many stakeholders. You want to make sure everyone is on the same page and has the right information to make the best possible decisions within their specialities. It's also important to have the right information on hand to relay to the general public as needed. Therefore, the biggest challenge of the MCI project was providing timely information





in the right format and including the most relevant details. This involved countless presentations, meetings and review sessions to give updates on our progress and address any questions that arose based on the data we provided. In short, communication was the biggest challenge as well as the solution.

The project has been open for a little over a month at this point and the positive feedback has far exceeded what Henderson Engineers could have hoped for. In hindsight, we could have advocated harder for all-electric cooking kitchen facilities. Concessionaires on projects we're undertaking now are more receptive to it, so we may have had success back then. But overall we're proud of being part of delivering the New Terminal on time and on budget while meeting the needs, goals and expectations that were set forth by the Kansas City Aviation Department and the city of Kansas itself.

A source of inspiration

As the largest ever infrastructure project in the history of Kansas City, the New Terminal provided an opportunity to push the boundaries of what's possible, serving as a catalyst for other developments. Once you earn that LEED stamp of approval for sustainable approaches, it makes it easier for smaller projects to jump on the bandwagon. It's a case of: "If a once-in-a-generation project like MCI can do it, we can do it too."

Many municipalities, as well as design and construction firms around the globe, have ambitious climate goals that typically target 2040 or 2050. So, over the next decade, we expect to see an uptick in the use of renewables like solar energy and more all-electric facilities given their higher redundancy and reliability. We'll also see more greenery in facades and interiors, which helps with cooling, ✈





Above: **All-electric boilers contributed to the project becoming the first and largest LEED v4 GOLD BD+C: NC-certified terminal/concourse project in the midwestern United States.** *Below:* **Speaking at the New Terminal's opening, US Transportation Secretary Pete Buttigieg described the airport as "a model for similar efforts across the country"**





Above: **The project's electrical substations power everything except for kitchen cooking facilities at concessions**
Left: **Members of the Henderson Engineers team celebrate winning a LEED Gold award for their work on the New Terminal at Kansas City**

> **We expect the all-electric system to avoid 92% of operational CO_2 emissions by 2050 compared to a mixed-fuel system**

dampens noise and absorbs carbon. More attention will also be paid to areas that often aren't first in mind when it comes to sustainability, such as baggage handling systems and operational systems like boarding bridges and gates.

Eco inspo

What inspired us? When it comes to airports that have ticked the sustainability boxes, I love Palm Springs International Airport in California. It's amazing to go against the grain of our industry by eschewing an enclosed environment for a mostly open-air facility with outdoor concourses. The connection with nature and the outdoors provides a great experience, while limiting the energy needed for HVAC (heating, ventilation and air conditioning). The ongoing 20-year expansion at Vancouver International Airport in Richmond, Canada, is another favourite for its incorporation of a geothermal system for heating and cooling. Airports are 24/7 facilities that use a lot of energy, and the outdoor and geothermal concepts show that there are sustainable solutions from the natural world that could be applied when the local climate allows it.

In terms of non-airport buildings, one of our projects – Golden 1 Center in Sacramento, California – has been a real source of inspiration. The NBA (National Basketball Association) facility shattered venue design expectations by using 100% solar power, installing low-flow plumbing to reduce water consumption, using a displacement ventilation system with under-seat vents for air conditioning and incorporating natural cooling at the first ever indoor/outdoor arena – to name a few. It was the first LEED platinum-certified arena in the world, making it a standout model for every large project, including airports.

What next for Henderson?

We're currently involved in the expansion project at Austin-Bergstrom International Airport in Texas, as well as the new terminal at Des Moines International Airport in Iowa and the terminal modernisation programme at Eppley Airfield in Omaha, Nebraska.

We're a signatory to the Carbon Leadership Forum's MEP 2040 challenge, a commitment to achieve net zero carbon emissions on our projects by 2040. We also have our own 2040 Climate Pledge, which commits us to achieving net zero carbon across our business operations. So you can expect us to continue to strongly prioritise electrification, water conservation and other decarbonisation approaches. AI

Kansas City – bigger and better

The 40-gate New Terminal at Kansas City International Airport opened for commercial air service on February 28, 2023. At just over one million square feet and with a budget of $1.5bn, it is the largest single infrastructure project in the city's history. Design and construction work began in 2018 and the project broke ground in March 2019.

"This terminal is a new front door to the people of Kansas City – to everyone in our region, in Missouri and Kansas. We are on time, in fact a day early, and on budget," said Quinton Lucas, mayor of Kansas City. "Because of this project, thousands of Missourians and Kansans have got jobs and built new careers. Because of this project, we will bring millions, if not billions, of dollars in new economic development to Missouri and Kansas. Because of this project, we will build future generations of exceptional memories here at Kansas City International Airport ."

With future capacity in mind, the terminal has been designed to expand to 50 gates when passenger volumes require it, the airport operator said. Two moving walkways expedite transfers between the concourses, making it easier for travellers to navigate the airport. Consolidated and flexible security checkpoints with 16 lanes were designed to accommodate the ebb and flow of passenger volume. Adjacent to the terminal is a new 6,200-space garage offering covered parking.

A priority for planners was to make the New Terminal the most accessible airport building in the United States. As a result, it features gradual slopes, a play area for children of all abilities, sensory and quiet rooms for those who have disabilities, baby feeding rooms and service animal relief areas. The Kansas City Air Travel Experience is a partial airliner adapted to help individuals with anxiety or other conditions that may make them fearful of flying.

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Sustainable Airport Fleets

Ruben Creus of Revo Zero tells Tara Craig about his company's mission to launch a zero-emissions revolution – starting with airports



Revo Zero aims to roll out hydrogen-fuelled fleet vehicles across first US, then European, airports *All images: Revo Zero*

What is Revo Zero's background?

Despite the differences in opinions, professions, or ideologies, we all agree that fresh air always feels pretty good when you are outdoors. With that simple fact in mind, we thought, how can we make our air cleaner in an affordable and practical way?

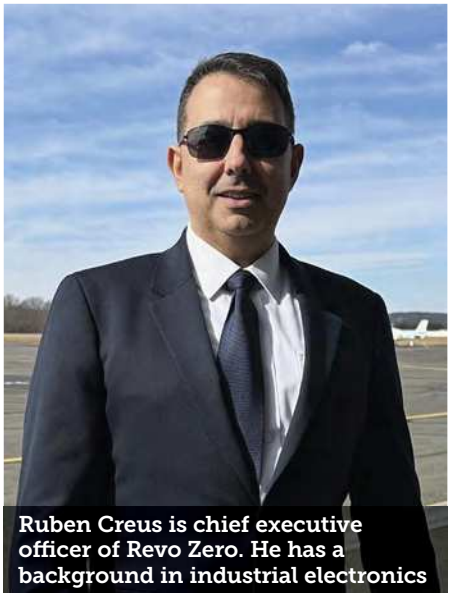
There's no doubt that with time and advances in technology, we will fix whatever problem we face, and while we must look at the future, we cannot forget that we are, in fact, living in the present and that we are the ones who are dealing with this problem right now.

At the same time, there is the crude reality that despite everybody's best efforts to make our environment more sustainable, effort and cost are something that everyone looks at before jumping on board. Good intentions are great, but if something costs more or requires significant effort, it won't be easy for it to become widely adopted.

We founded Revo Zero more than a year ago, focusing on developing affordable systems with currently available technologies. While we are targeting several industries, we began with the aviation industry because, as an aviator, I understand the struggles airports face when looking to decarbonise their operations.

What is the company's mission?

Our mission is to start a revolution towards zero-emissions by using existing technology in creative, practical, affordable ways for individuals and



Ruben Creus is chief executive officer of Revo Zero. He has a background in industrial electronics

businesses to access clean resources. We now have the tools to create a cleaner and more sustainable future and are committed to making it happen for everyone, everywhere.

Revo Zero provides zero-emissions systems to help fleets transition to a zero-emissions economy. Our offerings include green hydrogen production, distribution and refuelling infrastructure. We focus on utilising green hydrogen, made from renewable sources such as solar, wind and hydroelectric power, to create a renewable and sustainable way to decarbonise the atmosphere.



The hydrogen dispenser is 3½ x 5½ft

As an aviator, I understand the struggles airports face when looking to decarbonise their operations

Q ***What other companies do you admire?***

There are many great companies in the sustainability space, but the principles of successful companies are universal. For instance, I remember when Steve Jobs invented the concept of the iPhone. He showed phones and MP3 players from other companies and asked, "Why do I need to carry two devices if I can carry one?" That was a pivotal moment in the definition of creativity. Nowadays, most companies are looking for the next big thing, when in fact the next big thing is what we already have, but we just need to use it differently. This mindset defines our creative process.

For instance, our society has been using hydrogen to power rockets to go to the moon for decades, and we're still struggling with how to power our cars. This reminds me of a sentence from the Wright brothers: "If birds can glide for long periods of time, then...why can't I?". Well, with that same logic, if we use hydrogen to power a rocket to go to space, why can't we power a car with hydrogen to drive around town? And that is how the inspiration of others made us realise that we already had the answer.

Q ***What stage is Revo Zero at in its work with airports?***

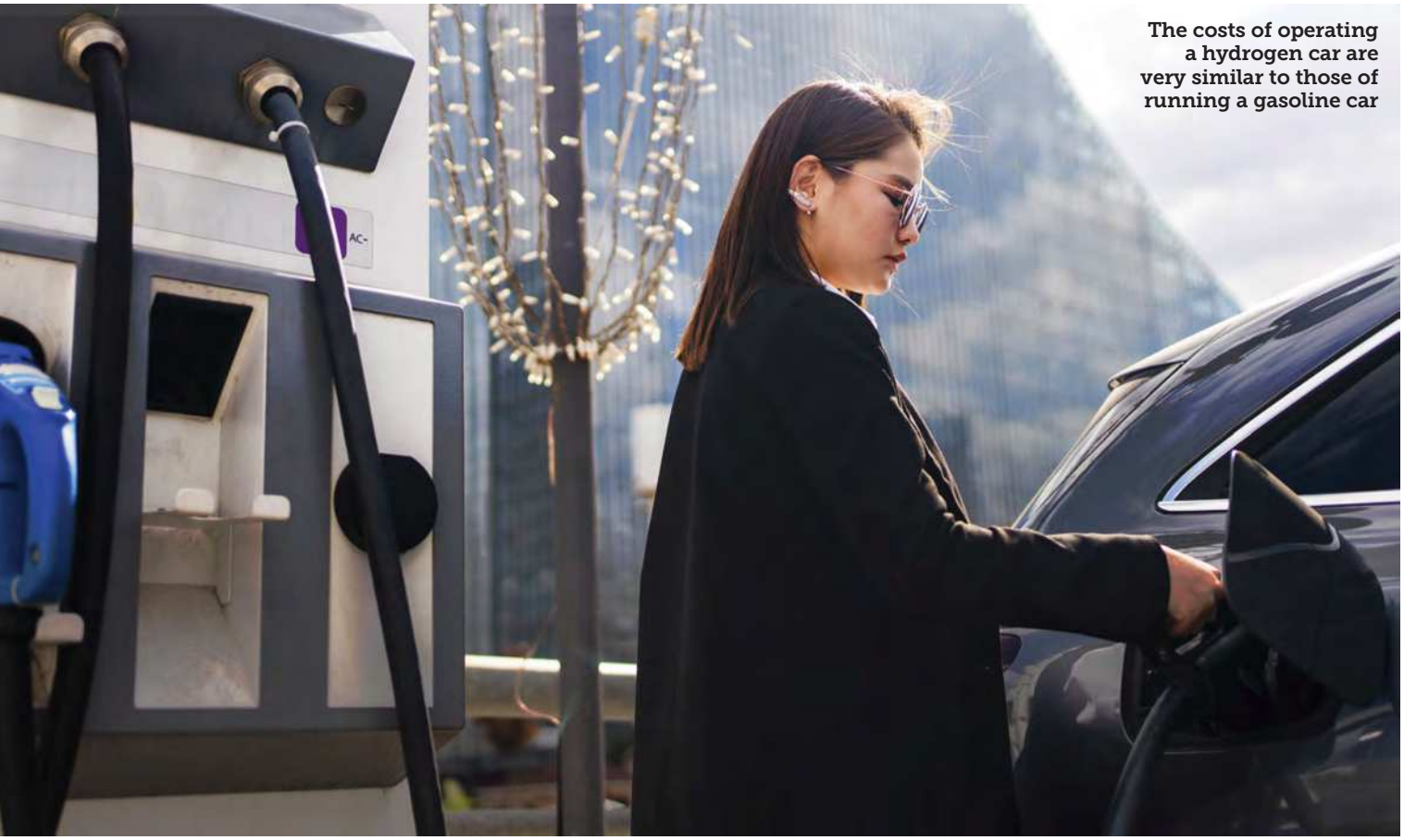
More than a year ago, we entered into a strategic agreement with the US airport operator Avports, to transition its airports' fleets away from gasoline and diesel to zero-emissions solutions utilising battery and hydrogen vehicles.

We are in the process of deploying the first hydrogen dispensers for its airports to begin their transition to on-campus hydrogen vehicles, including ground operations vehicles.

We are beginning with airports in the northeast, and we are planning to expand very quickly across the East Coast down to Florida. Some of the airports are already part of our agreement and we're going to work with Avports to bring additional airports to the list.



Revo Zero is currently installing the first hydrogen dispensers at operator Avports' airports



The costs of operating a hydrogen car are very similar to those of running a gasoline car

Q ***What can you offer airports?***

We provide HaaS (hydrogen-as-a-service). Our HaaS model allows any airport to host a Revo Zero hydrogen dispenser at no cost. We only require that the location is a publicly accessible area of the airport. The airport is responsible for the cost of installation, which is minimal, while we assume all equipment costs.

With our aviation partner, we have developed an airport-ready zero-emissions vehicle lease programme that enables an airport to lease a small number of hydrogen vehicles as a way to start the transition towards zero emissions. Eventually, the airport can buy the vehicles or it can continue to lease them. We also assist with the customisation needed for the vehicles to be ramp ready, by adding required equipment such as sirens, radios, labels or full-scheme colours. Airports pay for the hydrogen under a pay-as-you-go model. Our HaaS solution enables them to transition fleets towards zero emissions effortlessly and economically.

We are planning to deploy hydrogen dispensers in all of Avports' airports in order for them to transition their ground fleets to zero-emissions vehicles. We use hydrogen rather than electric batteries for a number of reasons. Hydrogen-powered vehicles enable operators to refuel in minutes, virtually eliminating any downtime, which is critical for the high-up-time aviation environment. For some specific applications, a battery vehicle could be suitable and that's why we also provide EV chargers. But, for most of an airport's operational needs, maintaining little downtime is vital and only hydrogen can achieve that.

Hydrogen-powered vehicles enable operators to refuel in minutes



With our hydrogen technology, we can achieve very similar costs to operating a gasoline car, therefore there's no excuse for an airport to continue pouring gasoline into its vehicles. Hydrogen vehicles can be recharged in minutes, rendering them ideal for avoiding long periods of downtime. We will provide hydrogen vehicles for airports that are using our hydrogen dispensers.

Today, airports can transition their fleets to zero emissions virtually at the same cost or with little or no negative cost implications. No airport has a good excuse to keep their vehicles releasing CO_2 into the air and polluting our skies when they could use our HaaS model.

Q ***Tell me about your hydrogen dispenser***

Our hydrogen dispenser looks very similar to modern electric vehicle chargers. It is around 3½ft wide and about 5½ft tall. When we install a hydrogen

dispenser, a few feet away, we also install a storage unit for the hydrogen. The dimensions of the storage unit can vary depending on how much hydrogen we expect to be used. We look to ensure that each storage unit contains a minimum of two weeks of usage in reserve.

Q ***Are you targeting airports beyond the US?***

Yes, we are already in discussions with some airports in Europe, but as of right now, our main focus is to complete our East Coast corridor.

Q ***Tell me about your vehicles***

We have developed pFC (plug-in fuel cell) technology that we are utilising to create our Revo Zero vehicles. This technology uses a rechargeable battery and a hydrogen fuel cell to ensure that the battery remains charged by the fuel cell to preserve the optimal level recommended by using hydrogen. The pFC module uses AI to predict driving behaviour and activate the hydrogen fuel cell when needed.

The main benefit is that Revo Zero pFC vehicles can provide a range of up to 700 miles and can refuel in minutes. A key advantage of having a battery is that it enables the vehicle to be recharged when the automobile is not in use, taking advantage of lower electricity costs. The benefit of having hydrogen is that it provides a very long range and quick refuelling. Having both technologies combined in one vehicle ensures that it will always have a power option available when needed, thus eliminating range anxiety.

Q ***What is the vehicle's capacity?***

Our Revo Zero model Energy is a large luxury SUV with three rows that can be converted into a large cargo capacity. While mostly intended for residential use, it would work well in an airport environment, having been designed for the most challenging conditions.



Revo Zero pFC vehicles can provide a range of up to 700 miles and can refuel in minutes

Q ***Can you customise existing vehicles made by other manufacturers?***

We are working with our partners on some specialty vehicles we can convert to hydrogen, but that is on a case-by-case basis. However, retrofitting existing vehicles is not the best idea as it can create warranty and liability issues.

For now, we're using market-available hydrogen vehicles for the airports, and we expect to be able to offer our own in the future.

Q ***What next for Revo Zero?***

We are in discussions about developing new partnerships, especially in terms of the long-range hydrogen-powered zero-emission aircraft prototype for general aviation, but I can't tell you much about this just yet. It is a very ambitious project and we have the ingredients to make it a reality. We are eager to build a consortium of organisations that want to be part of revolutionising the airplane industry too.

We are growing our network agreements, advancing our vehicle development, and exploring international opportunities. But as an aviator, I personally can't wait to test fly the aircraft! AI

We have the tools to create a cleaner, more sustainable future and are committed to making it happen for everyone, everywhere


The Revo Zero Energy is a large luxury SUV with three rows that can be converted into a large cargo capacity



The Vienna Pharma Handling Center's ambition is to become the fastest, temperature-secure transit hub in Eastern and southeast Europe
Vienna International Airport

Cool, calm and collected

The demand for cold-chain logistics worldwide is growing. Chris Anderson looks into how airports are meeting cargo clients' ever-increasing needs

According to a report last year from market researcher Fortune Business Insights, the global cold-chain logistics market is predicted to be worth around US$647.47bn by 2028. It was previously valued at $221.85bn in 2020, and at $242.39bn in 2021, so the projected growth here is staggering.

A number of reasons are thought to be behind this increasing popularity. One is that the effective transportation of temperature-controlled products, via a supply chain using refrigerated packaging solutions, preserving the quality of food and pharmaceuticals, for example, minimises waste. There is less degradation of food quality en route, meaning that less is thrown away.

In addition, increasing government initiatives and subsidies have enabled cold-chain providers to tap into developing markets such as India, Japan and Canada, with innovative solutions to make the refrigerated transportation of difficult or unusual items easier. And the rise of e-commerce has boosted demand for perishables, such as fast-food delivery services, thus creating even more opportunities for the cold-chain market.

In the case of pharmaceuticals, clearly a spotlight has landed on cold-chain solutions as a result of the COVID-19 pandemic. Vaccines need to arrive in countries at controlled temperatures to maintain the desired effect, which means an effective cold-chain needs the right equipment and technology, trained staff, and efficient planning. Even the slightest error can have a devastating effect, resulting in a spoiled shipment.

Airports have the edge

Airports are one of the gateways that perishable goods can find themselves travelling through, and are always looking to grow and improve their cold-chain offering. Here Michael Zach, vice president of sales, finance and cargo at Vienna International Airport, explains how his own place of work handles products: "With the Vienna Airport Pharma Handling Center, we actually have our own dedicated facility to handle temperature-sensitive goods, especially pharmaceuticals and biotech products," he told *Airports International*. "It has two large-scale cooling warehouses, offering storage at either 2-8°C or 15-25°C, with mobile refrigeration to ensure safe connections between the air and land sides. And we have our state-of-the-art temperature-monitoring systems and CCTV, ensuring everything is transported exactly as it should be.

"COVID-19 has definitely led to a surge in the demand for cold-chain services. In 2022, we handled more than 3,600 tonnes of temperature-sensitive goods, which was a 64% rise on the previous year, and 173% up on 2019. Due to its speed and efficiency, air cargo will always be the preferred choice over land for transporting such materials."

Samuel Speltdoorn, cargo business development manager at Brussels Airport, agrees that perishables, in general, is a huge market. "We see flowers and vegetables from South America and Africa come via the airport, and the growth in e-commerce is also having an effect," he said. "And you might think beer and chocolate were the biggest exports from Belgium, but it's actually pharmaceuticals, around 20 times bigger – Belgium is third globally for pharmaceuticals, behind the US and India. So for a long time, before COVID, we've been heavily investing in our cold-chain cargo facilities at Brussels Airport, with dedicated warehouses, airside pharma transporters, special equipment and processes. We speak directly with the pharmaceutical companies, and meet regularly, to make sure we're able to cater to what they need.

"We have 35,000m² of dedicated pharmaceutical cold-chain warehousing available, which is among the largest in the world for an airport. What we need to do now is optimise the landside to airside transfer, which we're currently working on. That's the question we're always asked: how can we shorten the time



The Airside Pharma Transporter at Brussels Airport uses a new type of cooling technology. Solar power technology also means that it can operate autonomously for several days *Brussels Airport*



Through its local office, Lödige Industries planned, manufactured and implemented an automated cold-chain pallet-cargo system for AAT Coolport at Hong Kong International Airport *Lödige Industries*



Increasing digitalisation of processes means that it is not unusual to see cargo staff using tablets *Menzies Aviation*

between the warehouse and the aircraft for pharmaceuticals? That could mean dedicated pharma facilities on the air side, or specific conveyor belt systems. There are lots of ideas."

Expert opinions

Airports will lean on the knowledge of specialist companies to keep up-to-date in terms of the latest cold-chain technology. Among them is Lödige Industries – a supplier of automated guided vehicles (AGV), transporter lifts, truck docks, caster decks, multi-level storage systems and many more industry-specific solutions. Björn Ussat, director airport logistics solutions, explained what airports will need to offer in cold-chain terms.

"For highly-sensitive goods, fast and precise processes, as well as complete documentation, are crucial to ensure seamless cold-chain operations.

"Segregation requirements must also be taken into account when planning the unit load device (ULD) cold storage rooms in the warehouse to avoid cross-contamination. We always tailor the various infrastructure elements to the different sizes and process types of the airport terminals, ensuring fast handling, and the best possible use of the available space," Ussat said.

Menzies Aviation, based in Edinburgh, is another company offering a variety of services to airports, including cold-chain storage, and Alan Glen is its vice president of cargo development. "We've grown rapidly in the last few years, and now have 75 locations globally, with varying cold-chain capabilities in each," he told *Airports International*. "We also have several new warehouses in development



The cooler of two large-scale cooling warehouses at VIE offers storage at 15-25°C *Vienna International Airport*

> **You might think beer and chocolate were the biggest exports from Belgium, but it's actually pharmaceuticals**
> *Samuel Speltdoorn, Brussels Airport*



One billion COVID-19 vaccines were shipped through Brussels Airport between November 2020 and March 2022 *Brussels Airport*



to cater to market demand, and always include cold-chain requirements in the initial development stages to make sure they benefit from the optimum position to maintain the desired process, and have the necessary power supply."

Envirotainer is a leading supplier of active cold-chain solutions, meaning it offers electronically-controlled cooling systems or dry ice in its containers (passive solutions are insulated boxes with no active temperature controls). It has also seen demand rise, as COO Niklas Adamsson observes. "Our fleet covers more than 2,000 pharmaceutical trade lanes in more than 100 countries and 300 airports, and we're looking to increase our fleet of 7,500 containers by another 1,300 in 2023," he said. "Recent innovations have included the new CryoSure station in Singapore, offering ultra-cold transportation for medicines at -70°C. We have CryoSure dewars, or vacuum flasks, perfect for storing clinical trials, vaccines, biospecimens, and more."

New technology

As well as the equipment required to make a cold-chain system effective, the technology used can also improve efficiency. "It's important to seamlessly document all cold-chain processes, which we ensure with a comprehensive CCTV and sensor system, as well as our new cloud data system," Vienna Airport's Michael Zach told us.

For Samuel Speltdoorn at Brussels Airport, new technology is being considered as a way to increase its offering. "Cell and gene therapy is something we could be moving into, as an extension of our work with the pharmaceutical companies," he said. "We have to understand the needs of transporting these advanced treatment sets, as it's not a generic treatment like we're used to, and it'll be a case of dealing with smaller incubators. So we're advising on the type of packaging, or what traceability might be needed."

Menzies Aviation's Alan Glen is always looking to technology to make improvements to the existing processes. "As an industry, we need to take advantage of technology to continuously monitor temperatures in shipments," he says. "This would require data-sharing between parties, and while we're making progress, there's still some way to go before it's the norm."

At Envirotainer, technology is used to make more efficient storage. "Our most advanced container, the Releye, launched in 2021, and was created with control, monitoring, autonomy, value and sustainability in mind," said Niklas Adamsson. "We're talking giant, battery-powered, insulated units, with up to five pallets of pharmaceuticals loaded into them, maintaining a constant internal temperature for up to a week."

Lödige Industries is also making good use of the latest technology, from automated vehicles to state-of-the-art storage systems, in its latest

Cloud and proud

Cold-chain cargo providers and airports are increasingly using cloud technology to increase the transparency, efficiency and competitiveness of their services. Brussels Airport even offers its own cargo system, BRUcloud, and its applications, to other airports as a revenue stream.

Similar is happening at Vienna Airport. "Since the end of 2021, our Vienna Airport Pharma Handling Center has been able to upload all relevant data to an internet cloud," said the Austrian hub's vice president of sales, finance and cargo, Michael Zach. "This facilitates documentation, and enables a transparent overview, which optimises the planning and analysis of our customers' cold chains."

Likewise, Menzies Aviation has teamed with a provider called Wipro. "It's part of a new warehouse management system, architected using cloud-native technologies," explained Menzies' Alan Glen. "It enables the end-to-end digitalisation of our operations, process standardisation, and enhanced employee experience, which is hugely important in attracting a new generation of cargo professionals. Our customers benefit from the increased transparency of cargo status, the use of automation to speed up processes, and enhanced safety and security procedures. It will also enable us to adopt future technologies with ease."

For Envirotainer, the transportation of pharmaceuticals is a highly-regulated and sensitive operation, so involving the cloud gives customers more control and reassurances. "They want monitoring to ensure there is no temperature deviation, no tampering with their cargo, and to assist with investigations," said COO Niklas Adamsson. "They also need autonomy, to allow for delays and challenges, with an air freight system under pressure. We have our cloud-based Control Tower assisting a global team of operators."



The largest of the new-generation Releye containers, the Releye RAP holds five Euro pallets *Envirotainer*



Menzies continues to develop its air cargo services operations globally and is focusing on achieving CEIV Pharma certification across its bases *Menzies Aviation*



The Releye RLP container features integrated live monitoring which enables a unique insight into product condition, location and progress of the shipment *Envirotainer*



The pharma logistics at Vienna are directly connected to land and air facilities, including very short tarmac distances to all aircraft positions *Vienna International Airport*

cargo terminal designs. "These can independently and flexibly connect different areas, such as import/export and build-and-break work zones," said Björn Ussat. "Depending on the size and level of the automation required in the cool storage area, we make use of various roller decks, conveyors or transfer vehicles for transport, as well as storage and retrieval systems."

"AGVs, for example, can independently and flexibly connect different areas, such as import/export and build-and-break work zones, providing an automation solution for areas of all sizes," he added.

Going green

Cooling systems can be quite energy-intensive, so is there a way to make the cold-chain processes as sustainable as possible? "We're always looking to make our operations throughout the airport more environmentally-friendly, not just our cold-chain facilities," explained Vienna Airport's Michael Zach. "Last year, we commissioned the largest photovoltaic (PV) system in Austria, converting sunlight into electrical energy, which will cover all of the energy demands of the airport. Our fleets of airport vehicles are being converted to run on electric, and we use LED lamps and energy-efficient building insulation. Since 2012, the airport has already reduced its carbon emissions by around 85%."

The story is similar at Brussels Airport, where environmental upgrades are not limited to cold-chain facilities. "We're electrifying our vehicle fleets, and looking at hydrogen energy," said Samuel Speltdoorn. "And we have a lot of old buildings from the 1970s and 1980s that need upgrading, with better insulation, and a change over from fossil fuels, using more solar panels. Optimising processes, with monitoring, using digitalisation and IoT [Internet of Things], will also help our carbon footprint."

Alan Glen at Menzies Aviation agrees that this is not purely a cold-chain issue. "Yes, cold rooms can use a lot of energy," he said, "and we do have facilities where solar energy is utilised. But monitoring demand is also important, so we don't have cold rooms sitting empty, using energy unnecessarily."

Niklas Adamsson at Envirotainer has other ideas. "Is it possible to use packaging with a lower environmental impact?" he asked. "Keeping a pallet of treatments at low temperatures for an entire journey



Air services provider dnata recently commissioned Lödige Industries to develop a new cargo terminal at Amsterdam Airport Schiphol *dnata*

> **As an industry, we need to take advantage of technology to continuously monitor temperatures in shipments**
>
> *Alan Glen, Menzies Aviation*

traditionally requires lots of single-use plastics and coolants. Choosing to work with partners that prioritise sustainability can also make a difference."

Addressing the challenges

Clearly an efficient cold-chain model, transporting vulnerable goods as seamlessly – and ideally, as sustainably – as possible is the goal for all involved. But what challenges can arise, and how are they dealt with? "Planning and implementation is always key, and with Vienna Airport operating both its own cargo handler and pharmaceutical centre, it reduces the margin for error, as everything stems from a single source," Michael Zach said. "We have lots of handling and storage capacity, so there are no traffic jams or delays that could affect the handling of temperature-sensitive cargo.

"It's always a real test of a good logistics infrastructure in the headwinds of global events, such as the pandemic or the war in Ukraine. During COVID-19, we adapted quickly, with many additional cargo flights, and even spontaneous charter flights, with the handling of temperature-sensitive goods running without delays. With the war in Ukraine, you can get sudden cargo cancellations to Asia at short notice, as Russian carriers like Air Bridge Cargo have suddenly dropped out, but we've managed to adapt to this too."

The situation in Ukraine has had similar repercussions at Brussels Airport. "Some airlines – which flew in from Japan across Russia – have temporarily dropped out," said Samuel Speltdoorn. "But currently, there's also a general global market decline, with buying power a little weaker in the wake of the pandemic. This can be taken advantage of, though, as a time to reassess, develop new processes, and prepare for the market picking up."

Niklas Adamsson at Envirotainer talks about the specialist nature of cold-chain equipment, and states one of the challenges as ensuring staff fully understand the task at hand. "We provide our Academy courses to educate and train operators on best practice for the safe delivery of pharmaceuticals," he explained. "This is something offered free of charge, and our programme has a long tradition, helping thousands of cold-chain stakeholders, from ground handlers to manufacturers, develop their skills to meet the requirements of an increasingly-demanding regulatory landscape."

Adamsson also highlights the growing demand, and the logistics involved in meeting it, as a challenge in itself. "Medicines are needed everywhere around the world, and so are our temperature-controlled containers," he added. "We have more than 60 stations across the globe to cater to customers in need of a secure transportation of temperature-sensitive pharmaceuticals. In general, people favour bigger, better solutions, cost-effective and sustainable, and these are the factors driving the market."

And, of course, there is Ukraine presenting its own share of difficulties. "When the conflict escalated in 2022, many shippers were caught off guard," admitted Adamsson. "As a result, cargo hubs experienced congestion, as shipments were stopped by embargoes, bans and reduced services. Rerouting ✈

Efficient storage

Cold-chain cargo systems at airports need effective storage solutions, not only capable of maintaining temperature-sensitive goods but managing to deliver and retrieve items as quickly and seamlessly as possible, as even just the slightest delay or exposure to the wrong temperatures can render the products worthless. For this reason, airports are always looking to upgrade their pallet systems to the latest, most efficient designs.

Lödige Industries was recently tasked with creating a new cargo terminal at Amsterdam Airport Schiphol on behalf of air services provider dnata, set to become operational next year, as well as an automated cold chain pallet-cargo system at Hong Kong International Airport. "From special temperature-controlled truck docks and dolly docks, to electrically-driven transport systems for containers and pallets, such as the slave pallet mover, to workstations that allow the ergonomic build-up and break-down of cargo, these are both typical of the wide range of systems we offer for handling and transportation in a fully temperature-controlled environment," the company's Björn Ussat explained. "Automated guided vehicles (AGVs) can also be integrated for completely automated ULD transport."

Secure cold-chain solutions provider Envirotainer developed a world-first with its Releye RAP containers, which hold five Euro pallets. With their increased efficiency and capacity, the containers help to reduce the carbon emissions per shipment.

Brussels Airport has also been looking to improve its capacity and efficiency. "We have automatic ETVs (Electric Track Vehicles) and pallets, which transport the pharmaceuticals into a waiting system, ready for flights," said the airport's Samuel Speltdoorn. "We're always trying to optimise our processes."



Cautious optimism seems to be the mood of the day among cold-chain cargo stakeholders *Philadelphia International Airport*

cargo that was already in transit was also a challenge, because the packing and labelling requirements for the Russian market are very different from those in most other places.

"The economic war between the West and Russia as a result of the invasion has further complicated matters for the air cargo sector, as we now have air-space restrictions. Because civilian flights over Ukraine are not allowed, and airlines are avoiding Russian air space, freight rates have increased considerably. However, now that the initial shock is over, we are seeing prices slowly returning to normal. Nevertheless, shippers still have to take alternative and longer routes, which means that the cost of fuel remains high."

Seeing potential

As exciting as the cold-chain logistics market seems to be at present, with ever-increasing demand and plenty of opportunity for airports, stakeholders need to bear in mind the various challenges. This includes those within their control, such as forging close relationships with customers and investing in the latest technology, and those outside, including global events, not least the war in Ukraine.

Providers and airports should also gauge the market carefully. Recent reports suggest that available air cargo capacity increased for the 11th consecutive month in February, surpassing 2019 levels for the first time, just as the actual demand dropped 4% year on year, with shippers looking for cheaper modes of transportation. This reflects Samuel Speltdoorn at Brussels Airport's comments that any slowdown can be used to prepare for the market's return.

Regulations, as with the different requirements between locations, should also be carefully considered. But overall, there could be ample potential for airports and providers when it comes to cold-chain cargo. Very cool indeed. AI



The Releye RLP30000PC can monitor door openings, inside and outside ambient temperature, and humidity *Envirotainer*

> **People favour bigger, better solutions [that are] cost-effective and sustainable, and these are the factors driving the market**
>
> *Niklas Adamsson, Envirotainer*

Sofia opts for Alstef BHS



Alstef Group has signed a €10m deal to supply, install and maintain a baggage handling system at Sofia, Bulgaria's main international airport. The deal was agreed by Alstef Group CEO Nicolas Breton and Sofia Airport CEO Jesus Caballero (pictured, left to right).

The updated baggage handling system (BHS) will offer both self-service and agent-assisted check-in. The new technical solution is 70% more efficient than the current one and is fully managed by Alstef Group's BAGWARE software control solution. With the commissioning of the new BHS, Sofia's Terminal 2 will have a significantly higher passenger capacity.

Together with the replacement of the baggage system, the airport will also begin reconstruction of the check-in area in Terminal 2. In the coming months, the number of check-in counters will be doubled and the units will be relocated to increase passenger comfort.

The implementation of the new systems is in line with both the pace of traffic recovery and the airport's development plans. This means that, following the redevelopment, Terminal 2 will be able to accommodate diverted traffic from the nearly 70-year-old Terminal 1.

"The baggage management system is key to how the airport operates," said Caballero. "We're buying a state-of-the-art technology solution that will make us faster and more efficient, and that will benefit our millions of passengers. The project is part of the airport's overall transformation, in which we will have invested €76m by the end of 2025."

Multi-year NEOM contract for AECOM

Infrastructure consulting specialist AECOM has been awarded a multi-year contract to provide project management consultancy services for the new NEOM International Airport (NIA), located 48km from Sharm El Sheikh International Airport in the north west of Saudi Arabia.

AECOM's scope of activities will include project management for masterplanning, design and construction services right through to testing, commissioning, operational readiness, activation and transition (ORAT).

"We are very pleased to be part of this innovative NEOM project, which is set to transform travel between NEOM and the rest of the world," said AECOM president Lara Poloni. "Our track record in delivering large scale infrastructure projects in the region, as well as our mobilised global aviation resources and project management experts, will help ensure the successful delivery of NIA."

Hamed Zaghw, chief executive of AECOM's Middle East and Africa region, said: "We are delighted that AECOM will be adding another chapter to its relationship with NEOM. This contract is a testament to our leadership position in the region and to our continuous commitment to NEOM and the goals of Saudi Arabia's Vision 2030."

Siemens signs deal for Hefei Xinqiao T2



VarioStore, Siemens Logistics' early bag store, will have a 700-space storage capacity at Hefei Xinqiao
Siemens Logistics

Germany's Siemens Logistics has won an order to equip a new baggage handling and sorting system for the new Terminal 2 at Hefei Xinqiao Airport in the capital of Anhui Province, China.

With a scope of supply encompassing the VarioTray technology, the VarioStore early bag store and the intelligent BagIQ software, the company will make a key contribution to the airport's planned capacity expansion to around 30 million passengers a year.

Michael Schneider, CEO of Siemens Logistics, said: "With our high-performance products and solutions, we are generating significant added value for our customers. A prime example is Hefei Xinqiao Airport, where we are installing a state-of-the-art baggage handling system with a sophisticated control. These technologies will enable the airport to meet the growing demand for travel in the region and beyond."

Hefei Xinqiao Airport processed almost nine million passengers in 2021. To help it cope with increasing passenger numbers and the corresponding baggage volume now and in the future, Siemens Logistics will install its VarioTray handling system. The VarioTray TilterPlus component, which can route bags in three directions, will be used for seamless sorting. To further optimise the overall energy consumption of the system, variable-frequency drives will also be installed.

In addition, Siemens Logistics proposes integrating VarioStore, a modern early bag store (EBS) with a storage capacity of 700 spaces. The EBS will improve the transfer baggage process and enable passengers arriving at the airport to check in early. The BagIQ high-level control software, which guides luggage through the system, will manage baggage flow, in addition to co-ordinating data within the airport ecosystem, improving process transparency.

Siemens Logistics Automation Systems (Beijing) will be responsible for the project execution.



Keeping it cool

Airport operators need to keep their runways in prime condition all year round, whatever the weather. **Mark Broadbent** reports on the technologies and materials helping them

The impact of climactic extremes on airport infrastructure was obvious in July 2022, when record high temperatures in the UK caused damage to the runway at London Luton Airport. With the mercury on the thermometer rising above 37ºC, a small section of asphalt became so hot that it de-bonded and began to lift. The runway was closed for two hours while a repair was carried out, leading to departure cancellations and arrival delays.

Bachar Hakim, director of roads asset management at infrastructure consultancy AECOM, told *Airports International*: "Runways are the most valuable airport assets. This is particularly the case for single runway airports, such as most UK facilities. They must be maintained in a safe and sustainable condition throughout their entire lifecycles to provide continuous operation. Premature failure can lead to unexpected repairs and traffic delays, negatively impacting an airport's costs and reputation."

Effective surfaces

Hakim outlined the issues facing airports: "Runway pavements are designed to provide a durable structure with appropriate surface friction to carry aircraft loading and account for environmental variations. Pavements can be broadly classified into flexible (asphalt) and rigid (concrete).

"The most effective surfacing solution should be designed to account for multiple parameters, including temperature. Different asphalt mixtures and hydraulically bound materials are used in runway pavement construction, with consideration given to ground condition, traffic loading, environmental variations, materials availability and local construction practices, as well as capital and whole life costs, sustainability and users' costs in terms of runway availability during maintenance.

"Asphalt mixtures can be specified with appropriate aggregate gradation and binder properties, content and modifications to provide deformation and fatigue resistance. Concrete slabs are commonly used at runway ends to mitigate the risks of asphalt deformation under slow moving/stationary heavy aircraft in hot weather and poor fuel resistance. However, rigid pavements have higher construction costs. With the recent increase in temperatures and intensity of rainfall, climate resilient infrastructure should also be considered in the design."

Temperature change

All asphalt contains bitumen, a by-product of refined crude oil. Speaking to *Airports International*, Dr Greg White, director of the Airport Pavement Research Program at the Centre for Pavement Engineering Education – part of the University of the Sunshine Coast in Melbourne – pointed out how temperature extremes are not in themselves problematic.

White explained: "If everything is cold all the time, that can be accommodated. If everything is hot all the time, that can be accommodated. It's when there are big swings from summer to winter that things become difficult, because it's hard to make a single product that will cover the full spectrum. In my experience, the UK is not that variable from summer to winter. What happened [at Luton] last summer was a bit of an anomaly, I think, and you're not regularly getting below zero in winter."

White pointed out that many regions of the world are accustomed to big changes

in temperature: "There are parts of North America – Canada is a great example – where they get 35ºC in summer quite frequently and –30ºC in winter. Their swing is far bigger. Australia gets 40ºC in summer, but we rarely get zero in winter.

"Deserts are the other places that have big swings. They have the heat of summer, but they can reach sub-zero in winter because there's no insulation. Coastal areas usually have lesser swings than inland areas, so because the UK is coastal it's better off in terms of a smaller swing."

Temperature variance means the appropriate paving material changes depending on an airport's location. White said: "If you took an Australian pavement and put it in Germany or North America you might get cracks in winter because they're not engineered for that."

Even in Australia, though, unusual weather can cause problems: "If you have a few days in a row where things don't get to cool down and the heat builds and builds, you start to push the envelope." This applies to all paving in critical transport infrastructure, including roads, not just airport runways.

AECOM's Bachar Hakim noted: "Two main factors contribute to pavement deterioration: environmental effects and traffic loading. The environmental variations include temperature, which causes asphalt rutting in hot weather and cracking of the age-hardened brittle asphalt, as well as concrete wrapping and thermal cracking. Seasonal changes in foundation condition due to moisture and freeze-thaw action can lead to further damage. The designer should consider the expected temperature and moisture variations at the airport site during construction and life cycle when designing the pavement and materials."



The material used in airport runways and taxiways varies from location to location *AECOM*

BBA and its benefits

In the 1990s, a high-performing asphalt called BBA (béton bitumineux pour chaussées aéronautiques) was introduced in France and has increasingly been used in runway construction in Europe.

Civil engineering firm Colas has used BBA-spec asphalt in various resurfacing projects since 2005, including Manchester, Birmingham, East Midlands, Jersey, the Isle of Man, Southend and Sumburgh airports. In a case study, the contractor identified various benefits of the material: "The coarse surface texture and high friction characteristics of BBA negate the need for grooving, saving time and allowing aircraft [on the surface] as soon as it has been compacted and cooled.



In the 37ºC heat of July 2022, a small section of asphalt on the London Luton Airport runway became so hot it de-bonded and began to lift *London Luton Airport*



Maintenance should be a key consideration in runway construction *Dubai Airports*



"The material is able to demonstrate the required surface friction characteristics, reduced deformation and fatigue, and offers a longer lifespan than alternative materials. BBA can be laid as binder course due to its high wet friction properties. This enables aircraft to land on a BBA binder course and use it as a temporary operating surface during runway rehabilitation/maintenance work."

BBA can be laid at thicknesses of 15% less than asphalt, so less aggregate is required. Colas said the material has been shown to "produce comparable pavement strength and durability at a reduced layer thickness when used in combination with stiff asphalt base.

"Time and cost savings can be realised as BBA is easier to mix and can be manufactured at far greater output rates than traditional asphalt. Higher outputs also reduce the number of joints which, in turn, lowers whole-life costs. Un-grooved BBA negates the risk of premature groove closures, minimising maintenance requirements."

However, materials should not be the only runway design/build consideration, according to Hakim: "The designer should consider materials availability, project sustainability, local construction practices and environmental conditions in selecting the pavement type."

A range of performance requirements – durability, skid resistance, quality control, monitoring and future maintenance – should also be taken into consideration, Hakim stressed, telling *Airports International*: "The pavement designer should assess solutions for the expected performance, traffic loading and environmental condition, considering sustainability, climate resilience, whole life cost and user's cost."

Data collection

Big data is leading to some potentially exciting new opportunities for asset monitoring. Although still in the relatively early days of its development, eye-catching developments for runways include embedding data monitoring technologies in the surface, using 'self-healing' asphalt and concrete, as well as harvesting energy from aircraft friction and using pollution-absorbing materials.

AECOM's Centre of Excellence for Pavement Asset Management in Nottingham is working on these areas of innovative design to help improve costs and sustainability. The centre has a whole-life approach, encompassing design, specifying materials, quality testing during construction, surveying and monitoring existing pavements to assess performance, asset management, deterioration modelling, treatment prioritisation, and research and development into updating/rewriting design standards.

At Hong Kong Airport, the AECOM team recently developed a stone mastic asphalt specification for taxiways, investigated cracking on the north runway pavement and undertook a feasibility study on the use of reclaimed asphalt pavement materials in runway foundation layers.

Learning from other sectors

Hakim thinks airports can take on board lessons from other transport industry sectors: "We can learn from the highway industry, where new and innovative asphalt, concrete and composite



Concrete slabs are commonly used at runway ends to mitigate the risks of asphalt deformation under slow moving/stationary heavy aircraft in hot weather *AECOM*



Pavements can be broadly classified into flexible (asphalt) and rigid (concrete) *AECOM*



Different asphalt mixtures and hydraulically bound materials are used in runway construction, based on ground condition and traffic loading *AECOM*

constructions, low carbon and recycled materials are considered.

"End-product performance specification, commonly used for major highway pavements to ensure the design assumptions are met during construction, can be considered. However, runway performance expectation of durability, friction and safety, such as foreign object debris damage and associated risks, should also be assessed.

"Asphalt pavement with appropriate mix design and polymer modification can offer a cost-effective sustainable solution. Reinforced/unreinforced concrete pavement can offer durable low maintenance, but has high capital/construction cost."

The Centre for Pavement Engineering Education's Dr White highlighted the use of recycled materials in asphalt: "Instead of producing from scratch a polymer to put into the bitumen to make it better, you can put in recycled waste plastic to improve its performance, particularly in high temperatures."

Epoxy modifiers are another innovation. Dr White explained these are similar to polymers, but rather than using plaster-based chemicals, they use epoxy material. "[They are] good at providing very hard, robust materials," he said, because they do not have much built-in flex, making them well suited to applications such as bridge decks. They are expensive, but they do extend lifespans so may be something worth considering in the future.

Dr White agrees that future airport paving innovations are likely to follow the lead set by other transport sectors: "Although they don't carry the same types of loads [as runways], highways have to deal with the same kinds of issues. If the world got so hot that bitumen needed to be changed to function and perform in the way it needs to, that would apply to roads almost equally.

"Even though there are different outcomes and requirements, most of the principles and science of different pavement types would be most likely led by the road and highway people – airports would learn from that." **AI**



The most effective surfaces vary according to different parameters, including temperature, ground condition and traffic loading *Dubai Airports*

ADM targets YUL single-use plastic

ADM Aéroports de Montréal is to phase out certain single-use plastics in concessions and VIP lounges at YUL Montréal-Trudeau International Airport.

The policy, which applies to food and beverages packaged in concessions-owned kitchens, is part of ADM's sustainability goals to achieve a 70% recovery rate by 2025 and zero waste by 2030.

It covers items such as utensils, food containers, cups and bags.

"ADM is more committed than ever to operating its business and facilities in a sustainable manner," said Philippe Stas, vice-president, services and business operations, ADM Aéroports de Montréal. "The implementation of this new policy will reduce the amount of residual material sent to landfills, reduce contamination of recovery channels and improve the recovery rate of waste at YUL.

"This is obviously a transition that requires adaptation, but the mobilisation of our airport community around this issue is clear and we thank all our partners who have complied with this new policy or are in the process of implementing solutions to do so." Waste management is a priority area for ADM.



ADM aims to cut the amount of residual material sent to landfill by YUL food and beverage concessions *Lisa Müller / EyeEm*

The airport authority has been actively working with its concession partners and VIP lounge operators for several months to make this transition as efficient and quick as possible. The new policy also dovetails with the City of Montréal's ban on certain single-use plastic items in restaurants and food stores in the metropolitan area, the authority said.

Inverness to offer continuous SAF supplies



There is ongoing demand for sustainable aviation fuel at Inverness Airport *HIAL*

Airports operator HIAL (Highlands & Islands Airports Limited) has begun offering sustainable aviation fuel (SAF) at Scotland's Inverness Airport.

The cleaner fuel product is supplied by World Fuel Services as a 35% blend and is available to all flight operators at the airport.

HIAL's ambition is to become a net-zero regional airport group and it is committed to providing a continuous supply of SAF at Inverness Airport, where there is an ongoing demand beyond previous supplies for one-off events or trials.

The Scottish airports operator has taken several steps towards understanding and reducing its carbon emissions, and undertakes annual carbon footprint calculations. Initiatives already introduced across the group include solar powered passenger boarding ramps, and 100% electric or hybrid Ground Power Units (GPUs).

The group has also replaced a number of large fire-fighting appliances with smaller equivalents that provide 30% fuel savings and require less diesel consumption.

HIAL managing director Inglis Lyon said: "At HIAL we are committed to reducing our environmental impact. As an operator of 11 airports, it is important to work with aviation partners to decarbonise flights within Scotland, and SAF will play a vital role in helping meet the Scottish government's target to create the world's first net-zero aviation region by 2040.

"The offering at Inverness Airport takes us one step closer to meeting our sustainability goals. Making SAF available at Inverness will hopefully be a catalyst for its wider introduction across the Highlands and Islands, giving those flying in and out of our airports real choice to support decarbonisation and sustainability goals."

FAA prioritises **ATC tower sustainability**

The Federal Aviation Administration (FAA) has selected a sustainable design for new air traffic control towers that will be used primarily at municipal and smaller airports in the US.

The design – by Practice for Architecture and Urbanism (PAU) of New York – meets key sustainability requirements and means that the tower height can be adjusted to meet each airport's traffic and sightline requirements, while also reducing construction and operational costs.

Key sustainability elements incorporated in the design include all-electric building systems; materials and products free from chemicals known to pose health risks; a thermally efficient façade; ground-source heating and cooling in some environments; and high-recycled steel and metal products; and the use of renewable mass timber where possible.

US Transportation Secretary Pete Buttigieg said: "These new air traffic control towers will mean that smaller airports can handle more flights, more sustainably and more affordably.

"I look forward to seeing this design go from the drawing board to construction sites across the country, helping our nation's airports support more travellers, grow their local economies and prepare for the future of low-carbon aviation."



The height of the new towers can be adjusted to meet traffic and sightline requirements *Federal Aviation Administration*

The FAA's specifications for the design included standardised elements to reduce construction and operational costs while allowing the building to be tailored to local climate and location issues such as very high and very low temperatures, wet and dry environments and high winds.

The initial set of 31 control towers will replace towers that are functioning beyond their intended design life. The new towers will range in height from 60 to 119ft.

The FAA has set aside more than $500m from the Bipartisan Infrastructure Law to support site evaluation, preparation and early construction work. The first groundbreaking could begin next year.

PIT opts for **electric**



PIT will receive funding in excess of $1.4m to purchase electric buses and a charging station *adventtr / Getty Images*

Pittsburgh International Airport (PIT) is to introduce electric shuttle buses and an additional electric vehicle charging station for travellers.

The Federal Aviation Administration (FAA) selected PIT for its Zero Emission Vehicle (ZEV) grant programme. The airport will receive more than $1.4m towards the purchase of two electric shuttle buses and a direct current fast charging station for its Terminal Modernization Program. The grant has been ratified by the Allegheny County Airport Authority board of directors and PIT is working with the FAA to finalise plans for the electric buses.

The new electric shuttles will reduce carbon emissions while adding capacity to the shuttle bus fleet that transports travellers between the parking areas and the Landside Terminal, the authority said.

The new rapid charging station, which is expected to open along with the new terminal, will add to PIT's current 15 charging stations available for travellers using electric vehicles; five are located in the short-term parking garage and ten in the long-term parking zone.

The award is the first non-core aviation federal funding received by PIT for sustainability efforts.

Appoin

The latest personnel cha

Manship named Vanderlande CEO

Airport solutions specialist Vanderlande has appointed Andrew Manship as its chief executive officer, effective from January 1, 2024. Manship will succeed current CEO Remo Brunschwiler.

At the present time, Manship is Vanderlande's executive VP BU Airport & Parcel Solutions. He brings a strong customer-driven focus to his new role, as well as a deep understanding of Vanderlande's business strategy, activities and global markets. He has been with the company since 2016 and has successfully merged Vanderlande's airport and parcel businesses. According to the company, Manship also brings a wealth of experience within the automated material handling industry and a track record of delivering added value to customers in highly competitive markets.

Norio Wakabayashi, chairman of Vanderlande's supervisory board, commented: "We are convinced that Andrew is the best candidate to lead Vanderlande through its next phase of growth. He has successfully expanded the global airport business for the company and realised valuable portfolio synergies with the parcel business. Vanderlande will continue to benefit from his visionary industry expertise and unwavering customer focus, reinforced by his value-driven ethos."



Shannon beefs up board

Two new directors have joined the board of The Shannon Airport Group, both appointed to serve for a three-year term by Eamon Ryan, Ireland's Minister for the Environment, Climate, Communications and Transport.

Aisling Curtis is an organisational leader with more than 20 years' experience in the telecommunications and technology sectors including global, regional and Irish market roles. She is currently strategy and sustainability director at Microsoft, and has held non-executive roles in the UK, the Netherlands and South Africa.

Prior to founding Limerick-based RHH International, John Moran was secretary general at Ireland's Department of Finance. He is well known for championing SMEs and advocating for more balanced regional and sustainable development in Ireland. Until recently, he was chair of the Land Development Agency and has been a board member of the European Investment Bank, a Commission member of the Central Bank, and CEO of Zurich Bank and Zurich Capital Markets.





Mary Considine, CEO of The Shannon Airport Group, said: "Our new directors will be a great asset in assisting us as we continue to deliver on our strategic vision, which we hope can further grow our impact and benefit even more people in the region and beyond."

tments

nges from across the global airport industry

Harrison to drive PHL workforce development

The City of Philadelphia Department of Aviation, operator of Philadelphia International and Northeast Philadelphia airports, has appointed Chevelle E Harrison director of workforce development. She has 29 years' experience of working with the City of Philadelphia.

Harrison will be responsible for overseeing the airports' Bridge Program, an initiative that creates internal/external pipelines and career mapping pathways for employees and jobseekers. Harrison's remit also includes directing programmes for reskilling and upskilling employees to staff-critical and hard-to-fill positions, employee retention and succession planning.

"Chevelle has been successful in establishing programmes that create opportunities for individuals with a variety of skills and life experiencess," said the Department of Aviation's chief administrative officer, Delicsha Wilds. "She has also been instrumental in growing partnerships between her City departments and the community to provide local students with training for trades positions. Chevelle's experience is crucial to the airports as we work to strengthen our pipeline of candidates for mission-critical jobs."

Outside work, Harrison has also been actively involved with numerous organisations dedicated to developing opportunities for minority youths in the city, including the My Brother's Keeper initiative and the Philadelphia Youth Network.



New Brazil head for dnata

Global air and travel services provider dnata has appointed Phil McGrane chief executive officer (CEO), dnata Brazil. In his new role, McGrane will lead dnata's overall strategy and business in the South American country.

McGrane has worked with dnata for more than ten years. Since last July, he has overseen dnata Brazil's operations as acting CEO at 29 airports, managing a team of 5,000 local staff. In his previous position as chief commercial officer, he was responsible for leading all of the company's commercial activities, including business development and customer relations. He has worked for more than 30 years in the aviation and transport industries. Prior to joining dnata, he held various senior roles, supporting the commercial operations and growth of global companies in the USA, Middle East and Europe.

David Barker is dnata divisional senior vice president for airport operations. He said: "Phil's appointment is a reflection of our commitment to promoting from within and recognising the contributions and achievements of our high-performing colleagues."

In 2022, dnata acquired the remaining 30% stake to assume full ownership of dnata Brazil and has further plans to enhance its operations across the whole of South America.



Last Call



Waseem Al Rousan has been the IT director at Queen Alia International Airport in Amman, Jordan since 2018. Here, he shares his thoughts on the importance of customer-centric operations, technology investment and reaping the benefits of better understanding data

What is the biggest challenge facing airports today?

As we adapt to changing passenger behaviours and expectations — from safety concerns and related hygiene regulations to the increased demand for seamless and contactless travel experiences — modernisation strategies are becoming vital for airports seeking operational efficiency and healthy profits. Therefore, airports must increasingly invest in new digital solutions and contactless processes, while ensuring they are technically ready for these digital demands.

How can this be tackled?

Such challenges can be tackled through customer-centric strategies, which involve understanding the needs of passengers and ensuring each stakeholder within the airport ecosystem can meet them. Airports can leverage data-driven insights to optimise operational efficiency with an enhanced understanding of previously unseen passenger trends and behaviours. This will significantly improve engagement with passengers to provide a more convenient and personalised travel experience. Collaboration between airports, airlines, government agencies and technology providers will be the primary enabler for streamlining processes and implementing effective solutions.

What has the sector learned from the COVID-19 pandemic and the ensuing recovery period?

The industry now views technology and digital solution readiness as crucial. While this was accelerated by unprecedented circumstances, it's clear that the speed to embrace new solutions provided key benefits, from adhering to new hygiene requirements to bolstering the passenger experience. Another important lesson was the need for contingency plans to manage risk – these are often reliant on technology, too.

What have you learned?

I now realise the importance of understanding and accessing data anytime, anywhere, using tools in real time. Data insights offer airports the ability to build use cases, from pre-empting operational challenges such as adverse weather conditions to forecasting passenger behaviours and understanding financial trends.

What do you most want to see happen in the sector?

As traveller confidence returns, I'd like to see the acceleration of digital transformation efforts and the adoption of technologies such as artificial intelligence (AI), internet of things (IoT) and data analytics. Ultimately, I would like to see airports foster innovation and collaboration among the different stakeholders to drive meaningful change across the entire eco-system.

Which technology is likely to have the biggest impact?

AI has the potential to revolutionise many aspects of airport operations, including predictive maintenance and intelligent security screening, to create seamless and more personalised passenger journeys.

Which technology has had the biggest impact on your airport?

We've been leveraging Amadeus Airport Insights to obtain a better understanding of our operations, optimise resource allocation and make data-driven decisions. It has enabled us to identify trends, patterns and areas for improvement, resulting in enhanced operational efficiency and improved passenger satisfaction. The ability to integrate Airport Insights into other airport systems is really important, providing real-time analytics to drive performance improvements and enhance airport operations. **AI**



AI has the potential to revolutionise many aspects of airport operations *Ammar Eid/ Getty Images*

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