



AIRPORTS 2024 OUTLOOK:
RESILIENCE & ADAPTABILITY

LETTER FROM THE DIRECTOR

Welcome to the 2023 Airport Report.

Winston Churchill famously said never let a good crisis go to waste. The airport sector, it seems, is taking that adage to heart. From COVID-19, to the energy crisis to geopolitical strains, airports are taking on board the lessons learned from these major disruptions to drive change and transform their businesses.

Airports are putting into place masterplans and upgrades, in anticipation of increased traffic volumes. But rather than executing former plans they put on hold, they are now completely reevaluating their entire operations and systems in light of insights gained from the disruptions.

The sharp recovery that dominated 2022 caught many airports off guard and the sector is still working to restore passenger confidence. At the same time, it has forced airports to accelerate their digital transformations, as they seek to be less dependent on human resources, more in control of their operations and improve the

passenger experience. It is now airports that are driving innovations, including those that support their infrastructural sides.

For airports, this means improving the passenger experience while gaining shorter returns on investments. Accordingly, more airports are recognising the value of existing but previously unexplored technologies, such as self-bag drop, batch building, automatic baggage storage and automatic loading systems.

We are also seeing digital initiatives to enhance the passenger journey, such as Rome Airport's adoption of wayfinding technology and Düsseldorf Airport's systems indicating the fastest screening tracks. But passengers are also incentivising airports to improve their journeys by adopting solutions of their own, such as using air tags in their luggage.

In this context, what can we expect for the airport sector in 2024?

Recent geopolitical events, in tandem with significant developments in the digital world,

render cyber security at airports critical. This is reflected in new regulatory requirements that demand airports employ stronger measures in securing both their IT and OT (operational technology) networks. We devote a chapter to how airports should look to protect themselves as they advance into this new era of travel.

Pressure is on the airport sector from passengers and regulatory authorities alike to become more sustainable. We look at the issues that airports could potentially tackle in implementing their sustainability roadmaps. We also uncover some of the many initiatives airports worldwide are taking. We notice a shift in mindset as airports seek to embed sustainability in their ecosystems and expect their suppliers to provide innovations that help them meet their sustainability targets.

Finally, we note passenger expectations of personalised, flexible and on-demand digital travel experiences. Virtual interlining technology is one area in which airports are meeting this demand. We delve into the benefits these digital solutions will deliver for passengers, airlines and airports.

We hope our findings will give you useful insights to help strengthen your airport business in the year ahead. Enjoy.

Best wishes



Ronald Willems, Director, Airport
BEUMER Group

TABLE OF CONTENTS

CHAPTER 1:	#04	CHAPTER 4:	#20
Resilience amidst the turbulence: The airport industry right now		Improved interlining with virtual solutions	
> The current situation: A snapshot	#05	> Airsiders: A new model for interlining	#22
> The way forward	#07	> The advantages of a virtual interlining solution	#23
		> Virtual interlining in action	#23
CHAPTER 2:	#09	CHAPTER 5:	#24
How airports can improve their sustainability journeys		Insights into how airports are recovering their operations and dealing with macroeconomic volatility	
> The five issues airports can confront	#10	> Royal Schiphol Group, The Netherlands	#25
> Implementing sustainable strategies	#12	> Changi Airport Group, Singapore	#27
> Steps airports have taken to become more sustainable	#13	> Taoyuan International Airport, Taiwan	#29
CHAPTER 3:	#15	CONCLUSION:	#30
Cyber security at airports: Ensuring safety in a digital age			
> The need for heightened cyber security measures	#16		
> TSA's emergency security amendment	#17		
> ECAC's cyber security study group	#18		
> Implementing more robust cyber security measures	#18		



CHAPTER 1:

Resilience amidst the turbulence: The airport industry right now

The turbulent state of the global economy is now the main factor shaping the immediate future of the airport sector.

The world remains susceptible to impactful events such as ongoing global conflicts and other geopolitical disputes. Additionally, there is volatility in energy prices, surging inflation rates and an unprecedented high cost of living in numerous regions across the globe.

However, in the midst of these macroeconomic challenges, airports have demonstrated remarkable resilience and adaptability. This is evident as travel picks up pace and the resurgence of long-haul journeys becomes more pronounced.

The current situation: A snapshot

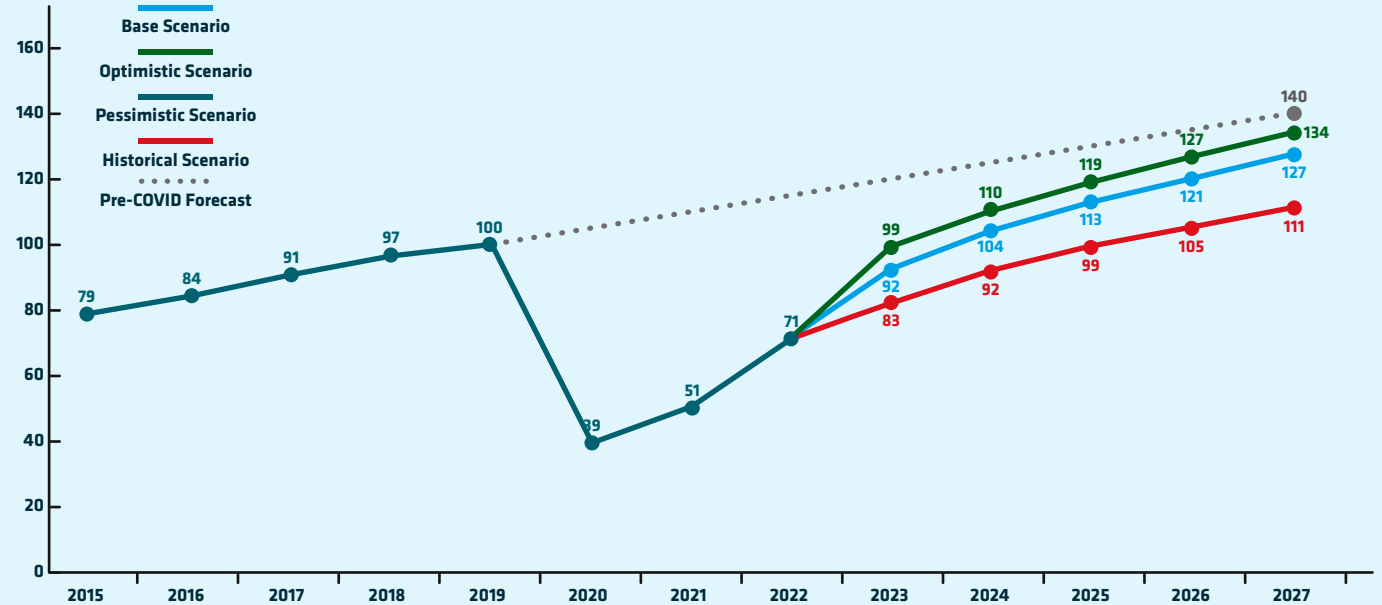
According to the [ACI's industry outlook for 2023](#), global passenger traffic experienced a significant rebound in 2022 due to the easing of travel restrictions and quarantine requirements.

THE THIRST FOR TRAVEL IS STRONG

A survey conducted by ACI World revealed that 86 percent of respondents expressed their intention to travel by air in 2023, marking the highest travel intention score since the start of the pandemic. In 2022, passenger volumes reached 72 percent of the levels recorded in 2019.

The forecast indicates that global passenger traffic will reach 92 percent of the 2019 levels by 2023 and a full recovery to the pre-

Medium-term global passenger traffic projection (indexed, 2019 = 100)



Source: ACI World

pandemic figures of 2019 is not expected to be achieved until 2024.

REGIONAL AND MARKET IMBALANCES

Recovery in passenger volumes continues to be inconsistent across global regions,

according to [ACI](#). The recovery of Latin American-Caribbean markets, for example, remained significantly greater than the Asia-Pacific region.

It is anticipated, however, that the re-opening

of Chinese borders will support the recovery of both the Asia-Pacific regional and global airport passenger traffic. China was historically the largest contributor to global passenger traffic growth prior to the pandemic and will no doubt play an important role in the recovery.

The recovery of various market segments also varied significantly. International passenger numbers reached 60 percent of 2019 levels, while domestic markets achieved 79 percent in 2022. As a result, the ongoing recovery is primarily fuelled by domestic travel, which is expected to reach pre-pandemic levels earlier than international travel.

RISING AIRFARES AND LESS DISPOSABLE INCOME

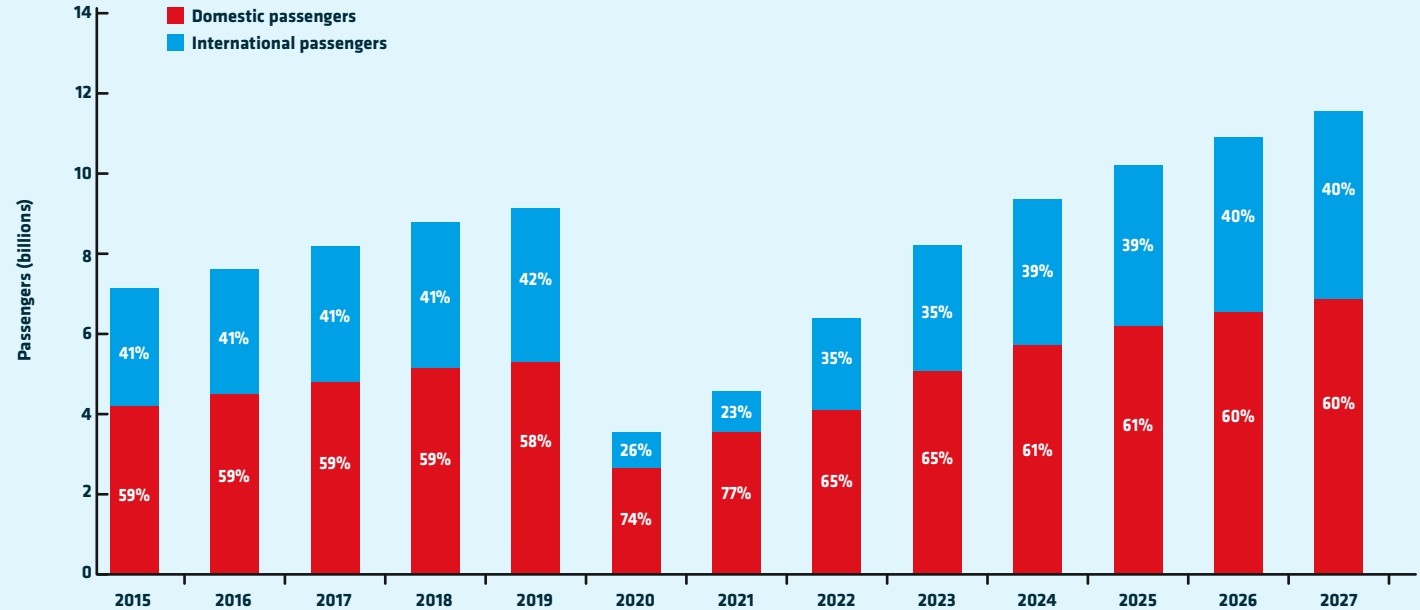
In late 2022, and continuing into 2023, G20 countries faced unusually high levels of inflation. Central banks globally responded by raising interest rates and implementing stricter monetary policies. Additionally, the surge in jet fuel prices and personnel expenses significantly contributed to increased airfares in 2022 compared to previous years. It is undeniable that the influence of prices and disposable income will play a **crucial role** in shaping air transport demand.

Even so, **IATA** noted that the robust demand for leisure travel in the first half of 2023 set the stage for a healthy rest of the year in many markets.

ENDURING HURDLES: VOLATILE PRICES AND SUPPLY CHAINS

The global **economy's fluctuations** have significant implications for the aviation industry. Economic slowdowns can reduce consumer and business confidence and lead to a decrease in travel demand. Moreover, inflation, increased interest rates and fluctuating energy costs can lead to higher ticket prices, thus making travel more costly for passengers.

Medium-term global passenger traffic by type (in billion passengers)



Source: ACI World

Supply chain disruptions caused by the global economic situation also affect various aspects of air travel, including the availability of essential resources, spare parts and maintenance services.

Source: [International Airport Review](#)

RESTORING CORPORATE MOBILITY

The demand for business travel is expected to experience a positive trajectory over the next two decades. This projected rise in business travel demand signifies the anticipated resurgence of corporate activities,

including meetings, conferences and trade events. Source: [Boeing Commercial Market Outlook 2022-2041](#)

The way forward

There are some further global trends we can see taking centre stage in the aviation industry that airports can benefit from.

PERSONALISING THE TRAVEL EXPERIENCE

Airports are increasingly tailoring their services and offerings to cater to different passenger segments, recognising that the needs and preferences of travellers vary significantly.

The aviation industry's dynamism fuels innovative business models, including passenger segmentation strategies. By targeting specific customer groups, airlines improve the passenger experience, satisfaction and revenue opportunities.

Source: Boeing Commercial Market Outlook 2022–2041

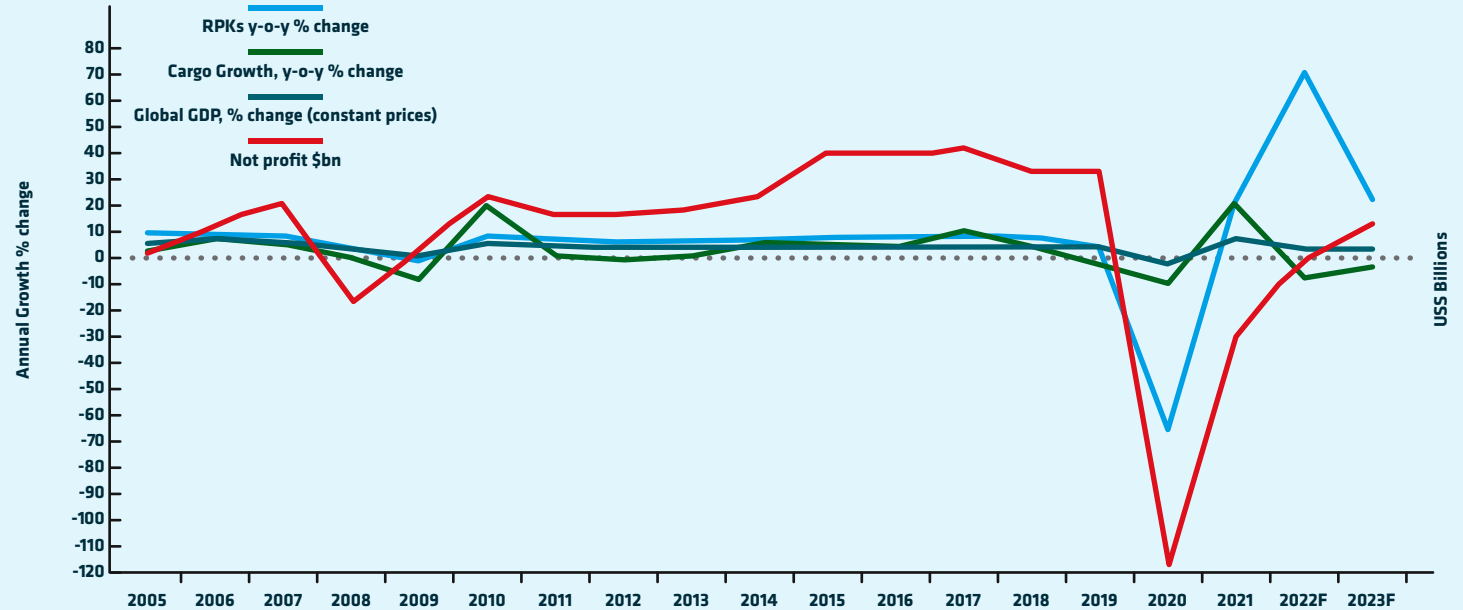
THE SOARING DIGITAL TRANSFORMATION

Airports are focused on improving the overall journey experience for passengers. Personalised and seamless navigation now start even before reaching the terminal. Artificial intelligence and smart algorithms are enabling personalised information delivery based on location, flight schedule, passenger characteristics, preferences and spending habits.

BAGGAGE TRACKING

Airports are making great efforts to enhance their baggage tracking systems, with technology playing a pivotal role in improving overall baggage handling operations. In fact, baggage tracking – alongside automation,

World economic growth, air traffic & airline profit growth



Source: IATA; International monetary Fund, World Economic Outlook Database, October 2022

robotics and sustainability – is now identified as **one of the key areas that will help transform the baggage experience** in 2023.

There have been noticeable improvements in baggage tracking, through the leveraging of advanced tracking technologies. Airports are

aiming to ensure better accuracy and efficiency in managing luggage and minimise the instances of lost or mishandled bags.

DIGITAL IDENTITIES

The growing demand from younger passengers for digital identities and convenience is

reshaping the expectations and requirements of airports. Today's younger generation, which is digitally savvy and accustomed to seamless online experiences, seeks efficient and frictionless processes when travelling. Airports are embracing digital technologies such as biometrics that offer convenience,

speed and personalised services throughout a passenger's journey.

Source: [Airport Technology](#)

CYBER SECURITY

Airports are increasingly recognising the need to enhance their cyber protection measures to safeguard critical systems and passenger data. The importance of this issue is further underscored by the amendment introduced by the [Transportation Security Administration \(TSA\)](#) that emphasises the need for robust cyber security practices within airports. Meeting the four major points of the TSA amendment and implementing an internationally recognised framework for Information Security Management Systems (ISMS) like the ISO 27001 are some of the steps airports are taking to enhance cyber security.

EMBEDDING SUSTAINABILITY INTO THE AIRPORT ECOSYSTEM

The aviation industry is striving to reduce its environmental impact and contribute to global sustainability goals.

But there is increasing recognition that the sector needs to be careful in its use of the term 'sustainable' and what it means by it. As the International Airport Review states in its report, [The Big Sustainability Issue](#):

"By sustainability we do not simply mean environmental concerns, but rather the wider, more metaphorical use of the word and what airports must do to future-proof and retain their licence to operate in the future."

Digitisation Area	Transformational Objective	Digital Transformation Benefits
Passenger journey	Maximise the time spent in shops and lounges vs. waiting in a queue for dropping luggage or getting a boarding pass	<ul style="list-style-type: none"> ➢ Push real-time travel information to passengers to help them anticipate changes to their journey ➢ Guide the passenger throughout his or her travel journey via a smartphone ➢ Increase the level of self-service to save time and avoid queues
Operational efficiency	<ul style="list-style-type: none"> ➢ Streamline processes to achieve better efficiency in ground activities, i.e., security, ground handling, runway and maintenance operations ➢ Reduce operational risks causing potential delays or incidents 	<ul style="list-style-type: none"> ➢ Automate ground activities, including luggage management and security checks with the potential for automated runway activities over the longer-term ➢ Automate proactive measures for irregular operations (caused by weather, political events, technology outages by carriers, etc.) with the right use of AI platforms. ➢ Monitor operations in real time to quickly deal with issues and anticipate incidents ➢ Optimise preventative maintenance leading to cost savings
Retail, ancillary revenue	<ul style="list-style-type: none"> ➢ Maximise revenues generated through travel retail ➢ Optimise the use of valuable space at the airports 	<ul style="list-style-type: none"> ➢ Proactively push commercial information to customers, e.g., special deals or tailored offers ➢ Optimise retail space to increase revenues, e.g., using digital walls to order duty-free products ➢ Introduce new retail possibilities, e.g., online orders and pick-up at the airport

Source: ISG

This means that airports need to integrate sustainability into their business strategies. They must also build climate-positive cultures throughout their ecosystems and educate and empower employees to understand the

importance of sustainability and their part in delivering it. Moreover, they need to ensure their airports and air travel are accessible to everyone.



CHAPTER 2:

How airports can improve their sustainability journeys

Without question, sustainability is a key theme for airports in 2023 and beyond, as their role in climate change and environmental degradation is subjected to closer scrutiny.

Sustainability in aviation is starting to reframe not just the opinions of governments, regulators and investors but the travelling public. Increasing numbers of concerned passengers are deliberately avoiding air travel, as borne out by 'flight shame', the concept coined by an anti-flying movement aimed at reducing the environmental impact of aviation.

It's imperative that airports, alongside airlines, implement the right strategies to meet their targets of being more sustainable. This means taking a wider look at the concept of sustainability.

The five issues airports can confront

But what is a sustainable airport? Aviation consultants, [Arup](#), state:

"The sustainable airport is much more than one that is protected from physical climate risks like extreme weather and rising sea levels. At a minimum, airports will have to tackle these five [issues] if they're to become truly sustainable."

Source: Arup

Royal Schiphol Group is one of the players in the airport industry displaying the issues that are central to their sustainability vision.



Source: Sustaining your world: Vision and strategy towards the most sustainable airports, Royal Schiphol Group, April 2022

According to Arup, these issues include:

1. ACHIEVING NET ZERO EMISSIONS

While the majority of aviation carbon emissions are caused by flying aircraft, airports need to reduce carbon emissions in their ground operations by switching to renewable energy and investing in both energy efficiency and energy storage. [Source: Arup](#)

Importantly, airports will need to reduce their surface access-related emissions – these accounted for 33 percent of Heathrow Airport's emissions in 2018, for example – by prioritising public transport. [Source: Arup](#)

2. DESIGNING AIRPORTS TO BE MORE PHYSICALLY SUSTAINABLE

Airports also need to embed circular economies in the design, construction and operation of their physical assets. This needs to come from a system-wide approach that anticipates reuse wherever possible. [Source: Arup](#) A key focus area here is reconciling asset life cycles with sustainable business practices and looking at the electronic waste that airports produce daily. [Source: Int'l Airport Review Advisory Board report](#)

3. ALLOWING AIRPORT GROWTH WITHOUT DAMAGING NATURE AND BIODIVERSITY

Arup states that:

"There is a growing expectation that airports commit to 'green managed growth' – the concept of setting limits to environmental impacts while continuing to grow economically."



'Green managed growth' requires airports to monitor and manage their impacts on noise levels, carbon emissions, surface access impacts and air quality and adopt offsetting measures with initiatives such as green roofs,

extra planting within their estates and improving local water bodies.

[Source: Arup](#)

4. CREATING HEALTHIER AIRPORTS

A sustainable airport takes a human-centred design approach to its infrastructure, operations and environment, making efforts to reduce light and noise pollution, improve internal air quality, introduce biophilic designs and encourage electric vehicles within their estates.

5. PLAYING A ROLE IN LOCAL COMMUNITIES

A sustainable airport can do more than just provide jobs; it can act as a hub for a range of technical, engineering and service skills by offering apprenticeships to those that lack conventional educational opportunities in its local community.

Implementing sustainable strategies

Having considered the ingredients of what makes an airport sustainable, airports need to then formulate their sustainability roadmaps. It can be valuable for airports to consider these approaches:

Holistic systems thinking: Meeting sustainability objectives will require airport leaders to work holistically across their common systems, rather than in departmental silos and disparate systems. Sustainability calls for **fresh ways of thinking** to capture the big picture.

Data and digital solutions: Relying on data and deep learning models can provide airports with essential insights across their ecosystems



into how and where they can reduce their carbon emissions. Through data-driven understandings, airports can achieve greater operational efficiencies which are estimated to save **up to 10 percent of aviation's emissions**. Using digital solutions, airports can be better placed to make informed decisions at every

level – whether it's predicting energy demand, analysing flight operations, reducing fuel consumption or shutting off baggage handling systems momentarily, based on throughput predictions.

Communication is key: It is crucial that airports

promote the positive transformations they are undertaking. With their data-driven insights, they are actually able to evidence their sustainability progress. But this will also mean **reconstructing their sustainability reporting strategies** in ways that enlighten and engage their stakeholders.

Steps airports have taken to become more sustainable

There is much evidence to suggest that airports around the world are responding to the demand for sustainability as they take the lead in pursuing a myriad of sustainable innovations and initiatives. We consider just a few of them.

SAN FRANCISCO INTERNATIONAL AIRPORT (SFO)

SFO is driving the sustainable airport objective. In 2016, it [embarked on a strategic initiative](#) to achieve zero net energy consumption. Its multifaceted plan aims to reduce energy use across its campus operations and supply the balance with 100 percent renewable energy.

One of its energy-reducing initiatives has been the implementation in 2020 of a high-performance, energy-efficient ICS BHS at its new [Harvey Milk Terminal 1](#). This and other energy-saving measures lead it to become the first airport terminal in the world to earn Platinum certification in the Leadership in Energy and Environmental Design programme (LEED) and the [Wall Street Journal's best airport of 2022](#).

SWEDAVIA, SWEDEN

In 2020, Swedavia became the [first in the world](#) to achieve carbon neutrality across its airports:

"From back-up airport generators to a fleet of 800 vehicles, all elements of Swedavia's network of 10 airports are now powered by renewable energy, eliminating 8,000 tons of fossil carbon dioxide a year from a decade ago when changes began."



↓ 50%

Our new baggage system halves our energy use. That's like shrinking a coyote to chihuahua size!



Source: San Francisco International Airport, April 2022

Swedavia has also [implemented a solution](#) that measures and adjusts its climate system to the number of people in an airport zone – decreasing its air-conditioning use by 30 percent.

COCHIN INTERNATIONAL AIRPORT, INDIA

Cochin Airport has developed on-site energy generation from solar, wind, biomass and hydrogen sources. It claims to produce 100

percent of its energy through renewables.

Source: Arup

FINAVIA, FINLAND

In 2022, Finavia developed a new sustainability programme to reduce the carbon emissions of its airports to net zero by the end of 2025.

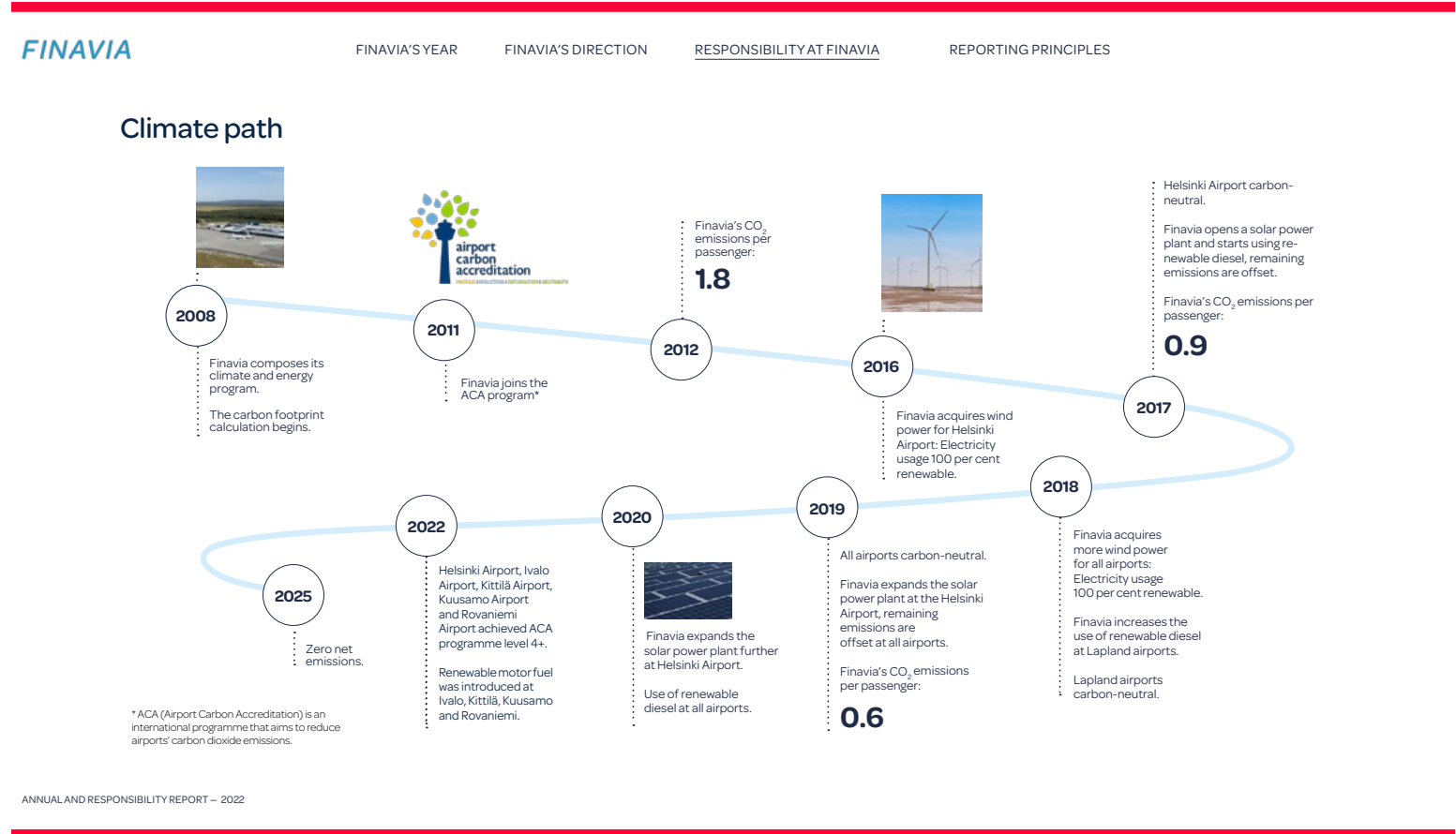
For several years now, **all electricity used** has been 100 percent powered by wind and solar energy and airport maintenance vehicles use renewable diesel made from waste and leftovers. Furthermore, Finavia is **restoring a nature reserve** at its Turku Airport and constructing an **underground wetland** at its Helsinki Airport.

BERLIN BRANDENBURG AIRPORT

As part of its sustainability initiatives, Berlin Airport is addressing how passengers get to its airport. **In collaboration with Deutsche Bahn** and Lufthansa, it has been working to offer passengers a codeshare on the German train network.

Many airports are well on their way to making the transition to be more sustainable. As the **World Economic Forum** states, doing so is the only way forward:

"Airports are at the heart of the decarbonisation challenge and are on the frontline to provide sustainable solutions."



Source: Finavia Annual and Responsibility Report

They have the potential, in fact, to transform passenger hubs into energy hubs, with renewable energy production being at the centre of their operations to decarbonise all airport-related activities and those in their vicinity.



CHAPTER 3:

Cyber security at airports: Ensuring safety in a digital age

The increasing reliance on digital systems and interconnected networks has meant that cyber security is one of the core areas airports are now focussing their investments on. Many are making the protection of their digital infrastructure, sensitive data and passenger safety a top priority.

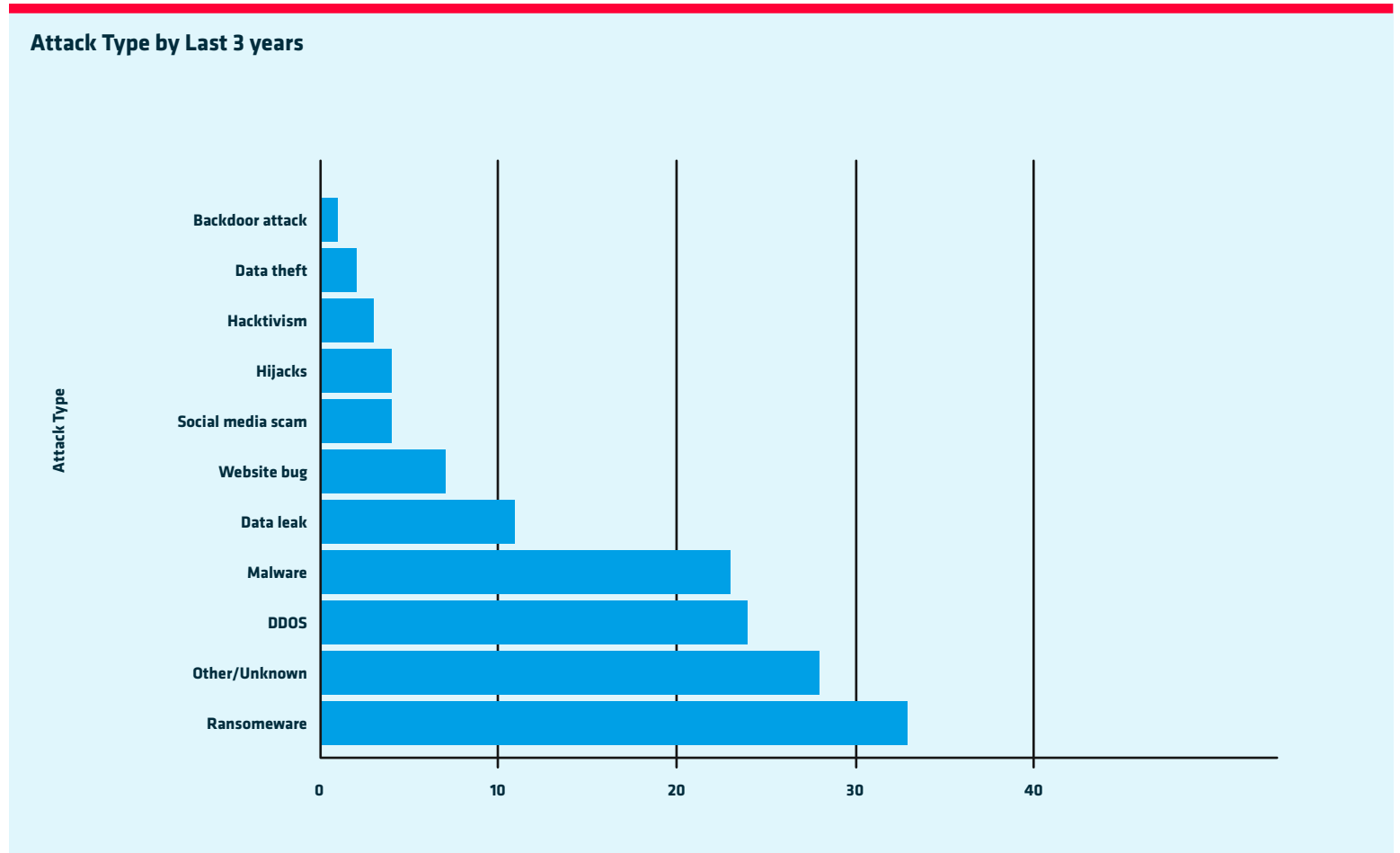
Having said that, however, some in the airport sector note that they have a long way to go. [The International Airport Review's Advisory Board Meeting Report 2023](#) observes, for example, that there's a lack of maturity across the sector of what needs to be done around cyber-controls:

"Operational technology systems, baggage and HVAC and SCADA systems are often not actually under the purview of the IT group from a security perspective. That's an area of risk for airports. Cyber security isn't just about a data breach or ransomware."

Airports need to significantly step up their cyber security measures but crucially, also understand the importance of cyber security at the operational level.

The need for heightened cyber security measures

A confluence of developments has led to the imperative that airports elevate their cyber security levels.



Source: Source: SOC Radar

Firstly, it's clear that the potential attack surface for cyber-criminals widens as airports continue to adopt advanced technologies.

With the rise in IoT (Internet of Things) devices to manage and optimise airport operations, the opportunities to exploit vulnerabilities in both IT

infrastructure and OT (operational technology) infrastructure are greater. Airports need to therefore reduce the risks of IoT hacking, but also secure information generated by their operational assets, such as baggage handling systems.

Secondly, the global pandemic accelerated the use of new technologies and digital solutions to create touchless passenger journeys. But this next-generation self-service travel infrastructure – with its integrated cloud, mobile and biometric-enabled touchpoints for check-in,

bag-drop, border control and boarding – also increases vulnerabilities to digital attacks and interference with digital processes.

Thirdly, in seeking to implement technologies to enhance the passenger experience, airports expose themselves to further possible cyber attacks. Passengers are increasingly demanding digital travel experiences, for instance, with the key enabler being a digital identity on our mobile devices. But while physical e-passports and other travel documents are certain to become a thing of the past and be **replaced with digital identities**, such developments have the potential to be susceptible to cyber attacks if not secured properly.

And finally, but importantly, the Russian invasion of Ukraine and other geopolitical conflicts pose significant threats to airports around the world. As **cyber plays an integral role in armed conflict**, disruptive and destructive attacks in cyberspace are expected to increase in response to developments on the battlefield.

TSA's emergency security amendment

These developments make obvious just how insufficient firewalls and anti-virus protections are to protect sensitive infrastructure such as airports from cyber attacks.

So it was almost inevitable that TSA would **announce an emergency amendment** to the security programmes of certain TSA-regulated airports and aircraft operators.



Source: [securityweek.com](https://www.securityweek.com)

The recent **amendment** requires impacted TSA-regulated entities to proactively assess the effectiveness of their measures to improve their cyber security resilience and prevent disruption and degradation to their infrastructure by:

- Developing network segmentation policies and controls to ensure OT systems can continue to safely operate if an IT system has been compromised, and vice versa.
- Creating access control measures to secure and prevent unauthorised access to critical cyber systems.
- Implementing continuous monitoring and detection policies and procedures to detect and defend against cyber security

threats that affect critical cyber system operations.

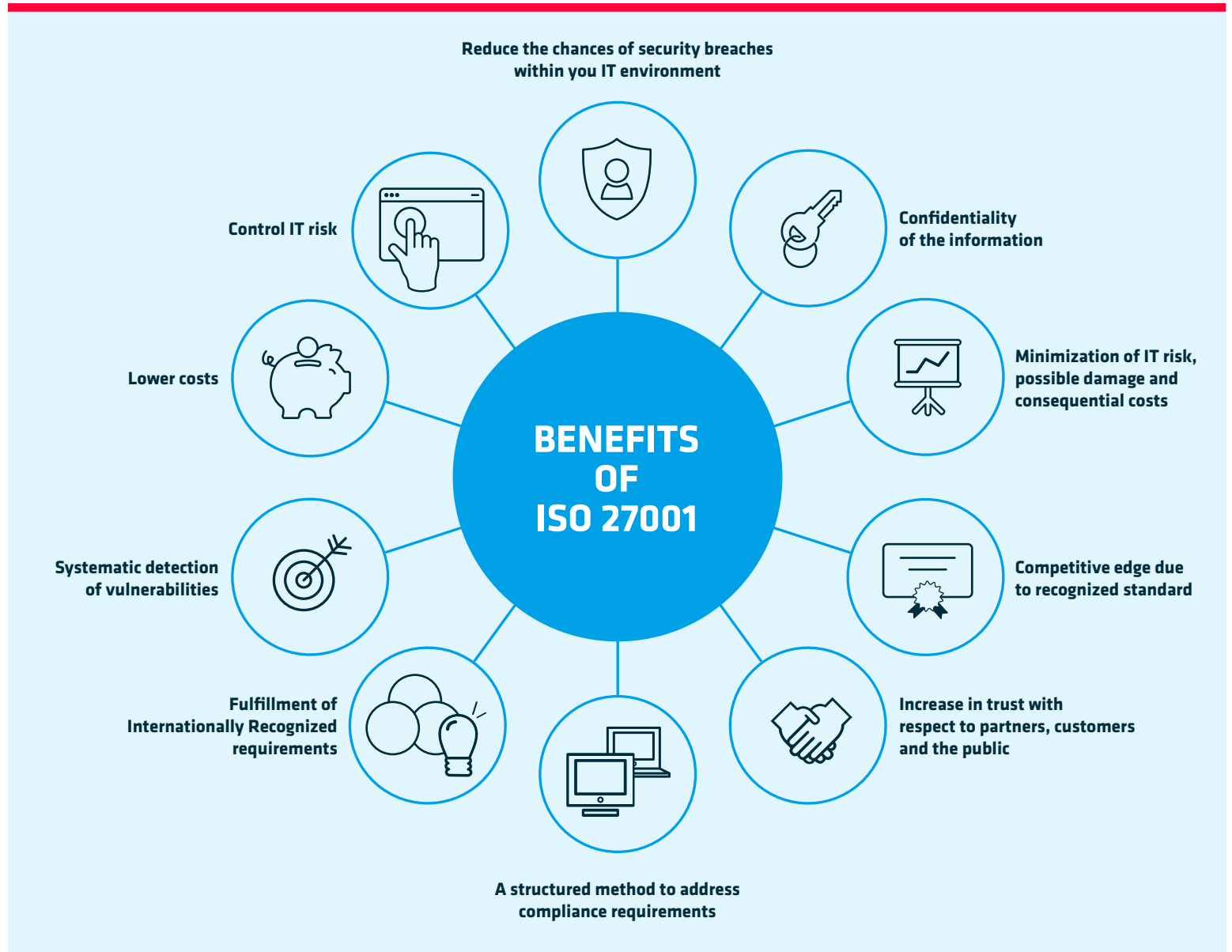
- Applying security patches and updates for operating systems, applications, drivers, and firmware on critical cyber systems using a risk-based methodology.

ECAC's cyber security study group

Meanwhile, the European Civil Aviation Conference (ECAC) continuously updates its cyber security measures through its specially constituted [Study Group on Cyber Security in Civil Aviation](#) (CYBER).

The study group keeps the relevant [ECAC Doc 30, Part II Chapter 14](#) recommendations on cyber security governance – applied in Europe and other parts of the world that follow ECAC's standards – and its annexes up to date. Airport operators and other stakeholders must implement and follow these risk-based recommendations by applying processes and procedures to maintain the confidentiality, integrity and availability of their systems and data.

The study group also develops guidance material and best practices on cyber security for ECAC Member States and raises awareness of cyber risks in ECAC Member States.



Source: MOORE ClearCom

Implementing more robust cyber security measures

How, then, can airports comply with TSA amendment or ECAC standards and effectively boost their cyber security?

As a first step, it's important that all airports and their suppliers recognise these cyber security developments and implement TSA's initiative and ECAC Doc 30 recommendations.

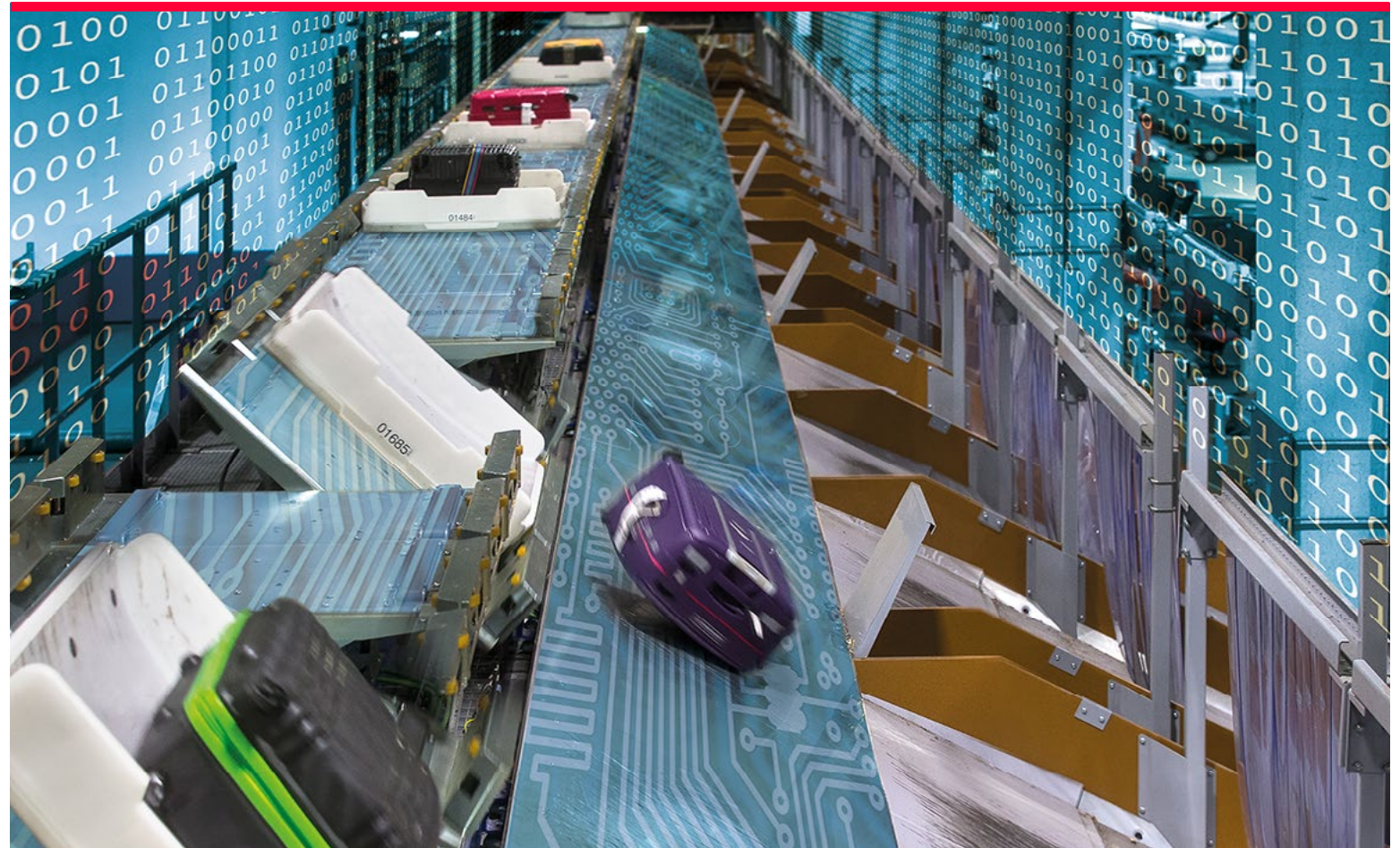
Following that, airports can strengthen their cyber security resilience by working with ISO 27001-certified suppliers that are also IEC 62443-compliant.

ISO 27001 AND IEC 62443 CYBER SECURITY STANDARDS

The ISO 27001 certificate is an [internationally recognised framework](#) for Information Security Management Systems (ISMS) that uses fundamental cyber hygiene to establish a baseline level of security.

While the focus of ISO 27001 is on information security, IEC 62443 targets industrial automation and control systems, providing guidelines for their lifecycle security. Both standards emphasise risk assessment, risk management and continuous improvement in cyber security.

The ISO 27001 standard is aligned with TSA's amendment and ECAC's cyber security recommendations, so those airports that work with ISO 27001-certified suppliers can be assured they are complying with both



TSA and ECAC cyber security governance measures.

As national infrastructure, airports are prime targets for attacks, particularly as they rely increasingly on digital technologies. By

partnering with ISO-certified suppliers, airports can strengthen their cyber security awareness and mitigation measures more effectively, while adhering to upgraded TSA and ECAC criteria.



CHAPTER 4: **Improved interlining with virtual solutions**

One area in which airports are now navigating the digital era is in their use of new technologies to connect passengers and assist airlines in their interlining arrangements.

The interlining framework – an agreement between airlines to coordinate passengers with an itinerary that uses multiple airlines, without having to check in again – in its traditional form has been a cornerstone of the airline industry for decades.

In our 2021 report, we examined this interlining model and why it's time for airports to rethink it with the adoption of virtual solutions.

THE CHALLENGES OF THE LEGACY INTERLINING FRAMEWORK

Firstly, the traditional interlining model was introduced for a very different time, premised on the hub and spoke framework, in which long-term partnerships were formed between main carriers feeding passengers into smaller airports and vice versa.

This legacy framework needs a large amount of infrastructure, resources and maintenance. As [IATA reported in 2019](#), it limits the involvement of many players such as low-cost carriers, and airlines often have to negotiate and manage separate agreements that complement or replace a traditional interline agreement. (Boeing, in its [Commercial Market Outlook 2023-2042](#), notes that low-cost carriers will operate more than 40 percent of the single-aisle fleet by 2042, up from 10 percent 20 years ago.)

Secondly, passenger expectations are shifting. Younger passengers, in particular,



are demanding greater travel flexibility. They expect their travel experiences to be fully digitalised, highly personalised, and readily available on their mobile phones. Moreover, they want to explore less-travelled, unique and remote places without engaging in a lot of DIY

searches to get there.

THE EMERGENCE OF VIRTUAL INTERLINING

We are seeing emerging in the market, therefore, interlining models that provide

alternatives to traditional interlining. Virtual interlining models are able to fill the gap between traditional interlining and the self-connecting approach, with AI-based algorithms combining separate routes from carriers into seamless itineraries.

THE FUNCTIONALITIES OF A VIRTUAL INTERLINING SOLUTION

A virtual interlining model offers the following features:

- **Analysis of routes:** Software maps the origins, destinations and city pairs that have a high passenger demand but no direct connection, with the view to offering that connectivity and market opportunity.
- **Analysis of flight and passenger flows:** Software maps the world's airports and connecting flights to predict the inbound journey for any passenger itinerary and thereby calculate the expected time and risk scores for transfer flights. It leverages the map to personalise the passenger experience while identifying connection opportunities between new carriers.
- **Booking and distribution:** It offers airport data and routing information as an API to third parties to integrate into their booking systems. It guarantees virtual interline tickets to end consumers, protecting passengers in the case of disruption by automatically re-booking new flights and tracking, re-routing and re-tagging baggage onto a new flight.
- **Baggage check-through:** Enables automated baggage check-through between carriers that are not formally cooperating under an interlining agreement.



New, low-cost carriers are able to optimise their point-to-point networks, service other routes and connect passengers – without the overheads and costs of the traditional interlining model.

Airsiders: A new model for interlining

Given these trends in air travel, it's not surprising that many airports are now looking at adopting virtual interlining solutions, such as the

interlining platform provided by Berlin-based company, [Airsiders](#).

Airsiders is a virtual interlining platform that acts as a third party between airline and airport systems. Airsiders' products enhance the

whole interlining journey of a passenger while also providing B2B solutions for industry stakeholders.

The first option for working with Airsiders is by way of a partnership through a consumer-facing travel platform. In this end-to-end platform, passengers can search and secure flights, book a baggage-through service and receive personalised guidance on their airport journeys, including the future ability to book intermodal services. (Airsiders is currently cooperating with certain airports and rail companies to enable this virtual intermodality.)

The solution is specifically designed for stakeholders interested in a virtual platform but who would like to experiment with it and build it within their ecosystems and processes. It could be implemented for a subset of flights, for instance, before being fully embedded in their brands.

Airsiders also **partner with airports** that are looking to improve the current self-connect process by promoting virtual connectivity with their airlines. With its technology and know-how, Airsiders brings together everything that is required for the airlines to start offering connectivity between each other, without interline or codeshare commitments.

The advantages of a virtual interlining solution

All stakeholders in aviation operations stand to gain from alternative connectivity solutions such as Airsiders'.

For airlines, virtual solutions facilitate the sale of seats, enabling airlines to increase their load factors and flexibly grow their networks without the expenses attached to traditional interlining.

For passengers, virtual products provide greater options, choices and convenience in terms of prices, destinations and dates. Virtual solutions also enable passengers to connect with providers of intermodal services. (Airsiders are currently working on an intermodal partnership with Germany's Deutsche Bahn, for instance.)

For airports, virtual solutions capture transfer traffic that they would otherwise not acquire. They attract premium passengers by offering a viable alternative to self-connecting and its inherent risks. By deploying virtual solutions, airports and their respective carriers can offer significantly cheaper flights with shorter connection times, for example.

In addition to attracting passengers, airports can also attract entirely new routes. Virtual solutions can unlock previously unavailable data, providing airports with additional sales opportunities based on connectivity and not purely on destination. And given that transfer passengers are treated as two separate passengers, airports stand to make more revenue with the virtual interlining model.

Virtual interlining in action

With the advantages that virtual interlining presents to the various stakeholders, we are now seeing increasing interest in these

solutions from airports – both hubs and smaller airports – and airlines around the world.

Düsseldorf and Keflavik's international airports, as well as the German airline, Lübeck, are already cooperating with Airsiders. Rome international airport is cooperating with Airsiders for the implementation of its digital wayfinding solution, while Airsiders is in the process of launching distribution capabilities with Play Airlines (Iceland) and Azul Airlines (Brazil).

We are recognising two different use cases for these early adopters of Airsiders' virtual solution and both are in demand.

AN AIRPORT-DRIVEN APPROACH TO INTERLINING

At some airports, Airsiders's solution is in the process of being integrated into their baggage handling systems. When baggage arrives at the transfer belt, Airsiders's software recognises it must be sorted at a special labelling station where it will be processed for its second flight.

This type of adoption is well suited to hub airports. The solution allows them to open up their entire networks to the whole airport because they can process any transfer bag passing through them.

AN AIRLINE-DRIVEN APPROACH TO VIRTUAL INTERLINING

Another way of adopting virtual interlining is integrating the software at the check-in of the origin airport, where the passenger receives a

regular transfer baggage tag. This approach is premised on close cooperation between airlines and is therefore very airline-driven.

While this use case does not rely on any manual intervention, it does require cooperation from the airports involved in the network. But it's well suited to airlines as they can spread it to their networks as desired.

Virtual interlining is proving to be a viable alternative to the shortfalls of the traditional interlining framework for all stakeholders in the travel ecosystem. For airports, a virtual integration with their systems that provides better connectivity for both their passengers and airline customers might just be the answer to some of the deficiencies of the traditional model.



CHAPTER 5:

Operational recovery and dealing with macroeconomic volatility

Royal Schiphol Group, The Netherlands



What are the greatest changes Royal Schiphol Group has noticed about travel amidst the current global economic volatility (increased energy prices, rising inflation, interest rates and cost of living)? What adaptations is it making to deal with them?

We can see there is a global and local increase in demand for air travel, despite headwinds, such as the war in Ukraine, challenging labour market conditions and economic downturn being potential obstacles on the path to recovery.

Unfortunately, Schiphol was not able to provide the service we wanted to meet that demand in 2022, due to the impact of the pandemic, combined with the huge demand for labour in the Netherlands and the surge in passengers and flights shortly after a period of travel restrictions and lockdowns. The need for resilience is therefore critical to respond effectively to external influences on our business such as continuing fluctuations in air travel.

Achieving our long-term ambitions will depend

on our ability to adapt to our much-changed operating environment and the many logistical and economic challenges this brings. Our top priority now is to redress the balance and re-establish our reputation as a leading international airport.

We are now an airport in transition. Insight into day-to-day operations is now central to Schiphol's business model. This means changing the way we manage our business. And that is what we are doing now. Schiphol must be a place with good working conditions and with a good salary. And this is the foundation on which we want to bring the service we offer travellers and airlines to the desired level.

In what ways have customer expectations and demands shifted and what is Royal Schiphol Group doing to accommodate them? Can you highlight one technological initiative you have taken to meet these demands?

In 2022, passenger perceptions of waiting times at check-in, security and passport control for the departure journey all declined and we

know that our customers expect seamless flows and little-to-no queuing. The younger generations, in particular, expect a digital travel experience.

Schiphol Group is therefore working to develop new digital solutions aimed at improving efficiency and meeting passenger expectations. For instance, we are working together with a security technology provider, Pangiam, to create a new model for screening hand luggage. We're investigating how Pangiam's technology can expedite the hand baggage screening process at Schiphol and our other airports. The AI-powered system analyses photos of hand luggage to identify prohibited items and other security items and we hope it will enable passengers to pass security checks more quickly in the future, without sacrificing safety.

We are also promoting the increased use of rail and other public transport during journeys to and from our airports. To this end, we facilitated an air-rail pilot by KLM and Thalys in 2022 at Schiphol, which gave us insights into passenger expectations and experiences.

Together with air-rail partners, we will further evaluate the pilot and continue to improve the air-rail journey.

What approach is Royal Schiphol Group taking in moving to create a more sustainable airport?

Royal Schiphol Group wants to operate the world's most sustainable airports. We aim to ensure that our own operations produce zero-carbon emissions and zero waste by 2030. Schiphol Group's four Dutch airports are on track to become zero-emissions airports by 2030. This means, for example, that we aim to phase out natural gas in all our offices and buildings by 2030.

Our goals for 2030 are that:

- Our airports are waste and emission-free;
- CO₂ emissions from aviation are at 2005 levels; and
- We've improved the balance between our airports and their local communities.

Decarbonising aviation will prove far more challenging than greening our own operations and, as an airport operator, we are also actively

Royal Schiphol Group, The Netherlands



involved in this objective. After all, a significant reduction in aviation emissions is the only way to continue connecting our passengers with the rest of the world. To this end, we are playing a leading role in driving sustainability across the aviation sector, starting with the use of sustainable aviation fuels (SAF).

In what ways has the push for airports to be more sustainable impacted your business model and what measures has Royal Schiphol Group taken to create sustainable airports for the future?

In order to realise our ambition of becoming the world's most sustainable airports, we have developed a roadmap that helps us achieve the following four objectives: to be energy positive by 2050; to have a circular economy by 2050; to contribute to sustainable aviation with net-zero mobility by 2050; and to improve the balance between our airports and their communities. Ultimately, we aim to operate as an energy-positive, fully circular organisation.

To prevent the destructive consequences of climate change, Royal Schiphol Group accelerates where we can, to achieve scale

in our transformation as soon as possible. This requires collaboration across the aviation ecosystem and with governments. We believe target setting, policy and regulation, carbon pricing, innovation, industry investments and consumer behaviour have to reinforce each other. We are optimistic that we can accelerate the path to more sustainable journeys, by relying on the shared commitment of our many dedicated colleagues, partners and other stakeholders.

What should be the number one priority for airports right now, in terms of mitigating their risks to potential cyber-attacks?

IT and data play a central role in our transition and in ensuring quality of service for all visitors to our airports. Schiphol's number one priority is to ensure our airports are secure, and this applies to cyber security.

The Schiphol Cyber Security Centre (SCSC) is responsible for the security of our digital processes, whether it's for new solutions, our Tech & Data foundation or 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 (SOC) to prevent potential cyber security incidents or data breaches. An incident response team is prepped to take action as soon as an issue occurs.

Royal Schiphol Group intends to further develop its cyber security resilience in line with our ongoing digital transformation. We invest continuously in the resilience of our information technology (IT) and operational technology (OT) and have set out a Cyber security Roadmap that will guide us in becoming even stronger in this domain.

"We are optimistic that we can accelerate the path to more sustainable journeys, by relying on the shared commitment of our many dedicated colleagues, partners and other stakeholders."

Changi Airport Group, Singapore



What are the greatest changes Changi Airport Group has noticed about travel amidst current global economic volatility (increased energy prices, rising inflation, interest rates and cost of living) and what adaptations is it making to deal with them?

The global aviation industry is still undergoing a period of pent-up, demand-induced recovery. This is amidst an uncertain economic outlook, elevated interest rates and global rising inflation environment. At the same time, the world is closely monitoring the rebound of the Chinese economy and eagerly waiting for the return of Chinese tourists. Despite the ongoing pressing global issues, we believe the air travel industry will continue to grow.

However, as the restoration of airline passenger capacity is uneven across regions and countries, airports will have to grapple with demographic changes in travellers which may affect the airport capacity. For example, a longer transfer connection time may mean that the airport's early bag storage facility capacity will be soaked up much quicker than what it was designed for. So airports have to be nimble

and agile to adapt by implementing measures to sustain the travel recovery and beyond.

In what ways have customer expectations and demands shifted and what is Changi Airport Group doing to accommodate them? Can you highlight one technological initiative you have taken to meet these demands?

The COVID-19 pandemic has accelerated the pace of digital transformation. People are now more accustomed to transacting digitally in their daily routines. Passengers expect more information at their fingertips, more self-help and contactless options, as well as for the processes at the airport to be more seamless and efficient.

In late 2021, Changi Airport embarked on a baggage transformation journey to use technology to improve the way baggage is handled and tracked. It also successfully introduced a personalised baggage tracking function on the Changi app in December 2022. This function, currently in beta trial, is the first of its kind to be launched by an airport in Southeast Asia. It enables passengers travelling

to or from Changi to keep track of the status of their bags, as well as be updated should their arrival baggage at Changi be delayed due to inclement weather.

What approach is Changi Airport Group taking in moving to create a more sustainable airport?

We adopt a multi-prong approach to create a more sustainable airport. On the design front, we procure and use equipment with best-in-class energy efficiency, and adopt sustainable procurement criteria in our evaluation process. We have committed to a Zero Absolute Growth carbon emissions target until 2030, which means that as Changi continues to grow, we will voluntarily cap our absolute emissions at 2018 emission levels, with longer-term aspirations towards net zero by 2050 by using new technologies and increasing the adoption of renewable energy.

Besides our own initiatives, it is also important to work closely with our partners to support their sustainability initiatives, as the airport operator's carbon emissions are only part of the overall carbon footprint of the whole

"We have committed to a Zero Absolute Growth carbon emissions target until 2030, which means that as Changi continues to grow, we will voluntarily cap our absolute emissions at 2018 emission levels."

Changi Airport Group, Singapore



airport community. To help our airport partners decarbonise and achieve our shared vision of a Sustainable Aviation Hub, we work with airlines on Sustainable Aviation Fuel adoption and with our ground handling agents to transition to cleaner energy vehicles such as battery electric vehicles.

In what ways has the push for airports to be more sustainable impacted your business model and what measures has Changi Airport Group taken to create a sustainable airport for the future?

As consumers become more eco-conscious, their purchasing habits and behaviours will be positively influenced by companies offering sustainable products and services. Therefore, it is not only about protecting our environment for the next generation but also to sustain our businesses in the long run. To illustrate, investments in renewable energy make good business sense, as it increases our resilience against volatile and potentially-higher energy prices.

In addition to carbon reduction measures, Changi plays a role in sustainable air travel by

encouraging travellers to recycle more and conserve water.

What should be the number one priority for airports right now, in terms of mitigating their risks to potential cyber-attacks?

Airports should constantly keep themselves abreast of the ever-evolving cyber security threats perpetrated by state actors or cyber criminals, on top of diligently implementing basic hygiene factors to safeguard critical information systems against cyber attacks. These cyber hygiene factors should be considered from a pragmatic design upfront and regularly audited for effectiveness throughout its system and product lifecycle.

As we protect and prevent, we must also be mindful of the need for preparedness for incident response should existing defences be circumvented. This would require a robust business continuity plan to be put in place and rehearsed regularly to minimise disruption to airport operations during a cyber emergency.

"Airports should constantly keep themselves abreast of the ever-evolving cyber security threats perpetrated by state actors or cyber criminals, on top of diligently implementing basic hygiene factors to safeguard critical information systems against cyber attacks."

Taoyuan International Airport, Taiwan



What are the greatest changes Taoyuan Airport has noticed about travel amidst current global economic volatility (increased energy prices, rising inflation, interest rates and cost of living) and what adaptations is it making to deal with them?

We have to change the transition infrastructure and revenue models. In addition, the airport space and airport facilities should be flexible to deal with [future] epidemics.

As income is declining sharply, the airport authority should take the following actions:

1. Review construction plans: It could be that some projects need to be sped up, given low passenger traffic and less possibility of interference while some projects ought to be slowed down due to the slow recovery.

2. Review the business model: The primary thing is planning for survival; after that, we need to develop ways to generate more income.

In what ways have customer expectations and demands shifted

and what is Taoyuan Airport doing to accommodate them? Can you highlight one technological initiative you have taken to meet these demands?

Passengers expect airports to provide a more convenient and faster service. So the airport should introduce smart facilities, such as common-use self-service kiosks, self-bag drop and One ID document-free processes. It should also provide a smooth flow for both passengers and their luggage.

What approach is Taoyuan Airport taking in moving to create a more sustainable airport?

We are continuously managing energy and greenhouse gases and promoting joint [carbon emissions] reduction with our stakeholders.

We also aim to apply ACA Level 4 before 2025 and set a 30 percent reduction in greenhouse gas emissions per passenger by 2025, compared with 2013 levels.

In what ways has the push for airports to be more sustainable impacted your business model and what measures has

Taoyuan Airport taken to create a sustainable airport for the future?

Taoyuan Airport has shifted its focus from risk thinking to resilience thinking. This means that the airport's facilities should not only be durable but also redundant. We also need to work in close cooperation with our stakeholders to find integral and flexible solutions.

What should be the number one priority for airports right now, in terms of mitigating their risks to potential cyber-attacks?

Airports should build safe information-secure environments. Firstly, they need to establish their information security policies and make all colleagues and related parties aware of them. In addition, their IT and OT facilities should set up different working environments with different regulations.

"Taoyuan Airport has shifted its focus from risk thinking to resilience thinking. This means that the airport's facilities should not only be durable but also redundant."

CONCLUSION

While we've seen a significant rebound in air traffic over the last year, airports continue to contend with prevailing uncertainty. Airports have to manage an economic downturn, higher costs of living and inflation hikes and their impacts on disposable incomes. Moreover, energy prices are impacting airfares, which in turn, influence the demand for travel.

Performance, then, is not expected to fully recover until 2024, subject to the uneven passenger volumes across global regions and the continued imbalance between international and domestic markets. In addition, labour markets continue to hamper the full restoration of airport operations.

Despite these ongoing hurdles, the appetite for travel is strong, continuing its upwards surge and forecasts for a comeback in business travel are positive. And for all the turbulence, airports around the world are proving their resiliency and taking on board the revelations borne from the recent crises – demonstrating how disasters and major disruptions have a tendency to change social, technological and economic behaviour. They are fully integrating these fresh insights into their plans going forward.

Airports are fast-tracking digital initiatives to personalise the passenger experience, optimise their operations to streamline processes and reduce operational risks. They are continuing to maximise their retail revenue and strengthen the value of their physical spaces. The push to implement advanced tracking technologies has also enabled airports to improve their baggage handling operations.

Airports will, however, need to keep up with the demand for digital travel. Biometrics, fast becoming standard in airports around the world, is just the beginning. Digital identities on our mobile devices may quickly become the **primary token** against which identity confirmations, risk assessments and authorisations are made. Airports will need to equip themselves to manage the replacement of physical e-passports and other travel documents with a digital identity, especially if they are seeking to achieve more with fewer resources.

The development of full digital identities simply reinforces the need for airports to ensure their cyber security measures are able to withstand even further access to their critical systems. The sector must address protecting their operational technologies – in addition to their

more usual IT procedures – and work with suppliers that understand and can guarantee the most stringent security in the new digital era.

Many airports are well on their way to making their infrastructures and operations more sustainable with the implementation of multifarious initiatives. The measures taken around the globe are varied, as each airport finds its own way to embed sustainability into its organisational framework. It's now a matter of continuing to meet the demand for sustainable change and communicating that effectively to all stakeholders. However, if it's to secure its place as an industry in the future, it's imperative that the airport sector understands and implements what 'sustainability' means in the broader context.



For more airport operations Insights and Inspiration, go to:
knowledge.beumergroup.com/airports