



Engineering exceptional experiences into airports

Digitizing, transforming and delivering smarter, greener airports



Executive summary

Airports of the future will deliver seamless passenger experiences. For the US, that means the entire airport ecosystem is transforming to become smart, efficient and sustainable. At the heart of this new ecosystem are an airport's ground operations, power infrastructure and e-mobility assets – which are all primary areas of expertise and experience for ABB. Airports are strong influencers of experiences along the aviation value chain. For that reason, they're central to public perceptions of the industry and for delivering change that benefits people, passengers and the planet.

ABB's experience and expertise in airport operation & infrastructure



Benefits people



Benefits passengers



Benefits the planet



The journey to sustainability

The era of aviation is a pivotal chapter in the story of humans. The incredible invention of flight is an achievement that people had been dreaming about for millennia. As soon as these magnificent flying machines took off, they began to change the course of history – and have been shaping the future ever since. In the US, airports of the future create many opportunities and challenges with the amount of airports capacity, enhancement and upgrade projects in planning or already underway.

From the birth of commercial airlines and the first airports in the 1920s, humankind has flown a long, long way. The international trade, tourism and mobility that are now possible – and increasingly demanded by customers – have made the world smaller and the global economy far bigger. A study of the impact of European airports found that a 10% increase in a country's air connectivity was associated with a 0.5% increase in GDP per capita¹. In 2018, 8.8 billion passengers passed through the world's airports². By 2037, annual passenger numbers are predicted to double to 19.7 billion³.

Today's airports are catalysts and drivers of economic activity, and social and cultural exchange. Across the physical and digital worlds, this is now happening at

unprecedented speed and global scale. But progress is not always steady. Before the global pandemic, travel and tourism accounted for 1 in 4 of all new jobs created across the world, 10.3% of all jobs (333 million) and 10.3% of global GDP (US\$9.6 trillion). While international visitor spending amounted to US\$1.8 trillion in 2019 (6.8% of total exports)⁴.

Aviation brings people together like no other means of transport, but its impacts are also divisive. That will continue for as long as aviation is a major contributor to human-made climate change. While airports, airlines and aviation are impossible to separate when it comes to emissions, how they respond to climate change involves different challenges and timescales. The leadership that airports show in meeting passenger expectations through digitization will also be a critical success factor in achieving their sustainability and carbon-neutral goals.


But if we accept reality – that the sector will continue to grow at pace – then the need for smarter, more efficient and sustainable airports becomes more urgent than ever.

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A large commercial airplane is positioned on a runway, viewed from the front. The runway has a prominent yellow center line that leads directly towards the aircraft. In the background, airport infrastructure and a clear blue sky are visible.

Where next for airports?

Airports are critical infrastructure in all senses – critical to the way we live our lives today, critical to our environmental and economic wellbeing, and critical to everyone's future. But how we will fly in the future is uncertain. As demand for air travel continues to soar, airports must serve customers' needs even more efficiently.

But right now, there are strong global headwinds – the triple challenges of economy, environment and energy – that could divert airports from a more sustainable future. These could slow the industry's progress in reducing emissions and create instability for airports just when they need long-term infrastructure investment.

Triple trouble ahead



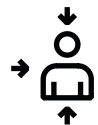
No industry is immune from **economic** downturns, but they create significant financial challenges for airports. Despite everything, passenger demand is returning to pre-pandemic levels and bigger populations are fuelling airport growth. At the same time, more mature airports are needing to upgrade so they can drive efficiencies that will help them operate more profitably and secure investment



The **environment** is reaching a tipping point. It's a sobering fact that passenger air travel produces one of the highest and fastest growths of individual CO² emissions. While aircraft remain difficult to decarbonize, airports must take a leadership role and be part of a concerted effort to reach carbon neutrality goals. In the airport, this means adapting to a sustainable future with smart ground operations and future-proof infrastructure. And it's about embracing innovation around the airport, like transport infrastructure and electric vehicles (EVs).



Current global **energy** security issues are accelerating the switch to renewable sources. They also highlight energy efficiency across airports' ground operations. The scale of today's terminal buildings means some can use nearly two-thirds of an airport's total energy. For example, Indira Gandhi Airport in New Delhi has over 100,000 light fittings and illumination points in its Terminal 3 building. ABB solutions are helping to control and optimize energy usage and ensure safety and comfort in a space that covers 70 miles.



Linked to this trio is a fourth area of **experience**. Specifically, passenger experience which is currently a challenge for many airports. However, experience is also an opportunity to meet rising expectations and grow revenues. Increasingly, passengers desire instant gratification, greater personalization and choice. Sustainable, digitally enabled solutions can help meet all these demands and expectations – and evidence indicates that some people are prepared to pay more for a greener flying experience⁶.



It is estimated that **electrification will reduce CO² emissions by 35%** of the total 2050 emissions reduction. More than 50% of the savings are in the transportation sector.⁵

While these challenges will be difficult, they also present opportunities for airports to make rapid progress. This is vital given the increased scrutiny from the public, governments, aviation regulators, and campaign groups. Airport owners, operators and suppliers (such as ABB) are making sustainability a top priority by focusing on economic, environmental, energy and passenger experience impacts. They're investing heavily in smart technologies that automate operations like smart lighting and HVAC, while making resources and assets easier to monitor, manage and automate, as well as modeling travelers' behaviors by analyzing data.

Digital flight path to airport 4.0

The integral relationships between airports and airlines have changed. Not so long ago, most airports were publicly funded and owned. They were seen as infrastructure providers at the service of airlines. Today, airports aren't so dependent on airline carriers as their commercial revenues (non-aeronautic and subsidies) are a large proportion of their profits.

So, what will future airports look like and how will they operate?

There are lots of answers to those questions – at ABB, we use the concept of Airport 4.0. This explains how airports will need to be run and the scale of the digital leap forward to become more sustainable and efficient. Plus, the concept highlights the digital capabilities that future airports will need based on this latest evolution.

Airport 1.0

Slow, manual and analogue processes for every aspect of operations

Airport 2.0

Self-service automation helping passengers with travel essentials from tickets to baggage

Airport 3.0

(Where many now sit) Digital technologies for monitoring, managing and optimizing passenger flows

Airport 4.0

Linked to terms like 'cognitive airports', 'smart airports' and the 'connected traveler', where digital technologies enable connections across the entire infrastructure, assets, resources, and equipment. Which in turn means data sharing for every part – and partner – of the airport.

For power systems the benefits for Airport 4.0 include:



Hyperconnected, multi-technology spaces



Improved productivity



Reduced energy usage



Extending the lifecycle of assets spanning across both airside and landside

A hyperconnected digital ecosystem

As a concept, Airport 4.0 is a hyperconnected digital ecosystem where every 'thing' is connected to everything else. The term is borrowed from manufacturing where Industry 4.0 production is characterized by automation and data exchange with machines making autonomous decisions. Multiple technologies co-exist and communicate – wired and wireless connectivity, automation, artificial intelligence (AI), robotics and digital twins.

All these innovations have a part to play in building sustainability and efficiency into the fabric of airports. But this is about more than combining technologies and data – applying them into the real working world takes real-world expertise. That's where ABB can draw upon decades of first-hand experience of providing clear, practical steps to help turn specific plans for Airport 4.0 into a reality.



Airports: where sustainability meets digitalization

If there's something that airports produce in volume, it's data. By collecting the right data and making it accessible across the airport, it can unlock efficiency and sustainability.

To explore the digital-sustainable link, ABB recently commissioned a global research study that asked over 700 key decision-makers across 12 industrial segments how their businesses will address sustainability and digitalization.

'Billions of Better Decisions' research shows the convergence of digitalization and sustainability – with connectivity as a bridge. Among the research findings, the views of respondents on digital technologies were unanimous that the visibility and understanding from connectivity and analytics will power billions of better decisions in the future. And that data-led decision-making will be a hallmark of high-performing, digitally enabled airports in the future.

How airports connect people will also be crucial to deliver efficiency and sustainability. According to SITA, an aviation industry communications provider, by 2030 there will be an average of 18,000 airline communication connections needed across the world's airports⁷. These will enable both infrastructure and operations to run smarter – a solid foundation for airports to deliver more for less. Plus, digital connectivity delivers new capabilities that help every aspect of airport operations to be managed more sustainably.

“96% of decision-makers say digitalization is “essential to sustainability”

Digital transformation in turbulent times

For existing airports with expansion plans, one of the most challenging aspects is how to involve every part of the airport. That's one reason why the costs of digital transformation can spiral. And airports are often trying to retrofit new systems into ageing infrastructure while continuing to operate to full capacity during transformation projects.

“When it comes to airports, digital transformation is not just about embracing technology; it is also about **business transformation** in a digital world”

Airports, as critical infrastructure, need electrical infrastructure to match. That means robust, resilient, reliable and ready to serve digitally enabled airports and their business-critical demands – where some older electrical installations might struggle. Smart, safe and energy-efficient power distribution – across a wider area and in every corner of a terminal building – is the backbone of future-proof airports. Without the right power infrastructure and distribution, nothing works, and the benefits of digital transformation will be hard to achieve.

Clearly, digitally enabled airports are at a competitive advantage. Whether that's helping passengers on their journeys, saving time or maximizing revenues, they can automate ground activities from bag handling to security checks. Different tools and technologies enable them to track the performance of assets, predict maintenance issues, repurpose spaces, reuse resources and so much more. But for all these smart innovations to work together, they require reliable, safe power distribution solutions.



“Building green

embraces circular economy thinking. Put simply reduce, reuse, recycle.

The lifecycle of an airport

Some airports have been operating for decades. While they've expanded, upgraded, or been rebuilt during that time, many still have a patchwork landscape of buildings, energy systems, infrastructures, and technologies.

Not only are these airports disparate, the different 'parts' can be at opposite ends of their lifecycles – some may even be at or beyond end of life. As the industry has committed to net-zero growth since 2020, the ageing parts of airports will gradually disappear as they struggle to keep up with expectations of travelers. It's what and how airports choose to replace them that really matters when it comes to achieving carbon neutrality.

Circular economy makes sense for airports

Airports are entering a period of rapid change – especially how they operate – driven by advances in digital technologies. Given all the different elements that need to come together to create a seamless passenger experience, there needs to be an equally joined-up approach in the design and engineering phases. This means that engineers need to future-proof designs as much as possible, by understanding project specifications and ensuring goals are aligned across airport partners and stakeholders. Essentially, engineering for today and tomorrow.

Building green embraces circular economy thinking – put simply, reduce, reuse and recycle. It opens considerations for waste and end-of-life products as a resource, which reduces the dependency on the import of raw materials or on remotely located supply chains. As soon as possible in a project, it's vital to identify opportunities for reusability and consider passenger experience in infrastructure designs.

ABB has developed both Lifecycle and End-of-life Services that can help airports think circular economy at the very earliest stage of a construction project. For example, when choosing components – and exploring the use of green materials that are both sustainably sourced and can be reused or recycled at end of life. We can help extend the value of your infrastructure investments, with direct access to spare parts and the upgrade or retrofit to existing power systems. Our approach is helping you take practical steps to transition seamlessly to new digital connected power equipment, for advanced monitoring and control, and smart efficiency.

The heights of predictive maintenance

Airports have a vast array of assets to manage and maintain. They also run complex operations around the clock and there's little room for error. So, outages, breakdowns and other operational disruptions are costly, but they're also more avoidable than ever with predictive maintenance.

The Internet of Things (IoT) and data analytics are the main technologies underpinning this proactive approach. These are now central to operations in assets that include baggage handling systems, elevators and escalators, lighting, HVAC, airside transport, security and surveillance, and power back-up systems.

This hardware will enable the thousands, if not millions, of connected devices and sensors to provide a data-led understanding of how assets are performing in real-world conditions. Data is the raw material of predictive maintenance and it's shifting the focus from reactive and periodic maintenance to measuring real-time performance. This helps to ensure maximum efficiency for the entire lifecycle and increases assets' reliability and longevity. And in circular economy terms, while poor maintenance generates waste, proactive maintenance minimizes it.

Instead of replacing, a circular approach keeps components and equipment in good condition and operating under the right conditions. This approach also empowers operational management teams with actionable insights and tools for making informed decisions. Armed with the performance information they need, faster and more informed decisions regarding asset availability and reliability are possible.

Predictive maintenance also helps operation managers to integrate, analyze and discover new ways to reduce costs, decrease maintenance and drive sustainability.

In fact, our airport partners are already experiencing the real-world impacts of these actionable insights on their performance and profitability:

Up to
30%
reduction in maintenance requirements

Near to
100%
predictability of avoiding unplanned shutdowns

Up to
40%
reduction in operating expenditure

Predictive maintenance for critical infrastructure at scale

ABB installed an intelligent predictive maintenance solution for power supplies in the Burj Khalifa, keeping the tallest building in the world running 24/7 – totally transparently. Using the ABB Ability™ Electrical Distribution Control System, the tower's facility management team can remotely monitor the power supply of each of the 400 electrical loads at the site, including the 57 elevators and a 24MW air conditioning system among other loads. Remote access via smartphone, tablet or PC allows everyone to monitor, manage, and maintain these critical assets in real time. The maintenance service installed at the Burj Khalifa can reduce operational costs by up to 30% by using real-time sensor data and condition monitoring, replacing routine maintenance work⁸.

8. <https://new.abb.com/news/detail/39091/abb-helps-power-the-burj-khalifa>

The electrification revolution

Aircraft CO₂ emissions grab the headlines, but one of the biggest contributors to aviation industry emissions is ground transport. Specifically, the networks, infrastructure and vehicles that operate, feed and surround airports.

It's also worth noting that 40% of airport revenues come from non-aeronautical activities – a majority of which is car parking and rentals. For some airports, the proportion is much higher⁹ which is why some airports have been slow to embrace EV infrastructure for ground operations.

ABB's broad industry experience of charging infrastructure can help airports who are looking to run EV fleets and transform passenger mobility. From design to deployment, ABB can enable airports to realize the operational efficiencies and maximize ROI. ABB technologies can optimize uptime and reliability by connecting chargers, service solutions and people.

From parking to charging

Many airports have land devoted to parking, but for how much longer? The long-stay parking lot's days are numbered as transport links improve, EV ownership increases, and autonomous vehicles

become commonplace. Existing airport parking lots could be the well-connected locations that new transport services need. And freeing up land for more sustainable use could also generate income for airports.

ABB is seeing this demand first-hand and already supporting the future of EV on both landside and airside. We've developed the world's fastest charging solution that can deliver 62 miles of range in three minutes, fully charge an EV in 15 minutes and charge up to four vehicles at once. Airside, these can power an entire airport fleet with greater energy efficiency and help optimize energy storage and distribution.

Airports are also prime locations to satisfy the ever-increasing demand for the charging infrastructure that supports EVs. Los Angeles International Airport (LAX) built a fully electric Automated People Mover (APM), a train system to provide convenient, reliable, and timely connections to terminals for passengers and employees. In partnership with ABB, LAX decided to adopt a traction energy storage system to provide backup power to the APM in the event of a power outage. This future-proof power infrastructure will guarantee power for the estimated 87 million passengers per year.

Los Angeles driving the EV trend

Los Angeles World Airports continues to invest in vehicles and charging infrastructure needed to support a fully electrified fleet. This is all part of a goal to achieve carbon neutrality from airport operations by 2045.

The Los Angeles International Airport (LAX) are leading charge with the installation of electrical infrastructure for electric vehicles. In 2022, LAX installed 1,300 charging points for EV, placing the airport as one of the biggest charging facilities within the US.



Working with the right partner

Airport construction and the integration of digital technologies always involve a complex set of interdependencies and partnerships. For critical infrastructure like airports, minimizing disruption is vital. To do that, everyone needs to be on board and working towards the same business and sustainability goals.

Collaboration is key

Collaboration can unlock the aviation industry's long-term sustainability goals. Airports are places where many partners and stakeholders converge – this can be challenging but also creates many opportunities for joint working toward sustainable solutions. The sheer volume and variety of different stakeholders requires a culture of collaboration with a common language, information exchange and strategies to be in sync.

As a technology leader with a comprehensive offering of digital solutions for multiple industries, we've experienced collaboration at its most productive and innovative.

The best outcomes and greatest collaboration exist when:



There's a common language

- airports are international by nature. Agreeing on terminology and ways of working across the stakeholder group creates shared understanding that helps to build trust.



Information is freely shared

Clear and concise information and consistent communication aids decision-making as it's based on complete information.



When strategies are connected

Each stakeholder's interests and goals are more likely to be achieved when strategies are aligned.

Daxing Airport's Partner of Choice

For global ambition, airports don't get much bigger and bolder than Daxing Airport, Beijing. It's the first with a high-speed train passing underneath, the world's largest single terminal and will serve 72 million passengers by 2025. During its four-year construction, ABB delivered critical infrastructure – from power to water systems.

ABB's leading role in working with construction partners helped deliver the goals of safe, reliable and robust operations while reducing maintenance costs and raising operational efficiency. Examples using ABB technologies include a water station that conserves water and reduce engineering costs, plus electricity installations that combine high reliability with improved energy efficiency. As Daxing Airport's partner of choice, we're enabling critical infrastructure to drive efficiency and sustainability at scale¹⁰.

Sustainability by design

To deliver sustainable and more efficient airports, it's important to ensure that different stakeholders' business and sustainability goals are communicated openly and early. That's where designers – the design teams and construction consultancies – can be the glue in a matrix of relationships.

Making this cross-disciplinary approach work means designers must think creatively to accommodate different stakeholders' needs and insights into airport operations. Often, they are piecing together a picture from stakeholders who aren't used to sharing knowledge with each other. Some of the data will be complementary too. For example, in power systems some of the most valuable and usable information is from outages, failures and anomalies.

Changes to airport operations and infrastructure can only be successful when they take into account everyone's viewpoints and objectives. Digitalization and sustainability touch every area of operations, so again designers can add a lot of value as connectors.

The payback for comprehensive stakeholder engagement is more commitment to change and closer technological convergence – which are foundations of successful airport designs that deliver on sustainability goals.





The ABB approach

Our real-world experience as a technology leader for over 130 years means we understand how connection and collaboration are essential to achieve a more productive, sustainable future. We connect software and hardware to drive performance to new levels, and our 53,000-strong team in more than 100 countries have a strong track record of partnership in every industry and sector.

For airport construction, we're there for the long haul. Our work with consultants often begins with identifying and validating pain points. To help problem-solve, we show how ABB products and solutions can overcome challenges – no matter how unique they are. We also help to develop power system architecture and technical specifications – from construction to technology decisions and evaluating the proposed designs at every step. Plus, ABB goes beyond fulfilling the brief and delivering the project specification with after sales support and lifecycle services.

Together, we can:



Optimize
your site's energy
efficiency for
more sustainable
operations



Improve
system reliability
for maximum
uptime



Benefit
from long-term
cost savings



Ensure
the safety of
people, equipment
and buildings



Meet your targets
and comply with local
aviation authority
and governments'
environmental
standards.



Planning and design: Data gathering and fact-finding, mapping customer KPIs with products and solutions that can be delivered.



Engineering: Engineering and consultation, tool and solution design, system design and calculations.



Procurement: Putting together solution packages and leveraging our global supply footprint.



Construction: Partnership at each connection and touchpoint during the installation and commissioning, on-site testing and quick adaption to project changes.




Operation: End-user teams meet with ABB teams to develop solutions and speak with R&D teams and to build a project roadmap.



After sales: ABB services and support, maintenance and repairs, spares and consumables, and training.



Lifecycle services: Upgrades and retrofits to preserve your existing investment while driving efficiencies and digitalization.



Creating a more certain future, together.

Many airports are currently investing, re-developing and future-proofing. But they face strong headwinds of economy, environment and energy. Plus, ever-increasing customer demands, expectations and the need for a seamless passenger experience.

All this creates uncertainty, but ABB can help make the future more certain – from the ground up.

Together, we can create airport infrastructure that's digital, smart, efficient and, above all, more sustainable.

For more information and to get in touch please visit:
<https://electrification.us.abb.com/industries/airports>

