

wsp





Airports: prepare for take-off! With passenger numbers set to double, and technology shaking up everything from retail to runways, aviation is soaring into a new golden age

WORDS BY KATIE PUCKETT

The world is taking to the skies. And every one of those journeys will begin and end at an airport.

“There is an ever increasing thirst for travel, whether for business or leisure. We want more from our airports, our aircraft, our journeys, and more for our communities” **Tim Morrison, WSP**

Great cities of the past were built around ports and railway stations. But in today’s globalized world, airports are arguably the most important link to prosperity. Digital

communications allow us to talk to or trade with anyone, at any time, anywhere in the world. But if we want to actually meet them or receive the goods we’ve bought, by far the fastest way is by plane.

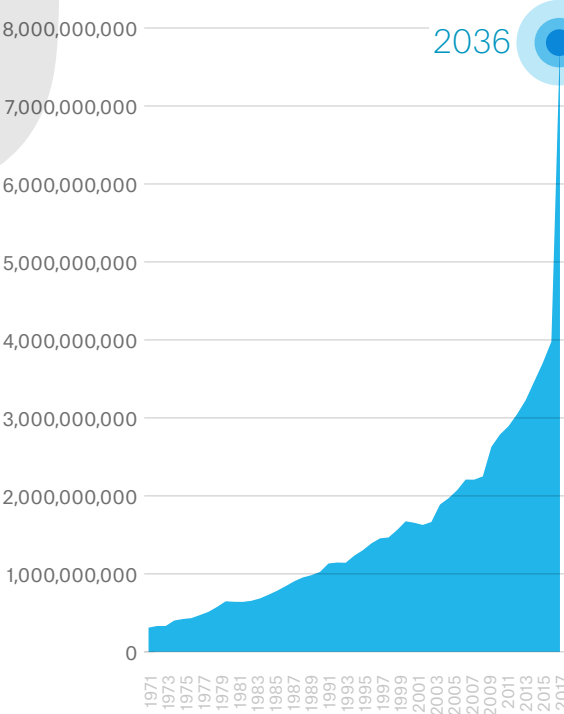
Aviation is a catalyst for economic growth, enabling people and businesses to reach a global marketplace for goods and services and to travel for work, leisure or education. A study of the impact of European airports found that a 10% increase in a country’s air connectivity was associated with a 0.5% increase in GDP per capita. Airports and associated aviation activity create and facilitate €675bn in GDP each year, just over 4% of

the entire European economy.^[1]

Air freight is essential to modern life, but it is in the movement of people that airports have the greatest effect on economic development. Researchers studying the impact of US airports found that higher economic output, wages and incomes, the share of college graduates and high-tech industry all correlated strongly with the number of passengers per capita, rather than with flights or cargo.^[2] “In today’s knowledge economy, far and away, the most precious cargo [airports] move is people,” said Richard Florida at the University of Toronto.

John Kasarda, author of *Aerotropolis*, describes aviation as the “physical internet” underpinning global trade. As the virtual internet exponentially increases the connections between people and places, the physical one will have to keep up ...

Rise in passenger numbers, past and future^[6]



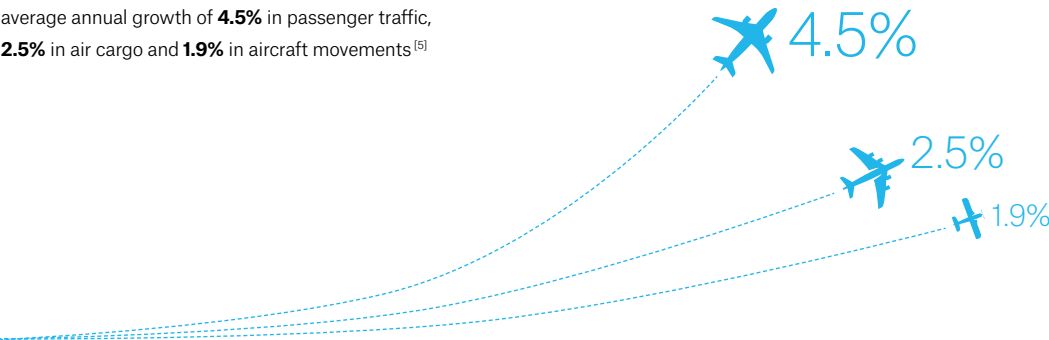
In 2017, more than **8 billion** passengers passed through the world’s airports^[3]



By 2040, annual passenger numbers are predicted to surpass **22 billion**^[4]



Between 2016 and 2040, ACI World predicts average annual growth of **4.5%** in passenger traffic, **2.5%** in air cargo and **1.9%** in aircraft movements^[5]



^[1] Economic Impact of European Airports, ACI EUROPE/InterVISTAS, 2015 ^[2] Richard Florida, Charlotta Mellander, Thomas Holgersson, “Up in the Air: The Role of Airports for Regional Economic Development”, *Economics and Institutions of Innovation* 267, Royal Institute of Technology, Centre of Excellence for Science and Innovation Studies, 2012 ^[3, 4, 5] ACI World, Annual World Airport Traffic Forecasts, 2017 ^[6] ICAO/IATA/World Bank DataBank

SPACES

So airports will have to grow too ...

Between now and 2040, US\$2.6tn of investment will be needed in airport infrastructure, 0.1% of global GDP.^[7] But who's going to pay for it all?

Airports are expensive and asset-intensive — and most of that investment has to happen upfront, before a single plane can land.

"Airports are under intense pressure to expand and to make very large capital investments to renew their facilities," says Jason Brooks, aviation director at WSP. "The pace of change has been very dramatic over the last decade, and it will be even more so over the next." Projects are becoming larger, as the scale, quality and associated infrastructure increases. And they're more complex too, because the building work must be completed without interrupting airport operations.

They may be essential infrastructure, but airports also have to make money.

With investment has come a greater emphasis on profitability and returns. Until relatively recently, nearly all major commercial airports were government-owned and operated. The UK was the first to privatize its airports authority in the mid-1980s, and since then, deregulation has led to a proliferation of different ownership and management models. In 2017, 51 of the busiest 100 airports had some private sector participation, five more than in 2016. Of the busiest 500 airports, 39% had private sector participation, a one percentage point increase on 2016.^[8]

"The fundamental motive for airport privatizations is to finance upgrades or expansion that states are unable to pay for," says Stefano Baronci, director of economics at Airports Council International (ACI) World, the international organization that represents airports. "In an economic climate where states are increasingly

cutting expenditure to reduce debt, government financing and full ownership is not always sustainable. Even government-owned and managed airports are increasingly required to have a commercial focus. Private capital needs to generate fair returns proportionate to the risk."

Airports operate in a market that is tougher than ever.

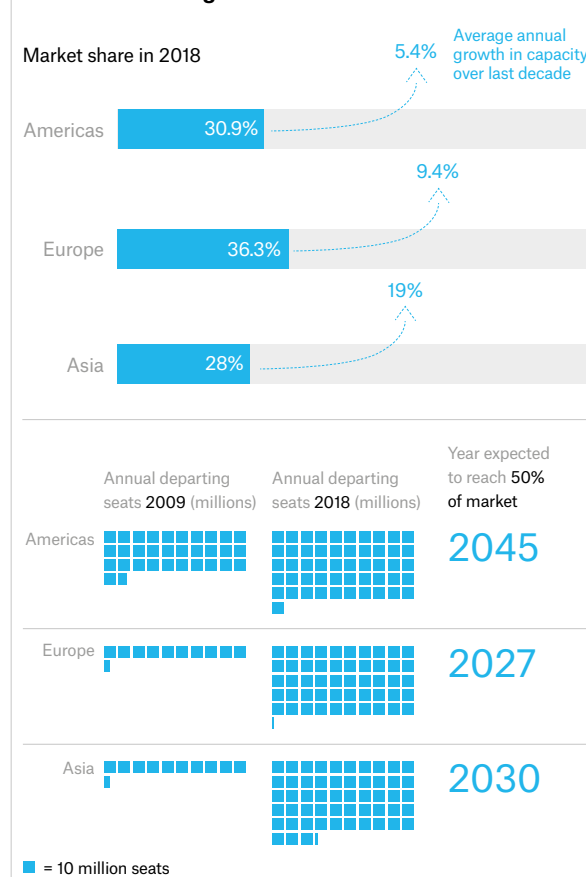
Liberalization opened the door to a new, disruptive breed of carriers such as Southwest, Ryanair, Condor, Easyjet and AirAsia, which now account for around one-third of air traffic worldwide.^[9]

To keep fares low, they offer a no-frills service and demand that airports do the same. Traditional airlines have had to follow suit to compete. So airports' core aeronautical activities have become less profitable, and they are more dependent on other sources of income.

To stay in business, airports need to keep passengers streaming through their departure gates and through their shops, restaurants and bars. We may be paying less for plane tickets, but one way or the other, we'll be paying more for bigger, better airports.

Two-fifths of airport revenues come from non-aeronautical activities, such as food and retail concessions, car parking and advertising. For some airports, the proportion is much higher^[10]

Low-cost airlines growth and market share^[11]



SMALL COMFORTS

Two-thirds of airports operate at a net loss — typically the very smallest

Some 92% of loss-making airports handle fewer than 1 million passengers a year.^[12] But if they weren't there, the loss to the communities they serve would be far greater. "A small region with few inhabitants may not generate sufficient passenger flows for an airport to be profitable," says Mattias Frithiof, strategy consultant at WSP, who has studied the viability of regional airports for Swedish municipalities. "But if you lose it, you lose extremely vital accessibility and you can lose the business community or employers that you do have."

... and take on rivals near and far.

"Airports face pricing pressure from airlines, so they can only make money from passengers. That totally changes the concept, and drives them to put passengers at the centre" Frank Lin, WSP

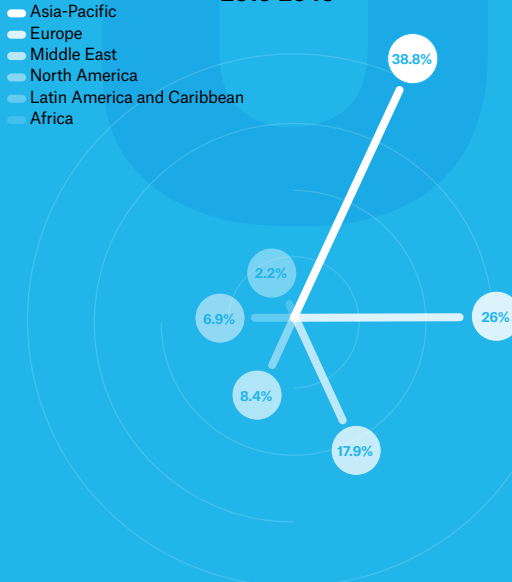
The expansion of aviation has given passengers more choice than ever before, and increased competition between airports, regions and countries.

The global aviation industry operates on a "hub and spoke" model, so airlines typically route passengers through hubs that serve many destinations, rather than offering point-to-point flights between every single combination. This means they can serve a greater range of places more efficiently, and that passengers have a choice of possible routes — and places to make their connection.

The biggest hubs were traditionally in the US and Europe, but a new breed of ambitious mega-hubs has come online across the Middle East and Asia. The global pattern of air traffic is shifting eastwards, as population growth and prosperity is swelling the numbers travelling for work and the middle classes who can afford to fly for leisure in countries such as China, India and Indonesia.

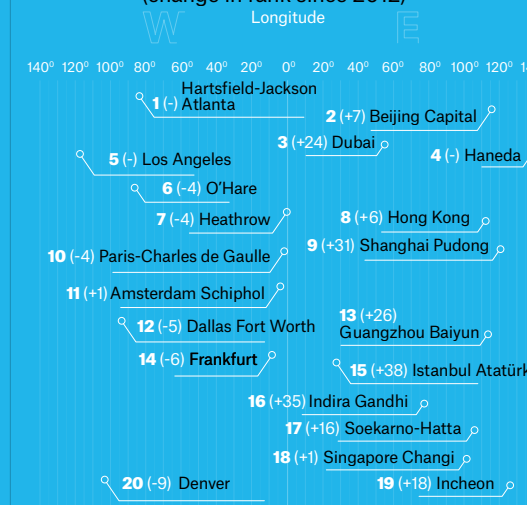
By 2022, passenger traffic in emerging economies will overtake advanced economies. By 2040, airports in emerging economies will handle 61.6% of passengers — 10 billion more each year they do today.^[13]

Growth in international passenger traffic by region, 2016-2040^[14]



Heading east: top 20 busiest hubs

(change in rank since 2012)^[15]



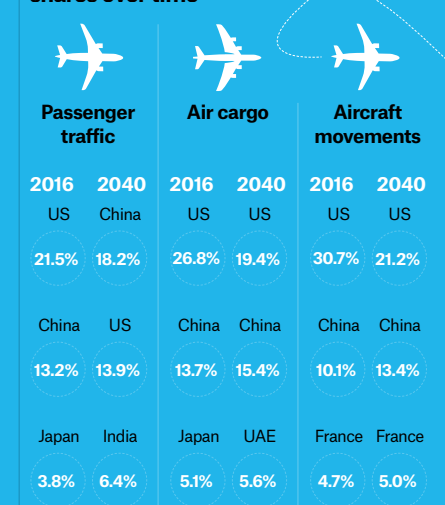
In an increasingly crowded global market, the world's hubs are pitted against one other to attract a fickle, footloose customer base.

"Certain locations are more convenient, but it's all about the level of service that people experience when they're travelling," says Brooks. "Transfers are a very different experience — most people probably never go outside of the airport."

Smaller airports, meanwhile, will compete among themselves to attract the most direct flights and be the best-served gateway to their region.

In a global beauty contest, they all need something to set them apart.

Changing aviation market shares over time^[16]



^[7] G20 Global Infrastructure Outlook ^[8] Policy Brief: Airport ownership, economic regulation and financial performance, ACI World ^[9] STATFOR, EUROCONTROL ^[10] Airport Economics 2018, ACI World ^[11] anna.aero/OAG ^[12] Policy Brief: Airport networks and the sustainability of small airports, ACI World ^[13,14,16] ACI World, Annual World Airport Traffic Forecasts, 2017 ^[15] ACI World

"It is an extremely competitive marketplace and passengers can vote with their feet. Airports neglect passenger experience at their peril" Andy Thomas, Grimshaw

The best security experience is one you don't know you've had.

“It’s about making it as seamless as possible, using AI or biometric screening, so people are hardly aware they’ve been through security” *Antoinette Nassopoulos-Erickson, Foster + Partners*

Even the most frequent flyers admit that air travel can be stressful.

“It’s viewed with a certain degree of glamour, but for most people it’s unsettling,” says Robert Chicas, director of aviation and transportation at HOK. “You don’t know how long it’s going to take to get to the airport or how long it will take to go through security. You’re not sure whether you’ll be permitted to carry your bags on or whether you’ll have to check them. You don’t know if your flight is going to be on time.”

Much of this is down to heightened security measures: the biggest drag on the airport process, and the most disruptive element for how airports look and function. The first were introduced in the early 1970s in response to the threat of hijacking, but it’s since the terrorist attacks on the US in September 2001 that security has become such a dominant feature of airport operations.

There is no question of relaxing security. But we aren’t far off the next best thing: making it invisible. Advances in biometrics, facial recognition and scanning cameras that detect hidden objects will allow

passengers to be identified and cleared to fly while they are walking through the terminal. And it helps that almost every passenger now carries a tracking device — otherwise known as a smartphone. Greater data collection and analysis will be used to screen people and track their progress through the terminal building and on to the plane.

“All of the separate processes that passengers are filtered through nowadays — check-in, immigration, security, boarding — will be much more integrated in future,” says Jelmer van der Meer, director of airport civil engineering at Netherlands Airport Consultants (NACO). “You’ll go through one process and all the others will automatically run in the background without you noticing.” Frequent flyers who are well known to airports, airlines and immigration services could have a “trusted passenger” status, so they go through an even quicker, streamlined process. “There will be a lot of focus on using data to predict human behaviour and to find out their preferences and how to cater for them.”

This is not necessarily far away, says van der Meer. “There is a lot to gain by optimizing how we use the infrastructure we already have, but it very much depends on the willingness of countries and government bodies to work together. That will always be a big bottleneck. Security services, immigration, aviation police,

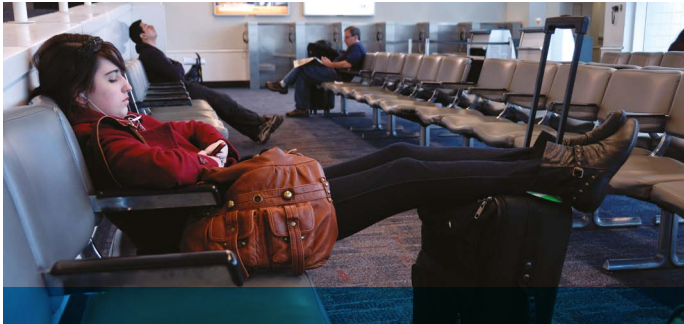
airlines and airports will all need to collaborate, rely on each other and share data.”

You won’t have to worry about that suitcase either.

“Uber and Lyft have revolutionized what it means to take a car service or a taxi to the airport,” says Chicas. “It’s pretty clear that there’s going to be a similar revolution in how baggage goes from point A to point B. Rather than travellers taking their bags to the airport and waiting in line, the

baggage handling process will be completely streamlined.”

More and more elements of a passengers’ journey have been relocated outside the airport — it’s possible to check-in and buy duty free before you arrive at the airport, and baggage is likely to go the same way. Passengers might drop their suitcase downtown before continuing to the airport unencumbered, or it might be collected by an autonomous vehicle from their homes on the morning of their flight.



[18]

LAGUARDIA'S TERMINAL CURE

Enhanced security has been extremely difficult for older airports to accommodate. “The evolution and unexpected consequences of today’s security protocols were simply never anticipated,” says Chicas. “Airport terminals that pre-date security either function very poorly or they’ve been replaced. The US is littered with airport terminals built in the 1950s or early 60s that have failed to adapt.” One airport of this vintage is New York’s LaGuardia, where HOK and WSP have designed the new 35-gate, 1.3 million ft² Central Terminal B, set to more than double its capacity. The existing terminal was built in 1964 to accommodate 8 million passengers a year, but now serves 15 million. The vision is to restore LaGuardia as a “unified airport”, rebuilding outdated infrastructure, streamlining passenger flows and creating an exceptional traveller experience, says Chicas. “This is a very good example of the type of terminal that the industry needs as we move into the 21st century.”

70% of travellers are prepared to share their personal information for a quicker airport experience. 64% would prefer to use biometric identification [17]

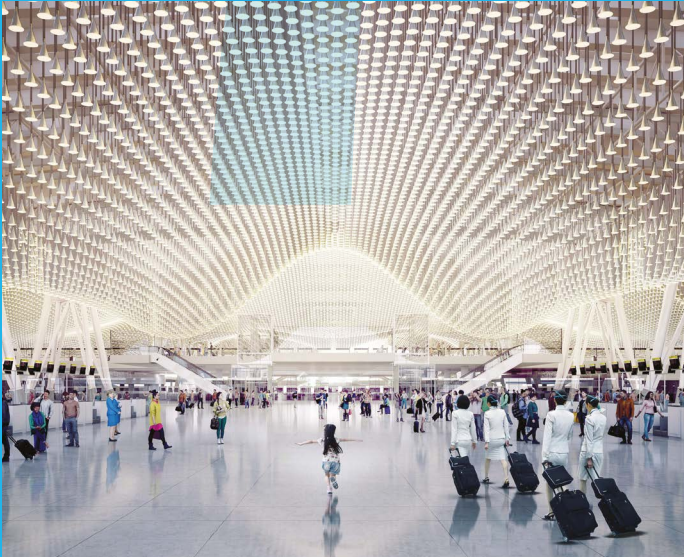
Facial recognition and intelligent vacuum cleaners: Welcome to the automated airport.

“When you go to the airport in 2025, there probably won’t be any people serving you. There will be robots instead” *Frank Lin, WSP*

In the future, technology will underpin every aspect of the passenger experience and operations in the terminal and on the airfield.

Tailored information will be pushed to passenger smartphones, from the best route through the airport to the least crowded seating areas, as well as offers from retailers, restaurants and bars. This will have profound implications for wayfinding — and for the giant banks of signage that dominate airport interiors. Why would we need signs when everything we need to know is on our phone, and we can simply touch any wall for an instant, personalized update?

The airport workforce will be much smaller, and concentrated in customer-facing roles. Robots are already taking their first tentative steps to welcome passengers, answer their questions, escort them to gates, and clean up after them. Fitted with touchscreens, cameras and rapidly improving algorithms — and speaking multiple languages — they will take your drinks order at Oakland Airport, or dance for you in San Jose. At Geneva, Leo the bag-drop robot will print your tag and take your suitcase at the taxi drop-off. Robots do more than



[19]

schmoozing. At Incheon, a cleaning robot with cameras, light sensors and bumpers learns which areas need vacuuming most frequently. Shenzhen’s Bao’an security “Anbot” takes pictures of passengers and sends them for analysis, and is fitted with a taser.



[20]

It’s on the airfield that automation is really coming into its own. “The airfield is a dangerous and highly controlled environment,” says Brooks. “Instead of putting people out there to go and get bags, refuel planes or load meals, that will be readily automated pretty quickly.” Airports also have much greater freedom freer to experiment with technologies such as autonomous vehicles (AVs) because they’re not governed by the same regulations as public highways.

➔ At **Charles de Gaulle** in Paris, driverless shuttles are ferrying airport employees on an intelligent road network. ➔ **London Gatwick** is experimenting with electric AVs to move staff between locations

Smart service

The new Terminal 3 at Taoyuan International Airport in Taiwan, designed by Rogers Stirk Harbour + Partners, will have an “integrated passenger self-service programme”, where passengers will be able to do everything themselves using a smartphone, or with the help of friendly robots, using facial recognition and natural language processing. “You will be able to speak to them, and they will help you to handle baggage or book flights,” says Frank Lin, WSP general manager in Taiwan, who is leading the ICT design.

on the airfield, allowing transport needs to be met by a much smaller fleet of vehicles. ➔ **Rotterdam The Hague** in the Netherlands is launching an autonomous baggage handling system that replaces fixed conveyors and sorting systems — each vehicle carries a single piece of baggage and determines the optimal route through the airport. ➔ Norway’s **Fagernes Airport** has become the first to use self-driving snowploughs, each able to clear 357,500m³ in one hour. ➔ Airport operator Ferrovial has trialled drones to carry out airfield inspections at **Southampton Airport** in the UK. Unmanned aerial vehicles can cover large areas quicker than humans, capturing images and video in high resolution.

[17] IATA 2017 Global Passenger Survey [18] LaGuardia airport, Amy Cicconi/Alamy Stock Photo [19] Rogers Stirk Harbour + Partners [20] Airport cleaning robot at Incheon International Airport, LG Electronics

SPACES

Is it a bird? Is it a plane?
The changing shape of aircraft.

“There really is no limit to what is possible over the next 100 to 200 years. When we’re talking about aviation, our wildest imaginations need to be taken seriously” *Robert Chicas, HOK*

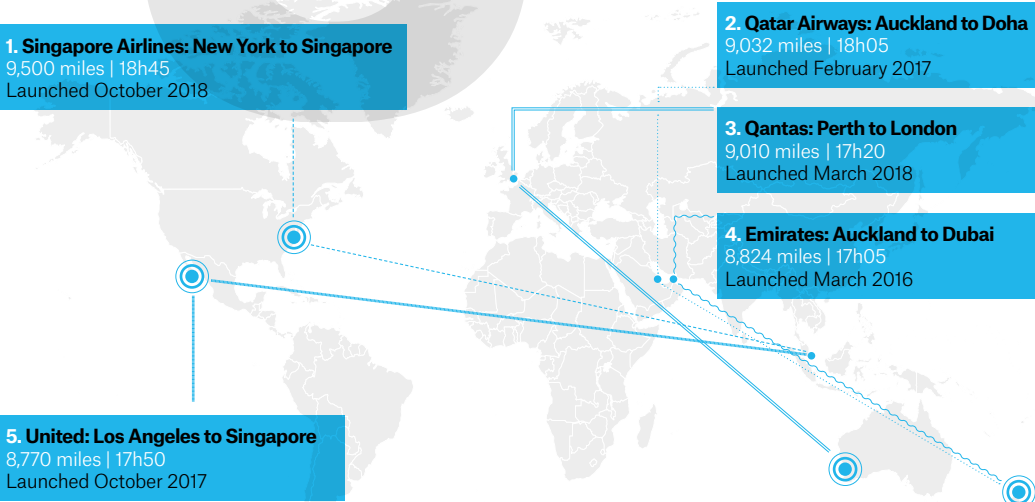
The technology that will have the greatest impact on airports is aircraft themselves.

“Currently we are facilitating landing, take-off and parking of aircraft that have essentially been the same for the last 70 years: a flying cylinder with wings and a jet engine,” says Jelmer van der Meer at NACO. “But everything that’s happening in the car industry will happen at some point in aeronautics. Aircraft will start using hybrid type engines, maybe even electrical or solar power.”

Aerospace companies are under pressure to innovate: from 2019, aircraft operators will have to report their carbon emissions and, from 2021, pay to offset them. They also face competition from disruptors such as Elon Musk’s Space X and Google’s Planetary Ventures. In 2016, a KPMG survey of aerospace and defence manufacturers found that investment in R&D was set to “skyrocket”, with 45% intending to spend more than 6% of revenues on research.^[24]

Jim Heidmann, manager of NASA’s Advanced Air Transport Technology Project, has described this as a “tipping point” for commercial aviation: “We are exploring and developing game-changing technologies and concepts for aircraft and propulsion systems that can dramatically improve efficiency and reduce environmental impact.”

The world’s longest flights are getting longer ...^[25]



Aircraft will become lighter, more efficient, cleaner and quieter.

Manufacturers are exploring new materials and more aerodynamic structures, electric propulsion and energy storage. “We’re already burning a fraction of the jet fuel per passenger kilometre than we used to,” says WSP’s Tim Morrison, “and aircraft manufacturers are spending tens of billions a year on alternative propulsion — not just biofuels and mixing up various fuels to make them leaner and greener, but actually completely changing the technology.”

Technologies developed for the military and space exploration will also find commercial applications, such as “hypersonic” flight at more than five times the speed of sound. Earlier this year,

Chinese researchers unveiled a hypersonic jet that could whizz 50 passengers from Beijing to New York in just two hours.

Less radical for passengers but massive for airports will be the retractable wing. Boeing’s 777X is the first passenger plane to feature wing tips that fold in while it’s on the ground, so it has an extra-wide wingspan for more efficient flight but can park up at smaller gates. Airports have already had to adapt to accommodate supersized Airbus A380s, but this could enable them to shrink down again.

Further off and even more radical would be vertical take-off and landing, or VTOL. In 2016, Boeing filed a patent for a VTOL passenger plane for up to 100 passengers; earlier this year, Airbus completed the first full-scale test

flights for Vahana, an all-electric self-piloting VTOL aircraft that can carry a single passenger. “If aircraft could take off vertically,” says Morrison, “then all of a sudden, rather than needing a plot of land a few miles across, it could be a fraction of the size. You could start to use building rooftops or transport hubs, such as stations or car parks.”

Each new generation of aircraft is on average 20% more fuel-efficient than the one it replaces. Over the next decade, airlines will invest US\$1.3tn in new planes^[26]

ROOFS OVER THE UNKNOWN

Changing tech will require flexible, expansive spaces

It may be several decades before today’s disruptive innovations become the norm. But when they do, the airports we’re designing now will still be around and they’ll have to accommodate them. Airport buildings typically have a design life of at least 40 years and take a decade to deliver. That’s why the single most important feature of a new airport is flexibility — which means long spans with few columns, so the structure doesn’t interrupt the floor plates and they can be easily reconfigured. Contemporary airports are, more than anything else, capacious roof structures soaring over spaces with as few fixed elements as possible.

“We sit on the cusp of some really fundamental shifts in the way that airports are operated and the way that passengers experience them,” says Andy Thomas, partner at Grimshaw. “As so much of this change is unknown, there’s a limit to how much we can design and plan for it now, so we need strategies that will allow the airport to evolve over the next 30 to 40 years. Those that don’t will slowly decline and ultimately cease to be fit for purpose.”



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CLEAN, GREEN, RUN BY MACHINES

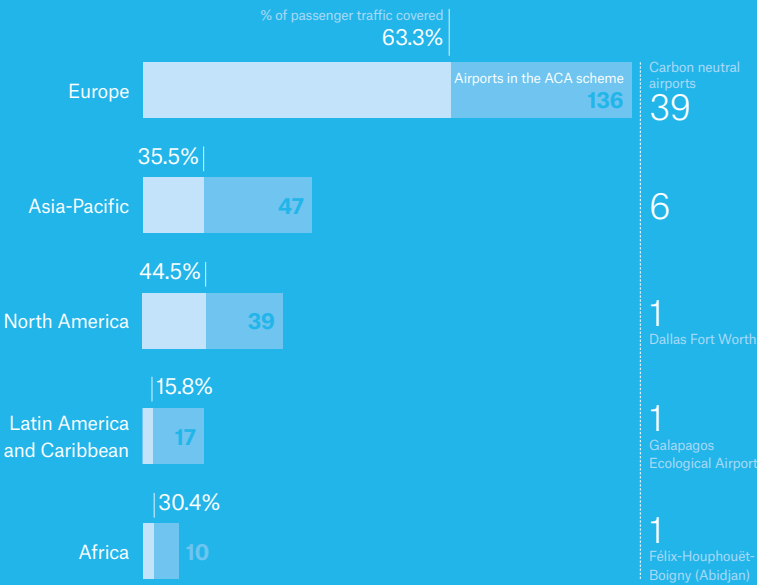
A carbon neutral future for airports

Civil aviation is responsible for 2% of global man-made carbon emissions, and the sector has committed to carbon-neutral growth from 2020.^[22] Airports account for a relatively small proportion, but they still have plenty of scope to improve — WSP found that one UK airport operator could cut its annual utility costs by £2bn.

“To become carbon neutral, we often just have to do the right thing very well,” says Tim Morrison, aviation director at WSP. “We know what to do, the science hasn’t changed. It’s inexcusable not to design and implement sustainable solutions.” Building performance can be optimized by analyzing the thermal properties of the envelope, reducing the energy demands of the operations inside, and using renewable technologies to provide the residual demand for heat, cooling and power. With their large roofs and even larger pavements, airports have ample opportunity to harvest rainwater and generate their own clean energy on-site. In India, Cochin International is the world’s first solar-powered airport, with 45 acres of solar PV panels. In the less sunny UK, Gatwick also has a solar array, complemented by a unique biomass system for disposing of aircraft waste to generate heat and electrical power, while reducing off-site disposal of contaminated waste.

Airports could also help aircraft operators to meet their own commitment to carbon neutrality. WSP is advising Seattle-Tacoma on the infrastructure it will need to offer a reliable supply of biofuels on-site — with the potential to cut aircraft emissions by 25%.

In the ten years since Airports Council International launched the Airport Carbon Accreditation programme, administered by WSP from the outset, 249 airports in 68 countries on every continent have been certified, representing 43.3% of global air traffic. So far, 48 have reached the highest level, which means they have reduced their direct emissions as far as possible and offset any that remain. The goal is for 100 airports to be carbon neutral by 2030.^[23]



^[21] Queen Alia International Airport by Foster + Partners, Nigel Young ^[22] IATA

^[23] airportco2.org ^[24] Global Aerospace and Defense Industry Outlook 2016, Forbes Insights ^[25] BBC and other sources ^[26] IATA

SPACES

Heathrow 2030: Sustainability, saunas and very little signage.

Expansion programme director Phil Wilbraham explains how the UK's biggest airport intends to double passengers while creating a more personal service

You don't embark lightly on a £14bn construction project on a constrained site next to one of the world's busiest airports. But Heathrow has no choice if it is to remain a hub of choice in an increasingly crowded market — it has been operating at close to full capacity for a decade. With a long-awaited third runway just given parliamentary approval, Heathrow will be able to boost annual passenger numbers from 78 million to 130 million and add 40 new long-haul routes, says Phil Wilbraham, expansion programme director. "It's so we can continue to connect Britain to where the growth is in the world. If we don't take this opportunity, it will be very difficult for a two-runway airport to grow beyond 85-90 million passengers."

That growth is also dependent on Heathrow continuing to meet passengers' growing expectations, and Wilbraham is well aware of the competition it faces from hubs elsewhere in Europe and in the Middle East. "I think it's about providing a more individualized service. In the past we have tended to think of passengers as they are on the plane: first class, premium, economy. It's not as simple as that. We need to give people more choice so that they can create their

"It's about providing a more individualized service. In the past we tended to think of passengers as they are on the plane: first class, premium, economy. It's not that simple"



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own journey rather than having to fit into the mould of the airport."

Technology will liberate travellers from queues — "it has the potential to take us to a place where you don't even feel that you're being processed, you're just walking through a building to get to where you want to be" — and empower them to roam more freely through the airport. "I don't think it will be that long before people will start to find their way

using their phone or tablet. So in 20 years' time, you won't need many physical signs because most people will know their route." As conventional shopping goes online and retail takes up less space, travellers will be able to pick and mix from a much wider range of activities: "There could easily be a place where you watch a movie or TV or go and relax or get some kip between flights — maybe have a sauna."

Wilbraham expects that fewer travellers will arrive by road, with improved public transport options and new high-speed rail links. Driverless cars will ease capacity issues by reducing the

space required for car parking and forecourts. Electric vehicles will need somewhere to charge — but their batteries could be used as storage for renewable energy, to even out supply and demand. Ultimately, the target is to make the airport's expansion zero-carbon.

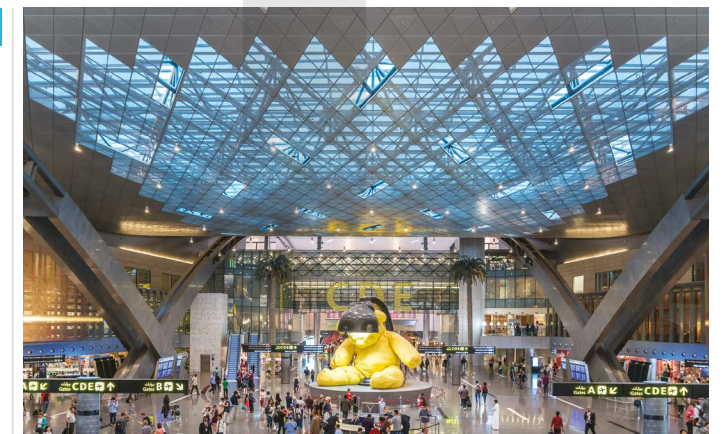
Sensitive growth

Like many global cities, London has an uneasy relationship with the airports that have underpinned its success, and especially its major hub. It took almost 20 years to plan and build Heathrow Terminal 5, and it is already nearly that long since the third runway

was first mooted. So Heathrow intends to "grow sensitively", says Wilbraham. Quieter engines will help — airlines are incentivized to bring their newest planes and stick to the least disruptive flight paths. "We also want to ensure that the local community is properly attached to the airport, to merge the transport gateway and the city as much as possible, and at the same time create a great place to live and a great place to actually work. It's really important that those things merge more than they have done in the past."

Heathrow's workforce of 70,000 will grow too, but probably only by about 20%, and the skills profile

will change with the advent of automation. Autonomous tugs already work on the airfield and it has hosted a trial of a "CargoPod" that could move goods around the airside perimeter. "People are going to want a personal service as much as they are going to want the benefits of automation, so there will always be someone around who can help. It will be no bad thing when people don't come to work to move bags by hand, but to use a machine that moves bags. But it will need to be very sensitively worked through to ensure that the passenger gets the right service and that we get the right sort of efficiencies."



HAMAD: YOUNG, DELUXE AND DISRUPTIVE

It only opened in 2014, but it's already challenging established hubs

Ten years ago, just over 5 million people a year passed through Qatar's Doha International Airport; today, its successor, Hamad International, serves 30 million, with a planned rise to over 50 million for the 2022 World Cup. In 2018, it was ranked as the best in the Middle East, and the fifth best in the world. CNN called it "the most luxurious airport on the planet".

HIA is well located to capitalize not only on the growth in global air traffic, but on its eastwards shift. Its expansion plans are ambitious — a second cargo terminal will double capacity to 2.8 million tonnes, and 100ha are set aside for an airport city. But it's in the field of technology that chief operating officer Badr Mohammed Al Meer sees the real competitive advantage. The future of HIA will be more automated, he says, as artificial intelligence frees staff to focus on more complex

issues. The airport's app already acts as shopping directory, e-commerce platform and routefinder, but Al Meer foresees augmented and virtual reality playing a greater role, for passengers and staff. "It can enhance wayfinding through camera navigation and create new ways to visualize and interact with the airport's operational data, including aircraft movement, passenger movement and retail analytics."

Biometrics and facial recognition will further speed up security, and robotics and AI will be trialled to respond to simple passenger requests. HIA will also explore the use of blockchain for rapid, secure data sharing across the network. "Automated decision-making, as the next major trend, will see the use of technology to analyze real-time airport operations to aid in decision-making, which in turn leaves no room for wrong decisions."

So what will we do in the airport of the future? Anything we want.

“As airport processes recede and cease to define the passenger experience, there’s an opportunity to spend time there in a much more enjoyable way” Andy Thomas, Grimshaw

Tomorrow’s airport is not just a place to catch a plane or pick up some duty-free. It’s a destination restaurant, a legendary cocktail bar, a comfy place to sleep, a wellness sanctuary, all tailored precisely for each traveller with smartphone notifications and special offers. No two journeys through it will be the same.

Airports could even become destinations in their own right, the stopover as much a part of the journey as the end point. But they will need to pay far more attention to the arrival experience — traditionally the poor (and low-spending) cousin of departures. “When we design airports, there’s far too much focus on the departing passenger,” says WSP’s

Tim Morrison. “It’s really important to have that wonderful sensation of arrival too. And then you might think, ‘It’s such a spectacular place to be, why don’t we stay here?’ You might spend a few days in the airport as part of your R&R before moving off into the city for the rest of your break. As a concept, it sounds nuts. But the airport experience is already light-years ahead of what it used to be.”

Airports still need passengers to spend money. But they need to be clever about it. The most successful retail offer isn’t the most densely packed, says Grimshaw’s Andy Thomas. “People who feel harassed and harangued, like they’re being attacked on all sides

by retail offers that don’t interest them, can start to close up. People who are comfortable, relaxed and happy in their environment are much more likely to spend money.”

Grimshaw designed Istanbul New Airport, with Nordic Office of Architecture and Haptic, inaugurated in October 2018 and one of the largest in the world. “There is a very substantial, grand airside hall which offers pretty much every type of experience, including wonderful, peaceful spacious areas for people just to sit and relax,” says Thomas. “You don’t have to commercialize every square foot of the international departures lounge. If we provide places for people to sit and rest and take stock, they’ll be in a

much better frame of mind to get on their plane. But also they might decide that there is something within that space that’s appealing to them and that they’d like to take the opportunity to explore and be entertained.”

As on the high street, airport retail will be more about engaging travellers with the brand than persuading them to spend then and there. “Some of the most valuable pieces of space within the airport are big brand and media experiences, for a company to share their brand identity and values with a customer base that tends to have money in their pockets and be prepared to spend it,” says Thomas.

Singapore’s Changi Airport already has a butterfly garden where weary travellers can reconnect with nature. But the Jewel development takes it a step further. Opening in 2019, it is intended to become a “lifestyle destination” in its own right, both for international visitors to Singapore and local residents. It includes a five-storey air-conditioned garden, with walking trails, slides, a maze and the world’s tallest indoor waterfall, as well as dining, retail, business facilities and hotel cabins that can be rented in hourly blocks.



“What airports need in order to be genuinely successful destinations is ‘spirit of place’. Spirit of place helps pivot passengers to shoppers. It can disrupt the traveller’s mindset by revealing the rich bounty of a local story. To be effective it must be a ‘living story’, meaning it has continuity with the past, represents the present too and grows as the local story evolves.”

Lewis Allen, director of environments at retail designer Portland



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Above all, the airport of tomorrow will be somewhere.

“The airport is your first impression of a place and your last recall when you leave,” says HOK’s Robert Chicas. “So your arrival in one location should be fundamentally different than another location with a completely different culture or vibe. It’s the difference between an airport being a vessel to receive and send passengers and it being a reflection of a particular place.”

HOK’s new Central Terminal B at LaGuardia will feature “pocket parks”, places to sit and rest with indoor trees and play areas for children, echoing those found throughout New York City. Meanwhile, Long Beach, couldn’t be anywhere other than southern California, with outdoor areas where passengers can chill by a firepit with a glass of wine while

waiting for their flight.

Grimshaw’s giant terminal for Istanbul New Airport draws on the classical structures of Mimar Sinan, father of Turkish architecture (or “mimari” in Turkish). “It’s about how we create environments that have a kind of warmth for passengers and a scale that’s understandable, all within this genuinely massive building enclosure,” says Andy Thomas. “We took inspiration from how light animates spaces, the rhythm and proportion of these environments, the texture and the patterning. These all help to make the building particular to its place and something that the people of Istanbul can take to their hearts.”

As airports have become larger, architects are also borrowing concepts from urban planners. “It’s about differentiation and placemaking,” says Antoinette Nassopoulos-Erickson, senior



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[27] Grimshaw [28] gnoparus/
Shutterstock.com [29] Jewel Changi
Airport Devt. [30] Grimshaw
[31] HOK

SPACES

“SOME AIRPORTS TREAT YOU LIKE SHEEP”

Not everybody loves duty-free ...

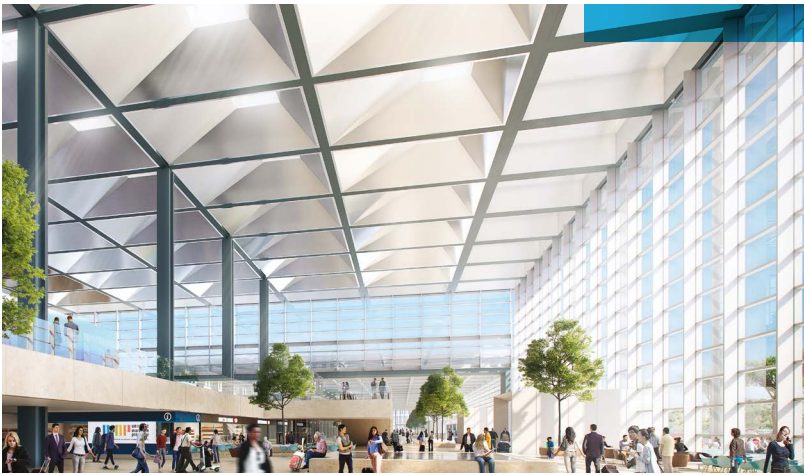
Richard de Neufville admits that his is a “contrarian” view. Like many frequent business travellers, the MIT professor hates having to march through a shopping centre when he just wants to get home. “Some airports treat you like sheep. They want to keep you in the shopping area for as long as possible so you can’t go to where you actually want to be. What I really want to do is get to my gate with a minimum of fuss.”

De Neufville is an engineer and system designer who specializes in airport planning. He has been associated with airport projects on every continent, and is currently working with Singapore’s Changi on its massive 1,080ha extension. In the future, he believes more passengers will think as he does. “There won’t be that much emphasis on shopping malls anywhere, let alone at the airport. Big box stores are closing because people prefer to buy things more cheaply online. So the idea that it would be a special treat to go to a duty-free store and then have to carry the stuff around doesn’t make sense. The cost of building a shopping mall in a very congested expensive place doesn’t make sense either.”

The other part of the equation is the rise of low-cost travel, making flying more accessible and less of a special occasion. “Low-cost airlines are taking over and they’re increasingly asking for facilities that serve their needs.” Low-cost travellers need somewhere to buy a takeaway sandwich, as they won’t be offered free food on the plane, but they’re less likely to view their journey as an extended shopping trip.

Efficiency, convenience and ease of operation will be the hallmark of future airports, says de Neufville — not just for passengers but for airlines too. Outside of the US, airports have not typically been designed around operators — for example, to minimize taxi time or make it easier to manoeuvre. “But the cost of even small delays really mounts up — the full economic cost to operate an aircraft is about £100 a minute. Making it efficient for operators means they can deliver better prices to customers. Ultimately that can drive a lot of the design.”

Airports can be bigger but still user-friendly, he argues. Look at Atlanta, which serves more passengers than any other airport in the world: “It’s huge but in terms of what’s provided, it’s really very simple. The future is not an extension of the past. Right now the tendency of a lot of places is to build monuments for themselves. But if that’s important to them, there are ways of doing it more economically and efficiently.”



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partner at Foster + Partners. Its extension to Marseille airport, on which WSP is the engineer, will make the most of the legendary Provençal lumière with a continuous grid of skylights that act as giant lanterns. “When you arrive in Marseille, you’ll know you’re in Provence,” says Nassopoulos-Erickson. “The colours, the light, the relationship to the landscape, the relationship to the sky, the food

that’s on offer ...”

Transparency and glazing is important, not just for natural light and views but so that people can watch the planes, she adds. “We’re keen that people have a connection not just to the landscape but to the aircraft, so they don’t feel like they’re in an anonymous place with no relationship to the experience of air travel.”

Welcome to ... Earth



For the ultimate sense of place, head to Spaceport America in New Mexico, designed by Foster + Partners. “Astronauts who’ve had the experience of going into space and coming back talk about how precious the Earth is and how concerned they are about the environment,” says Nassopoulos-Erickson, the project architect. “Our design for that spaceport was very terrestrial: when you look at it, it’s very earthy, it’s something buried in the ground, in contrast to the sleek spacecraft. There’s a wonderful view across the New Mexico desert to the hills beyond, to give you sense that you are part of that world.”



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Airports may even become cities in their own right.

“Look for yesterday’s busiest train terminals and you will find today’s great urban centres. Look for today’s busiest airports and you will find the great urban centres of tomorrow” John D Kasarda

The airport will become the best connected place in the city, and a much more integral part of it.

The key word for sustainable airport development is multimodal. Airports will be hubs for city and regional links and mass transit of many kinds: high-speed rail, autonomous vehicles, hyperloop, drone taxis ...

As airports become quieter, cleaner and better connected by mass transit — and cities more crowded and congested — they suddenly present a much more interesting development opportunity. Gensler aviation lead Ty Osbaugh believes that with better transit links and landside amenities, the airport city will evolve from logistics centre to mixed-use development to micro-city: “This evolution makes the airport part of the larger community. The reality of living near an airport has many benefits, and the amenity of quick travel to the central city will attract talent.”

The earliest examples of the

“Connected airports will connect not just one city to another, but to passenger lifestyles, to the cities in which they are located, and to the emotional experience of travel” Ty Osbaugh,

Gensler

aerotropolis — a city whose layout and activities centred around an airport — were founded on time-sensitive manufacturing and distribution businesses that relied on fast links to distant customers, such as FedEx in Memphis or UPS in Louisville. In his book *Aerotropolis: The Way We’ll Live Next*, University of North Carolina professor John D Kasarda describes the aerotropolis as “the logic of globalization made flesh in the form of cities”. That logic has made some form of airport connectivity essential for all businesses.

But it works both ways. In a world that is seamlessly connected by the internet, innovation is the greatest differentiator for companies. For that, they rely on attracting the brightest human minds — and those minds don’t want to work on an industrial estate. They’d rather be in a vibrant, thriving city, with the airport a short, easy hop away. Whether that’s a brand new city built around the airport, or an established city with a fast mass-transit connection, will depend on how successfully airports are able to become fully functional urban centres.

Many new airports are deliberately planned with adjacent city-sized lots.

Taiwan’s Taoyuan Aerotropolis Plan envisages jobs for 200–300,000 people, as well as homes, recreation facilities and amenities for the new communities. →

GOODBYE, AIRPORT PARKING

Parking is the single biggest chunk of airport’s non-aeronautical revenues, and rental cars are the next biggest: together they make up around 60%.^[34] The convenience of ride-hailing apps such as Uber and Lyft has already dented the appeal of car ownership for millennials, and in the not-too-distant future, shared autonomous vehicles could make it almost obsolete. That spells the end for airport parking as we know it. Why pay to leave your own car at the airport for two weeks when you can summon a lift when you need one? Driverless cars will simply drop off their passengers and head on to their next pick-up, but they’ll also need somewhere to wait and to recharge their batteries — and where better than the airport? “They tend to be very well connected to road networks and there will always be high demand,” says Grimshaw’s Andy Thomas.



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Connecting Ontario

Within 20 years, Toronto Pearson expects annual passenger numbers to almost double. It’s new regional transit centre, designed by HOK and WSP, will not only accommodate this growth but improve connectivity throughout the region. The airport is in a unique position to link towns and cities throughout Ontario, located between three municipalities, four major highways and a number of planned and existing transit lines.

^[32] Foster + Partners ^[33] Nigel Young/Foster + Partners ^[34] ACI North America ^[35] Union Pearson Express, Tom Arban Photography

SPACES

Or maybe the city will become an airport ...

“We’re seeing the largest innovation in aviation since World War II. Cities are becoming vertical” *Adrienne Lindgren, WSP*

A new space race is on. The goal is on-demand urban aviation: electric VTOL drones piloting themselves over congested cities, cutting commutes from hours to minutes.

Uber is aiming to start demonstrator flights of the Uber Air service by 2020, and full commercial operations by 2023. Dubai’s rulers are enthusiastically pursuing test flights of Volocopter air taxis to a similar timetable, and Singapore’s civil aviation authority is working with the European Aviation Safety Agency and Airbus to develop standards for urban aviation. The European Commission launched its Urban Air Mobility Initiative in May 2018 and nine cities and one region have since signed up to take part in pilot schemes.

“We’re seeing the largest innovation in aviation since World War II, and there’s certainly a component of first out the gate,” says Adrienne Lindgren, a specialist in urban aviation at WSP. “Cities are becoming vertical.”

Lindgren recently joined WSP from the mayor’s office in Los Angeles, one of two Uber Air launch cities in the US, where she was developing policies to help the city integrate new forms of mobility. Full-scale implementation won’t happen until closer to 2033, she believes, partly because airspace is so heavily regulated. But it is this that presents city planners with a golden opportunity, allowing them time to plan how and where urban aviation happens. It could be the

missing link that better connects existing transit systems into a more functional whole.

What this actually looks like will differ from city to city. “Aviation has

been built on a very specific standardized system, and this will really challenge all of the parties involved to think a little differently. If this becomes a reality, our conception of airports will change — the city will be an airport.” In Dallas — Uber Air’s other US launch city — urban aviation could connect the city’s sprawling suburbs and decentralized transport nodes. In southern California, it could add significant regional connectivity: “We don’t have trains, but we have a lot of people spread out. It’s so contentious to build on land in the US, owing in no small part to the number of competing and incumbent stakeholders on the ground, that I honestly believe it will be easier to activate airspace.”

Uber Air will link transit nodes rather than running point-to-point, at speeds of 150-200km. Its ideal city is large, sprawling, densely populated, polycentric

and congested, and if it has a large airport that can’t be reached inside an hour, that would make for a “compelling use case” too. It has narrowed the search for a third launch city down to Japan, France, Brazil, Australia and India. Lindgren foresees that small, forgotten or outlying airports could be brought back into the fold of a regional system. Major airports, meanwhile, will have to decide whether or not to welcome low-altitude interlopers, and how such services will integrate with their own transit, security and electricity networks.

There are armies of experts on both the technology and regulatory aspects. But there’s a crucial gap in the middle, believes Lindgren, for engineering and consultancy on how to implement urban aviation technologies for the good of city inhabitants. “What there hasn’t been a lot of to date are people working at the intersection — how do you integrate these into traditional infrastructure planning processes? Implementation is going to be extremely complicated because it’s going to touch so

many different areas.” The biggest challenge will not be technical so much as political: gaining public acceptance. “It’s going to really change the visuals of the city. We have to think about defining the public benefit of these technologies, otherwise why are people going to accept having them clutter their skyline?” Services will need to be affordable, says Lindgren: “As aviation becomes local, people will have the capacity to legislate you out of their airspace. That’s a real concern: if no one sees the value, or the value is only there for 2-5% of your population, people will resent having it in their skies.” There will be a cultural shift for all concerned, as ground transport providers and municipalities get to grips with aviation for the first time. This is where airports are uniquely placed to help. “Airports have tended to do their own thing in the past, but increasingly you will see them included in conversations about how we plan cities and about oversight of all these different assets. Airports will continue to become more important in dictating urban power centres.”

“We’re trying to build an ecosystem for all the logistics and cargo companies, but also to boost totally new industries to contribute to GDP growth,” says WSP’s Frank Lin. The government particularly wants to encourage innovation in four tech fields — Internet of Things (IoT), smart city technology, AI and green energy — and is building dedicated R&D facilities to lure entrepreneurs from across Asia.

Older, landlocked airports are sitting on vast tracts of land currently devoted to parking —

for which redevelopment looms. “That’s a scary thought for many airport operators — but it presents a tremendous opportunity to rethink the types of facilities and services that airports offer their customers on the landside,” says Max Hirsh, professor at the University of Hong Kong and author of *Airport Urbanism*. “At present, some of the airport’s most valuable real estate is occupied by parking structures. Successful airports are re-evaluating whether that still makes sense.” He gives the example of Amsterdam

Schiphol’s new valet-parking model. Passengers drop off their cars next to the terminal, which are then parked at a remote facility, freeing up land for more lucrative uses.

Those budding aerotropolises will be in competition with the cities they serve. So they have to offer the things that real cities do. A mix of commercial and residential buildings is not enough — developers must fill the gaps in between with all of the less

obviously valuable or glamorous amenities that are essential to city life: childcare, gyms, grocery stores, outdoor seating areas, places for food trucks. “If we really want to create a new type of airport urbanism that is irresistible to both residents and visitors,” says Hirsh, “we need to focus on things that people enjoy doing in their free time: playing with their children, relaxing with friends over a tasty meal, shopping for unusual products, listening to good music, going for a walk in nature.”



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[36] Swedavia Airports [37] NASA

Co-working in arrivals

In the fast-growing, land-poor, more communal societies of the East, airports are becoming places of social interaction for people who aren’t even flying. Changi is a favoured study location for Singapore’s university students, lured by free wifi, aircon, 24-hour access and the variety of quiet spaces and refreshments. “Rather than keeping everyone out, airports are beginning to open up and they’re looking at spaces in a completely different light,” says WSP’s Jason Brooks.

Arlanda’s city vision

For the last 100 months, Stockholm’s Arlanda airport has served record numbers of passengers. In 2017, 27 million people passed through its gates; by 2040, it expects 40 million, and by 2070, 70 million. To balance expansion with development in the surrounding area, government-owned operator Swedavia is preparing land-use masterplans with a 50-year horizon for Arlanda and its nine other airports across Sweden. “The airport is increasingly seen as a destination and a meeting place in its own right,” says Anna Norin, head of masterplanning at Swedavia. “By definition you would go there as a traveller, but because of Arlanda’s great connectivity, a lot of city elements are also developing in the immediate surroundings.”



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“Autonomous aircraft is a major area of exploration right now because it really captures the imagination of innovators — it’s about the best materials, the most efficient forms, the most powerful propulsion systems. It’s a whole new world”

Tim Morrison, WSP

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