



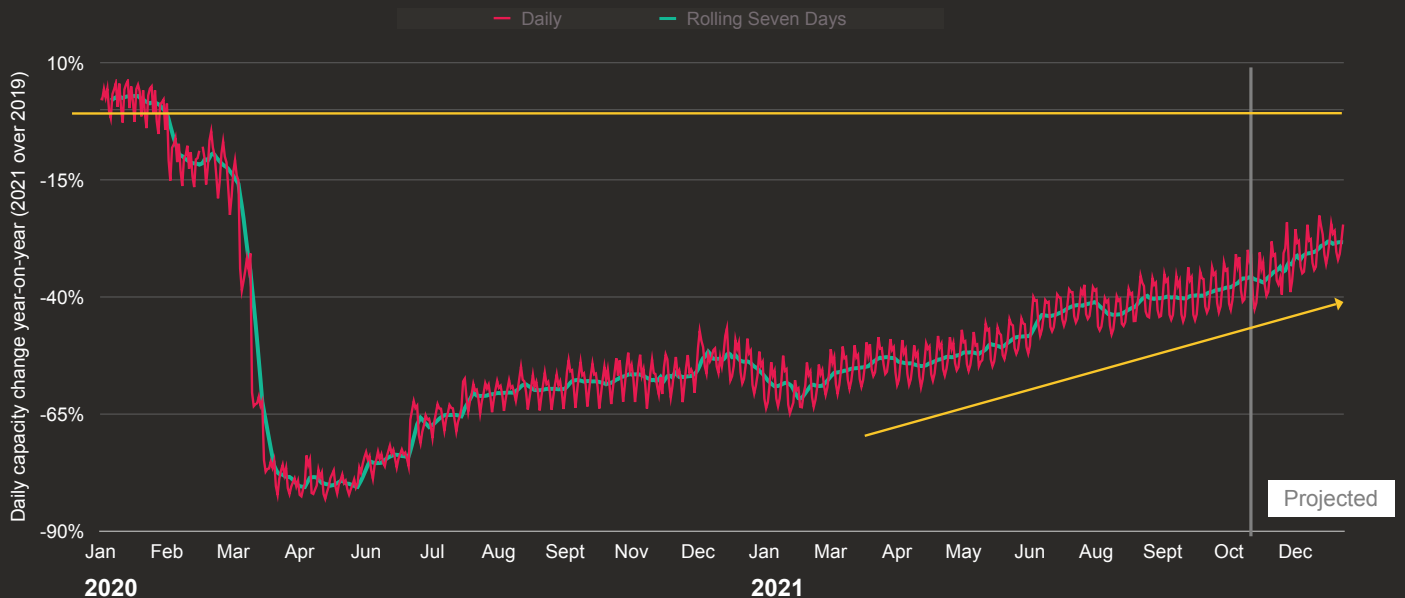
CIRIUM

AIRLINE INSIGHTS REVIEW

Analysis of the industry's recovery from the pandemic

2021

Upwards and onwards: 2021 ends with global capacity down only 30% compared to 2019.



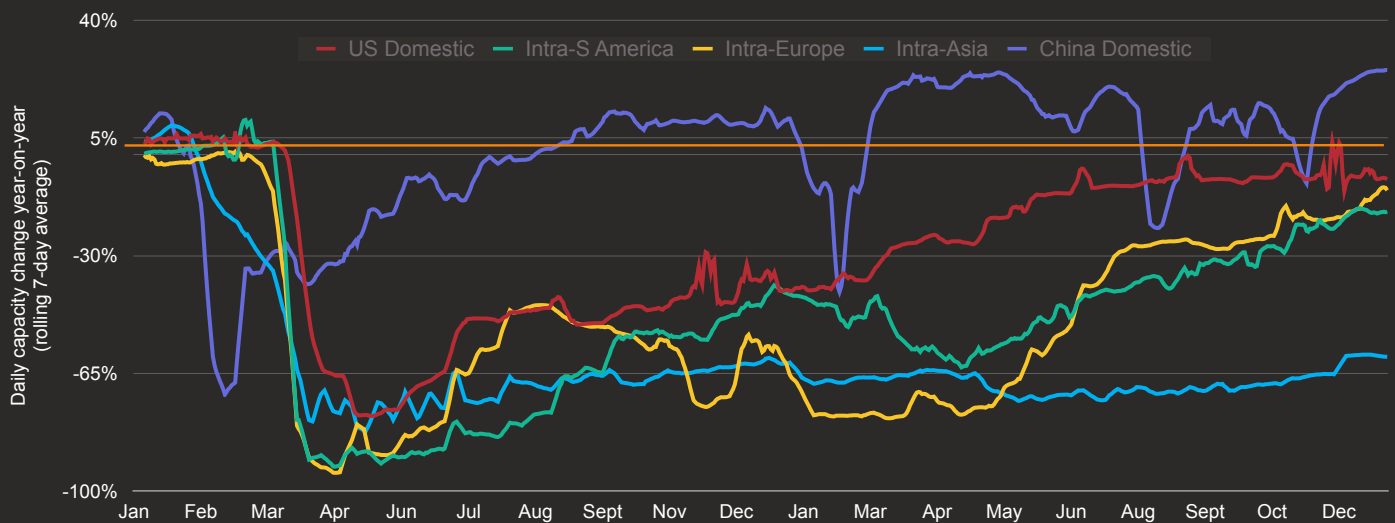
Source: Cirium Schedules, data filed 7 November 2021, 2021 change is over 2019 equivalent



The world has seen steady improvement in airline traffic and capacity through 2021, with most markets moving in the right direction. We knew domestic markets would be the first to recover. However, certain domestic markets like China are now growth stories—and the US and Brazil are not far behind. Recovery proceeds more quickly where vaccination rates are above 70% and where domestic travel restrictions are removed.

It's a different story for long-haul markets, however. Cirium believes recovery there will probably occur in the second half of 2022. By the end of 2022, traffic will be down about 15%—with capacity even better.

Regional differences are prominent.

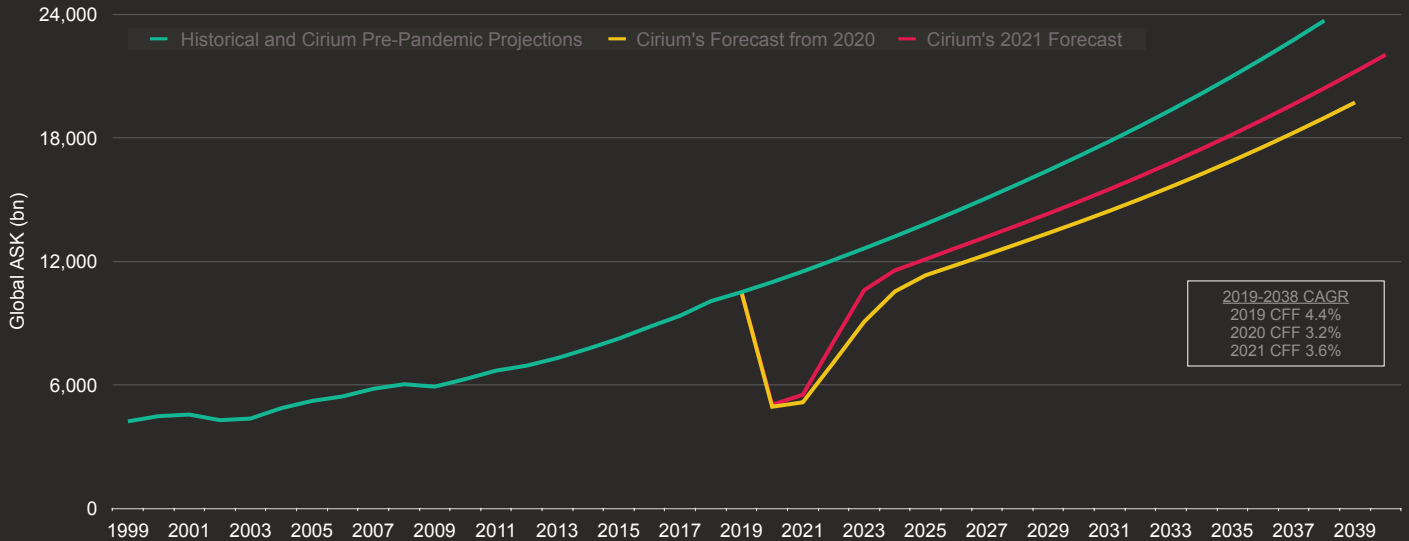


Source: Cirium Schedules, data filed November 7, 2021, 2021 change is over 2019 equivalent



China has led the world in recovery, but you can see several dips in 2021 where there's been COVID-19 outbreaks in Chinese cities or provinces. When the government restricted or advised against travel, the airlines reacted by pulling capacity. The US has seen steady growth in 2021, with the US and Europe reaching similar points by the end of 2021 with South America only just behind them. Intra-Asia flying has been hammered. By and large this relates just to international travel, with each country taking a very cautious view on border reopenings

Back to 2015 capacity by the end of 2022.

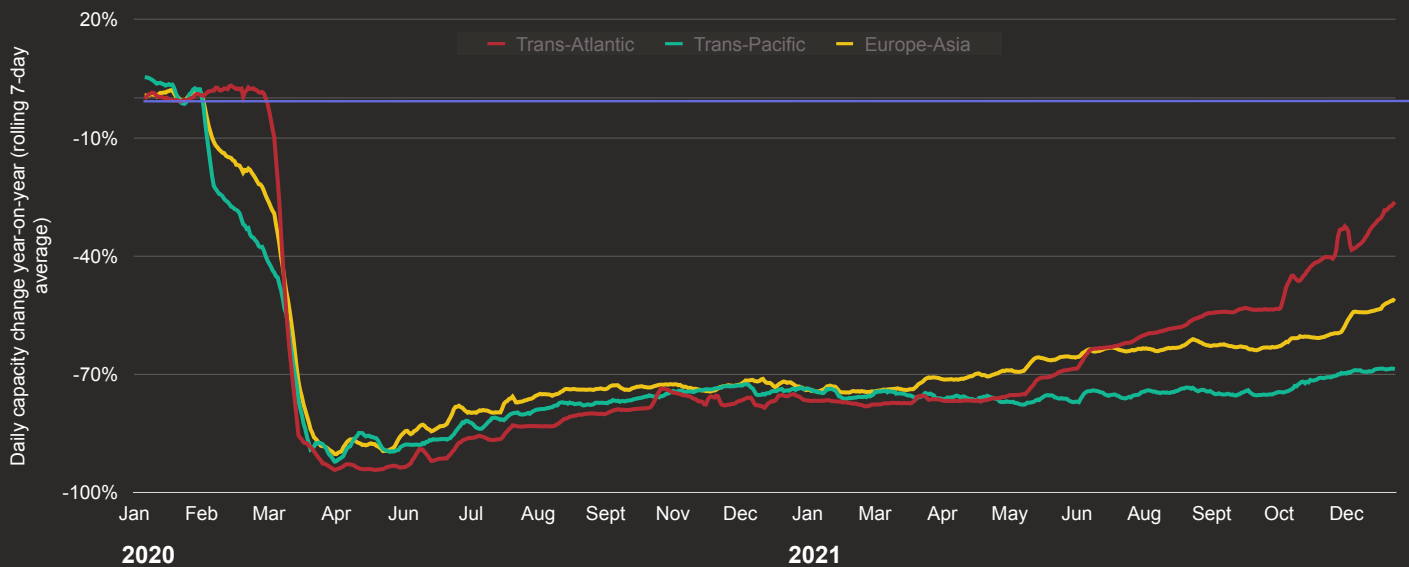


Source: Cirium Fleet Forecast



The pandemic wiped out 15 years of passenger capacity growth. Traffic was hit even harder, and fell back to 1999 levels. In 2021, we've seen the start of the recovery, and our latest outlook is more optimistic compared to what we predicted in 2020. For 2022, capacity is projected to grow at 47%, recovering to around 2015 levels. However, our long term forecast is that the world will still have lost some three to four years of growth—as far into the future as 2038.

Is a transatlantic rebound inbound?



Source: Cirium Schedules, data filed October 31, 2021, 2021 change is over 2019 equivalent



Transatlantic travel probably won't return to 2019 levels until sometime in 2023, and the fares are likely to jump though, and in the longer-term may be under upward pressure due to sustainability initiatives.

If we rewind to summer 2021, New York to London fares rose significantly for travel in August compared to 2019 One-way economy. Economy fares rose from \$300 to \$396, up some 32%. In contrast, business class fares dropped 10%, from \$1,598 to \$1,441 for travel in August 2021. UK carriers were eager to add capacity when the US reopened in early November.

Until we see data from November and December 2021—there's always a lag—it will be hard to predict the return of the transatlantic corridor.

Fleet surplus is rapidly absorbed in 2022 and 2023.



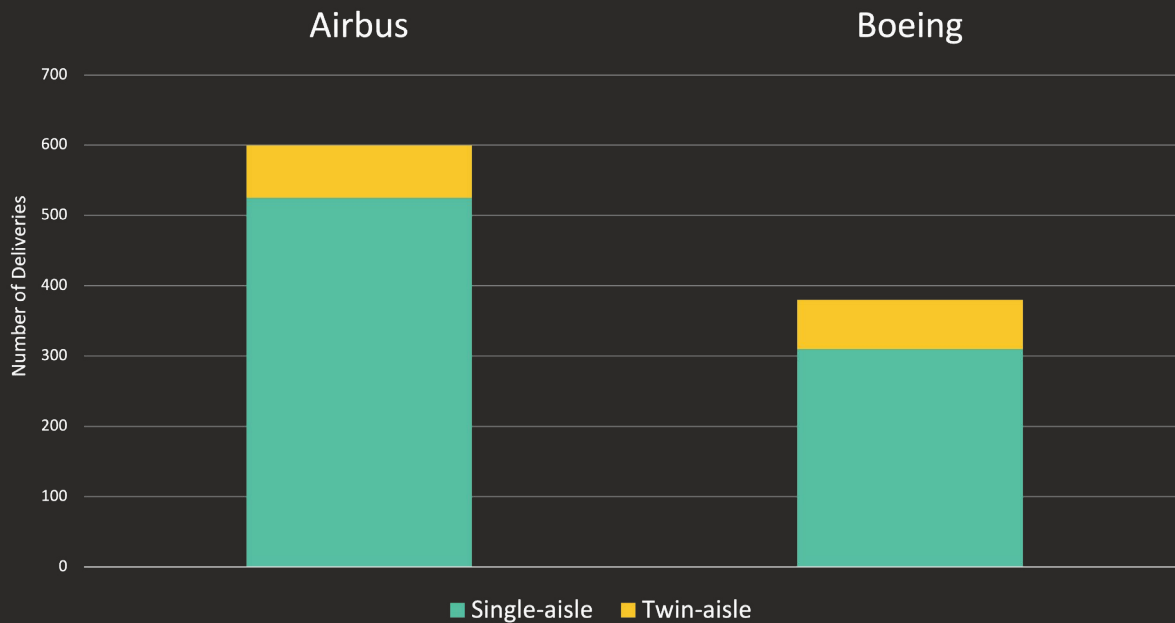
Source: Cirium Fleet Forecast, November 2021



Before COVID-19, there were normally about 2,000 aircraft in storage. Today, we've got about 5,000 aircraft in storage. That's still 3,000 aircraft more in storage than before COVID, but the trend is very positive and we think it will continue through 2022. In fact, by the end of 2022 most of the single-aisle surplus fleet will have returned to service, with 2023 seeing the twin-aisle follow suit.

In January 2021, single-aisle aircraft were averaging around 6.6 hours of daily flying on a global basis, well down compared to 2019. Twin-aisles were similarly averaging 10.2 hours per day. By November, utilization had increased to 7.7 hours and 11.4 hours, respectively.

Airbus remains on course for deliveries in 2021, Boeing less so.



Source: Cirium Fleets Analyzer and Ascend by Cirium analysis, November 2021



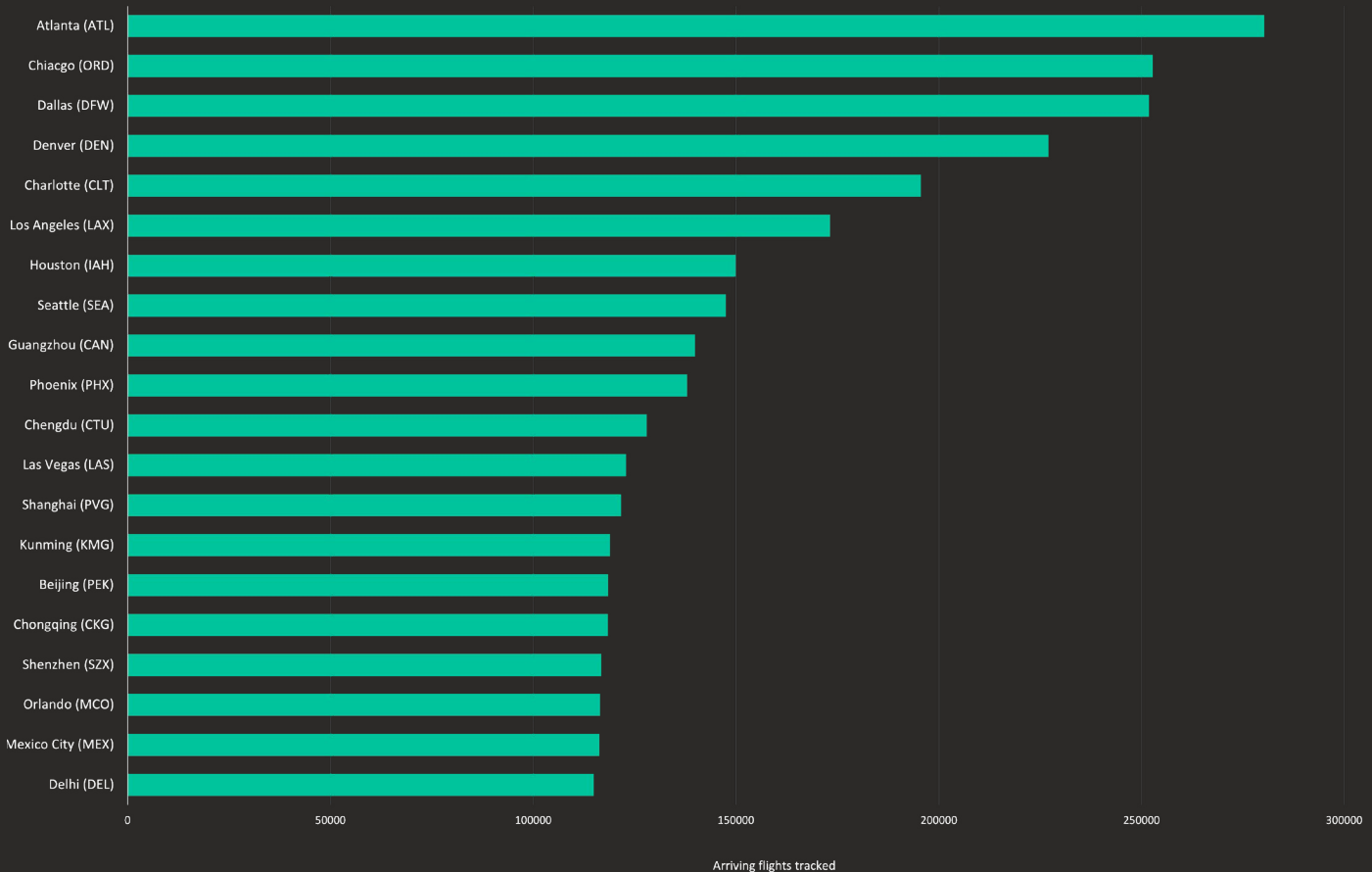
Aircraft deliveries during 2021 have been hampered by a multitude of factors. Initially, it was due to a lack of appetite by airlines to take new aircraft amid ongoing lockdowns, but more recently there have been supply-chain issues and the enforced suspension of Boeing 787 deliveries amid production quality issues.

Airbus remains on course to achieve its 2021 target of around 600 shipments, almost 90% of which will be from its single-aisle lines. The picture is far less certain at Boeing, with no end in sight yet for the pause in B787 deliveries and a sustained large inventory of undelivered aircraft including some 320 B737 MAX at year end.

THE TOP 20

Top 20 Busiest Airports of 2021

Atlanta tops the list as the busiest airport by arriving flights tracked between January 1 and October 31, 2021.



Source: Cirium Tracked Utilization Data, date filed November 30, 2021



THE TOP 20

Top 20 Busiest Routes of 2021

Bidirectional routes

Arriving flights tracked

Jeju (CJU)	Seoul Gimpo (GMP)	71,388
Seoul Gimpo (GMP)	Busan Gimhae (PUS)	28,809
Jeddah (JED)	Riyadh (RUH)	24,879
Fukuoka (FUK)	Haneda Tokyo (HND)	23,079
Haneda Tokyo (HND)	Sapporo (CTS)	21,851
Mexico City (MEX)	Cancun (CUN)	21,352
Shanghai (SHA)	Shenzhen (SZX)	19,945
Beijing (PEK)	Shanghai (SHA)	18,624
Hanoi (HAN)	Ho Chi Minh (SGN)	18,342
Bogota (BOG)	Medellin (MED)	18,086
Guangzhou (CAN)	Shanghai (SHA)	18,066
Jeju (CJU)	Busan Gimhae (PUS)	17,630
Delhi (DEL)	Mumbai (BOM)	17,069
Los Angeles (LAX)	San Francisco (SFO)	15,828
Haneda Tokyo (HND)	Okinawa (OKA)	15,687
Cape Town (CPT)	Johannesburg (JNB)	15,208
Chengdu (CTU)	Beijing (PEK)	15,180
Las Vegas (LAS)	Los Angeles (LAX)	15,026
Guangzhou (CAN)	Chengdu (CTU)	14,746
Bogota (BOG)	Cali (CLO)	14,604

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THE RUNWAY TO RECOVERY



Jeremy Bowen
Chief Executive Officer - Cirium

If you're like me and love to travel, you look forward to your next flight, be it for leisure with family or friends, or for business. I'm happy to report that in 2021, many passengers took those first, tentative steps and booked travel again—and then some. Every single passenger that flew in 2021—but didn't in 2020—bodes well for an industry seeking to recover. And 2022 shows even more promise.

Last year, we launched the Cirium Airline Insights Review 2020 to analyze and understand the impact of the COVID-19 pandemic on air travel. With the success of the report last year, we are bringing back the report for 2021.

The Review encompasses multiple voices from across Cirium, covering topics ranging from sustainability in aviation, forecasting travel demand, fare and fleet analysis, application of machine learning, and air cargo.

It has had its challenges as we continued to tackle fluctuating cases of COVID-19, new variants, and varied vaccinations programs per country.

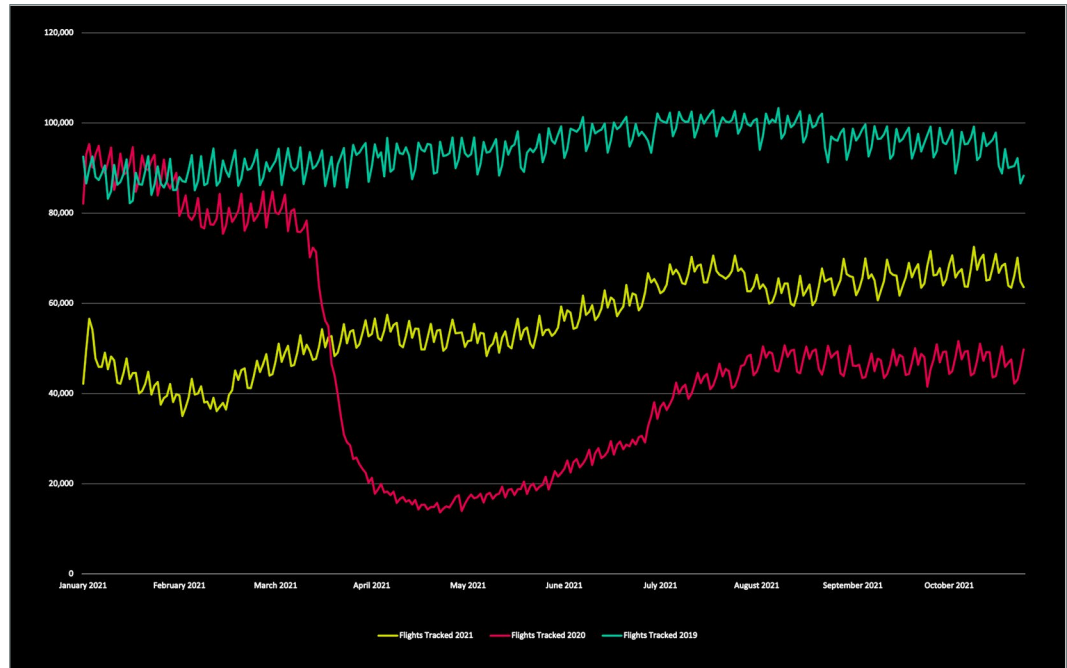
International border closures meant that markets with strong domestic travel, such as the US and China, bounced back rapidly. Markets that rely on open borders and the airlines operating in those markets struggled.

But, there are signs of recovery. international corridors are reopening, such as between the UK and US. While new variants put a damper on some of the pomp and circumstance, the airlines have responded by staying the course.

From January to October 2021 (based on full-months available), the total number of passenger flights reached around 17,882,000 compared to 15,000,000 in 2020, so the recovery is underway. However, compared to the same timeframe in 2019, flights are still 38% down year-over-year from a total of 28,980,000 flights tracked in 2019.

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Passenger flights tracked January to October 2021, 2020 and 2019.



Source: Cirium, Tracked Utilization Data, date filed November 30, 2021.

Traffic is still hugely down compared to pre-pandemic levels. From January to September 2021 (based on full-months available), there was 56% less passenger traffic versus the same period in 2019.

Domestic passenger traffic accounts for 79% of total traffic in this period and international traffic accounts for 21%. When looking back at 2019, domestic traffic accounted for 58% of the total, and international 42%.

From a regional perspective, the passenger traffic in Europe is down the most compared to 2019 levels with 66% less traffic year-over-year. In Asia-Pacific, traffic is down 61%, in the Middle East it is 60% less than 2019, and in Latin America and the Caribbean it is 55% down. North America shows a more positive outlook with 40% less passenger traffic than pre-pandemic levels.

We are far from being out of the woods, but as we enter 2022, global recovery is at least moving in an upward direction. At Cirium, we look to what to expect next year and beyond—working closely with the industry to anticipate the future scenarios. Here are seven key things to consider for 2022.

Seven things to look for in 2022

1. Worldwide domestic passenger traffic will be back to pre-pandemic levels; international traffic will reach two-thirds

We are steadily seeing more passengers return to the skies as the number of fully vaccinated people increases across many countries, and the subsequent easing of travel restrictions. By September 2021, domestic traffic (as measured in passenger numbers) had improved and was down only 36% compared to 2019.

We expect this trend to continue through 2022. We expect China Domestic traffic to surpass 2019 levels. Domestic traffic in North America, Europe and Latin America is projected to end 2022 at 2019 levels and other regions just five to 10% down.

There was little international traffic until mid-2021, when intra-European travel demand opened, facilitated by the EU Digital COVID-19 Certificate. Since then, there has been a steady improvement, as well as in international demand to and from North America. However, September international passenger numbers were still down 62% compared to 2019. Cirium's baseline scenario for 2022 is one of continued border openings, as countries achieve vaccination rates of 70% or more for the total population. China remains an unknown, as there is currently no sign of a change to its COVID elimination strategy. International traffic is made up of many distinct regional flows, but we expect a significant increase in long-haul travel in the second half of 2022 and predict that by the end of 2022 international passenger traffic will be down around 25 to 30% compared to 2019.

Collectively, this means that we expect to see global passenger traffic recover from being 47% down against 2019 in September 2021 to just 15% below 2019 by the end of the year.

2. Passenger fleet in-service will almost return to pre-pandemic levels

The Cirium consultancy team, Ascend by Cirium, project that the global passenger fleet in service will increase to 20,700 by the end of 2022. This is only a few hundred fewer than at the end of 2019. By the end of 2021, almost 17,000 passenger aircraft are projected to be in service. Airbus and Boeing are expected to deliver over 1,400 new aircraft in 2022 and almost 1,600 in 2023. The current parked fleet of some 4,800 surplus aircraft are expected to continue to decline to around 3,700 by the end of next year. This will reduce further to 2,400 by the end of 2023.

As recovery continues in most markets and global passenger traffic exceed 2019 levels by mid-2023, the surplus of passenger jets—which exceeded 14,000 at the peak of the crisis in April 2020—is expected to be largely reabsorbed into the fleet. We expect to see around 550 aircraft retirements annually between 2022-2024 as the older less fuelefficient aircraft of those surplus aircraft are scrapped.

Airlines are emerging from the crisis with a reshaped fleet, where next generation aircraft have 15% better fuel burn than the less efficient aircraft they

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replaced. This includes a backlog of almost 9,600 new generation single-aisle and 1,600 new generation twin-aisle aircraft scheduled to be delivered through the 2020s and into the 2030s.

3. Business travel will accelerate in 2022, steered by a rise in business events and meetings

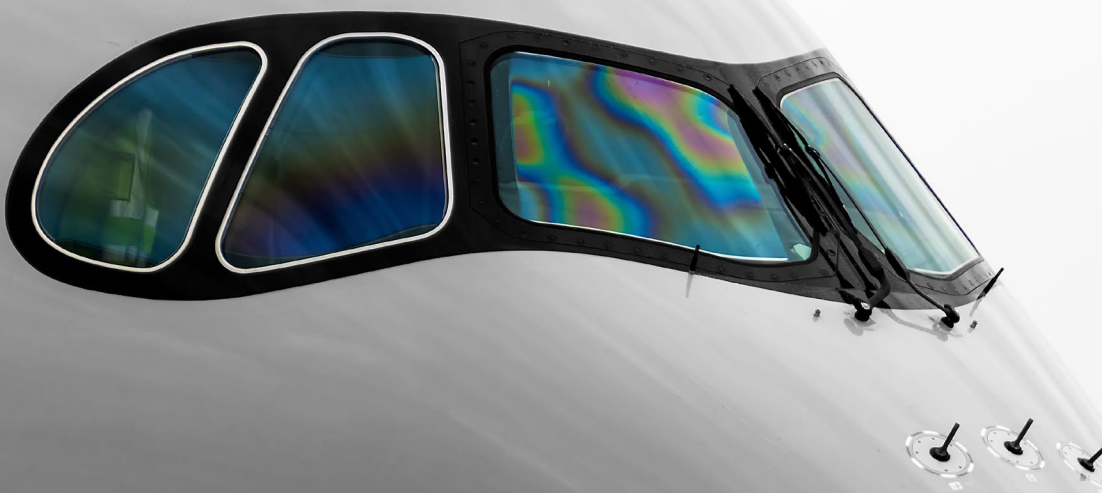
As vaccines are being rolled out globally and economies recover, organizations have already increased their business travel spend. According to the Global Business Travel Association (GBTA), business travel spending is projected to have increased by 21% in 2021, on the back of the easing of restrictions on international travel. For example, in March 2021 there were 217,100 international flights tracked compared to 542,300 in October—1.5 times more international flights taking place.

This trend will continue, and we expect

to see further acceleration in business travel in 2022. GBTA predicts a 36% surge in business travel year-over-year in 2022. We expect to see business events and meetings drive this surge. Cirium is tracking the online activity around business events and applying machine learning to this activity, to then integrate the data into airline forecasting models. Cirium Diio Signals shows increased activity on the web around corporate events and conferences. For example, according to Cirium data, Barcelona hosted 10 major business events that impacted air travel in January 2019, 23 events in January 2020 and only two in January 2021. It is expected that there will be four events in January 2022. This is a clear sign that business events are slowly returning.

The positivity is also reflected in GBTA's prediction of full recovery of business travel by the end of 2024, where business travel spending annually will take over pre-pandemic revenues to \$1.48 trillion.

4. Conversions of passenger jets to



freighters will surpass previous highs

The air cargo market continues to grow and has had a strong year in 2021. Traffic (calculated by Freight Tonne Kilometers) are up over 8% for the first nine months of 2021, compared to 2019. Capacity however is down almost 12% for this year, which reflects the continuing lack of passenger belly capacity.

In an analysis of Cirium's Fleets data, 61 orders for new freighters were made in 2021—the strongest year for orders since 2018. Airbus seeks launch orders for their new A350 freighter, which will compete in the larger capacity freighter market. It is expected that Boeing will respond with a 777-X freighter.

In the first ten months of 2021, 97 passenger jets were converted to freighters, which is well beyond the 70 conversions made in 2020. There are potentially more conversions to happen between the time of writing and the end of this year, which could see a total of 140 conversions—double the amount in 2020. This hugely surpasses the previous highs of 107 conversions made in a single year. 2022 is forecast to be even higher, with a potential total of 160 passenger jets converted to freighters. There have been over 250 conversion orders received already in 2021. The high level of activity in this sector is due to a combination of factors, including available aircraft at lower values and the boom in e-commerce.

5. We've reached the bottom of aircraft values, but some aircraft remain on watch

Aircraft values and lease rates took an unprecedented hit in the 12 months from April 2020 to March 2021. From April to September 2021, the values and

lease rates for many types appear to have stabilized, and a few are improving.

The fortunes of the global fleet are diverging, not only between single-aisle and twin-aisle aircraft but also within the single-aisles themselves. In 2021, the ATR 72s, the Embraer E190/195s and the Boeing 737 MAX family have seen improvements. The Airbus A320 has experienced mixed fortunes, with older vintages improving in value while younger ones decreased further. We have seen values improve first while lease rates remain stable at what appears to be the bottom of the market.

On the twin-aisle front, lease rates continue to fall with A350-900 rentals recently reduced by up to 19% and 787s continue to be on watch. This was necessary to stimulate demand from opportunistic airlines and to see some of the idle fleet finding new homes. At the moment there have been no willing sellers, so values have held firm. However, consider that some of the lease rate factors on twin-aisles have dropped to below 0.5% relative to market values—it raises the questions of how much longer those values can be sustained.

6. Airlines will rely more on partnerships to carry passengers into partner home markets

We anticipate a shift in airlines flying secondary markets post-pandemic and instead see airlines taking advantage of their partners to transport passengers to secondary cities.

Delta Air Lines is instructive. In 2019, Delta served 88 US-Europe markets outside of the hubs of their major European Skyteam partners—KLM, Air France, and Alitalia. Looking forward

to the year ending 2022, Delta is only scheduled to serve 72 of the original 88 markets. Such markets include Atlanta to Stuttgart, Dusseldorf, Brussels, and Zurich, and New York (JFK) to Berlin and Malaga. All these markets are served over KLM's Amsterdam hub or over Air France's Paris hub.

While seats scheduled by Delta into Amsterdam and Paris for the year-ending 2022 versus 2019 are still down 25%, transatlantic traffic is down dramatically as well. It's a logical step for Delta to take by filtering the passengers to those now-cancelled routes over their partners' hubs rather than investing in their own aircraft on long thin routes. By code-sharing on these intra-Europe legs, the partners can feed each other's flights on routes that may not be full without the efforts of each carrier.

7. CO₂ emissions will increase as flights increasingly return to service—but airlines now have cleaner fleets

As fewer flights operated in 2021—flights tracked from January 1 to October 31, 2021, are 29% down versus 2019—the CO₂ emissions from flights were 40% less than pre-pandemic. Although the trend seen in 2021 shows fuel burn increase as domestic flights started to return, it is lower because airlines are flying their aircraft far fewer hours and prioritizing more efficient aircraft.

The proportionally greater decline in emissions was also because of long-haul international markets taking longer to recover than domestic and intra-regional. This reduced the average aircraft size being flown and the flight distance, while airspace and airports were less congested, resulting in less

time spent in take-off queues and holding patterns.

OEMs are already ramping up production rates of latest-technology aircraft that will come into service. With the return of flights this means that overall CO₂ emissions will increase as markets recover, however as more efficient aircraft are brought into service, the fleet is expected to deliver average per-seat efficiency gains of several percentage points compared with pre-pandemic levels.

To achieve the net zero 2050 targets, the industry will increasingly look at understanding the actual fuel burn of flights, and to Sustainable Aviation Fuels and offsets. We expect discussions will continue around hydrogen and electric aircraft also—albeit these methods will play a much smaller part in reaching these targets.

Sustainability is not the future. It's the present.



By Mike Malik

Mike Malik is the Chief Marketing Officer at Cirium and long-time airline industry executive.

Airlines are making huge strides in becoming greener, even if often their efforts are unrecognized and underappreciated. The topic has moved to the center of airline decision-making, influencing everything from where the industry invests to how it interacts with customers. There's no escaping the new reality: airlines are all-in on a green future.

I saw this first-hand this fall at the first in-person conference I attended since the pandemic began. At the 77th Annual IATA AGM in Boston, the big topic was sustainability, and the big news: an industry pledge to achieve net zero carbon emissions by 2050.

That goes well beyond ICAO's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), still an important program for stabilizing emissions in the short-to-medium term. Longer-term, Sustainable Aviation Fuels will need to do much of the heavy lifting. Electric, hybrid and hydrogen propulsion will hopefully play a role as well. And governments, airports, air navigation service providers, energy companies, aircraft manufacturers and engine providers will need to play their part.

Make no mistake: Achieving net zero won't be easy. Aviation is considered a "hard-to-abate" sector—there's simply no getting around the present absence of economically viable mass-scale alternatives to oil-based jet fuel yet. There won't be any Teslas in the sky anytime soon. What's more, demand for air travel is expected to grow significantly in the coming decades. Flying is, after all, a service essential to the development of economies. IATA projects 10 billion people

flying in 2050, implying 1.8 gigatons of carbon that must be abated in that year alone. Put another way, that's 21.2 gigatons of carbon will need to be abated between now and 2050.

That is no easy challenge. But that's not stopping IATA's Director General Willie Walsh. He earned his reputation delivering on difficult promises, not least building International Airlines Group (IAG) into one of the world's most profitable airlines, pre-pandemic. He's now leading the charge to reach net-zero, moving the industry to an aggressively proactive sustainability push.

Just look at the data on fleet renewal. As Cirium's detailed database of the world's aircraft reveals, there's a clear industry preference for newer and cleaner aircraft. At the start of 2020, for example, there were 10,751 prior-generation A320s in active service. Today, there are 22% fewer, owing to a weaker demand environment, for sure, but also a steady desire to achieve a cleaner and greener fleet. By contrast, the number of A320neos in service is up 54% since the start of 2020. The data show similar trends in the widebody space, exemplified by a 22% drop in B777s but no change at all for more fuel-efficient B787s (despite a recent moratorium on deliveries).

The trend is evident everywhere. American Airlines, for example, retired more than 650 older-generation aircraft during the past seven years. IAG said in its most recent earnings call that it had cancelled none of its many orders, even throughout the darkest days of 2020. As Robert Isom, newly-named

OUT WITH THE OLD

A look at selected aircraft types in service

source: Cirium



AIRCRAFT	TODAY	START OF 2020	CHANGE
B737NGs	5,950	6,656	-11%
A320ceos	3,198	4,095	-22%
A320neos	1,786	1,163	54%
B777	1,129	1,445	-22%
A330	974	1,275	-24%
B787	885	885	0%
B767	747	799	-7%
B757	556	674	-18%
B737 MAX	392	0*	

*all MAX airplanes were grounded at the start of 2020

Source: Cirium Fleets Data, October 2021

CEO of American Airlines, said: “The most important thing any airline can do is retire older aircraft and replace them with new, more fuel-efficient aircraft.”

Are environmental considerations the only motivation for this aggressive fleet renewal strategy? No. But a keenness for greenness clearly looms large. For the industry to meet its net zero goal, investment in new planes will be essential.

It’s not just the distant goal that matters, however. Already in parts of the world, regulatory and tax regimes make flying older aircraft more expensive. Airports too, notably in Europe, are in some cases moving toward new models of charging airlines based on carbon emissions rather than aircraft weight. Some airlines are themselves already pledging no

net increases in carbon emissions going forward. Many are likewise allocating sizeable sums of money for research, operational changes, sustainable fuel projects and onboard service adjustments that help cut emissions. Some carriers now have chief sustainability officers. Others showcase their sustainability efforts as a lynchpin of their marketing campaigns.

Recall the 1980s and 1990s, decades mostly characterized by extended periods of low fuel prices. With sustainability much less of a consideration back then, carriers routinely acquired older planes—why pay for fuel efficiency when fuel is cheap? Attitudes have changed, however, and demand for new aircraft remained strong even during times of oil market distress, like the mid-2010s. When oil prices collapsed in the early

months of the pandemic—and even with demand collapsing catastrophically—airlines thought twice about revising their fleet renewal plans. Order deferrals? Yes. But order cancellations? Not too many. And a reawakened appetite for older planes? Not at all. On the contrary, carriers rushed to accelerate retirements of old fleet types, conscious of their environmental drawbacks.

Sustainability is even starting to influence where airlines fly. France, for one, hoping to convert people from planes to trains, made domestic flying cutbacks a condition of its airline bailout measures. Elsewhere in Europe, where high-speed trains are often a viable alternative to air travel, governments—and public opinion, too—are similarly pressuring airlines to shrink their short-haul networks.

Environmental consciousness is especially strong in the Nordic region, where carriers have been forced to adjust their networks in response to public campaigns against flying. This change in sentiment is one reason, if not the only reason, that the number of domestic flights within Sweden

dropped 17% from 2016 to 2019, according to Cirium schedule data.

Looking longer-term, aircraft manufacturers and their suppliers are no less thinking about sustainability as they design the next generation of planes. Some are betting on electric-powered aircraft, if only realistic at this point for ultra-short-haul routes. Others developing next-generation supersonic jets are promising that they'll run on sustainable fuels. Airports are thinking green too. So are investors, some determined to allocate money only to companies with a commitment to environmental stewardship.

LAG's British Airways earlier this year raised money through a "green bond," assuring lenders it will cut carbon dioxide emissions per kilometer over time. A green bond is a financial tool to borrow money for an environmentally friendly project, in this case buying cleaner airplanes. It's another example of the industry's seriousness on sustainability—now, even its financing has a green tint.



Measuring emissions by airlines



A Q&A with Robyn Grassanovits, Cirium's sustainable travel product leader

Road warriors are the most profitable passengers for airlines and the travel ecosystem. And while business travel has been hit hard by the pandemic, corporations and airlines are laser-focused on managing their carbon footprint for when business travel does return. We sat down with Robyn Grassanovits, Vice President of Emerging Business at Cirium. A long-time innovator and startup leader within airlines, hotels, car rentals and eCommerce, she sits on the sustainability committee at the Global Business Travel Association (GBTA).

Q *Before the pandemic, sustainability was a major buzzword amongst the airlines around the world—to say nothing of the traveling public itself. Post-pandemic, that attention seems to be coming back. Where is the demand to address sustainability coming from?*

A The topic of climate change is not new but it has certainly emerged as one of the most challenging issues of our time. A study by the International Council on Clean Transportation found that emissions from air travel actually increased between 2013 to 2018 70% faster than anticipated. I found that shocking. Then, during the height of the pandemic when we were in lockdown mode, emissions from air travel decreased by 75%. While the lockdowns devastated the industry, it also opened a lot of eyes to the environmental issues we face if we don't take action. I think the pandemic heightened our awareness of the challenges and how vulnerable we are to the world around us.

I'm seeing a demand for unbiased and accurate emissions insight coming from a variety of sources. One of the largest areas of demand is coming from the corporate travel sector as they announce their own aggressive goals and rollout strategies to reduce their emissions, including their Scope 3 emissions from air travel. Corporate travel managers hold the travel data from previous purchases and manage future travel procurement decisions. So naturally, companies turn to their travel managers. But measuring emissions from air travel purchases presents special challenges and most travel managers simply don't have access to quality flight emission data to confidently address their needs.

Q *There is an increasing awareness amongst the public generally, right? And for that matter, people bring that awareness to their place of work.*

A That's right. There is quite a bit of research that shows that consumers—led by Millennials and Gen Z—are increasingly considering sustainability when they are making purchase decisions, including their travel purchases. While rudimentary emission calculations have been provided in several air shopping solutions for quite a while, more and more travelers I speak to are using the information to influence their purchase decisions, choosing more environmentally friendly options even if it costs a bit more. Corporations are also facing pressures from their own employees. I saw an interesting article earlier this year about how the pandemic and climate change are impacting the workplace. 83% of employees surveyed said they thought their company was not doing enough to address climate change.

Q *What about pressure from the investor community? Is that also a factor?*

A Yes, there has been a lot of news about institutional investors re-evaluating their investment in companies that they may not deem to be sustainable and I think that definitely contributes to the pressure facing corporations. I think it's important to recognize that this problem can't be solved by airlines alone. It requires involvement from all of us to drive behavioral change. If Wall Street can help drive action, that's great.



Q *Cirium is well-known for on-time performance, schedule, and fleet data. Is that part of the toolset to address sustainability?*

A Yes, all of the data you mentioned contribute to the production of accurate emissions insights. We treat every flight as a unique event that needs to be measured. For example, let's say there are multiple flights from A to B and they all use the same aircraft type to fly the route. Each flight produces very different emissions even when they fly the same distance and use the same aircraft type. Why? Because each aircraft may be outfitted differently such as the engines, some may use winglets or contain a different number of seats, that are configured differently and have a different amount of space allotted to them. Also, each aircraft may have a different age and deteriorates at a different rate. We consider all of that as well as the actual flight operations because emissions are produced as the aircraft taxis, takes off, climbs, cruises, or in holds.

Q *How does that work for a corporation?*

A Corporations have the added challenge to ensure that emissions are calculated for the flights consumed. Business travel experiences more changes to travel plans that result in tickets getting rebooked, refunded, get used by another employee or even go unused. That reconciliation is not always so straightforward. Fortunately, we have extensive experience monitoring trips in real-time for some of our proactive alerting services. We are currently doing some pilot testing with some corporations to measure emissions down to the division, department or traveler level, if they so choose.

Q *You mentioned that some flight booking search engines display some emissions data. What do you think is distinct about Cirium's emission data and do you do something different for future flights?*

A What's distinct about Cirium's emission data is its unbiased accuracy. The accuracy of emissions is not just about our methodology, it's about the quality of the data ingredients that go into it. This

is an area where Cirium shines. We are a travel data and analytics company. It's not just about creating an algorithm and you're done. It's tracking individual data elements along the way. If an airline changes the seating configuration on an aircraft, swaps out aircraft on the day of travel or introduces an entirely new aircraft, we are going to catch that and reflect it in our emissions calculations.

With regards to emissions, there are two use-cases that influence the data. First, is the historical data. This is a great starting point for a decision-maker to determine their baseline from which to create goals and subsequently measure progress against their goals. Second, there is predictive modeling component that goes into assessing future flights. In this case, there will always be a larger degree of uncertainty simply due to the nature of airline operations. However, understanding the historical data allows us to provide much greater certainty, in predicting emissions for future flight schedules and we are working to get this information in the hands of travelers so they can make more informed decisions at the point of sale.

Q *So who is your customer here, corporations with their road warriors, or airlines?*

A We are receiving interest throughout the industry including airlines, corporations, OEMs, and lessors among others. As I said earlier, addressing our planet's climate change issues requires all of us. Our goal is to bring the most accurate and unbiased source of data to the market so that we can all consistently measure emissions and monitor progress against our goals as we implement mitigation strategies.

Q *How accurate is your data for something that seems relatively nascent?*

A In internal reviews of our data, the airlines have said that we are some 1% plus or minus of their internal calculations. So, it's a strong start for us and we're pleased. But it is an iterative process. We have a team of experts that include aeronautical engineers, PhDs and industry veterans focused on this challenge and we will continue to refine it as the industry continues to advance.

Q *At a typical airline, there are departments like revenue management, alliances, and networking planning. What's the status of the sustainability departments, generally? Do those exist and how many people are staffed?*

A Sustainability as a need has been around a long time but unfortunately, it hasn't received the prioritization it needed. In recent years we've seen the need for an ESG strategy go from a "nice-to-have", to a "should have" to now being a "must have". While all airlines have staff focused on sustainability, I have heard of a few airlines that have created dedicated departments with a small staff to create their strategy and work across departments to deploy it and monitor progress. The size of the departments can be a bit misleading because within airlines, there are several folks that work on sustainability issues as members of other departments.

I think we can expect them to grow as they continue evolve sustainability programs, monitor progress against goals and facilitate communication to their customers.

Q *Are there airlines that are leading the way, and others that are following?*

A That's a great question and one that is challenging to answer. Airlines are progressing in different ways such as the use of Sustainable Aviation Fuel (SAF), carbon neutrality, newer fleet, commitment to electric aircraft. Advancement is going to take time, commitment and dedication. IATA member airlines took a big step by committing to the aggressive goal of becoming net-zero by 2050. I think it is important to acknowledge that airlines can't achieve this goal on their own and it's not going to be cheap. It also requires commitment and dedication from the supply chain, from governments and from consumers. The airlines that rely on revenue from negotiated corporate agreements have added pressure from their corporate accounts, who have their own ambitious goals. In fact, some airlines are partnering with their corporate accounts to financially contribute to the development of SAF. This is an example of how airlines are thinking outside the box and working with their customers.

Q *So what do you anticipate are the trends for the next five years?*

A I think that we will become significantly better at measuring emissions, and analyzing contrails, waste and the supply chain of the food options offered.

Airfares: The fall and rise of airfares before, during and after the pandemic



By Mike Arnot

Mike Arnot is a former contributor to The New York Times, and now manages Juliett Alpha, a media communications firm in the airline industry.

The most frequent question Cirium receives from journalists are insights into what the airlines are planning for the future. The firm's magic ball is quite good as it turns out, as the schedule data tells the tale. Indeed, most of the airlines of the world use Cirium's schedules data to understand what the competition is up to between city pairs, with what equipment, and when.

The second most frequent question we receive is related to bookings and fares data. While bookings are not part the Cirium remit and closely guarded by the airlines, Cirium boasts historical fare data in its Diio tool, through FM Traffic.

Dare I say the data is fascinating?

The fare data methodology

Cirium fares and traffic data is created using a variety of traffic and fare information sources and a suite of statistical models to come as close as possible to an accurate value for the full market size. The data is an historical estimate, and includes itinerary (origin, destination, connections, and marketing and operating airline) and other sources. There is a time lag, but much shorter than the US DOT data. The historical data in the database extends to January 2014. Cirium receives a preliminary estimate 30 days after the close of the month with final estimates later. The data is presented typically as a one-way, non-directional

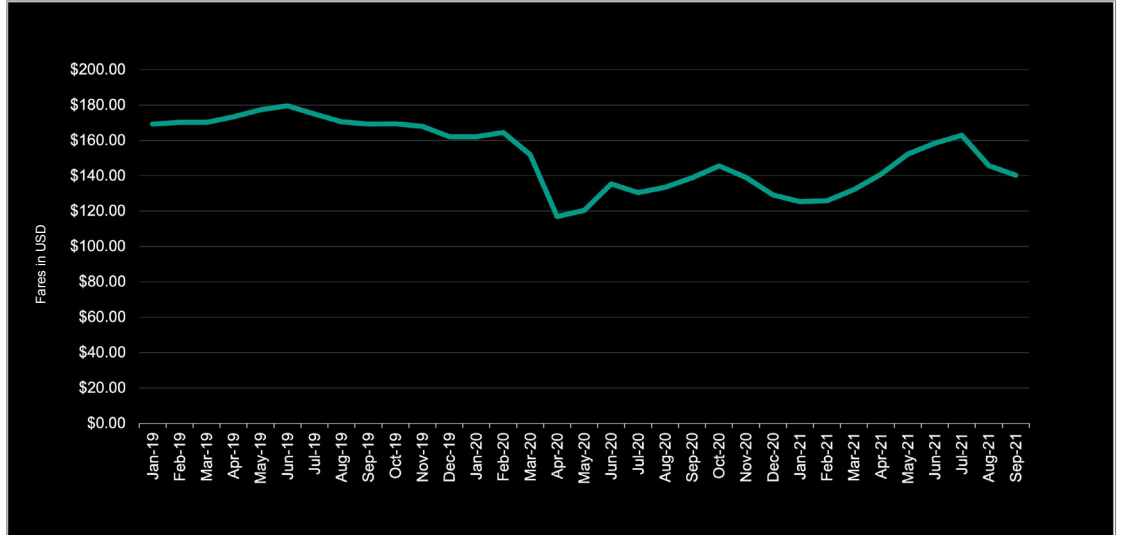
fare, exclusive of taxes. To get a sense of a return fare, double it. The values below are presented as one-way, non-directional fares.

So, what exactly happened to average fares during the pandemic in a few key markets?

US domestic flying bounces back, fares rise

US domestic economy fares showed a market bottom in March 2020, at the height of the pandemic shutdown. Fares dropped to \$116 compared to \$169 in January 2019, a whopping 31% decrease. By the summer 2021, fares jumped back up to \$162.80 in June 2021. Fares fell again in August 2021 to \$140 versus \$169, some 17% lower than before the pandemic for travel in August 2021. At the time of writing, indications are that fares will continue to rise into holiday 2021, particularly as airlines grapple with staffing-related and other operational challenges that will prevent them from flying the schedule they'd prefer. The largest US carriers will only be down some 14% on flights and 10% on seats, comparing December 2021 to December 2019, with American Airlines aiming to only be down a remarkable 6.3% on seats for the two periods. Those percentage points of difference on capacity will pinch US traveler pockets in favor of airlines seeking a better revenue picture to end the year.

US Domestic Fares



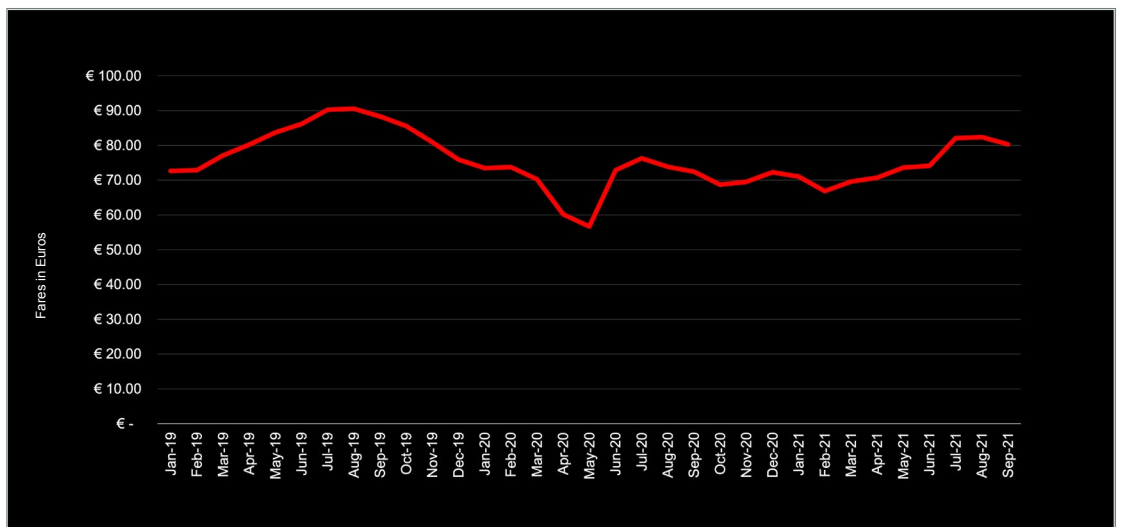
Source: Cirium Diio Mi FM Traffic, November 2021

EU domestic fares flying straight and level

Fares were flatter Europe-to-Europe over the period compared to the US market. The average fare bottomed in March 2020 at €56.70 and remained generally flat until the summer 2021 travel season, when fares rose to €82.37. (The above data is converted from US dollars to Euros at

\$0.88). This is up around €10 from €72.67 in January 2019. Europe still is hindered by a slower recovery than the US (and certainly China). Seats for Q4 2021 are expected to be down 25% compared to Q4 2019, which will likely continue the upward pressure we've observed on European fares in the summer of 2021.

European Domestic Fares



Source: Cirium Diio Mi FM Traffic, November 2021

Up, up and away: Chinese domestic fares and capacity up

A major story coming out of the pandemic is China's rapid airline capacity growth compared to prior to the pandemic. Flights are up almost 8% in Q4 2021 compared to Q4 2019, with seats also increasing 9.2%. Accordingly, even with the added capacity, fares are up, pointing to further growth potential in the market. Fares in China for domestic flying rose some 10% in August 2021 compared to August 2019, from \$120 to \$132.

Across the pond: From North America to Europe

Economy fares between North America and Europe were up 11%, from \$384 to \$424, in August 2021 compared to 2019. The major carriers plying the route did not add much capacity in the fall of 2021, even with the reopening of the skies to European tourists. Americans who wanted to explore the continent faced higher fares.

The transatlantic route: NYC to London Heathrow

On November 8, 2021, with much fanfare, British Airways and Virgin Atlantic jets each departed for New York on parallel runways. The US had lifted its blanket ban on travel there from Europe and the UK. The US carriers had already been operating on the route, as US tourists were permitted to visit based on the UK and European testing regime put in place. Accordingly, US carriers plying the route did not add capacity on the route, preferring to put bums in seats on flights already flying. JetBlue and Virgin Atlantic, however, did add capacity.

If we rewind, however, to summer 2021, fares actually rose significantly for travel in August compared to 2019. For example, economy fares rose from \$300 to \$396, up

some 32% between the two periods. In July 2021 fares increased 6%, from \$317 to \$334, compared to the same period in 2019.

Business class fares: Impact of JetBlue?

In contrast, business class fares dropped 10%, from \$1,441 to \$1,598 for travel in August 2021. For travel in July, the business class fares held firm, dropping only 2% in July 2021 compared to July 2019; fares were \$1478 versus \$1501.

JetBlue launched its heralded service between New York (JFK) and London Heathrow (LHR) with the Airbus A321LR on August 11, 2021. The New York-based carrier is offering daily service with 138 seats. It remains to be seen whether the additional capacity will reduce fares in the economy class market. The offered fares in their Mint service business class fare had an impact, however, and reduced average fares for service across the pond. The advertised price of a Mint seat on the route was around \$1,400, half of the fares of major competitors, and corroborated with Cirium data.

Airline startups eye unlikely opportunity amid COVID: 132 new airline startups during the pandemic



By Jonathan Robins

Jonathan Robins is an Aviation Reporter for Cirium's Dashboard news service

The greatest crisis ever to face aviation is perhaps not the obvious moment to launch a new airline onto the market. New ventures are prone to failure from shaky finances and curious business strategies even when conditions are stable.

Yet a growing number of companies have chosen the COVID-19 pandemic to do exactly that.

Cirium's data shows that no fewer than 132 airline startups were formed between January 2020 and November 2021.

Those that have launched in current conditions see compelling reasons to do so.

"It's the perfect time to start an airline," commented Nino Judge, Chief Executive Flypop, which plans to offer ultra-low-cost flights from the UK to India, targeting diaspora travellers.

Speaking to an industry event in June, Judge explained that Flypop secured a power-by-the-hour deal with lessor Avolon for four Airbus A330s, under which the airline will pay nothing for the aircraft until operations start.

"This would not have been possible pre-COVID," he said. "We locked-in these deals at the bottom of the market."

When asked if opting for second-hand aircraft could increase maintenance costs, he responded that at "the cost that we got our widebodies for, I don't need to worry about that", adding "I got four for the price of one."

His thinking is typical of the sector.

Birgir Jonsson, the Chief Executive of Icelandic startup Play, highlighted in June the "unbelievable terms" he received on the Airbus A320 family aircraft that his carrier launched with.

"In the past few decades, I am not sure there has been as good a time to do this," he said of their entry into the market.

It is not difficult to see why such stellar deals are on offer. Ascend by Cirium counts at least 68 airlines that became embroiled in bankruptcy protection or were liquidated because of COVID-19, operating a total of 1,465 aircraft. This includes well-known names such as Flybe in Europe and Cathay Dragon in Asia-Pacific.

Meanwhile many surviving airlines have retrenched and parked up swathes of their fleets. The resulting influx of aircraft into the market has severely pressed down both valuations and lease rates. With Cirium's data showing that over 50% of startup airlines are acquiring aircraft on lease, allowing them to mitigate the risk of overcapacity and minimize their capital spends, this has been a gift to new entrants.

Lessors, keen to put their assets to use—even if at weak rates—have eagerly engaged with the new players.

Speaking in September, Carlyle Aviation Partners President Robert Korn highlighted that new airlines were a key opportunity area for lessors.

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Carlyle's credit team has "spent quite a bit of time" identifying which of these new operators the company wants to deploy assets, he said. Korn called these "calculated bets".

Likewise Air Lease Corporation Executive Chairman Steven Udvar-Hazy noted increased demand coming from startups entering the market after the upheaval of the crisis.

The mass failure and retrenchment of carriers has also created a demand vacuum that startups are eager to fill.

For example, routes once operated by Cathay Dragon, which ceased operations in October 2020, were quickly snapped up by Greater Bay Airlines, a low-cost regional startup airline based in Hong Kong.

And in Scandinavia, Norse Atlantic Airways has launched with a stated aim of stepping into the long-haul, low-cost business model that Norwegian was forced to abandon.

It plans aims to launch transatlantic flights from London, Oslo and Paris to New York, Los Angeles and Miami, and later to Asia.

Similarly, several carriers have noted the sudden surge in availability at previously congested airports, as established carriers have shrunk or gone under.

In Flypop's case, Judge commented that whereas previously Heathrow Airport would not even return his calls, "now they are calling me saying 'do you want to go to terminal four?'"

The same market forces have resulted in a large pool of trained pilots and crew, often keen to work at competitive rates, although signs are that this may be dissipating as the restart gains ground.

The availability of finance has been yet another boon. Historically low interest

rates have flooded markets with liquidity, allowing startups to raise capital at extremely attractive rates.

"We are in no hurry to drive things too fast," explained Play's Birgir Jonsson, citing the \$90 million his new carrier has secured. "We are very focused, have clear strategy - and deep pockets."

Likewise Norse Atlantic Airways raised NOK1.4 billion (\$167 million) through a private placement, and fellow Norwegian startup Flyr, backed by industry veteran Erik Braathen, noted in February its efforts to access NOK600 million (\$70 million) in private equity financing.

Topping them all, US startup Breeze, founded by serial airline entrepreneur David Neeleman, had by August raised more than \$300 million in startup capital, the Salt Lake City-based carrier stated.

New entrants have sought that this financial firepower to enable them to hone their products and provide a buffer as they work towards profitability.

This perhaps underlines the greatest benefit to startups launching amid these troubled times, which is that the crisis has knocked off balance established players, who now also find themselves loaded with debt.

Startups hope to take this window of opportunity to carve out their market positions while the bigger firms, and the wider market, is in historic flux.

As Flypop's Judge put it: "As an ex-soldier, when does a small army beat a big army? When they have new equipment, no disease, and choose when the battle starts."

Route growth in 2021: More capacity between origins and destinations despite the headwinds



By Herman Tse

Herman Tse is an Aviation Analyst with Ascend by Cirium

Recovery is afoot in different regions of the world and market segments. Many airlines are restructuring the network to prepare for that. This article considers examples where recovery is proceeding rapidly, as evidenced by frequency of service between origins and destinations.

No surprise: Domestic flying is tops

Domestic markets dominated the recovery in 2021 as people are less restricted in travelling domestically, either by preference or by travel restrictions. Domestic traffic is one of the key drivers behind the industry wide improvement. Of those, China, India and the US are some of the domestic markets showing major improvement in 2021. Of the top 20 domestic routes in terms of seat capacity in 2019, there were 19 city-pairs from Asia-Pacific and one from the Middle East. That has now changed. The previous high-capacity routes were a result of the high concentration of passengers in particular routes within the countries—unlike the US where airports are widespread, geographically.

“South Korea’s Hawaii”: Gimpo to Jeju

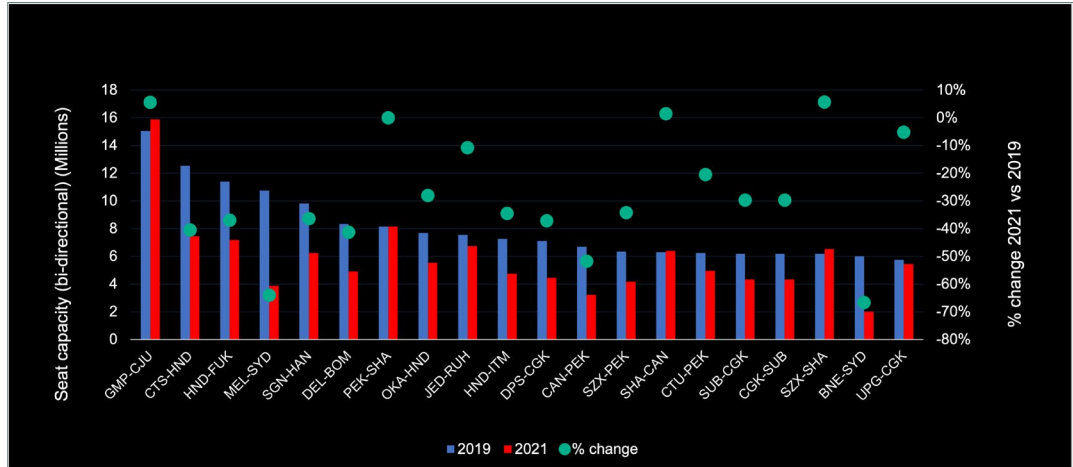
Jeju Island is one of the favourite tourism spots of South Korean locals. It is sometimes called “South Korea’s Hawaii”. South Korea Gimpo to Jeju (GMP-CJU) route ranked at the top of the domestic capacity table. There are more than 100 daily flights (one-way) operated by several airlines. The capacity in this route in 2021 is 6% higher than 2019. The local tourism

demand is very strong. Even as we exit the pandemic, quarantine requirements still apply in many countries. People returning to South Korea are required to quarantine after travelling abroad. Therefore, many locals prefer travelling locally to avoid any unnecessary quarantine. This has been observed in many other countries as well.

The Chinese market also shows positive growth in 2021. For instance China has three leading routes: China - Beijing International Airport to Shanghai Hongqiao Airport (PEK-SHA), Shanghai Hongqiao Airport to Guangzhou Baiyun Airport (SHA-CAN) and Shenzhen Bao’an International Airport to Shanghai Hongqiao Airport (SZX-CAN). China is returning to a semblance of pre-pandemic normalcy. However, any new outbreak could affect the recovery overnight as Chinese government adopts strict measures under “Zero COVID” approach.

In the rest of the top 20 domestic routes by market, they are generally still some 30-40% below 2019 levels. Daily confirmed COVID-19 cases remain high in some countries which discourages travelling. Vietnam is a good example. In May 2021, the Vietnamese domestic market rapidly returned to 2019 levels and even exceeded pre-COVID levels. However, at the time of writing in November 2021, the country is experiencing another large outbreak, with over 7,000 daily confirmed cases. This restricts the recovery. Unsurprisingly, nearly all top 20

Top 20 domestic routes in 2019 (bidirectional)



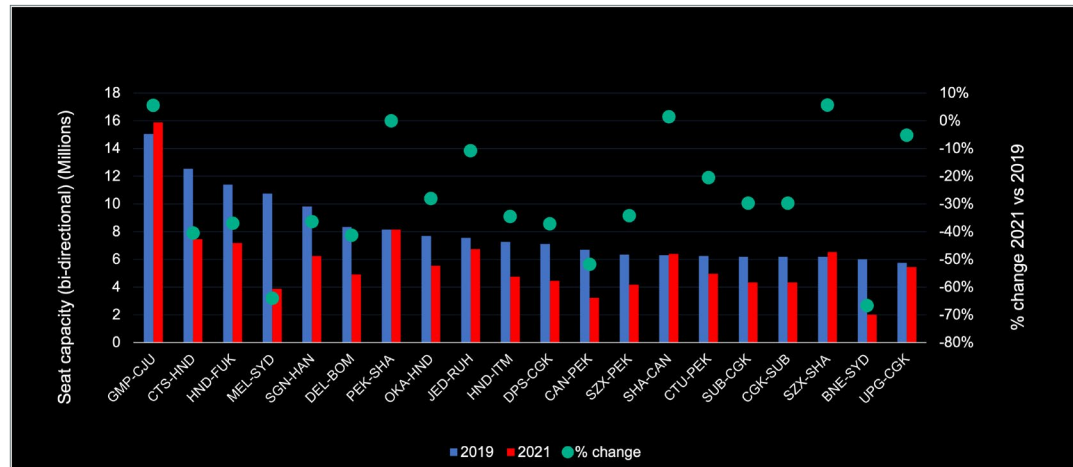
Source: Cirium Core, Schedules, dated November 9, 2021

intercontinental routes recorded significant drop in capacity limited by border restrictions and quarantine requirements. Unlike domestic markets, most of the top 20 intercontinental routes are between Europe, the US and Middle East. The vacation routes such as Bangkok to Dubai (BKK-DXB) and Honolulu-Tokyo Narita (HNL-NRT) recorded the most significant drop with over 80% drop in 2021 compared to 2019. Quarantine requirements and the COVID-19 PCR tests

add time and cost to the trip. Leisure travellers are usually reluctant to spend these “extra costs” for non-essential leisure trips during the pandemic.

In a recent development at the time of writing, the US reopened its borders to fully vaccinated international travellers from 33 European countries. This will have a positive impact on Transatlantic routes towards the year-end. Europe to Asia also shows some

Top 20 intercontinental routes in 2019 (bidirectional)



Source: Cirium Core, Schedules, dated November 9, 2021

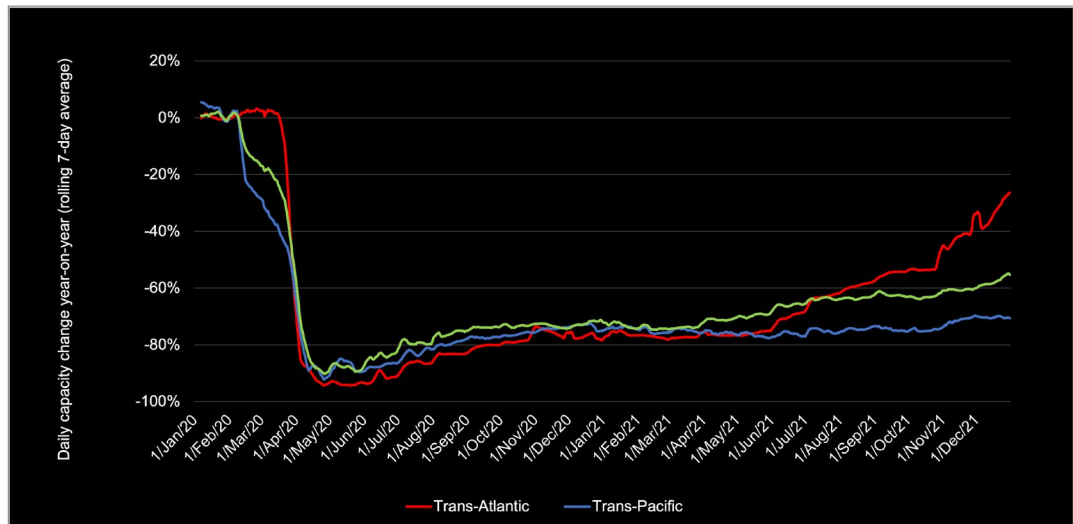
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signs of improvement as there are more Asian countries opening up their borders to select European countries. For example, Singapore expanded the Vaccinated Travel Lane (VTL) scheme to the UK, Germany, Denmark, France, Italy, Netherlands, Spain, and Switzerland in early November. On the other hand, transpacific routes are still 70% down through December. Mandatory quarantine requirements still apply in the major markets in China (including Hong Kong), Japan and South Korea which

restrict the growth in trans-Pacific routes. Japan and South Korea are expected to gradually lift their travel restrictions. However, China remains firm on its “Zero COVID” policy. It is unlikely to see any significant growth between China and the US anytime soon.

Despite the challenging times, there are some routes being launched (or resumed) in 2021. The Qatar diplomatic crisis has ended and the airlines there resumed flights

Long-haul flight capacity trend



Source: Cirium Schedules, data filed November 8, 2021, 2021 change is over 2019 equivalent

between Doha and the Middle East and African countries. Given the close economic activities between these countries, passenger demand is high and these routes are likely to continue after 2021.

Chengdu: A Southwest China hub

Of the top 20 routes in 2021, one airport factors frequently: Chengdu Tianfu International Airport. It is the second airport in Chengdu, and newly opened on June 27, 2021. Its focus is on domestic services. The airport is planned to be the hub of south-

west China and to connect to global routes in the long-term.

Southwest Airlines in the US

In the US, Southwest Airlines planned new routes in 2021 to capture the passenger demand. Three of the new destinations are Houston(HOU), Chicago(ORD) and Colorado Springs(COS) to/from its hub in Dallas(DAL)—and they are among the top 20 new routes, globally. However, the passenger demand did not come back as quickly as planned, especially the business

Top 20 new routes in 2021 (bidirectional)

Route	Seat capacity in 2021
DOH-DXB (Hamad International Airport-Dubai International)	685,234
TFU-KMG (Tianfu International Airport-Changshui International)	650,490
DOH-CAI (Hamad International Airport-Cairo International Airport)	642,817
TFU-SHA (Tianfu International Airport-Hongqiao International)	507,864
DOH-JED (Hamad International Airport-King Abdulaziz Intl)	440,204
DAL-IAH (Dallas Love Field-George Bush Intercontinental)	426,218
DOH-DMM (Hamad International Airport-King Fahad International Airport)	399,696
TFU-PVG (Tianfu International Airport-Pudong International)	385,296
TFU-HGH (Tianfu International Airport-Xiaoshan International)	327,115
DAL-ORD (Dallas Love Field-O'Hare International)	327,470
TFU-NKG (Tianfu International Airport-Lukou International)	319,025
TFU-XMN (Tianfu International Airport-Gaoqi International)	311,599
TFU-WUH (Tianfu International Airport-Tianhe International)	298,035
TFU-LXA (Tianfu International Airport-Gonggar)	241,358
TFU-PEK (Tianfu International Airport-Capital International)	231,892
IAD-MDW (Dulles International-Chicago Midway International)	237,376
DAL-COS (Dallas Love Field-Colorado Springs Municipal)	235,885
TFU-TNA (Tianfu International Airport-Yaoqiang International)	232,004
TFU-CSX (Tianfu International Airport-Huanghua International Airport)	220,458
LGB-OGG (Long Beach Municipal-Kahului)	216,055

Source: Cirium Core, Schedules, dated November 9, 2021

passenger sector. The airline admitted that the business remains unpredictable and volatile. It is planning to trim down the capacity from Q4 2021 onwards.

Government policy is the key factor to determine the progress of recovery. "Zero COVID" and "living with COVID" are two extreme strategies in dealing with COVID-19. It affects both domestic and international passenger supply and demand. We have observed that some countries are switching the strategy by reopening the borders to

international travellers for quarantine-free travel. More countries will follow.

Eventually, international travel demand will return close to pre-COVID levels. We are finally seeing the light at the end of the tunnel in 2021. Let's hope for an even better year in 2022.

Start spreading the news: New York-London's outsized role in aviation recovery



By Steve Goldstein

Steve Goldstein is an Airlines Reporter in the Americas for Cirium's Dashboard news service

In November 2021, British Airways (BA) and Virgin Atlantic (VS)—normally two carriers fighting neck and neck for passengers between the UK and US—launched a simultaneous take-off from London Heathrow bound for New York's JFK. It served to highlight the importance of this route across the pond.

US and UK carriers may not be alone in attaching great significance to the US government's November 8 easing of restrictions on inbound international travellers and its effect on flights between New York and London.

A sustained recovery to near-2019 levels of capacity on the New York-London route would carry different meanings for various aviation sectors and industry watchers.

Foremost, it would fill a portion of the gap in revenue versus pre-pandemic 2019 levels for the carriers that operate flights on the route: US-based American Airlines, JetBlue Airways, Delta Air Lines and United Airlines, and UK-based British Airways and Virgin Atlantic.

But a return to 2019 levels of capacity on the New York-London route would also signify a comeback in demand for long-haul international travel, which would have a positive rippling effect on global aviation.

United stated on November 2 that it "has been preparing for the reopening of travel to the US for more than a year." The Chicago-based carrier says that in the days immediately after the US announced on 20 September that it would lift restrictions

for non-essential travellers arriving in the nation fully vaccinated against COVID-19, its transatlantic bookings for November and beyond "exceeded 2019 levels for the first time since the start of the pandemic".

On October 28, United disclosed that it would in March 2022 be adding five new daily flights to London Heathrow. All told, the Star Alliance member will operate 22 flights per day to the UK capital in the spring.

"London is an integral part of United's network, and we remain confident demand will continue to grow, particularly as international business travel returns in 2022," states Patrick Quayle, United's Senior Vice President of International Network and Alliances.

United's capacity in November for its Newark-London flights is down 57% compared with the same month in 2019, Cirium schedules data shows.

Delta similarly disclosed on November 4 that its international point-of-sale bookings were up 450% versus the six weeks prior to the Biden administration's announcement that it would be reopening the US to fully vaccinated international travellers.

Delta's capacity in November for its New York JFK-London Heathrow flights is down 29% versus 2019 levels.

Airlines hope that workers will return to offices in large numbers in January, which they expect would stimulate demand for long-haul international travel. If all goes as

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planned and the route's traffic rebounds strongly in the early months of 2022, demand for widebodies could be spurred as well.

While that would have positive effect on the revenue streams of aircraft manufacturers, maintenance providers and lessors, it could

also draw more attention to aviation's carbon emissions overall and, potentially, to the specific aircraft operated currently for the New York-London route and the jets that might be used for the route three to five years down the road.

Marketing Airline	Aircraft Type	Flights	Seats	ASMs
American Airlines	B777-200/200ER	2	546	1,884,792
American Airlines	B777-300ER	116	35,264	121,731,328
JetBlue Airways	A321neo	120	16,560	57,305,880
British Airways	A350-1000	2	662	2,285,224
British Airways	B777	311	73,829	255,107,748
British Airways	B777-300ER	50	12,700	43,840,400
Delta Air Lines	B767-400	85	20,230	69,833,960
United Airlines	B767-300	116	19,372	67,143,352
Virgin Atlantic Airways	A330-300	18	4,752	16,403,904
Virgin Atlantic Airways	A350-1000	148	49,580	171,150,160
Virgin Atlantic Airways	B787-9	14	3,612	12,468,624
	TOTAL	982	237,107	819,155,372

Source: Cirium schedules data. *NYC: EWR, JFK, LGA. London: LCY, LGW, LHR, LTN, SEN, STN , November 2021

American in November is using Boeing 777s for its 118 flights between New York and London, Cirium schedules data shows. Its 67 777s are on average 17 years old; 20 are under 10 years old.

Three to five years from now the Fort Worth-based carrier will likely still be flying 777s on the route, having recently installed premium-economy cabins in those aircraft.

American's 43 on-order 787s will include premium-economy seating, the carrier tells Cirium. Some of those aircraft could eventually be assigned to the New York-London route, joining the 777s.

"New York-London premium economy [was] quite popular [prior to the pandemic]," Ascend by Cirium Analyst Syed Zaidi says. "There used to be a lot of business traffic that used to encourage that kind of travel. And these cabins are relatively new, so a lot of people used to book them."

JetBlue, which launched transatlantic services in August, is operating single-aisle Airbus A321LRs for its 120 New York-London flights in November. The New York-based carrier has five A321LRs in service and eight on order.

The carrier has no plans to add widebodies to its fleet, choosing instead to rely on its A321LRs and the 14 A321XLRs it has on order for its transatlantic flights for the foreseeable future.

BA announced on October 6 that it would increase the frequency of its New York-London flights to five times daily in November, rising to eight times daily the following month. The IAG-owned carrier also disclosed that it is bringing back into service its A380s, although not for the New York-London route.

The carrier is operating 777s for nearly the entirety of its 363 New York-London flights in November. It will use A350s for just two flights on the route.

The 59 777s in the BA fleet have an average age of 18 years. It has 18 of the type on order, as well as 10 787 and 10 A350 widebodies.

BA might use its 777s on the route for years to come, as it tends to keep its aircraft in service to the end of their life, as it did with its now-retired 747s, Zaidi notes. In five years, some frequencies might be operated with some of the carrier's newer A350s and 787-10s, which could ultimately dominate BA's transatlantic travel.

Delta, which is operating 85 New York-London flights in November, and United, which is operating 116, are both using only 767s on the route.

Delta's fleet of 21 767s and United's 54 each have an average age of 24 years. The aging gas-guzzlers are very expensive to operate and are due for imminent replacement by both carriers.

Atlanta-based Delta's widebody future will be shaped by the 26 A330-900neos and 20 A350-900s it has on order, while United has 45 A350-900s on order.

In a few years Delta might be using both the incoming A330s and the A350s on the routes.

United's 777s, which were operated for some flights to London Heathrow from Houston and Chicago in November 2019, might be an option in the future for the carrier's Newark-London route, but its incoming A350s are the likely replacements for its 767s.

Virgin Atlantic has switched to using primarily A350-1000s for its New York-London flights from its previous mix of 747-400s and A330-300s. In November, the carrier will operate A350-1000s for 148 of its flights on the route, A330-300s for 18 and 787-9s for 14.

Although Virgin Atlantic's entire fleet is shifting to the more-fuel-efficient A350s,

A330-900s and 787s, its 13 A330-300s are not that old—they are approximately 12 years old on average—so they might remain on the route for a few years to come.

Virgin Atlantic has six A330-900neos and five A350-1000s on order.

Role of emissions in travel decisions

Corporate customers and individual consumers who might factor fuel consumption and carbon emissions into choosing a carrier on the New York-London route might be best served by considering data from 2019, before the pandemic reduced load factors. The global average system-wide load factor for all commercial flights for calendar year 2019 was 84%.

The only holdover aircraft from August 2019 being operated on the route in November 2021 are American's 777-200s and -300s, BA's 777s, United's 767-300s and Virgin Atlantic's A330-300s. This makes aircraft-to-aircraft and airline-to-airline comparative estimates of block-fuel consumption and CO₂ emissions per flight in August 2019 not entirely relevant for New York-London flights this month.

The pandemic has hastened the retirement of some aircraft types, and pressure on aviation from within and without to reduce carbon emissions is likely to further accelerate the transition to newer types and, airlines hope, innovation from aircraft manufacturers.

Four to five years from now, the shift toward the more economical and fuel-efficient widebodies—the 787s, the A350s, the A330neos—will be more pronounced.

Meanwhile, it remains an open question whether corporate travel managers, aviation investors and financiers, and individual passengers make pronounced shifts toward factoring carbon emissions into how they allocate their spending.

Asia-Pacific's fragmented recovery



By Simin Ngai

Simin Ngai is an Airlines Reporter in APAC for Cirium's Dashboard news service

Hemmed in by closed borders, Asia-Pacific has in 2021 lost its lead in air traffic recovery relative to other regions.

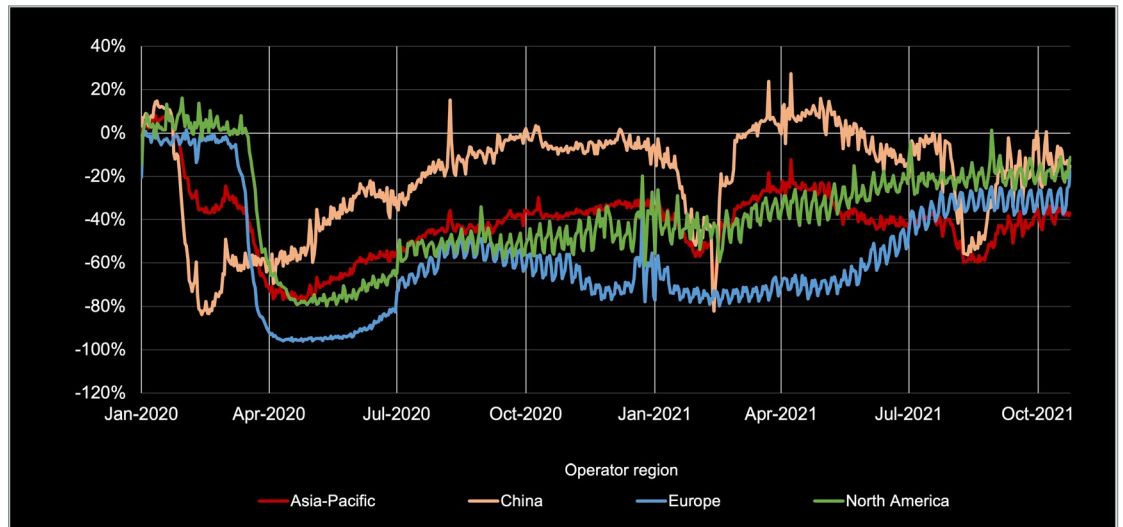
The region bounced back relatively quickly after the initial impact of the COVID-19 pandemic and was among the first to raise bilateral travel arrangements as a means of resuming cross-border travel.

Some of these attempts faltered—in the case of Hong Kong and Singapore—or

were less impactful than envisioned. Without North America's domestic market or a clear economic bloc like in Europe, by May air traffic activity in Asia-Pacific fell behind other regions, Cirium data shows.

China's air traffic has continued to weather domestic COVID-19 outbreaks, but no clear exit strategy exists for the rest of Asia-Pacific, especially Southeast Asia.

% Change in daily flights tracked versus 2019's



Source: Cirium data, retrieved October 26, 2021

Domestic networks

China has always been a big part of the Asia-Pacific equation and its share of the region's air traffic has only increased through the pandemic.

Cirium data shows China accounted for close to 60% of Asia-Pacific's air traffic

in 2021, supported by strong domestic market demand which in the second quarter exceeded 2019 levels. For the rest of the region, domestic flights tracked in the first nine months of 2021 stand at 56% of 2019 levels versus China's 97%.

Daily flights tracked, China as a % of Asia-Pacific



Source: Cirium data, retrieved October 26 2021

There were only two distinct points in 2021 that air travel in China showed a marked decline: between January and February, when authorities urged people to stay put for the Lunar New Year, and in August, due to a delta-driven COVID-19 outbreak.

Traffic bounced back in both instances, despite China and its territories holding steadfast to a zero-COVID approach. While it appears China draws strength from its domestic network, the trend is not observed in other key Asia-Pacific markets.

Even in major domestic markets pre-pandemic where underlying demand remained strong, the delta variant brought air travel to a standstill for most of 2021. India only began lifting limits on domestic travel from mid-October, while Australia's eastern states were under a month-long lockdown beginning in the third quarter.

The advent of COVID-19 vaccines brought little relief in the first half of the year, as governments struggled concurrently with vaccine hesitancy and supply shortages.

This was an issue for Japan, which scrambled to meet vaccination targets before hosting the summer Olympic Games and was from April to September under some form of COVID-19 restriction. Anti-China sentiment appears to have been an additional factor for Southeast Asia, a key target of Beijing's vaccine diplomacy.

Southeast Asia

Southeast Asia's diverse economic landscape has meant that constituent nations are recovering from the pandemic at varying pace, and against the backdrop of political instability.

At one end of the spectrum, Singapore in August surpassed its vaccination target of 70%. Inadequate vaccines, however, were in 2021 a focal point of other Southeast Asian nations' handling of the pandemic. For archipelagic nations like Indonesia and the Philippines, domestic border controls ramped up their challenges.

Early in the year, Myanmar saw sweeping political change as the military seized

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power on February 1. The incident will cast a pall over the ASEAN economic union for a long time, and despite the pandemic, makes the ASEAN Single Aviation Market policy—an open skies agreement for member states—seem even more unattainable.

Across the sub-region, discontentment with respective governments' COVID-19 responses spilled out into large-scale protests, including Thailand where a pro-democracy movement began pre-pandemic. The situation in Malaysia was made worse by political infighting that in August, culminated in a second change of prime minister in 18 months.

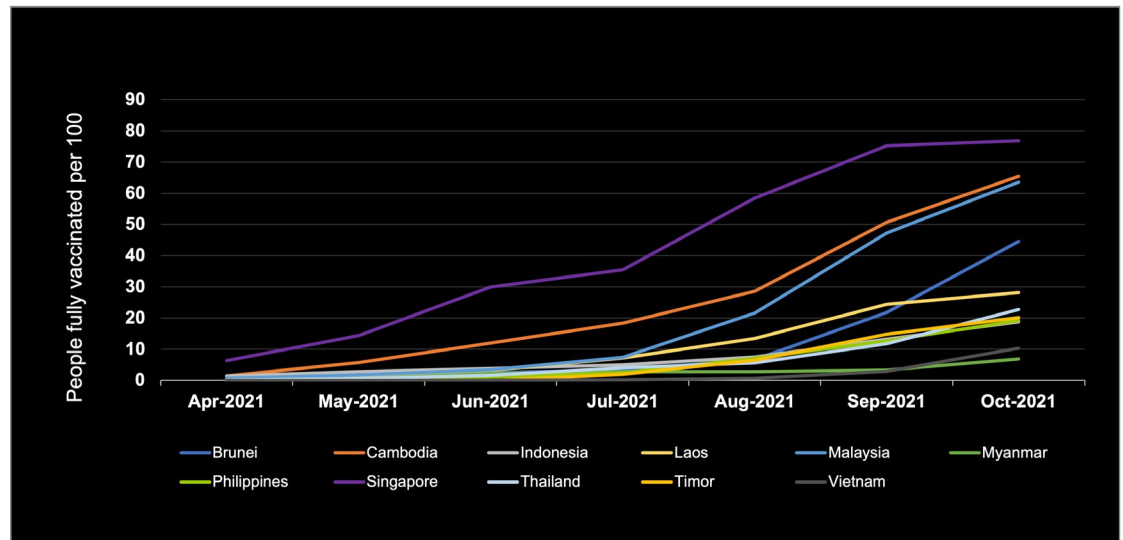
Minimal air traffic activity added to the woes of flag carriers Garuda Indonesia,

Malaysia Airlines, and Thai Airways International, which were in poor financial health pre-pandemic and had in 2020 entered restructurings with undefined end-dates.

Despite the challenges, underlying demand appears to remain strong. Thailand launched in July the 'Phuket Sandbox' and 'Samui Sealed Route' schemes, paving the way for similar travel lanes to popular island destinations in the Philippines, Vietnam and Indonesia. Vietnam's Bamboo Airways operated its first flight to the US in September.

Beyond these developments, plans to reopen international borders are still up in the air.

COVID-19 vaccination in Southeast Asia



Source: Our World in Data, retrieved October 26 2021

Making Contact

Asia-Pacific's early attempts at restoring international connectivity took the form of travel bubbles.

Australia and New Zealand's Trans-Tasman travel bubble launched mid-April and was largely successful, notwithstanding a month-long suspension due to outbreaks

in Australia's eastern states. Meanwhile, each nation has set vaccine targets for their respective reopenings and their COVID-19 strategies remain largely in sync.

This was not the case for Singapore and Hong Kong, which called off their 'Air Travel Bubble' arrangement in August as Singapore embarked on an endemic approach while Hong Kong maintained

its zero-COVID stance. The cities, each without a domestic market, have since taken divergent approaches to restoring international connectivity.

By October, soft targets for easing cross-border restrictions have converged upon November—Australia, Thailand, Malaysia, Indonesia, to name a few. With vaccination rates on the rise, more nations are warming up to the endemic view, seeking to live with COVID-19 and control its spread rather than eliminate it.

Singapore's experience presents itself as a case study. High COVID-19 vaccination rates delivered on the promise of fewer deaths and severe cases, but an "exit wave" that began around mid-September piled the pressure on the city-state's healthcare infrastructure.

Despite strict movement controls locally, Singapore by the end of October announced 'Vaccinated Travel Lanes' to 13 countries. These commenced between September and November, and the destinations include Australia, Brunei, South Korea, the UK, France, Germany, Switzerland, US and Canada.

Turning the corner

Most aviation markets are expected to recover to 2019 levels in 2023, according to Ascend by Cirium's analysis.

This is vastly improved from earlier forecasts of a 2024-25 recovery, but many airlines in Asia-Pacific are still burning through cash. Some have turned to long-term debt for near-term liquidity needs, often hybrid debt with 10-year tenors or longer.

This year, Korean Air affiliate Jin Air and Asiana Airline's Air Busan each issued 30-year bonds backed by their respective

parent companies. Japan Airlines disclosed plans to raise up to Y200 billion from a dual-tranche hybrid term loan, with 35 and 36-year tenors, and Y150 billion from a 37-year hybrid bond under the same fundraising programme.

The fundraising trend, which emerged in 2020 during the pandemic, suggests uncertainty about the near-term outlook and a possible long-tail effect on airlines' financial health.

More than 18 months into the COVID-19 pandemic, Asia-Pacific's reliance on bilateral agreements to resume cross-border travel has meant piecemeal recovery for the region though these have proven to be possible with effective testing procedures supported by high vaccination rates. Reaching those agreements and seeing them through to fruition have been the greater challenge.

Reflecting on when the delta variant first emerged, current known unknowns of the pandemic are around the efficacy of vaccines and booster shots, as well as widespread vaccination for children. The recently identified delta sub-variant AY.4.2 may well be yet another curveball, among factors that could spook bilateral or regional co-operation.

The world still has much to fear but economic activity in any region would grind to a halt if locked down indefinitely. Restoring connectivity in a pandemic should be a balance of public health and economics, rather than viewed as a toss-up.

The Asia-Pacific is a region more diversified than others and each jurisdiction will no doubt act in its own interest. Perhaps as the pandemic wears on, the impetus for economic recovery can be the great motivator to restore connectivity.

Spotlight on Latin America: Flight comeback awaits surge in demand



By Steve Goldstein

Steve Goldstein is an Airlines Reporter in the Americas for Cirium's Dashboard news service

Commercial flight activity in Latin America has been stuck at around 25% below pre-pandemic 2019 levels, even as the spread of COVID-19 has diminished in the region amid rapidly accelerating vaccination efforts.

The percentage difference in Latin American carriers' number of daily flights versus 2019 could soon narrow if travel demand throughout the Americas gets a boost from the US' November reduction of restrictions on incoming international travel.

A new surge in demand could also ease the hoped-for emergence of Mexican carrier Aeromexico, Colombian airline Avianca and Chile-based LATAM Airlines Group from US Chapter 11 bankruptcy protection.

Airlines such as Azul and GOL have lately been expressing optimism for a return to pre-pandemic levels of flight activity and revenue, touting the success of vaccination efforts since late spring and the subsequent revival in travel demand in their home country of Brazil.

Executives at the two rival carriers noted during their quarterly earnings calls in 2021 that Brazil's relative lack of vaccine refusal, particularly when compared with the entrenched opposition among a swath of the US' population, would likely aid in the acceleration of inoculation and in the driving down of the infection rate.

That has apparently been true of the entire region, as the vaccinated portion of individual countries' populations has ballooned concurrently with dramatically declining infection rates.

Nevertheless, the path taken by COVID-19 continues to surprise even public health and infectious disease experts. In fact, Chile's infection rate has been rising slightly since early October after a rapid summer fall in line with the rest of the region.

Vaccination efforts during the last several months have been particularly successful in the region's five countries with the most tracked flights.

At June 30, 66% of the population in Chile had received at least one dose of COVID-19 vaccine, followed by Brazil (35%), Mexico (24%), Colombia (23%) and Peru (14%), research from Our World in Data shows.

By November, the percentages had improved to 86% of Chile's population, 76% of Brazil's, 58% of Mexico's, 60% of Colombia's and 60% of Peru's.

By way of comparison, in the US the rate of vaccination (at least one dose) increased from 54% on June 30 to 67% on November 7.

Meanwhile, the rates of daily new cases of COVID-19 in the five countries declined significantly.

Colombia reported on June 30 a pandemic high among the five countries of 621 new cases per million population (seven-day average), World Health Organization data shows. By November 7, the daily rate in Colombia had declined to 32 new cases per million population.

The percentage change in the daily number of flights for all Latin American carriers

combined versus 2019 levels has meanwhile narrowed steadily since late spring, Cirium data shows.

Latin American carriers' daily flights were down 42% (seven-day average) on June 5. By September 13 the percentage difference had improved to down 28%, and by November 7 it had narrowed slightly to down 22%.

"Domestic and international demand [in Latin America] has been improving in the last couple of months on a yearly basis, likely an indication of the vaccination progress," JP Morgan analyst Fernando Abdalla wrote in an October 18 research note. "On one hand, domestic capacity is already close to pre-pandemic levels, while on the other international is still lagging. Moreover, [the] travel mix remains impacted by still subdued corporate demand."

Capacity for travel within Latin America improved from down 41% in June to down 19% in November, Cirium schedules data shows.

At November 7, 42% of Latin American carriers' aircraft were in storage.

Chapter 11 trio's emerging hopes

Latin American carriers have not received anything resembling the kind of governmental financial support that helped keep US carriers afloat during the darkest days of the COVID-19 crisis. Against that backdrop, Aeromexico, Avianca and LATAM filed for Chapter 11 bankruptcy in the US within months of the pandemic's onset in order to continue their operations.

Taking a different route entirely, Venezuela's state-owned airline Conviasa simply went into hibernation, and has not operated a flight since April 2020, Cirium schedules data shows. Conviasa's president Ramon Celestino Velasquez Araguayan on October 22 disclosed on Twitter that the airline would be reactivating the entirety of its domestic network beginning in November and continuing through 31 January.

The attempts by Aeromexico, Avianca and LATAM to emerge from Chapter 11 have been, and will continue to be, perhaps the most closely watched developments in Latin American commercial aviation. The three carriers altogether have 227 aircraft under operating leases, Cirium fleets data shows. Avolon and SMBC Aviation Capital are the carriers' most exposed lessors, with each leasing a total of 24 aircraft to the three airlines.

Aeromexico's parent Grupo Aeromexico on October 15 filed with the US bankruptcy court for the Southern District of New York an amended joint plan of reorganisation and related disclosure statements. A hearing to confirm the plan has been set for December 13.

The US' easing of international travel restrictions should help Aeromexico rebuild its transborder partnership with US carrier Delta Air Lines, a centrepiece of its Chapter 11 exit strategy. The lifting of other international travel restrictions will also give the Mexican flag carrier the opportunity to rebuild its partnerships with fellow members of the SkyTeam alliance, including Air France, KLM and Korean Air.

Avianca, meanwhile, edged closer to exiting Chapter 11 on November 2, when the US bankruptcy court confirmed the Colombia flag carrier's plan for reorganisation. The plan, which previously had been approved by Avianca's creditors, was set to become effective during the fourth quarter.

The same court on October 28 approved LATAM's 14 October request to once again grant it additional time to submit its own reorganisation plan.

LATAM now has until November 26 to present its reorganisation plan to the court.

The bankruptcy court had on September 23 granted LATAM an extension of its deadline to submit its plan, from September 15 to October 15. The September 15 deadline was

itself the product of an extension granted in late July.

Azul, which in May disclosed that it is “actively exploring” consolidation opportunities in the region, may make an offer to acquire LATAM if the airline group cannot come to terms with its creditors, according to a Chilean report.

Brazil's paused comeback

LATAM's Brazilian affiliate and its domestic competitors GOL and Azul saw their fortunes improve beginning in April amid an initial dip in the country's rate of new COVID-19 cases, followed by a more precipitous decline in the infection rate that began in late June.

The number of daily new cases of COVID-19 per million population in Brazil fell from 366 on June 26 to 40 on November 7.

Brazilian carriers' number of daily flights versus 2019 levels narrowed from down 66% on April 8 to down 27% on September 4. However, since mid-September, the number of daily flights has generally plateaued at down 20-25%.

The relative stasis in the comeback of Latin America's largest commercial aviation industry by flights tracked has mirrored that of the US' aviation industry. US carriers' daily flights were at 15-19% down from mid-July through early November, amid summer's spike in new COVID-19 cases caused by the delta variant, except for a couple of weekends during which the gap narrowed.

Further narrowing of the gaps in flight activity in the USA, Brazil and across Latin America in the early months of 2021 is contingent on several factors.

First among them is the large-scale return of workers to offices in the Americas, which

could stimulate a resurgence in demand for international business travel, assuming borders remain open.

Secondly, although no less important, is the continued efforts of individual nations to vaccinate their populations and to provide boosters to those who have already been inoculated.

And, finally, the attainment of 2019 levels of flight activity naturally remains dependent on the efficacy of the vaccines themselves in the face of COVID-19 variants still to come.

Finding gold amidst the noise: Next generation airline schedules and pricing with machine learning

A Q&A with Abheer Kolhatkar, Cirium's emerging technologies leader, on the promise of machine learning for airline schedules and pricing models



A new generation of technology is about to change how airline schedules and pricing models are created and maintained. If these tools deliver, network planners, revenue management and other key executives will be more successful. We sat down with Abheer Kolhatkar, Product Director at Cirium. Abheer oversees much of Cirium's research and product development in emerging technologies such as machine learning. He was CEO of Migacore, which Cirium acquired early in 2021.

Q *Abheer, you're a pilot and a software engineer. Which came first, and did one inspire the other?*

A I get asked this a lot. I was a commercial pilot first and was mostly drawn to it because of my family's pedigree in aviation. They're all pilots. Through luck, I found myself at a startup working in travel technology and became enamored with software. My attachment to travel has never wavered.

Q *When you started in machine learning, did you pick aviation because you saw an opportunity, or because of your interest and connection to flight?*

A When starting to think about the technology, we began thinking of what we wanted to see in the world and believed should exist. The thesis was to use completely GDPR-compliant contextual web data to drive insights into human behavior. It just so happened that my edge in travel technology played a part in finding an initial use case and home that spurred further interest. We quite quickly settled into forecasting augmentation for revenue management systems which is a super complex and fun place to build things.

Q *Cirium is not the only company applying machine learning to passenger demand modeling. Why is this specific problem an opportunity to apply this emerging technology?*

A It is a fascinating question, and whilst I am not going to do the entirety of this topic justice, I will give it a shot.

As airlines have digitized, understanding passenger behavior has gone through many iterations. This to me is just the next iteration along the path. Unlike financial or advertising companies that rely on automated bidding, settling, and distributing of inventory, airlines still have vast amounts of manual input into their primary levers—pricing availability, capacity, and marketing. This is due to the insular nature of airlines system today—where focusing on bookings and passenger numbers is first, followed by sparse industry data that is delayed and often not comprehensive enough. Including new data or insights will continue to be a struggle unless we upgrade the backend systems to be more flexible. Machine learning is a way of embedding this flexibility without complete overhauls that can be expensive for the net gain in performance.

Q *Cirium just launched Diio Signals for generating contextual demand insights. Obviously, traditional passenger demand models have been thrown off with COVID. How can machine learning and tools like Diio Signals build confidence back into airline planning and revenue management?*

Providing seamless context into airline systems and processes that are inexpensive and a massive value add is what we are aiming to achieve. For



example, augmenting forecasting systems with data from advertising or the web in general can be completely transparent to the airlines revenue systems, because the shape of the data does not change. But now, airlines need to spend less time fixing leaks in their revenue system and more time being creative with minor changes to their process. This style of enhancement can be achieved in a lot of areas, which is what I am excited about.

Q *Are airlines capable of being tech companies? I mean, is the aviation industry embracing machine learning? Where are we in its adoption lifecycle?*

A An industry like this which is data-heavy across operations, commercial and product is a great base on which to add—and try—newer technology capabilities. I see a lot of use cases being tackled as proof of concepts and some reaching commercial potential. But there is a strong resistive current in the form of existing mission critical systems who prefer to set the pace of adoption and in some cases control it entirely.

This paradigm is interesting to me because airlines have not really decided if they want to be technology companies yet and are quite demanding of their existing suppliers as is, which continues to make it incredibly difficult for innovative approaches to gain a foothold. I am a believer in smaller and more composable systems as opposed to large all-encompassing solutions, but that only becomes possible if airlines can come to terms with being technology companies. In short, we are still early in the adoption cycle with a lot of promising ideas that are starting to gain traction. The focus on value-add use cases is a good approach to breaking up the monotony of monoliths.

Q *What are some other fields in aviation that are likely to benefit from machine learning and “intelligent” data in the next 10 years?*

A Revenue management is an obvious choice with the caveat that it has already been in place for a while, and I am slightly biased by my background. I would look at tasks or problems that are either complex or complicated. By that I mean, “complex” where it is hard to understand the cause and effect. Or “complicated”—where there are too many variables to reach a solution, but one or a few options may exist. It should help narrow the focus on great machine learning use cases.

Q *If you could apply machine learning to any problem in your life, what would it be?*

A I would love a good recommendation system for books!

If you want to learn more about machine learning, connect with Abheer or recommend any good books, visit <https://www.cirium.com/data-innovation/contextual-demand-insight/>

Using the cabin for cargo: A doubling in 2021



By James Mellon

James Mellon is the Senior Aviation Data Research Analyst for Aircraft Interiors and Passenger Experience. Here, he reports with an update to the passenger aircraft with seats removed from the cabin, with research supported by Bin He.

In 2020, Cirium released analysis which showcased the new trend of passenger aircraft turning into temporary freighters—widely known as ‘Freighters’ (a portmanteau of passenger and freighter). We have continued to observe what has happened with the aircraft we have researched, and found that even more aircraft have adopted this role.

Cargo has been a relative bright spot for passenger airlines, giving it more emphasis than before to make up the shortfall from other revenue sources. To achieve this, an array of airlines have adapted their passenger aircraft to carry cargo in the cabin.

Since the pandemic began, Cirium’s Passenger Experience research team has identified 300 aircraft that have had most or all of their passenger seats removed in order to transport cargo in the cabin.

This is up from 155 aircraft which we reported last year, the size of the fleet has doubled since the last Cirium Airline Insights Review. These aircraft are also now increasingly called ‘Zero LOPA’ aircraft, referring to the technical documents which detail the ‘Layout of Passenger Accommodations’. Or in this case, the lack thereof.

This report does not account for any aircraft or flights operated where cargo has been placed into the passenger seats for carriage, or for any aircraft operating cargo-only flights where cargo has only been loaded into the hold.

Widebodies continue to make up the majority of the cabin cargo fleet: 84% of the aircraft we’ve researched are Airbus and Boeing twin-aisle jets, the same proportion of the global cabin cargo fleet compared to last year’s analysis. This correlates to the



effect that the pandemic has had on long-haul travel. Inter-continental routes have generally been slower to restart during 2021, so a surplus of widebodies continued to stay in storage. Widebodies have capacious cabins allowing them to carry a greater volume of cargo than a narrowbody. Many have been observed routinely operating long-haul flights where these aircraft types have the range.

Not only do widebodies make up the majority of cabin cargo aircraft, but the prevalence of particular aircraft types is also striking. For example, one in every three aircraft is a Boeing 777, with the twin jet making up 33% of the cabin cargo fleet, operated by 20 airlines worldwide.

With air corridors reopening, entry requirements easing, and passenger traffic levels rebounding, airlines have been bringing more aircraft back into service to support growing flying programs. In addition to reactivating aircraft which have been in storage for prolonged periods, some cabin cargo aircraft had their seats reinstalled and have returned to their original role. Swiss operated three Boeing 777-300ERs on cabin cargo flights, transporting over 33,000 tonnes of medical cargo. Cirium's flight tracking data shows that over 18 months, the 3 aircraft flew a combined total of 1,053 flights. 64% of that flying was to and from China. Between July and October 2021, each aircraft had all 270 economy class seats reinstalled and returned to passenger services.

106 aircraft have concluded cabin cargo operations, but two-thirds of the aircraft in our global fleet continue to fly in this temporary role. Limited shipping capacity is just one of the major challenges currently affecting the global supply chain. To meet the increasing demand for consumer goods, and to avoid disruptions such as congestion at shipping ports, certain circumstances make it more favourable to send cargo by air. But air cargo cannot solve all the

problems. "The air cargo market still carries a relatively small share of the global trade," said Ascend by Cirium head of market analysis Chris Seymour. "Ship and port difficulties cannot really be alleviated much by air cargo, which focuses more on higher-value goods, time sensitive products and e-commerce."

The high air freight rates allow airlines to earn revenue while passenger demand is still suppressed.

Air cargo has been particularly pertinent while nations have closed borders to passenger travel. New virus variants have caused a sudden and sharp increase in cases across South East Asia during summer 2021. Vietnam Airlines began cabin cargo operations with seven aircraft during this time, including five Airbus A350-900s.

The demand for cargo capacity presents new opportunities for airlines, especially those willing to bet big. Italian newcomer AlisCargo began operations in August 2021, and appears to be the first cabin cargo startup airline. Cirium's flight tracking data shows their pair of 19-year-old Boeing 777-200ERs most frequented route is Milan-Malpensa to Hong Kong.

Second-hand aircraft acquisition costs have declined due to the large surplus of available airframes, allowing airlines the opportunity to replenish or expand their fleets. Out-of-production widebodies such as the Airbus A330-200 and A330-300 have been in plentiful supply, made available due to early lease returns, airlines replacing fleets with the latest generation of twin jets, or by cutting long-haul operations entirely.

Having never operated widebodies before, SmartLynx have acquired four Airbus A330-300s and their Maltese subsidiary have deployed them onto long haul cabin cargo flights. The Latvian ACMI airline see this as an interim measure while cargo capacity



is limited. Once long-haul cargo markets recover sufficiently, SmartLynx intends to reinstall the seats and make the A330s available for passenger services. Cirium's Fleets Analyzer shows all four Rolls-Royce Trent 700-powered aircraft are between 8 and 13 years old, and managed by operating lessor CDB Aviation.

Cargo airlines have also been securing second-hand passenger aircraft to replace or grow their fleets. Slots for passenger-to-cargo conversions at MRO facilities are maxed out for the next few years, which means some aircraft are left waiting before they are converted. Turkish operator MNG Airlines have leased in two A330-300s with both to undergo P2F conversion work. While the first example was inducted at EFW's Dresden facility in April 2021, the second has in the meantime been performing cabin cargo flights providing additional uplift while waiting for its turn to be converted to a main-deck freighter.

The increasing importance of cargo is even a catalyst for major passenger airlines to introduce dedicated cargo services. Air Canada have operated 12 wide-body aircraft in the cabin cargo role since April 2020, providing additional cargo capacity

to destinations in Latin America, Europe and Asia. The Canadian flag carrier plans to reinstall seats and return all of the aircraft to passenger services by the end of 2022. In the meantime, the airline will go a step further by launching cargo services with dedicated main-deck freighters. Cirium's Fleets Analyzer shows that five Boeing 767-300ERs previously belonging to Air Canada as passenger aircraft will be converted to freighters, then leased back in from operating lessor, Cargo Aircraft Management. Air Canada announced that they plan to deploy the 767s on key air cargo routes, such as Lima and Quito in South America. Cirium's flight tracking data shows that Air Canada cabin cargo Airbus A330-300s and Boeing 777-300ERs have operated 416 flights to both destinations since June 2020.

The consensus is that cabin cargo aircraft will continue to be a temporary solution while the industry recovers to a pre-pandemic state. Two-thirds of the cabin cargo aircraft we have researched are still flying without seats, so it will be a long time before all of them have been returned to passenger services, or even get a new lease of life as a dedicated cargo aircraft.

2021 highlights in aircraft leasing: Operating leasing powers on



By Rob Morris



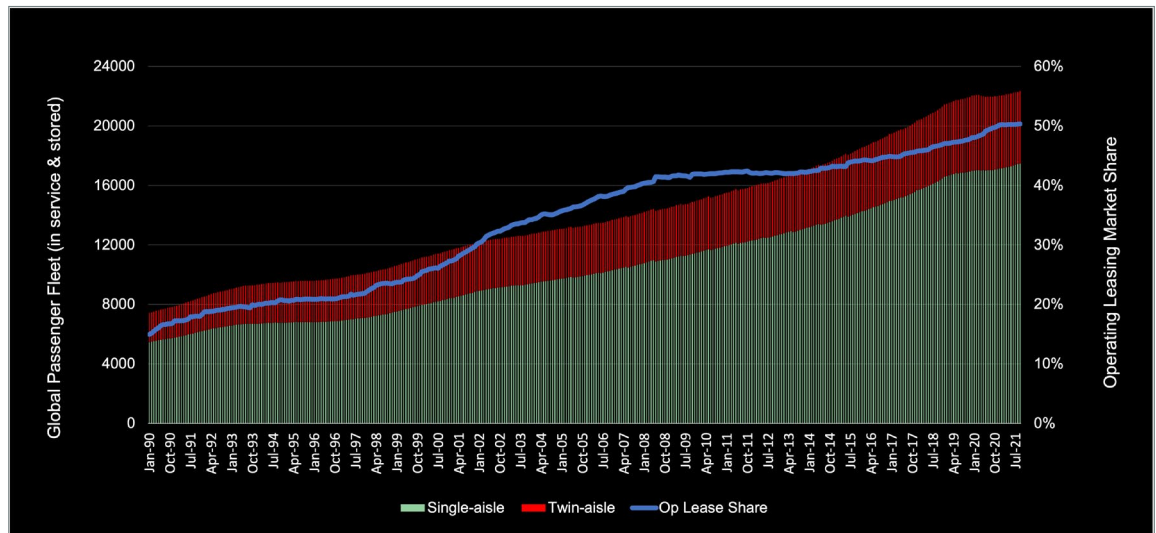
By George Dimitroff

Rob Morris is the Global Head of Consultancy and George Dimitroff is the Head of Valuations at Ascend by Cirium

This year presented challenges to many commercial aviation market sectors, not least operating leasing—the practice of leasing aircraft to airline operators without transferring ownership. Through the last growth cycle, operating leasing had continued to supply almost 50% of the global passenger single and twin-aisle fleet to airline operators. At the end of 2019, just over 48% of the 22,000 or so passenger jets operated by airlines or stored globally were managed by lessors. Some 22 months later—at the end of October 2021—as the airliner fleet in service and stored globally had grown by only around 300

units, leasing penetration had grown by 2.2% points as lessors increased their own portfolios by more than 660 aircraft. The mythical “50% market share” for leasing was finally achieved. This was driven largely by lessors financing almost 65% of all new aircraft deliveries since the start of 2020 (both from their own order books and also via purchase and lease back (PLB) but also by substantial further acquisitions of used (but often nearly new) aircraft via PLB. As aircraft entered portfolios, lessors retired fewer aircraft than usual with only just more than 250 jets parted-out—some 37% of all retirements—over the same period.

Global Market Share of Operating Leasing



Source: Cirium Fleets/Ascend by Cirium analysis, November 2021

June 2019: The peak of the last bull run for leasing

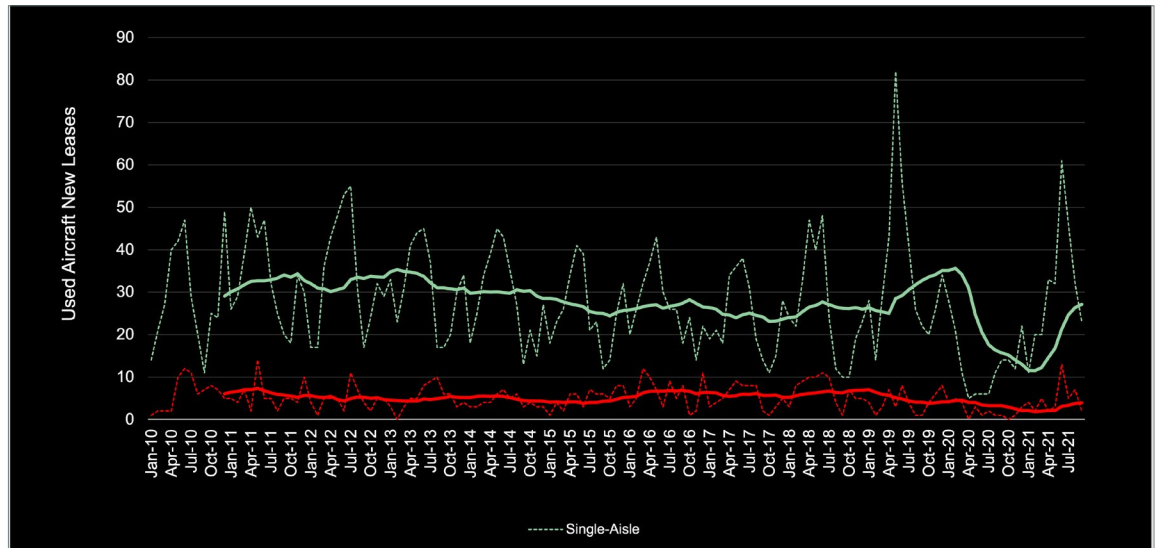
As the pandemic impacted demand through 2020, lessor idle inventory began to increase as secondary market leases

of used aircraft slowed for a period. Availability of both single-and twin-aisle aircraft for lease (as recorded in the Cirium

fleets data) more than doubled between July 2020 and March 2021 to total some 423 and 119 units respectively as we entered the second quarter of this year. However,

since that time inventory has remained relatively stable. Secondary lease activity—represented by the rolling 12 month average of new leases recorded—has

New Operating Leases (Used Aircraft Only)



Source: Cirium Fleets/Ascend by Cirium analysis (solid line is 12-month rolling average), November 2021

recovered towards pre-pandemic levels. The number of new leases recorded in June 2021 was greater than in any single month in the prior growth cycle aside from June 2019. We can now recognize that month as the peak of the last bull run for leasing.

Some of these new leases feature aircraft returning to previous operators on restructured terms. Many of those operators also restructured to meet the requirements of the new market paradigm. This is undoubtedly exerting pressure on lease rates. We have seen Current Market Lease Rate (CMLR) reductions average around 30% for single-aisle aircraft on a vintage based like-for-like basis since the start of the pandemic. Newest generation A320neo and 737 MAX family aircraft have fared better, with reductions averaging around 10%. Airlines prefer such aircraft and their lower fuel burn and corresponding lower CO₂ emissions, as they continue their recovery from the

pandemic. Older generation A320ceo and 737NG family aircraft have seen more competitive pressure deriving from greater availability, driving greater average CMLR reductions typically around 35% or more. Through 2021, most new lease structures required some element of usage based 'power-by-the-hour' rental terms, but as demand has strengthened somewhat we see less need for such terms. Into 2022, it seems like the bottom of the market has been reached and the next moves for CMLR are likely to be upwards, albeit tentatively at first.

Twin-aisle jets: Slower recovery

The same cannot be said for twin-aisle jets. For some key types like the 777-300ER and A330-300 we have seen average 30%-40% reductions. As international long-haul markets remain slower to recover, demand for such aircraft remains softer and thus pressure on rentals remains for

now. Although there are typically fewer twin-aisle aircraft in leasing ownership, availability remains relatively high and for now there could be more bad news for lessors for such aircraft types before recovery begins for these types.

The AerCap GECAS mega-merger

2021 has seen the largest ever merger in the leasing space. AerCap and GECAS entered 2021 with lease portfolios of 1,018 and 1,046 commercial jets and turboprops respectively, plus additional firm order backlogs of 288 and 250 units each. Whilst many expected some element of consolidation in the space, few foresaw the deal which brought together these two giants in early November. The consequent portfolio of some 1,971 aircraft at merger, with estimated Current Market Value around \$45 billion, renders the new AerCap more than twice the size of the next largest competitor Avolon (with a portfolio of almost 600 aircraft worth more than \$17 billion). The AerCap / GECAS deal wasn't the only consolidation in 2021, however. Carlyle Aviation's acquisition of Fly Leasing in August was the next largest. There will be continued activity into 2022 as AerCap aligns its portfolio strategy and disposes of any non-core assets, such as GECAS' turboprop and regional jets.

Beneath the merger and acquisition activity already discussed, lessors do continue to trade assets amongst themselves with lease attached. However, in 2021 such activity has typically been at lower volumes than we have seen in prior years. In the final three years of the last growth cycle, almost 400 single-aisle aircraft were traded annually between lessors with lease attached. Even in 2020, there were more than 200 such deals recorded in Cirium's fleets data, albeit many of these were deals agreed pre-pandemic and typically closed in the first few months of the year. To September 30,

2021, only 120 such deals were recorded. There is anecdotal evidence in the market of activity reawakening, but for now the lag of offer to agreement to closure means that it will likely be 2022 before we see this market really pick up again.

ABS resurgence

Finally, 2021 has also seen a relative resurgence in the Asset Backed Securitisation (ABS) market. At the time of writing in early November, lessors have already successfully brought 11 ABS to market covering almost 300 aircraft. Despite concerns in 2020 about rental collection rates across existing structures, the capital market appetite for operating leasing remains significant. ABS represents an elegant way to finance or refinance aircraft which lessors might otherwise have struggled to sell in the current market.

Operating leasing remains a vibrant and active sector in 2021, and with trading set to recover further in 2022 the outlook remains strong.

We hold the stopwatch:

Why airline on-time performance matters



A Q&A with Cirium's in-house On-Time Performance leadership

Jay Morgan and Jim Hetzel manage Cirium's much-heralded monthly and annual on-time performance database and reports.

Q In 2020, it seemed like every airline was on time. There were few of us flying and those that were benefited from seamless operations. We went from gate to runway in one fell swoop. That's not the case for 2021, starting with the summer travel season in the US. What happened?

A **Jim:** The industry is still in reboot, across the board. We're learning the new norm. And I think some airlines are having a harder time than others just by the nature of their flight networks. I believe when you look at legacy, hub and spoke carriers—from Air Canada to Delta and everyone in between—they have resources concentrated in hubs, which allows them to work through disruptions and delays more efficiently. When you look at other airlines, like LCCs who are operating point to point networks, those are much more susceptible to cascading delays. A delay early on in the day can ripple through to the downstream flights. And it becomes really, really difficult for those airlines to recover from that.

Q Why does Cirium put such an emphasis on on-time performance, of all of the metrics you measure?

A **Jim:** On-time performance is the most visible metric that impacts a consumer. If you say I'm going to land at noon and I land at noon, I feel like you've done your job. Now, 15 minutes tends to be the time that resonates most with consumers. It is but one metric, but it is tied to consumer expectations. 15 minutes allows for hiccups that are truly beyond the control of the airline like unexpected taxi time or gate unavailability. At the same time, we have airlines that measure themselves on how close they got to the actual, scheduled time—we call it A0.

Q So the airlines really care. Who is the glutton for punishment at the airlines?

A **Jay:** Oh, they care — certainly within the airline operations group. Their primary focus is monitoring their own performance against competitors. And we have clients that are fierce competitors. They reach out to us almost weekly to understand the performance metrics we're tracking. 80% of the US airlines and 50% of global airlines buy this data in the form of custom workbooks. They want to know how the industry is operating to schedule.

Jim: If I could add...they care because it is a direct measure of how efficient they are. I've seen an estimate that it costs about \$74 per minute of block delay, per aircraft. That adds up very, very quickly. Add in the cost of paying to park your plane overnight at an airport, because your operations were delayed and a resource is stuck at Tampa. You pay for that. And, ultimately, even beyond those unit costs, it's about asset utilization. You want your aircraft flying. You want your planes to be in revenue-producing mode.

Jay: The funny thing is that early arrival can cause just as much headache as being late. You're taxiing in, and waiting. Your support teams might be working a different flight. So, on-time performance is really a golden window. But the average is a taxi time of 14 minutes and a taxi in of about seven minutes.



Q *So, how exactly does Cirium start and stop the stopwatch?*

A **Jim:** At Cirium, we have one of the largest schedule databases in the world. We have schedules on over 97% of commercial flights around the globe. We have a baseline of what every airline should be flying, according to their schedules. But it's more than that. We leverage about 600 sources of information for the on-time performance data. Sourced from across the space, coming from the airlines directly, airports, air traffic control, and positional data.

Q *Why the need for 600 sources, and what exactly are they?*

A **Jay:** We're taking flight schedules by Cirium and sourced directly from the airlines. The airlines are also sending direct feeds from their air ops system. We're getting even more detailed information. We take MVT messages, which are airline movement messages from dozens of airlines, pushed to us via the SITA network. We're getting data from all of the Global Distribution Systems, like Sabre, Amadeus and Travelport. The FAA provides a data feed but also there are many other government data sources including airport advisories, ground stops and delays and information about traffic management systems. We're taking data from the airports themselves and passing it back to them for display on screens. We then have negotiated data coverage for regions like Mainland China and Others. We're ingesting weather data. In locations where weather data is less robust, we have means to collect the data from the various airlines operating there. Finally, we have Global ADS-B data from a service provider. It's an exhaustive list. In total The Cirium Core—our data warehouse—holds 300 terabytes of information from 2,000 sources of data, going wider than the data needed for on-time performance.

Q *Ok, tough question, but with all of that data, why do you not have 100% coverage, all time?*

A **Jim:** That is a very good question. While we certainly have a tremendous amount of resources to measure flights, there are still gaps. There are still parts of the world where maybe there's not

good positional information. There are some gaps where airlines are publishing their own data. Positional data only gives us part of the story. It gives us the part of the story where a flight touches down on the runway, but it doesn't tell us how long that flight is sitting on the taxiway and how long it takes to get to the gate. To me as a passenger, I can land "on time", but that doesn't mean I'm on time until I can get off that plane and start doing my business. So it's those kinds of little data gaps that do create some blind spots with on-time performance. But for the most part, we leverage a tremendous network of data and certainly can cover the vast majority of flights around the globe.

Q *When does the clock actually start and stop?*

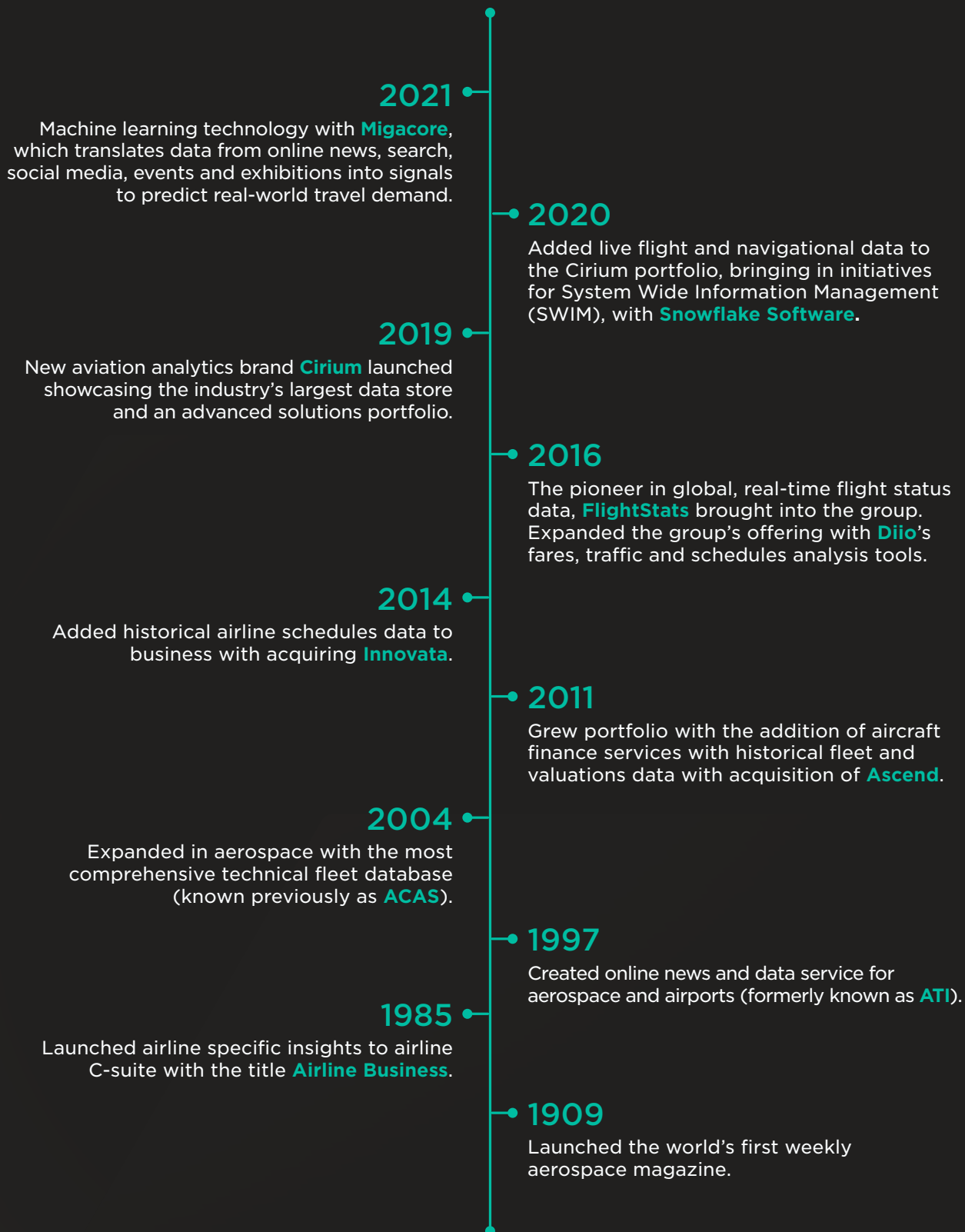
A **Jim:** The main metric used to measure performance is A15—did the flight arrive within 15 minutes of its scheduled arrival time. Block time is the metric. Block time is a measure of when the wheels move. It's a standard metric, but not all airlines use that. Some start when the door closes—for instance, some of the LCCs we work with.

Q *You guys seem like you're into timeliness. When you fly, do you bring a stopwatch on board?*

A **Jay:** [Laughs] I don't bring a stopwatch, but I bring my laptop. I look at my watch and my apps. Most of those are powered by Cirium. So, I'm also interested to see whether what the apps show matches what Cirium shows. Many times I've been notified of a gate change before the airline announces the gate change at an airport. Yes, I do keep track. I'm keenly interested in it.



Cirium brings together powerful data and analytics to keep the world moving. Delivering insight, built from decades of experience in the sector, enabling travel companies, aircraft manufacturers, airports, airlines and financial institutions, among others, to make logical and informed decisions which shape the future of travel, grow revenues and enhance customer experiences. Cirium is part of RELX PLC, a global provider of information-based analytics and decision tools for professional and business customers.





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