

**THE ANNOUNCEMENT by Airbus recently that it will end production of its flagship A380 in 2021 was unsurprising.**

Sales of the company's super jumbo have struggled for years. Airbus' latest orders and deliveries figures, updated in March to account for cancellations, show it sold only 290 examples of the A380 after the type's formal industrial launch back in December 2000, with the last new firm order placed in 2013 by Emirates. The declining backlog forced the manufacturer to scale back production rates in the last few years from the high of 30 aircraft in 2014 down to eight this year.

This didn't mean axing the aircraft was any less difficult, as Airbus' outgoing Chief Executive Officer Tom Enders (succeeded in April 2019 by Guillaume Faury) reflected: "It was painful to take the decision after all the effort, money and sweat our employees have poured into that programme, but we have to base our decisions on facts."

The most important of those facts is that the A380's quad-jet economics were more expensive than those of the efficient widebody twin-jets such as the Boeing 777 and the A380's own Airbus stablemate, the A350.

The A380 will of course remain a presence in the skies for years to come; Emirates plans to continue flying the type well into the 2030s and Airbus will continue to support the in-service fleet.

Even so, the axe falling on the A380 as a current-production aircraft marks a line in the sand in the history of commercial air transport. The A380 will probably be the last large passenger airliner with four engines.

As the airline industry commentator John Strickland of JLS Consulting reflected to AIR International: "The capability of aircraft to fly long range on two engines unfortunately means the days of four-engine aircraft are coming to a close in terms of new orders. Twins are the way airlines are going."

Boeing still offers the 747-8 Intercontinental, the passenger version of the 747-8, but sales of that aircraft have been even weaker than the A380, with just 47 sold since its launch in 2005. Boeing has for years now said the 747-8's future is tied to air cargo; it has sold 107 examples of the 747-8 Freighter variant so far.

Strickland believes there is logic to the A380 if used to its maximum potential of about 800 seats, which, he said, "would give you a very low cost per seat". However, no airline has ever used an A380 to that maximum capacity – the nearest is Emirates configuring a subset of its fleet with 615 seats – because, ultimately, there are only so many routes where that amount of capacity is required.

Strickland explained Emirates has been able to operate so many A380s (the carrier had 109 in service as of March 2019, with just 14 more to be delivered before A380 production ends), because, "they've built a hub where they've got Airbuses connecting Airbuses,

500 seats feeding another 500 seats, which is a logical nature of [passenger] feed".

For much of the market, however, a platform of the A380's size is simply too big for the demand on most of their routes and, even if A380-sized seat capacity is required, most operators only need it to a limited extent. It is a telling statistic that most A380 operators only have small fleets of the super jumbo compared to the fleet sizes of their other widebody aircraft, British Airways, for example, operating only 12 A380s compared to 58 777s.

With Emirates so instrumental to the A380's commercial prospects, it was clear the Gulf carrier would be decisive in the aircraft's long-term destiny. The airline signed an agreement early in 2018 to buy more examples, but with the airline reportedly unsatisfied with the performance of the Trent 900, it subsequently revised its plans, deciding instead to reduce its outstanding super jumbo backlog by 39 aircraft to 123 and order 40

A330-900s and 30 A350-900s.

Emirates' decision, combined with a lack of new orders from other customers, little interest from lessors and cancellations (Hong Kong Airlines and Virgin Atlantic were among those to scrap purchase plans, while Air France and Qantas cancelled repeat buys), all led to a sadly inevitable conclusion.

However, the A380's demise as a current-production aircraft is not quite an end of days for large passenger airliners. A new generation of giants is on its way, led by the initial Boeing 777X.

The 777-9, the first version in the updated Triple Seven range, is the largest commercial twin-jet yet developed. Although it doesn't quite match the size of the sole giant Antonov An-225 Myria, which with its 84m (275ft 7in) length and 88.4m-wide (290ft) wings, is the largest commercial aircraft ever developed, the new Triple Seven will still catch the eye.

It will have a very long fuselage (251ft 9in/76.7m), very wide wings

(235ft 5in/71.8m when the folding tips are fully extended for flight) and very large engines (General Electric GE9X turbofans with a 134in/3.4m fan diameter), making it the largest airliner Boeing has ever produced. The 777-9 will be followed by a longer-range variant, the 777-8.

More larger twins could be on the way. Both Boeing and Airbus have already said higher-capacity variants of their big twin families, dubbed the 777-10X and A350-2000 respectively, are technically feasible. The 2020s could well see these larger, longer aircraft developed and enter service.

To casual observers, twin-jets probably have less character than the quads. However, large commercial aircraft still have their place in air transport to cater for high-capacity requirements, even if – as the A380 has shown – this is a limited requirement.

If anything, with the A380 dropping out of the market there is now added potency to the contest between Airbus and Boeing's big twins. *Mark Broadbent*

## Etihad changes



**ETIHAD AIRWAYS has restructured its orders for Boeing and Airbus aircraft, with the Gulf carrier now committed to taking far fewer new jets than previously planned.**

The carrier has revised its commitments to just 20 Airbus A350-1000s, six Boeing 777-9s, an undisclosed number of 787s and 26 A321neos, media reports in the Middle East say.

These numbers compare to previous order announcements from the airline for 62 A350s, 26 777s, 52 787s and 36 A320neo family aircraft.

The airline's Chief Executive

Officer Tony Douglas told IATA early in March about the order changes. He said airlines have to be "ready to make fast decisions and to adapt at very short notice. This is the new reality, and you will see more and more major players who compete in the global market having to change or alter their operating model."

Douglas said Etihad would optimise its network and rationalise its fleet by phasing out older types. Douglas also said Etihad has been "seen exclusively as an uber-luxury airline" and is evolving into what he called a "fully inclusive full-service airline". *Mark Broadbent*

# Quads to twins



The Airbus A380 will not be built after 2021, with efficient twin-jets such as the A350 and 777 having usurped the aircraft.

*P Pigeyre/Airbus*

## Farnborough public days axed



**THE PUBLIC weekend of the Farnborough Airshow has been scrapped, with the famous aerospace event now reduced in size from seven to five days.**

In early March, organiser Farnborough International Ltd said the next edition of the biennial event in July 2020 would not have a two-day public weekend, the traditional end to the show following five trade days.

The public weekend has attracted criticism from enthusiasts in recent years because many of the new aircraft in attendance during the trade days leave the show ahead of

the public days, leaving a sparse flying display; at last year's event, some aircraft displayed twice during the day to fill the gaps.

Farnborough International said there will instead be public access on the Friday, including to the exhibition halls, which it said will better highlight new technology and manufacturing to the public and encourage aerospace careers in young people. The Friday event was promoted in 2018 as a Futures Day.

The organiser added there will be a flying display on each of the five days of the 2020 show.

*Mark Broadbent*

# Shockwave

**THE IMAGE you see on this page is one of the first ever pictures of the interaction between shockwaves from two supersonic aircraft in flight.**

It was captured by NASA's Armstrong Flight Research Center during the fourth phase of the agency's Air-to-Air Background Oriented Schlieren (AirBOS) flights from Edwards Air Force Base, California.

The flights were testing out advanced camera equipment capable of capturing high-quality images of the rapid pressure changes produced when an aircraft flies at supersonic speeds.

The equipment will be used in the forthcoming Low-Boom Flight Demonstration, which will use the X-59 QuEST (Quiet Supersonic Transport) demonstrator currently under development to gather data about the nature of supersonic booms and inform future decision-making about the regulations governing overland commercial supersonic flight.

The images from the AirBOS flights, released by NASA in March, show a pair of T-38s

from the US Air Force Test Pilot School at Edwards Air Force Base flying in formation approximately 30ft (9m) away from each other, with the trailing aircraft flying about 10ft (3m) lower than the leading jet.

A NASA statement said: "With exceptional clarity, the flow of the shockwaves from both aircraft is seen, and for the first time the interaction of the shocks can be seen in flight."

Neal Smith, a research engineer with AerospaceComputing Inc at NASA Ames' fluid mechanics laboratory, said: "What's interesting is, if you look at the rear T-38, you see these shocks kind of interact in a curve. This is because the trailing T-38 is flying in the wake of the leading aircraft, so the shocks are going to be shaped differently. This data is really going to help us advance our understanding of how these shocks interact."

Sonic booms are heard as a result of the shockwaves emanating from components such as the nose, wings, engine and tail that are created as an aircraft travels at supersonic

speed. Schlieren photography, which has its origins in the 19th century, is an imaging technique used by NASA for decades in laboratory wind tunnels and, more recently, in flying trials to visualise shockwaves.

The AirBOS phase four flights featured an upgraded version of the airborne Schlieren photography systems previously used, with NASA saying its researchers were able to capture three times the amount of data in the same amount of time.

Dan Banks, senior research engineer at NASA Armstrong, said: "We're seeing a level of physical detail here that I don't think anybody has ever seen before."

"Just looking at the data for the first time, I think things worked out better than we'd imagined. This is a very big step."

The AirBOS system was carried on board NASA's Beech 200 King Air, which flew in a pattern at around 30,000ft while the T-38s passed at supersonic speeds approximately 2,000ft beneath it, the cameras recording at the exact moment the jets came into

the advanced camera's frame.

The AirBOS system has several important differences from previous Schlieren imaging systems used by NASA. It has a wider field of view, a higher memory capacity (enabling researchers to increase the frame rate to 1,400 frames per second, making it easier to capture a larger number of samples) and an upgraded connection to data storage computers allowing for a much higher data download rate.

The result is more data can be collected, boosting the quality of the images and in turn giving researchers a better understanding about the behaviour of the shockwaves. NASA said the data from the AirBOS flights will continue to undergo analysis, helping it to refine the data-collection techniques and further improve quality of the data.

By understanding in detail how shockwaves behave, more information can be used to develop the X-59 and, in turn, work towards the target of achieving quiet overland supersonic flight. *Mark Broadbent*

A coloured composite image of NASA's recent Air-to-Air Background Oriented Schlieren (AirBOS) flights. *NASA*

