



NEW WIDEBODIES

OEMs ready entrants as market ‘rebalances’

by Gregory Polek

A downward trend in sales has hardened projections of persistently weak demand for wide-body airliners at a time airframers prepare to introduce several new and derivative models to the market. Although analysts predict airlines’ seemingly insatiable hunger for new narrowbodies to continue, the category of airplanes that historically produced the highest per-unit profit margins has struggled to maintain the sales momentum manufacturers had expected following impressive volumes of launch commitments.

In the case of the Boeing 777, for example, not only has the new 777X struggled to build upon an initial spate of orders that accompanied its launch at the Dubai Airshow in 2013, Boeing has failed in its original intent to sell enough legacy 777s to sustain production at last year’s rate of 8.3 per month. Now building seven of the big twins per month, Boeing expects to slow the rate to five by August, which effectively translates to a 3.5-airplane delivery rate with its plan to “fire blanks” down the line as part of “Lean” implementation and dedicating some airplanes to 777X flight-testing.

Still, Boeing vice president of marketing Randy Tinseth prefers to characterize the current environment as one marked by a “rebalancing” of demand following a period in which deliveries spiked for both major airframers in the wake of disruptions caused by delays to the 787, A350 and A380 programs. In fact, Boeing delivered the 500th Dreamliner last December to Colombia’s Avianca, just five years and three months after sending the first 787-8 to All Nippon Airways, setting a new record time to 500 deliveries for twin-aisle aircraft. But before Dreamliner deliveries started and accelerated in earnest, production upticks of other twin-aisle models filled a gap left by the 787’s extended development.

“We went through a period in which airplanes like the A330 and 777 went up in production to fill some of the spots that were left by delays in other programs,” explained Tinseth. “I would say we’re probably in a place of more normal demand because we’ve done our catch-up work in the marketplace.”

Although Boeing’s 787 lines haven’t felt the same sort of effect of what Tinseth characterized as a return to normalcy, Boeing’s rate hikes for the Dreamliner appear to have entered a period of moderation, likely holding at 12 per month until the end of the decade, when it hopes to see enough demand to raise the rate to 14. The latest member of the series, the 787-10, [flew for the first time](#) on March 31 and by that time had drawn firm orders for 149 copies from nine customers, a number Boeing considered acceptable for a derivative that won’t likely reach the market until the middle of next year.

“I think we have opportunity for [sales of the 787-10] to grow. Long term we look at the 787-9 and 787-10 being probably more the heart of the 787 market,” said Tinseth. “But the -10 is going to be the growth vehicle for the -9, so the -9 is just establishing itself. We especially think the -10 will

be great with its economics and range for Asia and for China.”

For Airbus, the A350 XWB series has yet to enter the phase of production acceleration the company had hoped to achieve early last year. Unfortunately, supply-chain problems associated mainly with seats and lavatories has forced it to play its own game of catch-up. Although the company nearly managed to meet its goal of delivering 50 A350-900s by year-end with a furious fourth-quarter delivery pace, reaching 49, schedules remain backloaded for 2017.

Meanwhile, following a decision last year by American Airlines to delay delivery of 22 A350-900s by an average of 26 months, long-term delivery schedules for the A350 remain in flux for reasons unrelated to the supply chain. In fact, early this year United Airlines said it had begun considering alternatives to the 35 A350-1000s on which it holds a firm order and, more recently, Delta Air Lines deferred delivery of 10 of 25 A350-900s by two to three years.

Notwithstanding the uncertainties surrounding the U.S. airlines’ A350 orders, that program remains a relative bright spot for Airbus, considering the travails of the A380 superjumbo. As sales totals for the big quad-jet continue to languish, Airbus has put to rest any thoughts of launching a so-called A380neo any time in the near or medium-term future. Instead, it has [introduced a new interior configuration](#) designed to create room for 78 more passengers on average in an effort to widen its appeal to current and future customers.

Of course, every airframe maker’s primary goal lies with cutting seat-mile costs, and whether a completely new design or a derivative of a ubiquitous industry workhorse, each new airplane model promises its own set of economic benefits. Here, **AIN** recaps the credentials of each widebody airplane program under full-scale development for market entry over the next decade.

BOEING 777X

Now well into its detailed design phase, the larger of two new Boeing 777X designs—the 777-9X—remains on schedule to reach completion of final engineering definition by the end of the year as program managers eye final assembly of the static-test airframe next year. Featuring 105,000-pound-thrust GE9X turbofans and structural improvements to the fuselage that will allow for a 6,000-foot cabin altitude, the airplane appears well positioned to meet Boeing’s 2020 entry-into-service target, as the company progresses beyond pre-production verification and into full-scale production of the all-new composite wing.

Common to 9X and the shorter 8X, the wingspan measures 235 feet, 5 inches, the widest ever designed for a commercial aircraft. One of the airplane’s most visually distinguishing characteristics, a 12-foot-long folding wingtip, will allow

regulators to classify both airplanes as Code E, meaning they’ll fit into the same size parking space the 777-300ER now uses. The Airbus A380, conversely, operates as a Code F airplane, significantly limiting the number of airports into and out of which it can fly.

Speaking with *AIN* before the Paris Air Show, Boeing 777X chief project engineer Terry Beezhold characterized the wing as a “big part” of the airplane’s efficiency gain, accounting for most of the aerodynamic contribution to the new jet’s 20-percent per-seat fuel-burn reduction compared with the 777-300ER.

Beezhold explained that the wingtips that allow for the extreme span operate with a fairly simple hydraulic system employing a geared rotary actuator and latch pins. The wings work on a so-called autofold system during the landing rollout; once the airplane slows to a certain speed, the wings automatically fold up.



BOEING 777-9X

“We’ve built a prototype rig and we have been abusing it, testing it, trying to identify any kind of issues and, frankly, it’s in really good shape so we’re now moving into full production design and build of all the components,” he said.

Boeing planned to build the first pair of wings for the program’s static-test article this year, followed by loading and the start of assembly of the second set for the first flight-test aircraft. Apart from the static-test article, the program will use four flight-test vehicles and a fatigue airplane Beezhold said would cycle for “a couple of years.”

Meanwhile, the new engines, scheduled for testing aboard a flying testbed later this year, account for 10 percent of the airplane’s fuel burn savings. The largest commercial engine ever developed, the GE9X features a front fan diameter of 134 inches, a composite fan case and 16 carbon-fiber composite fan blades; a 27:1 pressure ratio, 11-stage high-pressure compressor; a third-generation Taps III combustor for high efficiency and low emissions; and CMC material in the combustor and turbine.

For the fuselage, after much deliberation, Boeing chose to retain the aluminum design, while still incorporating not only a lower cabin altitude but also higher humidity and larger windows. Boeing’s familiarity with the legacy 777 allowed it to create an environment comparable to what passengers enjoy in the all-composite Dreamliner fuselage, said Beezhold.

“We know [the 777] well; we understand how it handles the fatigue aspects of the structure,” he said. “So when you change the pressure differential for every flight, we know exactly where to go to make the appropriate changes with minimal weight investment to handle the fatigue characteristics.

“So we’ve made some fairly modest changes to the fuselage to accommodate that, and then just looking at the mission and the number of cycles that this airplane will fly, we’re able to achieve that with this airframe. That was a pretty big deal and very important to our customers.”

The challenge, said Beezhold, centered on making those changes without adding much weight to the airframe. In fact, he reported that engineers have done a remarkable job of keeping to the airplane’s overall design weight. “In this phase of the program, typically you do see weight growth,” he said. “But we’ve seen it go the other way...Every engineer, every stress analyst needs to know what the requirements are for the part of the airplane they’re responsible for, and it’s been just amazing to see what people come up with to meet the requirements.”

BOEING 787-10

A straightforward stretch of the 787-9 and the largest of Boeing’s three Dreamliner models, the 787-10 can hold 40 more passengers than its smaller sibling carries, giving it a seating capacity of 330 in a two-class cabin layout. In the -10, Boeing engineers sought to nearly replicate the -9 in every way possible, endowing it with 95-percent design commonality. Apart from the 18-foot stretch, the only obvious difference lies in the landing gear, leaving minimal structural reinforcements in the wing and some systems modifications to account for the bigger cabin as the primary changes under the skin. Offering the same choice of Rolls-Royce Trent 1000 or General Electric GEnx engines found in the 787-9, Boeing lists the 787-10’s range at 6,430 nm, while the -9 can fly 8,500 nm.

Built exclusively at Boeing’s non-union plant in North Charleston, S.C, the 787-10—powered by Trent 1000-10s—made its first flight on March 31 from Charleston International Airport, less than four months after the start of final assembly. From Charleston, Boeing ferried the airplane to its Seattle-area facilities, from where it will conduct the bulk of the testing with the program’s three flying prototypes.

The -10’s mid-body section, which accounts for 10 feet of the fuselage stretch, does not fit into

Boeing's Dreamlifter cargo airplanes, meaning it would prove too long for efficient transport from North Charleston—the site of systems installation—to the company's Everett, Wash. facility for final assembly. Separately, said Boeing, introducing the 787-10 in North Charleston takes advantage of that facility's considerable capacity while allowing the Everett plant to continue improving productivity on the 787-8 and 787-9.

By the time of first flight, the second of the stretched Dreamliners—powered by GENx engines—had moved through all seven positions in North Charleston's final assembly building and outside onto the ramp for final preparations for first flight, while the third and final test airplane,

another Rolls-powered machine, had begun to take shape inside. The South Carolina facility fabricates and assembles composite Section 47, the last passenger section of the airplane, and Section 48, which integrates the horizontal and vertical stabilizers and the aft pressure bulkhead, for all Dreamliners built in Everett and North Charleston. It also joins and integrates mid-body fuselage sections from other suppliers. Spirit AeroSystems in Wichita provides 787 forward fuselage sections to both Everett and North Charleston.

Boeing's Everett operation currently produces seven 787-8/9s per month; North Charleston produces five. Although Boeing has previously talked of raising Dreamliner production rates to 14 by

Widebodies—Specifications

Model	Passengers	Range	Wingspan	Length	Mtow
Boeing 777-8X	375	8,700 nm	235 ft 5 in	229 ft	775,000 lbs
Boeing 777-9X	414	7,600 nm	235 ft 5 in	251 ft 9 in	775,000 lbs
Boeing 777-200LR	317	8,555 nm	212 ft 7 in	209 ft 1 in	766,000 lbs
Boeing 777-300ER	396	7,370 nm	212 ft 7 in	242 ft 4 in	775,000 lbs
Boeing 787-8	242	7,355 nm	197 ft	186 ft	502,500 lbs
Boeing 787-9	290	7,635 nm	197 ft	206 ft	560,000 lbs
Boeing 787-10	330	6,430 nm	197 ft	224 ft	560,000 lbs
Boeing 747-8i	467	7,730 nm	224 ft 5 in	250 ft 2 in	987,000 lbs
Airbus A350-1000	366	7,950 nm	212 ft 5 in	242 ft 5 in	681,000 lbs
Airbus A350-900	325	8,100 nm	212 ft 5 in	219 ft 5 in	590,800 lbs
Airbus A350-900ULR	325	9,700 nm	212 ft 5 in	219 ft 5 in	617,300 lbs
Airbus A350-800	280	8,200 nm	212 ft 5 in	198 ft 7 in	546,700 lbs
Airbus A330-900neo	287	6,550 nm	210 ft	208 ft 10 in	533,500 lbs
Airbus A330-800neo	257	7,500 nm	210 ft	193 ft	533,500 lbs
Airbus A330-300	277	6,350 nm	197 ft 10 in	208 ft 11 in	507,000 lbs
Airbus A330-200	247	7,250 nm	197 ft 10 in	193 ft	507,000 lbs
Airbus A380	544	8,200 nm	261 ft 8 in	238 ft 7 in	1,268,000 lbs
Comac C929	280	6,500 nm	182 ft 5 in	175 ft 6 in	550,000 lbs
Ilyushin Il-96-400M	380	4,860 nm	197 ft	210 ft	595,000 lbs

the end of the decade, it has not firmly established a time frame for a rate break.

Scheduled to enter service next year with launch customer Singapore Airlines, the 787-10 by mid-April had collected orders for 149 copies from seven airlines and two leasing companies.

AIRBUS A350-1000/ -900ULR/-800

The largest of the new line of composite-bodied airliners from Airbus, the A350-1000 measures some 240 feet long and carries 366 passengers in a typical three-class configuration. Powered exclusively by 97,000-pound-thrust Rolls-Royce Trent XWB 97s, it flies to a range of 7,950 nm, allowing it to support routes for emerging markets such as Shanghai-Boston or Paris-Santiago, as well as more traditional flight segments such as Manchester-Los Angeles or Dubai-Melbourne.

Program schedules call for the A350-1000's three flight-test airplanes to fly 1,600 hours over a 10-month period, culminating in certification in the second half of this year.

Equipped with a full passenger interior, the third airplane, MSN065, evaluates cabin systems and performs route proving. In April it performed external noise testing in Spain and water ingestion tests in France, ahead of route proving this summer. The February 7 first flight of MSN065 came only two-and-a-half months after the first A350-1000, MSN059, [flew for the first time](#) from Toulouse Blagnac Airport in France. Scheduled to fly 600 hours, the first airplane will explore the flight envelope, handling qualities, loads and braking. MSN059 performed the critical velocity minimum unstuck testing at Istres military base in France on March 5, while the second aircraft to fly, MSN071, evaluated braking, powerplant, systems and autopilot performance. In February MSN071 underwent five days of intensive cold weather testing in Iqaluit, Canada, at temperatures of between -28 degrees and -32 degrees C, followed by three days in March in La Paz,

Bolivia, at 13,300 feet, for warm weather and high-altitude testing.

Billed as a modern and more efficient replacement for the Boeing 777-300ER, the Airbus A350-1000 fills what the European airframer believes became a gap in the legacy 777's capacity range left when its U.S. competitor decided to start with a baseline of more than 400 seats for the 777X. Although Boeing's 777-8X—scheduled for certification in 2022—seats roughly the same number of passengers as the A350-1000 holds, Airbus thinks that the heavier weight of the smaller of the two 777X offerings will leave its biggest A350 XWB in a position to grab a sizeable portion of the market once dominated by the 777-300ER.

Meanwhile, Boeing calls the 777-8X “a far more capable airplane” than the A350-1000, while carrying the same maximum takeoff weight as the 777-300ER. Of course, the verdict remains out, as orders for the A350-1000, scheduled to enter service with Qatar Airlines this year, by mid-April stood at a modest 211 since launch in 2006. Although by the same time the 777-8X has drawn orders for 53 copies and the -300ER has seen a precipitous decline in interest since the launch of its successor, Boeing launched its new entrant in the 375-seat class seven years later than Airbus introduced the A350-1000 and likely won't place it into service for another five years.

Separately, in the 325-seat class, Airbus has stretched the capability of the in-service A350-900 with the A350-900ULR. Launched in October 2015 with a conversion of a firm order for seven standard A350-900s by Singapore Airlines, the ultra-long-range version of the first A350 XWB line to enter service will fly as far as 9,700 nm, allowing nonstop service from Sydney to London.

Engineers managed the additional 1,600 nm of range in the A350-900ULR—scheduled for certification and first delivery next year—through adapting the fuel system computer and the air venting and inert gas distribution piping in the

wing, allowing for the extra range without adding fuel tanks. The changes raise fuel capacity to 165,000 liters (43,588 U.S. gallons) from 141,000 liters (37,248 U.S. gallons), supported by a maximum takeoff weight increase to 280 metric tons from the originally specified 268 tons on the standard version. Airbus plans to increase the mtow on the standard A350-900 to as much as 280 metric tons in 2020, effectively matching it with the ULR's figure.

Singapore Airlines plans to use the A350-900ULR to re-open an 8,700-nm direct route from home base to New York. Prohibitive operating costs with the A340-500 SIA used for services to New York and Los Angeles effectively spelled those routes' demise in 2013.

According to Airbus, an airline would save 32 percent in fuel costs using the A350-900 ULR compared with the A340 while offering a larger cabin. Consequently, SIA continues to study other non-stop routes such as Chicago, Las Vegas and Miami.

Finally, precious few details have emerged on the A350-800, the market for which many analysts consider compromised by the launch of the A330neo. Airbus declines to entertain speculation that it will never build the -800, however, and the model officially remains part of its plans. However, only one customer remains on the order book: Asiana Airlines holds a firm order for eight of the airplanes.

AIRBUS A330NEO

Scheduled to fly some time "this summer," the baseline model of the A330neo program—the A330-900neo—benefits from a switch from the A330-300's Rolls-Royce Trent 700 to the new Trent 7000 and the addition of sharklet wingtip devices. Primarily as a result of those changes, both the A330-900neo and its smaller sibling, the A330-800neo (based on the A330-200), will burn at least 14 percent less fuel than their predecessors. While the fuselages remain unchanged, Airbus



specifications show 10 more passenger seats, giving the -900neo a capacity of 287 and the -800neo a capacity of 257. Meanwhile, range goes up by 200 nm in the larger variant, to 6,550 in the -900neo from 6,350 nm in the A330-300, and by 250 nautical miles in the smaller alternative, to 7,500 nm in the -800neo from 7,250 nm in the A330-200.

Although Airbus claims a marked improvement in aerodynamic efficiency with a 3.7-meter wing-span addition resulting from incorporation of the sharklets, most of the fuel-burn reduction comes from the new Trent 7000s. Rolls-Royce cites “significant” performance benefits in the 68,000- to 72,000-pound-thrust Trent 7000 compared with the Trent 700, improving sfc by 10 percent, doubling the bypass ratio and halving noise.

To meet A330neo requirements, Rolls-Royce has adapted the Trent 1000-10 to incorporate a new electronic engine control unit, new gearbox, air-start capability and related changes. Before beginning series production, the manufacturer planned to assemble four development examples of the engine, which also features a new nacelle and electronic bleed-air system that uses A350 technology. As of mid-April, the first pair of engines remained at Rolls-Royce for testing while the A330-900 awaited their arrival in Toulouse for installation. Although neither Rolls-Royce nor Airbus has provided many recent details of the engines’ progress, the original target for aircraft certification has shifted from the fourth quarter of this year to the first quarter of next year for the -900neo. Certification for the -800neo would follow roughly a year later.

COMAC/UAC C929

China’s Comac and Russia’s United Aircraft Corporation officially established their joint venture to develop a long-range widebody airliner during a ceremony in Shanghai on May 22. Dubbed China-Russia Commercial Aircraft International Company (Craic), the entity established with UAC calls an “equivalence principle,” under which each

side takes a 50 percent share in the program—known as the C929 by the Chinese. It remains unclear whether the sides have agreed on a name, however, given that the Russian partner believes it implies a Comac designation. In fact, the agreement calls for final assembly in Shanghai.

The new widebody would seat some 280 passengers and fly to a range of 6,500 nautical miles, placing it roughly in the category of the Airbus A330-900. The airplane, an agreement to establish a partnership for which Comac and UAC signed in June of last year during Russian president Vladimir Putin’s official visit to China, would cost between \$13 billion and \$20 billion to develop. The companies first revealed preliminary operating specifications during last November’s Airshow China in Zhuhai, along with plans to build a final assembly facility in Shanghai. Schedules call for first flight in 2023 and entry into service in 2026.

Plans call for Comac and its Avic subsidiary will carry responsibility for final assembly and the majority of parts manufacturing, using existing factories around Shanghai and other Chinese cities, including those now being used for the ARJ21 and C919 airliners. The Russian partner would perform mainly design and development work, according to UAC president Yury Slyusar. UAC’s newly built 463,000-sq-ft engineering center at Zhukovsky, near Moscow, will house Chinese and Russian engineers working on the program.

Initially, the 75,000-pound-thrust-class engines for the new widebody would likely come from Rolls-Royce and/or GE, according to Slyusar. Later propulsion options could include a larger version of the Aviadvigatel PD-14 now undergoing testing by the Russian design house in Perm called the PD-35. The Chinese side has also expressed a desire to develop a turbofan of its own to power the airplane and last year consolidated several state-owned companies to establish the new Aero Engine Corporation of China (AECC).

ILYUSHIN IL-96-400M

The Ilyushin design house has issued its first official presentation of the Il-96-400M, a four-engine design meant to fulfill Russia's aspirations to develop a new indigenous widebody as a contingency in the event a planned joint Russian-Chinese program fails to materialize. Ilyushin general designer Nikolai Talikov presented the details during an April 6 conference of Il-96 operators organized by Russian civil aviation authority Rosaviatsiya. Plans call for the latest iteration of the quad-jet to carry a 90,000-pound payload 4,860 nm. Officials expect the first prototype to fly in 2019 and become factory standard the following year.

Designed for a maximum takeoff weight of 595,000 pounds, the Il-96-400M incorporates the same fuselage used on the Il-96M/T stretch, which won U.S. FAA shadow certification in 1997. Plans call for production at the United Aircraft plant in Voronezh (Vaso), which has so far assembled 103 Il-86s and 30 Il-96s—the only commercially available widebody passenger jets of Russian origin. Three Il-96-300s remain in service with Cubana de Aviacion, and about a dozen with Russian government bodies.

The Kremlin instructed UAC to boost Il-96 production to guarantee air links between the European part of the country and big cities in Siberia and on the Pacific coast in case deterioration of East-West relations further limits the use of imported jets. The Russian government has approved construction of an initial batch of six to 10 of the quad-jets for government structures as a first step to revive widebody jet production at Vaso.

Talikov said the factory could boost annual Il-96 production from one to two aircraft in recent years to the eight to 10 it built during Soviet times.

Last year the Russian government allocated 53 billion rubles (\$925 million) for the program, of which half will go to a leasing company—IFC or GTLK—that would place newly built airplanes with airlines on operating lease terms. The remaining half will go to industry, including 10 billion

rubles (\$175 million) to the Ilyushin design house for modifications to the already certified Il-96.

Ilyushin won a formal contract for -400M development on December 29 of last year. Officials expect a short flight-test program given that earlier versions had already won a number of certificates, including the 1997 U.S. FAA shadow certification of the Il-96T/M. Talikov told AIN that designers have begun a special effort to replace old wiring as a weight-saving measure, promising to cut operating empty weight (OEW) by one to two metric tons.

Planning to limit Western content to an absolute minimum, Ilyushin will consider only Perm-based Aviadvigatel engines. The PS90A1 has won certification and became operational on the stretched freighter, whose maximum takeoff weight exceeds that of the baseline Il-96-300 by some 45,000 pounds. Voronezh-based Polet operated four Il-96-400Ts between 2009 and 2013 before going bankrupt. The airline's operational experience, however, allowed the industry to find and fix teething problems associated with the PS90A1 and subsequently reach average time between removals of 10,000 flight hours, generally considered a good figure for a Russian engine.

Since production of Il-96-300s for commercial operators ended in 2007 with delivery of two 262-seat machines for Cubana, design of a completely reworked interior has begun. Ilyushin has invited completion companies to compete in an associated tender.

Although designers have settled on a specification, Talikov said the terms aren't so firm that the winner will not enjoy room for creativity. However, he said the Il-96-400M must come with a central luggage bin, which neither the Il-86 nor Il-96-300 feature because their designers wanted to create a "spacious" impression. However, passengers now tend to bring more hand luggage into aircraft cabins, requiring more space than available with the existing sidewall bins. □