= Airbus A380 =

The Airbus A380 is a double @-@ deck , wide @-@ body , four @-@ engine jet airliner manufactured by European Union manufacturer Airbus . It is the world 's largest passenger airliner , and the airports at which it operates have upgraded facilities to accommodate it . It was initially named Airbus A3XX and designed to challenge Boeing 's monopoly in the large @-@ aircraft market . The A380 made its first flight on 27 April 2005 and entered commercial service in 25 October 2007 with Singapore Airlines .

The A380 's upper deck extends along the entire length of the fuselage , with a width equivalent to a wide @-@ body aircraft . This gives the A380 @-@ 800 's cabin 550 square metres (5 @,@ 920 sq ft) of usable floor space , 40 % more than the next largest airliner , the Boeing 747 @-@ 8 , and provides seating for 525 people in a typical three @-@ class configuration or up to 853 people in an all @-@ economy class configuration . The A380 @-@ 800 has a design range of 8 @,@ 500 nautical miles (15 @,@ 700 km) , serving the second longest non @-@ stop scheduled flight in the world , and a cruising speed of Mach 0 @.@ 85 (about 900 km / h , 560 mph or 490 kn at cruising altitude) .

As of May 2016 , Airbus had received 319 firm orders and delivered 190 aircraft ; Emirates is the biggest A380 customer with 142 on order and 80 delivered . Thai Airways International , British Airways , Asiana Airlines , Qatar Airways , Etihad Airways are other operators .

= = Development = =

= = = Background = = =

In mid @-@ 1988 , Airbus engineers led by Jean Roeder began work in secret on the development of an ultra @-@ high @-@ capacity airliner (UHCA) , both to complete its own range of products and to break the dominance that Boeing had enjoyed in this market segment since the early 1970s with its 747 . McDonnell Douglas unsuccessfully offered its smaller , double @-@ deck MD @-@ 12 concept for sale . Roeder was given approval for further evaluations of the UHCA after a formal presentation to the President and CEO in June 1990 . The megaproject was announced at the 1990 Farnborough Air Show , with the stated goal of 15 % lower operating costs than the 747 @-@ 400 . Airbus organised four teams of designers , one from each of its partners (Aérospatiale , British Aerospace , Deutsche Aerospace AG , CASA) to propose new technologies for its future aircraft designs . The designs were presented in 1992 and the most competitive designs were used .

In January 1993 , Boeing and several companies in the Airbus consortium started a joint feasibility study of a Very Large Commercial Transport (VLCT) , aiming to form a partnership to share the limited market . This joint study was abandoned two years later , Boeing 's interest having declined because analysts thought that such a product was unlikely to cover the projected $ 15 billion development cost . Despite the fact that only two airlines had expressed public interest in purchasing such a plane , Airbus was already pursuing its own large plane project . Analysts suggested that Boeing would instead pursue stretching its 747 design , and that air travel was already moving away from the hub and spoke system that consolidated traffic into large planes , and toward more non @-@ stop routes that could be served by smaller planes .

In June 1994 , Airbus announced its plan to develop its own very large airliner , designated the A3XX . Airbus considered several designs , including an unusual side @-@ by @-@ side combination of two fuselages from its A340 , the largest Airbus jet at the time . The A3XX was pitted against the VLCT study and Boeing 's own New Large Aircraft successor to the 747 . From 1997 to 2000 , as the East Asian financial crisis darkened the market outlook , Airbus refined its design , targeting a 15 ? 20 % reduction in operating costs over the existing Boeing 747 @-@ 400 . The A3XX design converged on a double @-@ decker layout that provided more passenger volume than a traditional single @-@ deck design , in line with traditional hub @-@ and @-@ spoke theory as opposed to the point @-@ to @-@ point theory with the Boeing 777 , after conducting an extensive

market analysis with over 200 focus groups . Although early marketing of the huge cross @-@ section touted the possibility of duty @-@ free shops , restaurant @-@ like dining , gyms , casinos & beauty parlours on board , the realities of airline economics have kept such dreams grounded .

On 19 December 2000 , the supervisory board of newly restructured Airbus voted to launch an ? 8 @.@ 8 @-@ billion programme to build the A3XX , re @-@ christened as the A380 , with 50 firm orders from six launch customers . The A380 designation was a break from previous Airbus families , which had progressed sequentially from A300 to A340 . It was chosen because the number 8 resembles the double @-@ deck cross section , and is a lucky number in some Asian countries where the aircraft was being marketed . The aircraft configuration was finalised in early 2001 , and manufacturing of the first A380 wing box component started on 23 January 2002 . The development cost of the A380 had grown to ? 11 @-@ 14 billion when the first aircraft was completed .

= = = Production = = =

Major structural sections of the A380 are built in France , Germany , Spain , and the United Kingdom . Due to the sections ' large size , traditional transportation methods proved infeasible , so they are brought to the Jean @-@ Luc Lagardère Plant assembly hall in Toulouse , France , by specialised surface transportation , though some parts are moved by the A300 @-@ 600ST Beluga transport aircraft , which is also used in the movement of other Airbus model components . A380 components are provided by suppliers from around the world ; the four largest contributors , by value , are Rolls @-@ Royce , Safran , United Technologies and General Electric .

For the surface movement of large A380 structural components , a complex route known as the Itinéraire à Grand Gabarit was developed . This involved the construction of a fleet of roll @-@ on / roll @-@ off (RORO) ships and barges , the construction of port facilities and the development of new and modified roads to accommodate oversized road convoys . The front and rear fuselage sections are shipped on one of three RORO ships from Hamburg in northern Germany to the United Kingdom . The wings are manufactured at Broughton in North Wales , then transported by barge to Mostyn docks for ship transport .

In Saint @-@ Nazaire in western France , the ship exchanges the fuselage sections from Hamburg for larger , assembled sections , some of which include the nose . The ship unloads in Bordeaux . The ship then picks up the belly and tail sections from Construcciones Aeronáuticas SA in Cádiz in southern Spain , and delivers them to Bordeaux . From there , the A380 parts are transported by barge to Langon , and by oversize road convoys to the assembly hall in Toulouse . In order to avoid damage from direct handling , parts are secured in custom jigs carried on self @-@ powered wheeled vehicles .

After assembly , the aircraft are flown to Hamburg Finkenwerder Airport (XFW) to be furnished and painted . Airbus sized the production facilities and supply chain for a production rate of four A380s per month .

= = = Testing = = =

Five A380s were built for testing and demonstration purposes . The first A380 , registered F @-@ WWOW , was unveiled in Toulouse 18 January 2005 . It first flew on 27 April 2005 . This plane , equipped with Rolls @-@ Royce Trent 900 engines , flew from Toulouse Blagnac International Airport with a crew of six headed by chief test pilot Jacques Rosay . Rosay said flying the A380 had been " like handling a bicycle " .

On 1 December 2005 , the A380 achieved its maximum design speed of Mach 0 @.@ 96 , (its design cruise speed is Mach 0 @.@ 85) in a shallow dive . In 2006 , the A380 flew its first high @-@ altitude test at Bole International Airport , Addis Ababa . It conducted its second high @-@ altitude test at the same airport in 2009 . On 10 January 2006 , it flew to José María Córdova International Airport in Colombia , accomplishing the transatlantic testing , and then it went to El Dorado International Airport to test the engine operation in high @-@ altitude airports . It arrived in North America on 6 February 2006 , landing in Iqaluit , Nunavut in Canada for cold @-@ weather

testing .

On 14 February 2006 , during the destructive wing strength certification test on MSN5000 , the test wing of the A380 failed at 145 % of the limit load , short of the required 150 % level . Airbus announced modifications adding 30 kg (66 lb) to the wing to provide the required strength . On 26 March 2006 , the A380 underwent evacuation certification in Hamburg . With 8 of the 16 exits arbitrarily blocked , 853 mixed passengers and 20 crew exited the darkened aircraft in 78 seconds , less than the 90 seconds required for certification . Three days later , the A380 received European Aviation Safety Agency (EASA) and United States Federal Aviation Administration (FAA) approval to carry up to 853 passengers .

The first A380 using GP7200 engines ? serial number MSN009 and registration F @-@ WWEA ? flew on 25 August 2006 . On 4 September 2006 , the first full passenger @-@ carrying flight test took place . The aircraft flew from Toulouse with 474 Airbus employees on board , in a test of passenger facilities and comfort . In November 2006 , a further series of route @-@ proving flights demonstrated the aircraft 's performance for 150 flight hours under typical airline operating conditions . As of 2014 , the A380 test aircraft continue to perform test procedures .

Airbus obtained type certificates for the A380 @-@ 841 and A380 @-@ 842 model from the EASA and FAA on 12 December 2006 in a joint ceremony at the company 's French headquarters , receiving the ICAO code A388 . The A380 @-@ 861 model obtained its type certificate on 14 December 2007 .

= = = Production and delivery delays = = =

Initial production of the A380 was troubled by delays attributed to the 530 km (330 mi) of wiring in each aircraft . Airbus cited as underlying causes the complexity of the cabin wiring (98 @,@ 000 wires and 40 @,@ 000 connectors) , its concurrent design and production , the high degree of customisation for each airline , and failures of configuration management and change control . The German and Spanish Airbus facilities continued to use CATIA version 4 , while British and French sites migrated to version 5 . This caused overall configuration management problems , at least in part because wire harnesses manufactured using aluminium rather than copper conductors necessitated special design rules including non @-@ standard dimensions and bend radii ; these were not easily transferred between versions of the software .

Airbus announced the first delay in June 2005 and notified airlines that deliveries would be delayed by six months . This reduced the total number of planned deliveries by the end of 2009 from about 120 to 90 ? 100 . On 13 June 2006 , Airbus announced a second delay , with the delivery schedule slipping an additional six to seven months . Although the first delivery was still planned before the end of 2006 , deliveries in 2007 would drop to only 9 aircraft , and deliveries by the end of 2009 would be cut to 70 ? 80 aircraft . The announcement caused a 26 % drop in the share price of Airbus ' parent , EADS , and led to the departure of EADS CEO Noël Forgeard , Airbus CEO Gustav Humbert , and A380 programme manager Charles Champion . On 3 October 2006 , upon completion of a review of the A380 program , Airbus CEO Christian Streiff announced a third delay , pushing the first delivery to October 2007 , to be followed by 13 deliveries in 2008 , 25 in 2009 , and the full production rate of 45 aircraft per year in 2010 . The delay also increased the earnings shortfall projected by Airbus through 2010 to ? 4 @.@ 8 billion .

As Airbus prioritised the work on the A380 @-@ 800 over the A380F , freighter orders were cancelled by FedEx and UPS , or converted to A380 @-@ 800 by Emirates and ILFC . Airbus suspended work on the freighter version , but said it remained on offer , albeit without a service entry date . For the passenger version Airbus negotiated a revised delivery schedule and compensation with the 13 customers , all of which retained their orders with some placing subsequent orders , including Emirates , Singapore Airlines , Qantas , Air France , Qatar Airways , and Korean Air .

On 13 May 2008 , Airbus announced reduced deliveries for the years 2008 (12) and 2009 (21) . After further manufacturing setbacks , Airbus announced its plan to deliver 14 A380s in 2009 , down from the previously revised target of 18 . A total of 10 A380s were delivered in 2009 . In 2010 Airbus

delivered 18 of the expected 20 A380s , due to Rolls @-@ Royce engine availability problems . Airbus planned to deliver " between 20 and 25 " A380s in 2011 before ramping up to three a month in 2012 . In fact , Airbus delivered 26 units , thus outdoing its predicted output for the first time . As of July 2012 , production was 3 aircraft per month . Among the production problems are challenging interiors , interiors being installed sequentially rather than concurrently as in smaller planes , and union / government objections to streamlining .

At the July 2016 Farnborough Airshow Airbus announced that in a ? prudent , proactive step , ? starting in 2018 it expects to deliver 12 A380 aircraft per year , down from 27 deliveries in 2015 . The firm also warned production might slip back into red ink on each aircraft produced at that time , though it anticipates production will remain in the black for 2016 and 2017 . ? The company will continue to improve the efficiency of its industrial system to achieve breakeven at 20 aircraft in 2017 and targets additional cost reduction initiatives to lower breakeven further . ? Airbus expects that healthy demand for its other aircraft would allow it to avoid job losses from the cuts .

= = = Entry into service = = =

Nicknamed Superjumbo , the first A380 , MSN003 , (registered as 9V @-@ SKA) was delivered to Singapore Airlines on 15 October 2007 and entered service on 25 October 2007 with flight number SQ380 between Singapore and Sydney . Passengers bought seats in a charity online auction paying between $ 560 and $ 100 @,@ 380 . Two months later , Singapore Airlines CEO Chew Choong Seng stated the A380 was performing better than either the airline and Airbus had anticipated , burning 20 % less fuel per seat @-@ mile than the airline 's 747 @-@ 400 fleet . Emirates ' Tim Clark claimed that the A380 has better fuel economy at Mach 0 @.@ 86 than at 0 @.@ 83 , and that its technical dispatch reliability is at 97 % , same as Singapore Airlines . Airbus is committed to reach the industry standard of 98 @.@ 5 % .

Emirates was the second airline to receive the A380 and commenced service between Dubai and New York in August 2008 . Qantas followed , with flights between Melbourne and Los Angeles in October 2008 . By the end of 2008 , 890 @,@ 000 passengers had flown on 2 @,@ 200 flights .

In February 2009 , the one millionth passenger was flown with Singapore Airlines and by May of that year 1 @,@ 500 @,@ 000 passengers had flown on 4 @,@ 200 flights . Air France received its first A380 in October 2009 . Lufthansa received its first A380 in May 2010 . By July 2010 , the 31 A380s then in service had transported 6 million passengers on 17 @,@ 000 flights between 20 international destinations .

Airbus delivered the 100th A380 on 14 March 2013 to Malaysia Airlines . In June 2014 , over 65 million passengers had flown the A380 , and more than 100 million passengers (averaging 375 per flight) by September 2015 , with an availability of 98 @.@ 5 % . In 2014 , Emirates stated that their A380 fleet had load factors of 90 @-@ 100 % , and that the popularity of the aircraft with its passengers had not decreased in the past year .

= = = Post @-@ delivery issues = = =

During repairs following the Qantas Flight 32 engine failure incident , cracks were discovered in wing fittings . As a result , the European Aviation Safety Agency issued an Airworthiness Directive in January 2012 which affected 20 A380 aircraft that had accumulated over 1 @,@ 300 flights . A380s with under 1 @,@ 800 flight hours were to be inspected within 6 weeks or 84 flights ; aircraft with over 1 @,@ 800 flight hours were to be examined within four days or 14 flights . Fittings found to be cracked were replaced . On 8 February 2012 , the checks were extended to cover all 68 A380 aircraft in operation . The problem is considered to be minor and is not expected to affect operations . EADS acknowledged that the cost of repairs would be over $ 130 million , to be borne by Airbus . The company said the problem was traced to stress and material used for the fittings . Additionally , major airlines are seeking compensation from Airbus for revenue lost as a result of the cracks and subsequent grounding of fleets . Airbus has switched to a different type of aluminium alloy so aircraft delivered from 2014 onwards should not have this issue .

Airbus is changing about 10 % of all doors , as some leak during flight . One occurrence resulted in dropped oxygen masks and an emergency landing . The switch is expected to cost over ? 100 million . Airbus states that safety is sufficient , as the air pressure pushes the door into the frame .

= = Design = =

= = = Overview = = =

The A380 was initially offered in two models , the A380 @-@ 800 and the A380F . The A380 @-@ 800 's original configuration carried 555 passengers in a three @-@ class configuration or 853 passengers (538 on the main deck and 315 on the upper deck) in a single @-@ class economy configuration . Then in May 2007 , Airbus began marketing a configuration with 30 fewer passengers , (525 total in three classes) , traded for 200 nmi (370 km) more range , to better reflect trends in premium class accommodation . The design range for the ? 800 model is 8 @,@ 500 nmi (15 @,@ 700 km) ; capable of flying from Hong Kong to New York or from Sydney to Istanbul non @-@ stop . The second model , the A380F freighter , would carry 150 tonnes of cargo with a range of 5 @,@ 600 nmi (10 @,@ 400 km) . The freighter development was put on hold as Airbus prioritised the passenger version and all cargo orders were cancelled . Future variants may include an A380 @-@ 900 stretch seating about 656 passengers (or up to 960 passengers in an all economy configuration) and an extended @-@ range version with the same passenger capacity as the A380 @-@ 800 .

= = = Engines = = =

The A380 is available with two types of turbofan engines , the Rolls @-@ Royce Trent 900 (variants A380 @-@ 841 , ? 842 and ? 843F) or the Engine Alliance GP7000 (A380 @-@ 861 and ? 863F) . The Trent 900 is a derivative of the Trent 800 , and the GP7000 has roots from the GE90 and PW4000 . The Trent 900 core is a scaled version of the Trent 500 , but incorporates the swept fan technology of the stillborn Trent 8104 . The GP7200 has a GE90 @-@ derived core and PW4090 @-@ derived fan and low @-@ pressure turbo @-@ machinery . Noise reduction was an important requirement in the A380 design , and particularly affects engine design . Both engine types allow the aircraft to achieve well under the QC / 2 departure and QC / 0 @.@ 5 arrival noise limits under the Quota Count system set by London Heathrow Airport , which is a key destination for the A380 . The A380 has received an award for its reduced noise . However , field measurements suggest the approach quota allocation for the A380 may be overly generous compared to the older Boeing 747 , but still quieter . Rolls @-@ Royce is supporting CAA in understanding the relatively high A380 / Trent 900 monitored noise levels .

The A380 was initially planned without thrust reversers , incorporating sufficient braking capacity to do without them . However Airbus elected to equip the two inboard engines with thrust reversers in a late stage of development , helping the brakes when the runway is slippery . The two outboard engines do not have reversers , reducing the amount of debris stirred up during landing . The A380 has electrically actuated thrust reversers , giving them better reliability than their pneumatic or hydraulic equivalents , in addition to saving weight .

In 2008 , the A380 demonstrated the viability of a synthetic fuel comprising standard jet fuel with a natural @-@ gas @-@ derived component . On 1 February 2008 , a three @-@ hour test flight operated between Britain and France , with one of the A380 's four engines using a mix of 60 % standard jet kerosene and 40 % gas to liquids (GTL) fuel supplied by Shell . The aircraft needed no modifications for the GTL fuel , which was designed to be mixed with normal jet fuel . Sebastien Remy , head of Airbus SAS 's alternative fuel programme , said the GTL used was no cleaner in CO_2 terms than standard fuel but contains no sulphur , generating air quality benefits .

The auxiliary power comprises the Auxiliary Power Unit (APU) , the electronic control box (ECB) , and mounting hardware . The APU in use on the A380 is the PW 980A APU . The APU primarily

provides air to power the Analysis Ground Station (AGS) on the ground and to start the engines . The AGS is a semi @-@ automatic analysis system of flight data that helps to optimise management of maintenance and reduce costs . The APU also powers electric generators which provide auxiliary electric power to the aircraft .

= = = Wings = = =

The A380 's wing is sized for a maximum takeoff weight (MTOW) over 650 tonnes to accommodate these future versions , albeit with some internal strengthening required on the A380F freighter . The optimal wingspan for this weight is about 90 m (300 ft) , but airport restrictions limited it to less than 80 m (260 ft) , lowering aspect ratio to 7 @.@ 8 which reduces fuel efficiency about 10 % and increases operating costs a few percent , given that fuel costs constitute about 50 % of the cost of long @-@ haul airplane operation . The common wing design approach sacrifices fuel efficiency (due to a weight penalty) on the A380 @-@ 800 passenger model , but Airbus estimates that the aircraft 's size , coupled with the uses of advanced technology , will provide lower operating costs per passenger than the 747 @-@ 400 and older 747 variants . The A380 also includes wingtip devices similar to those found on the A310 and A320 to reduce induced drag , thereby increasing fuel efficiency and range .

= = = Materials = = =

While most of the fuselage is aluminium , composite materials comprise more than 20 % of the A380 's airframe . Carbon @-@ fibre reinforced plastic , glass @-@ fibre reinforced plastic and quartz @-@ fibre reinforced plastic are used extensively in wings , fuselage sections (such as the undercarriage and rear end of fuselage) , tail surfaces , and doors . The A380 is the first commercial airliner to have a central wing box made of carbon fibre reinforced plastic . It is also the first to have a smoothly contoured wing cross section . The wings of other commercial airliners are partitioned span @-@ wise into sections . This flowing , continuous cross section optimises aerodynamic efficiency . Thermoplastics are used in the leading edges of the slats . The hybrid fibre metal laminate material GLARE (glass laminate aluminium reinforced epoxy) is used in the upper fuselage and on the stabilisers ' leading edges . This aluminium @-@ glass @-@ fibre laminate is lighter and has better corrosion and impact resistance than conventional aluminium alloys used in aviation . Unlike earlier composite materials , GLARE can be repaired using conventional aluminium repair techniques . The application of GLARE on the A380 has a long history , which shows the complex nature of innovations in the aircraft industry .

Newer weldable aluminium alloys are also used . This enables the widespread use of laser beam welding manufacturing techniques , eliminating rows of rivets and resulting in a lighter , stronger structure . High @-@ strength aluminium (type 7449) reinforced with carbon fibre was used in the wing brackets of the first 120 A380s to reduce weight , but cracks have been discovered and new sets of the more critical brackets will be made of standard aluminium 7010 , increasing weight by 90 kg (198 lb) . Repair costs for earlier aircraft are expected to be around ? 500 million (US $ 629 million) .

It takes 3 @,@ 600 L (950 US gal) of paint to cover the 3 @,@ 100 m2 (33 @,@ 000 sq ft) exterior of an A380 . The paint is five layers thick and weighs about 650 kg (1 @,@ 433 lb) .

= = = Avionics = = =

The A380 employs an integrated modular avionics (IMA) architecture , first used in advanced military aircraft , such as the Lockheed Martin F @-@ 22 Raptor , Lockheed Martin F @-@ 35 Lightning II , and Dassault Rafale . The main IMA systems on the A380 were developed by the Thales Group . Designed and developed by Airbus , Thales and Diehl Aerospace , the IMA suite was first used on the A380 . The suite is a technological innovation , with networked computing modules to support different applications . The data networks use Avionics Full @-@ Duplex

Switched Ethernet , an implementation of ARINC 664 . These are switched , full @-@ duplex , star @-@ topology and based on 100baseTX fast @-@ Ethernet . This reduces the amount of wiring required and minimises latency .

Airbus used similar cockpit layout , procedures and handling characteristics to other Airbus aircraft , reducing crew training costs . The A380 has an improved glass cockpit , using fly @-@ by @-@ wire flight controls linked to side @-@ sticks . The cockpit has eight 15 by 20 cm (5 @.@ 9 by 7 @.@ 9 in) liquid crystal displays , all physically identical and interchangeable ; comprising two primary flight displays , two navigation displays , one engine parameter display , one system display and two multi @-@ function displays . The MFDs were introduced on the A380 to provide an easy @-@ to @-@ use interface to the flight management system ? replacing three multifunction control and display units . They include QWERTY keyboards and trackballs , interfacing with a graphical " point @-@ and @-@ click " display system .

The Network Systems Server (NSS) is the heart of A380 's paperless cockpit ; it eliminates bulky manuals and charts traditionally used . The NSS has enough inbuilt robustness to eliminate onboard backup paper documents . The A380 's network and server system stores data and offers electronic documentation , providing a required equipment list , navigation charts , performance calculations , and an aircraft logbook . This is accessed through the MFDs and controlled via the keyboard interface .

Power @-@ by @-@ wire flight control actuators have been used for the first time in civil aviation to back up primary hydraulic actuators . Also , during certain manoeuvres they augment the primary actuators . They have self @-@ contained hydraulic and electrical power supplies . Electro @-@ hydrostatic actuators (EHA) are used in the aileron and elevator , electric and hydraulic motors to drive the slats as well as electrical backup hydrostatic actuators (EBHA) for the rudder and some spoilers .

The A380 's 350 bar (35 MPa or 5 @,@ 000 psi) hydraulic system is a significant difference from the typical 210 bar (21 MPa or 3 @,@ 000 psi) hydraulics used on most commercial aircraft since the 1940s . First used in military aircraft , high @-@ pressure hydraulics reduce the weight and size of pipelines , actuators and related components . The 350 bar pressure is generated by eight de @-@ clutchable hydraulic pumps . The hydraulic lines are typically made from titanium ; the system features both fuel- and air @-@ cooled heat exchangers . Self @-@ contained electrically powered hydraulic power packs serve as backups for the primary systems , instead of a secondary hydraulic system , saving weight and reducing maintenance .

The A380 uses four 150 kVA variable @-@ frequency electrical generators , eliminating constant @-@ speed drives and improving reliability . The A380 uses aluminium power cables instead of copper for weight reduction . The electrical power system is fully computerised and many contactors and breakers have been replaced by solid @-@ state devices for better performance and increased reliability .

= = = Passenger provisions = = =

The cabin has features to reduce traveller fatigue such as a quieter interior and higher pressurisation than previous generation of aircraft ; the A380 is pressurised to the equivalent altitude of 1 @,@ 520 m (5 @,@ 000 ft) up to 12 @,@ 000 m (39 @,@ 000 ft) . It has 50 % less cabin noise , 50 % more cabin area and volume , larger windows , bigger overhead bins , and 60 cm (2 @.@ 0 ft) extra headroom versus the 747 @-@ 400 . Seating options range from 3 @-@ room 12 m2 (130 sq ft) " residence " in first class to 11 @-@ across in economy . On other aircraft , economy seats range from 41 @.@ 5 cm (16 @.@ 3 in) to 52 @.@ 3 cm (20 @.@ 6 in) in width , A380 economy seats are up to 48 cm (19 in) wide in a 10 @-@ abreast configuration ; compared with the 10 @-@ abreast configuration on the 747 @-@ 400 which typically has seats 44 @.@ 5 cm (17 @.@ 5 in) wide .

The A380 's upper and lower decks are connected by two stairways , fore and aft , wide enough to accommodate two passengers side @-@ by @-@ side ; this cabin arrangement allows multiple seat configurations . The maximum certified carrying capacity is 853 passengers in an all @-@ economy

@-@ class layout , Airbus lists the " typical " three @-@ class layout as accommodating 525 passengers , with 10 first , 76 business , and 439 economy class seats . Airline configurations range from Korean Air 's 407 passengers to Emirates ' two @-@ class 615 seats for Copenhagen , and average around 480 ? 490 seats . The Air Austral 's proposed 840 passenger layout has not come to fruition . The A380 's interior illumination system uses bulbless LEDs in the cabin , cockpit , and cargo decks . The LEDs in the cabin can be altered to create an ambience simulating daylight , night , or intermediate levels . On the outside of the aircraft , HID lighting is used for brighter illumination .

Airbus 's publicity has stressed the comfort and space of the A380 cabin , and advertised onboard relaxation areas such as bars , beauty salons , duty @-@ free shops , and restaurants . Proposed amenities resembled those installed on earlier airliners , particularly 1970s wide @-@ body jets , which largely gave way to regular seats for more passenger capacity . Airbus has acknowledged that some cabin proposals were unlikely to be installed , and that it was ultimately the airlines ' decision how to configure the interior . Industry analysts suggested that implementing customisation has slowed the production speeds , and raised costs . Due to delivery delays , Singapore Airlines and Air France debuted their seat designs on different aircraft prior to the A380 .

Initial operators typically configured their A380s for three @-@ class service , while adding extra features for passengers in premium cabins . Launch customer Singapore Airlines introduced partly enclosed first class suites on its A380s in 2007 , each featuring a leather seat with a separate bed ; center suites could be joined to create a double bed . A year later , Qantas debuted a new first class seat @-@ bed and a sofa lounge at the front of the upper deck on its A380s , and in 2009 Air France unveiled an upper deck electronic art gallery . In late 2008 , Emirates introduced " shower spas " in first class on its A380s allowing each first class passenger five minutes of hot water , drawing on 2 @.@ 5 tonnes of water although only 60 % of it was used . Emirates , Etihad Airways and Qatar Airways also have a bar lounge and seating area on the upper deck , while Etihad has enclosed areas for two people each . In addition to lounge areas , some A380 operators have installed amenities consistent with other aircraft in their respective fleets , including self @-@ serve snack bars , premium economy sections , and redesigned business class seating . The Hamburg Aircraft Interiors Expo in April 2015 saw the presentation of an 11 @-@ seat row economy cabin for the A380 . Airbus is reacting to a changing economy ; the recession which began in 2008 saw a drop in market percentage of first class and business seats to six percent and an increase in budget economy travelers . Among other causes is the reluctance of employers to pay for executives to travel in First or Business Class . Airbus ' chief of cabin marketing , Ingo Wuggestzer , told Aviation Week and Space Technology that the standard three class cabin no longer reflected market conditions . The 11 seat row on the A380 is accompanied by similar options on other widebodies : nine across on the Airbus A330 and ten across on the A350 .

= = = Integration with infrastructure and regulations = = =

= = = = Ground operations = = = =

In the 1990s , aircraft manufacturers were planning to introduce larger planes than the Boeing 747 . In a common effort of the International Civil Aviation Organization , ICAO , with manufacturers , airports and its member agencies , the " 80 @-@ metre box " was created , the airport gates allowing planes up to 80 m (260 ft) wingspan and length to be accommodated . Airbus designed the A380 according to these guidelines , and to operate safely on Group V runways and taxiways with a 60 metres (200 ft) loadbearing width . The US FAA initially opposed this , then in July 2007 , the FAA and EASA agreed to let the A380 operate on 45 m (148 ft) runways without restrictions . The A380 @-@ 800 is approximately 30 % larger in overall size than the 747 @-@ 400 . Runway lighting and signage may need changes to provide clearance to the wings and avoid blast damage from the engines . Runways , runway shoulders and taxiway shoulders may be required to be stabilised to reduce the likelihood of foreign object damage caused to (or by) the outboard engines , which are more than 25 m (82 ft) from the centre line of the aircraft , compared to 21 m (69 ft) for

the 747 @-@ 400 , and 747 @-@ 8 .

Airbus measured pavement loads using a 540 @-@ tonne (595 short tons) ballasted test rig , designed to replicate the landing gear of the A380 . The rig was towed over a section of pavement at Airbus ' facilities that had been instrumented with embedded load sensors . It was determined that the pavement of most runways will not need to be reinforced despite the higher weight , as it is distributed on more wheels than in other passenger aircraft with a total of 22 wheels (that is , its ground pressure is lower) . The A380 undercarriage consists of four main landing gear legs and one noseleg (a similar layout to the 747) , with the two inboard landing gear legs each supporting six wheels .

The A380 requires service vehicles with lifts capable of reaching the upper deck , as well as tractors capable of handling the A380 's maximum ramp weight . When using two jetway bridges the boarding time is 45 min , and when using an extra jetway to the upper deck it is reduced to 34 min . The A380 has an airport turnaround time of 90 ? 110 minutes . In 2008 the A380 test aircraft were used to trial the modifications made to several airports to accommodate the type .

= = = = Takeoff and landing separation = = = =

In 2005 , the ICAO recommended that provisional separation criteria for the A380 on takeoff and landing be substantially greater than for the 747 because preliminary flight test data suggested a stronger wake turbulence . These criteria were in effect while the ICAO 's wake vortex steering group , with representatives from the JAA , Eurocontrol , the FAA , and Airbus , refined its 3 @-@ year study of the issue with additional flight testing . In September 2006 , the working group presented its first conclusions to the ICAO .

In November 2006 , the ICAO issued new interim recommendations . Replacing a blanket 10 nautical miles (19 km) separation for aircraft trailing an A380 during approach , the new distances were 6 nmi (11 km) , 8 nmi (15 km) and 10 nmi (19 km) respectively for non @-@ A380 " Heavy " , " Medium " , and " Light " ICAO aircraft categories . These compared with the 4 nmi (7 @.@ 4 km) , 5 nmi (9 @.@ 3 km) and 6 nmi (11 km) spacing applicable to other " Heavy " aircraft . Another A380 following an A380 should maintain a separation of 4 nmi (7 @.@ 4 km) . On departure behind an A380 , non @-@ A380 " Heavy " aircraft are required to wait two minutes , and " Medium " / " Light " aircraft three minutes for time based operations . The ICAO also recommends that pilots append the term " Super " to the aircraft 's callsign when initiating communication with air traffic control , to distinguish the A380 from " Heavy " aircraft .

In August 2008 , the ICAO issued revised approach separations of 4 nmi (7 @.@ 4 km) for Super (another A380) , 6 nmi (11 km) for Heavy , 7 nmi (13 km) for medium / small , and 8 nmi (15 km) for light . In November 2008 , an incident on a parallel runway during crosswinds made the Australian authorities change procedures for those conditions .

For takeoff , " Light " and " Medium " aircraft must wait 3 minutes behind an A380 takeoff , compared to the standard 2 minutes for takeoffs behind other aircraft types .

Singapore Airlines describe the A380 's landing speed of 130 ? 135 kn (240 ? 250 km / h) as " impressively slow " .

= = = = Maintenance = = = =

As the A380 fleet grows older , airworthiness authority rules require certain scheduled inspections from approved aircraft tool shops . The increasing fleet size (to about 286 in 2020) cause expected maintenance and modification to cost $ 6 @.@ 8 billion for 2015 @-@ 2020 , of which $ 2 @.@ 1 billion are for engines . Emirates performed its first 3C @-@ check for 55 days in 2014 . During lengthy shop stays , some airlines will use the opportunity to install new interiors .

= = Variants = =

= = = Improved A380 @-@ 800 = = =

In 2010 , Airbus announced a new A380 build standard , incorporating a strengthened airframe structure and a 1 @.@ 5 ° increase in wing twist . Airbus will also offer , as an option , an improved maximum take @-@ off weight , thus providing a better payload / range performance . Maximum take @-@ off weight is increased by 4 t (8 @,@ 800 lb) , to 573 t (1 @,@ 263 @,@ 000 lb) and the range is extended by 100 nautical miles (190 km) ; this is achieved by reducing flight loads , partly from optimising the fly @-@ by @-@ wire control laws . British Airways and Emirates are the first two customers to have received this new option in 2013 . Emirates has asked for an update with new engines for the A380 to be competitive with the 777X around 2020 , and Airbus is studying 11 @-@ abreast seating .

In 2012 Airbus announced another increase in the A380 's maximum take @-@ off weight to 575 t (1 @,@ 268 @,@ 000 lb) , a 6 t hike on the initial A380 variant and 2 t higher than the increased @-@ weight proposal of 2010 . It will stretch the range by some 150 nautical miles (280 km) , taking its capability to around 8 @,@ 350 nautical miles (15 @,@ 460 km) at current payloads . The higher @-@ weight version was offered for introduction to service early in 2013 .

= = = A380 @-@ 900 = = =

In November 2007 Airbus top sales executive and chief operating officer John Leahy confirmed plans for an enlarged variant , the A380 @-@ 900 , with more seating space than the A380 @-@ 800 . This version would have a seating capacity for 650 passengers in standard configuration , and approximately 900 passengers in an economy @-@ only configuration . Airlines that had expressed an interest in the ? 900 included Emirates , Virgin Atlantic , Cathay Pacific , Air France , KLM , Lufthansa , Kingfisher Airlines , and leasing company ILFC . In May 2010 , Airbus announced that A380 @-@ 900 development was postponed , until production of the A380 @-@ 800 stabilises .

On 11 December 2014 at the annual Airbus Investor Day forum Airbus CEO controversially announced that " We will one day launch an A380neo and one day launch a stretched A380 " following speculation sparked by Airbus CFO Harald Wilhelm that Airbus could axe the A380 ahead of its time due to softening demand . On 15 June 2015 , John Leahy , Airbus 's chief operating officer for customers , stated Airbus was looking at the A380 @-@ 900 programme again . Airbus 's newest concept is a stretch of the A380 @-@ 800 offering 50 seats more , not 100 as originally envisaged . The stretch would be tied to a potential re @-@ engining of the A380 @-@ 800 . According to FlightGlobal , an A380 @-@ 900 would make better use of the A380 's existing wing .

= = = A380neo = = =

On 19 July 2015 , Airbus CEO Fabrice Brégier stated that the company will build a new version of the A380 featuring new improved wings and new engines . Speculation about the development of a so @-@ called A380neo (neo for new engine option) had been going on for a few months after earlier press releases in 2014 , and in 2015 the company was considering whether to end production of the type prior to 2018 or develop a new A380 variant . Later it was revealed that Airbus was looking at both the possibility of a longer A380 in line of the previously planned A380 @-@ 900 and a new engine version , i.e. A380neo . It was also revealed by Brégier that the new variant would be ready to enter service by 2020 . The engine would most likely be one of a variety of all @-@ new options from Rolls @-@ Royce , ranging from derivatives of the A350 's XWB @-@ 84 / 97 to the future Advance project due at around 2020 .

On 3 June 2016 , Emirates President Tim Clark stated that talks between Emirates and Airbus on the A380neo have " lapsed " .

= = = A380F = = =

Airbus originally accepted orders for the freighter version , offering the largest payload capacity of

any cargo aircraft in production , exceeded only by the single Antonov An @-@ 225 Mriya in service . An aerospace consultant has estimated that the A380F would have 7 % better payload and better range than the 747 @-@ 8F , but also higher trip costs . However , production has been suspended until the A380 production lines have settled with no firm availability date . In 2015 Airbus removed A380F from the range of freighters on the corporate website .

= = Market = =

In 2006 , industry analysts Philip Lawrence of the Aerospace Research Centre in Bristol and Richard Aboulafia of the consulting Teal Group in Fairfax anticipated 880 and 400 A380 sales respectively by 2025 , whereas Airbus and Boeing estimate 1 @,@ 700 and 700 VLA (very large aircraft ; those with more than 400 seats) , respectively . According to Lawrence , parallel to the design of the A380 , Airbus conducted the most extensive and thorough market analysis of commercial aviation ever undertaken , justifying its VLA plans , while according to Aboulafia , the rise of mid @-@ size aircraft and market fragmentation reduced VLAs to niche market status , making such plans unjustified . The two analysts ' market forecasts differed in the incorporation of spoke @-@ hub and point @-@ to @-@ point models . The difference was illustrated in 2014 when British Airways replaced three B777 flights between London and Los Angeles with two A380 , per day .

In contrast , the airline strategy of frequency (offering multiple flights between the same two cities at different times of day) typically relies on smaller aircraft . United Airlines told Reuters that it follows this strategy because it offers business travelers more choices . Moreover , United 's Chief Financial Officer observed that the airline 's Boeing 787 Dreamliners operate at a lower trip cost than the A380 . Hence , the A380 " just doesn 't really work for us . " Operators Air France and China Southern have found that the A380 's capacity is too large for some markets ; China Southern has faced mounting losses on A380 operations out of its Guangzhou hub , although Emirates ' Tim Clark sees a large potential for Asian A380 @-@ users , and criticised Airbus ' marketing efforts . In 2013 , Air France withdrew A380 services to Singapore and Montreal and switched to smaller aircraft .

In 2007 , Airbus estimated a demand for 1 @,@ 283 passenger planes in the VLA category for the next 20 years if airport congestion remains at the current level . According to this estimate , demand could reach up to 1 @,@ 771 VLAs if congestion increases . Most of this demand will be due to the urbanisation and rapid economic growth in Asia . The A380 will be used on relatively few routes , between the most saturated airports ; 15 of the world 's 20 biggest airports are saturated . Airbus also estimates a demand for 415 freighters in the category 120 @-@ tonne plus . Boeing , which offers the only competition in that class , the 747 @-@ 8 , estimates the demand for passenger VLAs at 590 and that for freighter VLAs at 370 for the period 2007 ? 2026 .

At one time the A380 was considered as a potential replacement for the existing Boeing VC @-@ 25 serving as Air Force One , but in January 2009 EADS declared that they were not going to bid for the contract , as assembling only three planes in the US would not make financial sense .

The break @-@ even for the A380 was initially supposed to be reached by selling 270 units , but due to the delays and the falling exchange rate of the US dollar , it increased to 420 units . In 2010 , EADS CFO Hans Peter Ring said that break @-@ even (on the aircraft that are delivered) could be achieved by 2015 , despite the delays ; there should be around 200 deliveries by that time , on current projections . In 2012 , Airbus clarified that in 2015 , production costs to build the aircraft would be less than the sales price . As of March 2010 the average list price of an A380 was US $ 375 @.@ 3 million (about ? 261 million or £ 229 million) , depending on equipment installed . As of July 2012 this list price was US $ 390 million , but negotiated discounts made the actual prices much lower , and industry experts questioned whether the A380 project would ever pay for itself .

On 11 December 2014 , after slower than expected orders for the aircraft in 2014 , Harald Wilhelm , the company 's Chief Finance Officer , voiced the possibility to end the program in 2018 . His statement was met by protests from customers and a fall in share prices . Airbus responded to the protests by playing down the possibility the A380 would be abandoned , instead emphasizing that

enhancing the airplane was a likelier scenario . On 22 December 2014 , CEO Fabrice Brégier ruled out that the cancellation of the A380 program , stating that it will break even in 2015 but also that the A380 was introduced a decade too early . While no longer losing money on each plane sold , Airbus admits that the company will never recoup the $ 25 billion investment it made in the project .

As of mid @-@ 2015 , several airlines have expressed their interest in selling their aircraft , partially coinciding with expiring lease contracts for the aircraft . Several A380 which are in service have been offered for lease to other airlines . The suggestion has prompted concerns on the potential for new sales for Airbus , although these were dismissed by Airbus COO John Leahy stated that " Used A380s do not compete with new A380s " , stating that the second @-@ hand market is more interesting for parties otherwise looking to buy smaller aircraft such as the Boeing 777 .

On 15 June 2015 , Reuters reported that Airbus was discussing a stretched version of the A380 with a half dozen customers . This aircraft , which could also feature new engines , would accommodate an additional fifty passengers . Were this " A380neo " to be built , it would be delivered to customers sometime in 2020 or 2021 . On 9 July 2015 , Business Insider reported that Airbus had filed a patent application for an A380 " combi " which would offer the flexibility of not only carrying both passengers and cargo , but being rapidly reconfigurable to expand or contract the cargo area and passenger area as needed for a given flight .

An A380 's hourly cost is about $ 26 @,@ 000 , or around $ 50 per seat hour , which compares to $ 44 per seat hour for a Boeing 777 @-@ 300ER , and $ 90 per seat hour for a Boeing 747 @-@ 400 as of November 2015 .

= = Orders and deliveries = =

Nineteen customers have ordered the A380 . Total orders for the A380 stand at 319 as of May 2016 . The biggest customer is Emirates , which has ordered or committed to order a total of 142 A380s as of 31 May 2016 . One VIP order was made in 2007 but later cancelled by Airbus . The A380F version totalled 27 orders before they were either cancelled (20) or converted to A380 @-@ 800 (7) , following the production delay and the subsequent suspension of the freighter programme .

Delivery takes place in Hamburg for customers from Europe and the Middle East and in Toulouse for customers from the rest of the world . EADS explained that deliveries in 2013 were to be slowed temporarily to accommodate replacement of the wing rib brackets where cracks were detected earlier in the existing fleet .

In hopes of raising the number of orders placed , Airbus announced ' attractable discounts ' to airlines who placed large orders for the A380 . Emirates soon after , ordered 50 aircraft , totalling $ 20 @.@ 75 billion . Airbus gave a $ 2 @.@ 75 billion total discount , equal to $ 55 million in savings per aircraft for Emirates .

Airbus says that some A380s may not be delivered to customers or even built . This decision came when Airbus had not met the ' Accord and Satisfaction ' for three already built aircraft for an undisclosed Japanese airline . " Without referring to any specific airline , I can assure you that we have cases where airlines are in the order backlog but not in the production plan , " chief executive officer Tom Enders said in August 2014 during a conference call to discuss earnings with Bloomberg . " We are watching the situation carefully , and know about the strengths and weaknesses of customers . " Among customers that have ordered superjumbos yet remain undecided about actually taking them is Virgin Atlantic , with six units on the order book . Qantas had also planned to top up its existing fleet by as many as eight airplanes , an expansion that has been thrown into doubt amid a cost @-@ cutting drive . Amedeo , an aircraft lessor that ordered 20 A380s , has yet to find a single client for the jet .

Cumulative orders and deliveries

Data from Airbus through the end of June 2016 .

Orders

Deliveries

= = Operators = =

There were 193 aircraft in service with 13 operators as of 30 June 2016 .
Singapore Airlines first service on 25 October 2007
Emirates first service on 1 August 2008
Qantas first service on 20 October 2008
Air France first service on 20 November 2009
Lufthansa first service on 6 June 2010
Korean Air first service on 17 June 2011
China Southern Airlines first service on 17 October 2011
Malaysia Airlines first service on 1 July 2012
Thai Airways first service on 6 October 2012 .
British Airways first service on 2 August 2013 .
Asiana Airlines first service on 13 June 2014
Qatar Airways first service on 10 October 2014
Etihad Airways first service on 27 December 2014

= = = Notable routes = = =

The shortest regular commercial route that the A380 flies is from Dubai International Airport to Kuwait International Airport (861 km or 535 miles great circle distance) with Emirates , although Air France briefly operated the A380 on the much shorter Paris @-@ Charles de Gaulle to London @-@ Heathrow route (344 km or 214 miles) in mid @-@ 2010 . The longest A380 route ? and the second longest non @-@ stop commercial flight in the world ? is Qantas ' service from Sydney International Airport to Dallas @-@ Fort Worth International Airport at 13 @,@ 804 kilometres (8 @,@ 577 mi) .

= = Incidents and accidents = =

The A380 has been involved in one aviation occurrence and no hull loss accidents with no fatalities as of January 2016 , according to the Aviation Safety Network .
On 4 November 2010 , Qantas Flight 32 , en route from Singapore Changi Airport to Sydney Airport , suffered an uncontained engine failure , resulting in a series of related problems , and forcing the flight to return to Singapore . There were no injuries to the passengers , crew or people on the ground despite debris falling onto the Indonesian island of Batam . The A380 was damaged sufficiently for the event to be classified as an accident . Qantas subsequently grounded all of its A380s that day subject to an internal investigation taken in conjunction with the engine manufacturer Rolls @-@ Royce plc . A380s powered by Engine Alliance GP7000 were unaffected but operators of Rolls @-@ Royce Trent 900 @-@ powered A380s were affected . Investigators determined that an oil leak , caused by a defective oil supply pipe , led to an engine fire and subsequent uncontained engine failure . Repairs cost an estimated A $ 139 million (~ US $ 145M) . As other Rolls @-@ Royce Trent 900 engines also showed problems with the same oil leak , Rolls @-@ Royce ordered many engines to be changed , including about half of the engines in the Qantas A380 fleet . During the airplane 's repair , cracks were discovered in wing structural fittings which also resulted in mandatory inspections of all A380s and subsequent design changes .

= = Specifications = =

Sources : Airbus A380 specifications