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Special edition

FAST

Flight Airworthiness Support Technology

Incremental
Development



Keeping
the A330
ahead of
the game





EDITORIAL by Eric ZANIN

Head of the A330 Family programme

Dear Airbus friends,

Some may be surprised by Airbus saying the A330 is "The right aircraft, right now!".

How can an aircraft first operated over 20 years ago still be the right aircraft, right now? Those of you who have ordered and reordered the aircraft know the answer.

The answer lies in Incremental Development; the art of staying ahead of the game by continuous step-by-step improvement and innovation.

As you will discover in this special edition of FAST dedicated to A330 Incremental Development, today's A330 aircraft is not yesterday's A330. Today's A330 aircraft serves every business model. It is flying worldwide from the biggest megacities to the smallest dream islands; it is operated on 30 minute short routes up to 15 hour long haul flights and can be configured for 200 to 440 seats while maintaining Airbus' high level standard of comfort. What's more is that the A330 passenger aircraft is part of a bigger family developed over the years comprising a freighter, a corporate jet and a military combined tanker/transport.

The combination of low operating costs with high efficiency, flexibility and passenger experience is what makes the A330 popular with its ever increasing base of more than 100 customers, operating over 1,200 A330 aircraft.

Incremental development brings the latest technology on-board to maintain the A330s offer of the best services to passengers and versatility to operators.

Incrementally developing

In this special FAST edition, you will discover that the A330 programme is a technological pioneer that also benefits from proven successes on our other established Airbus families: A320 Family,

A340, A380 and from innovations designed on the new A350 XWB and A320neo (new engine option). As technology improves, so does the A330 Family.

Since the A330's service entry Airbus has committed to continuously improving the programme by spending approximately 150 million Euros each year on incremental improvements and innovations in systems, technology and on the cabin. The result is that the A330 Family is recognised for its Operational Reliability of over 99.4%, and the Maximum Take-Off Weight (MTOW) has now been certified and delivered at 242 tonnes with Specific Fuel Consumption (SFC) improvements.

The next step: neo

The next change for the A330 Family can hardly be termed 'incremental' - it is more of a giant leap! We are now preparing the transition to A330neo. There is a lot of work to do but it is already going well and the team, led by Odile JUBECOURT, is currently on track with all the milestones and preliminary design reviews. They are doing a great job, focusing on the key areas for the new engine option - propulsion systems, the pylon and wing reinforcement. We are also taking this opportunity to introduce some cabin innovations,

to make the interior even more comfortable, eye-catching as well as more efficient. The A330neo cabin will have the same look and feel as that of the A350.

A leader by design

A330 enhancement is not about 'keeping up with others', the A330 has often been the first in bringing on stream improvements for its customers and we will continue this in the future.

Based on our analysis of the future trends of world air travel and listening to our customers' expectations, we work on different cross-programme improvement projects. Under the leadership of Didier EVRARD (Head of Airbus Programmes) these include lead-time and inventory reduction, as well as quality improvement from our suppliers, plants and Final Assembly Line. All of which to ensure that we continue to produce the best product for our operators.



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The future of A330

The confidence that you, our customers, have demonstrated in the A330, ensures the success of both the 242t aircraft and A330neo. This reinforces our ambition to keep the A330 Family flying for many years to come. I know that by continuing to listen to our customer's feedback on how to improve and enhance the A330 and thanks to the dedication of our programme's teams, the A330 will maintain its leadership.

In this special edition of FAST, dedicated to the major Incremental Developments of the A330 Family you will discover how the A330 is more than ever '*The right aircraft, right now*'.

Erik

"Incremental development keeps the A330 ahead of the game".



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A330 Family overview

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A330

Family overview

The A330 Family - a tailored solution for every market today and for the future

As the 242 tonne weight variant enters into service with Delta Air Lines (May 2015) and the design freeze of the neo version (end of 2015), FAST magazine takes a look at the A330 Family's evolution over time.

More than 20 years after its entry into service in 1994, the A330 Family continues to attract both new sales (the top 10 customers have ordered the A330 on average 8 times) and new operators.

Since the first certification of the A330-300, at the end of 1993, Airbus committed the programme to continuous improvement. The company spends approximately 150 million Euros each year on enhancements and incremental improvements in systems, technology and cabin.



A330-200



A330-300



A330 REGIONAL



A330-200F

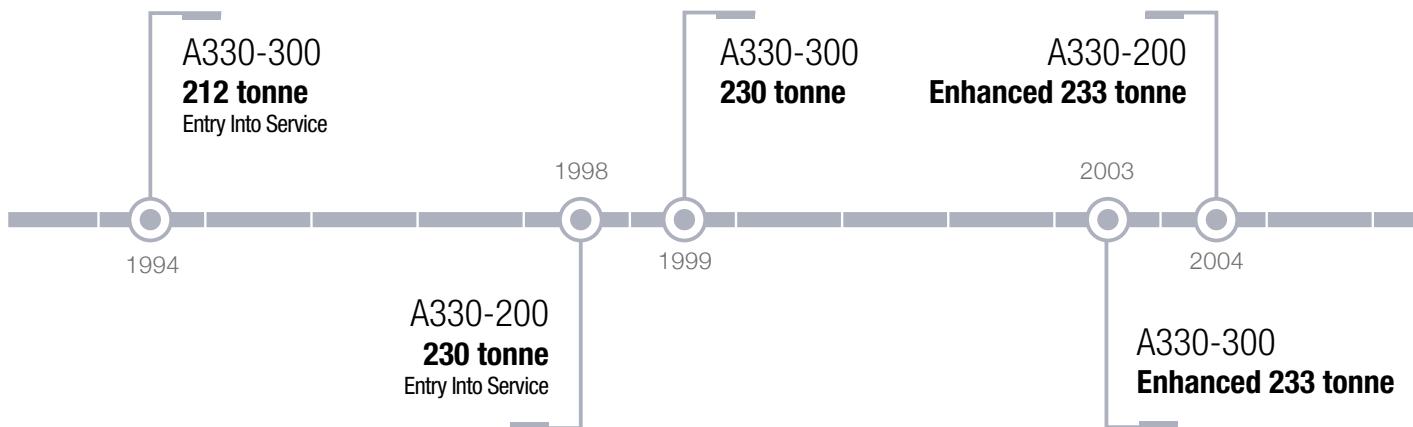


A330 ACJ



A330 MRTT

Multi Role Tanker Transport
111 tonnes of fuel/45 tonnes of payload





Versatile and popular
Serving all mission types



Cost efficient
High revenue generating aircraft



Reliability
99.4% Operational Reliability



Modern aircraft with state-of-the-art technology
Enhancing operational capability



Comfortable passenger experience
18 inch economy class comfort as standard



Airbus commonality
Integrated family of aircraft

Every 20 seconds, an A330 aircraft takes-off or lands somewhere in the world.

With an established dispatch reliability record of over 99% it's almost certain to be right on time, helping more than 100 operators worldwide serve over 300 airports with new levels of efficiency and profitability. From its entry into service, the A330 has been continuously improved with the latest technology structure modifications and cabin improvements, that makes its performance and economics exceptionally competitive and in many cases unbeatable.

The aircraft is serving everybody, everywhere from the biggest megacities to the smallest dream islands, from 30 minutes up to 15 hour flights and from 200 up to 440 seats.

	Typical seating	Max seating	Range	Wing span	Overall length	Overall height	Max Take-Off Weight
A330-200	247	406	7,250	197'10" 60.30 m	191'6" 58.37 m	58'2" 17.73 m	242 tonnes
A330-300	277	440	6,350	197'10" 60.30 m	208'12" 63.70 m	56'4" 17.18 m	242 tonnes
A330 Regional	400	440	2,700	197'10" 60.30 m	208'12" 63.70 m	56'4" 17.18 m	199 tonnes
A330-200F	-	70 tonnes	4,000	197'10" 60.30 m	191'6" 58.37 m	58'2" 17.73 m	233 tonnes
A330-800	257	406	7,500	209'12" 64.00 m	191'6" 58.37 m	58'2" 17.73 m	242 tonnes
A330-900	287	440	6,550	209'12" 64.00 m	208'12" 64.00 m	56'4" 17.18 m	242 tonnes

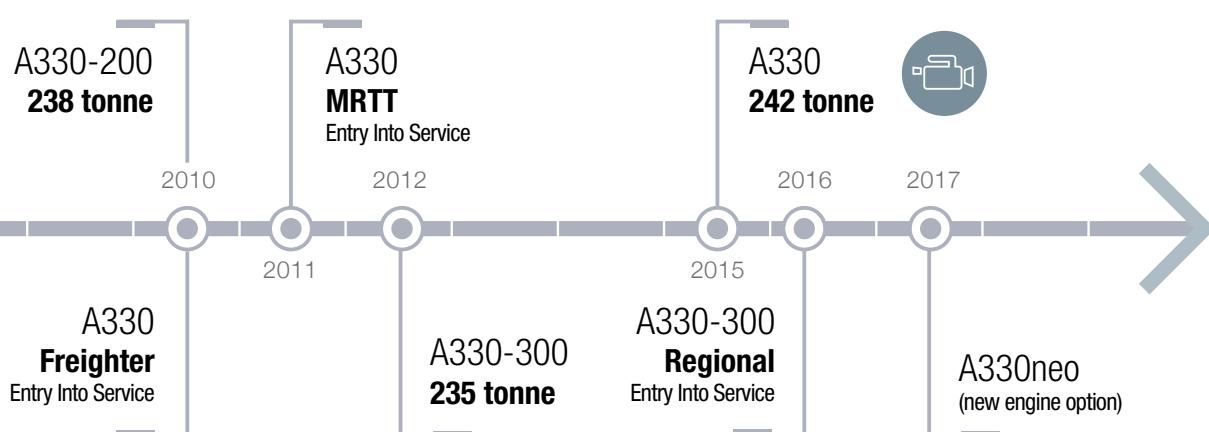
As a ground-breaker, Airbus designed the first:

- Twin-aisle twin-engine aircraft
- Widebody certificated for operation by two pilots
- Aircraft to incorporate wind-shear detection and reaction
- Twin-engined aircraft regularly operated on extended routes
- Aircraft with composite primary structure
- Aircraft with fly-through computer control

All these developments have been adopted by the A330.

The A330 is:

- The first wide-body qualified for Required Navigation Performance (RNP) - authorisation required in March 2009
- The first aircraft certified ETOPS (Extended-range Twin-engine Operational Performance Standards) beyond 180 minutes (up to 240 min in October 2009)
- The first aircraft in the world to fly with broadband Wi-Fi internet and mobile phone services from 2nd quarter 2010



A330 Family Incremental Development

In this special edition of FAST magazine we'll be highlighting the step changes that have allowed the A330 to lead the field in widebody aircraft for over 20 years. Airbus' continuous innovation has touched upon every aspect of operating an aircraft from the overall aircraft design, right through to reduced maintenance and upgrade compatibility.

ID for → Aircraft design

The A330 operational characteristics have been improved continuously, maturing this aircraft to operate efficiently on all kinds of routes from short to long haul, from 30 minutes up to 15 hour flights, whilst improving the flexibility and the versatility.

This has been made possible by the regular introduction of airframe modifications, technological fertilization from other Airbus products developments, as well as the use of more recent methods and tools.

Improving flexibility through payload/range variants

The payload and range capability improvement is primarily achieved through design weights variants:

- Maximum Take-Off Weight (MTOW) increase - more range at a given payload / more payload at a given range
- MTOW reduction - optimisation for high traffic regional routes
- Maximum Zero Fuel Weight (MZFW) increase - more maximum payload
- Maximum Lift Weight (MLW) - comes along with MZFW increase



Article by

Vincent LEVAS

A330/A340/A330neo

Chief Engineering

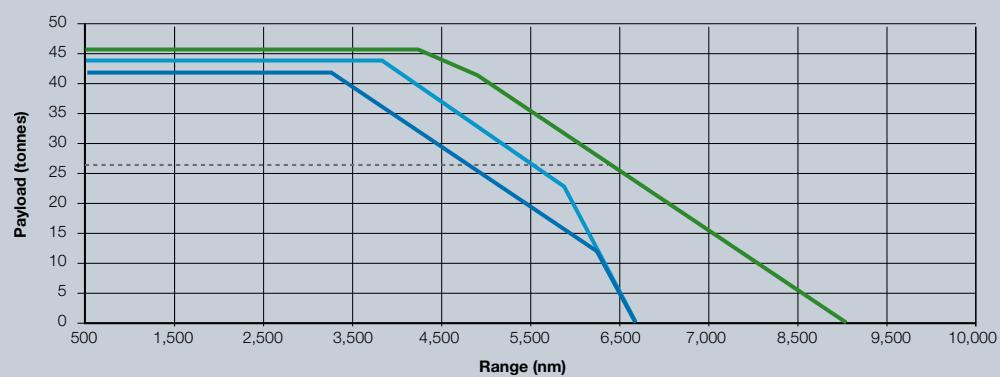
Overall Aircraft Design

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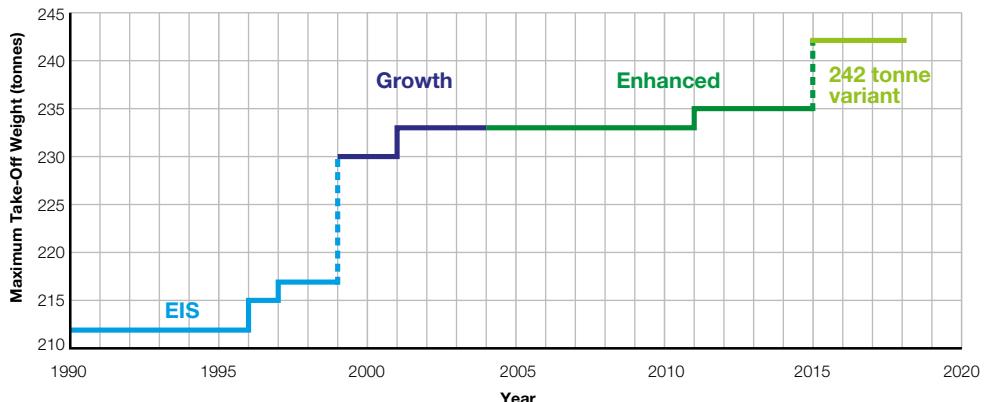
Payload range evolution

Aircraft	MTOW Pax	Max pax range
A330-300	217t	4760 nm
A330-300	230t	5510 nm
A330-300	242t	6320 nm



A330-300 development

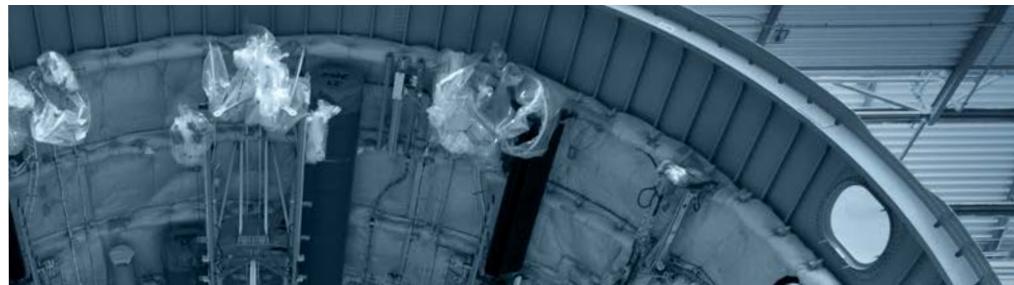
Big steps for Maximum Take-Off Weight increase or airframe optimisation



Improving payload/range

This has been made possible by demonstrating increased structural capability, in several steps:

- **"Small steps"** using the demonstrated margins from the airframe structural capability, resulting from re-analysis of the existing structural design with new methods & tools. Such developments only require minor – hence retrofittable – structural modifications.
- **"Big steps"** introducing a larger extent of structural modifications – hence non-retrofittable – thus allowing a large increase of design weights or fatigue characteristics improvement (A330 "enhanced").



Improving flexibility

Take-off performance

The engine thrust has been increased in conjunction to the MTOW increase, ranging from 64,000 lbs up to 72,000 lbs take-off thrust, thus preserving the airfield capability of the A330.

When maximized performance is not required, the engine thrust can be optimized on a case by case basis (for engine life and cost saving) to the airfield conditions and Take-Off Weight of the day by use of "Derate thrust" (up to 25 % thrust reduction) or "Flex thrust" (up to 40 % thrust reduction).

The A330 offers flexible design Weight Variants (WV) by using:

- Multiple Weight Variants: "switch" (on a seasonal basis) from, for example, a "low WV" to a "high WV" on the same aircraft
- Dynamic payload: fully optimized payload/range capability by trading Take-Off Weight vs Zero Fuel Weight (on a flight-by-flight basis)

A330 Family
incremental
developments
improving
flexibility and
efficiency

Improving airframe efficiency

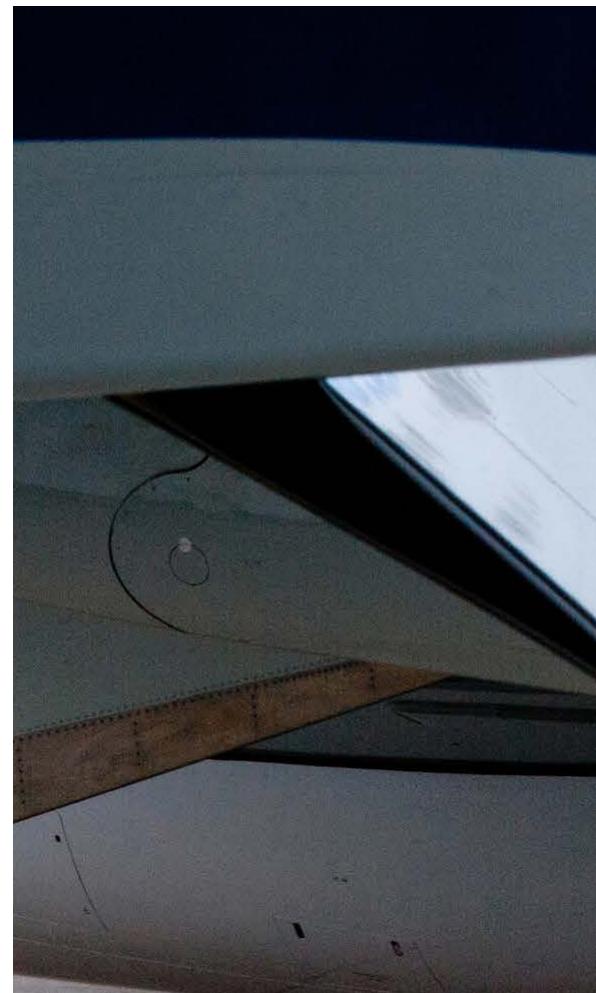
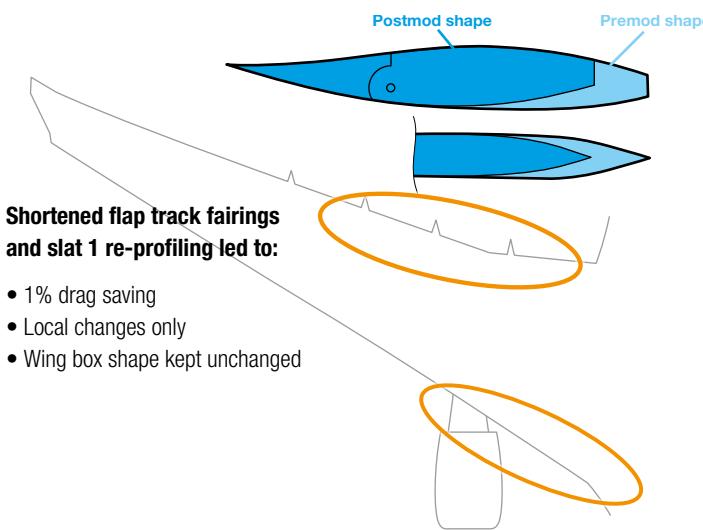
The airframe efficiency improvements introduced on A330 are:

- Modifications for fatigue life improvement:
 - adapted to the longer range capability (i.e. less Flight Cycles and more Flight Hours)
 - adapted to the shorter range capability (i.e. more Flight Cycles and less Flight Hours)
- Structural optimization for weight savings (contributing to better performance), by introduction of new materials (e.g. new aluminium alloys, composite material) or design re-optimization with new methods & tools

Aerodynamic efficiency

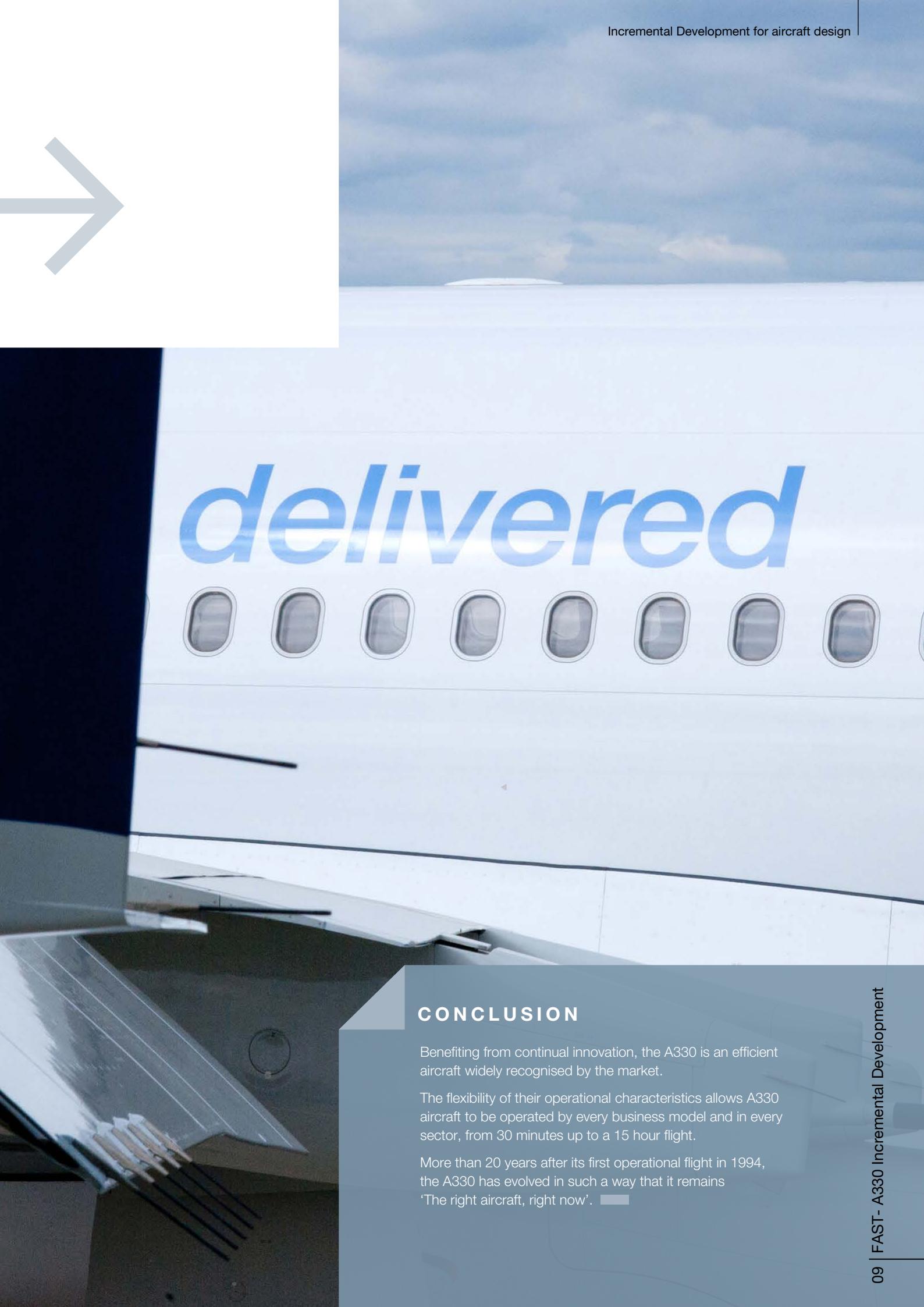
The A330 wing is achieving an excellent aerodynamic standard, thanks to its high Aspect Ratio wing and advanced transonic profiles. The developments of Computational Fluid Dynamics have however allowed evidencing opportunities for local design "tweaks" reducing cruise drag by 1%:

- Re-optimized slat1 profile
- Shortened flap track fairings



Future improvements

Beyond current definition, new features will be developed to further improve the performance such as weight reduction solutions or introduction of new aerodynamic technologies (riblets and hybrid laminar flow).



CONCLUSION

Benefiting from continual innovation, the A330 is an efficient aircraft widely recognised by the market.

The flexibility of their operational characteristics allows A330 aircraft to be operated by every business model and in every sector, from 30 minutes up to a 15 hour flight.

More than 20 years after its first operational flight in 1994, the A330 has evolved in such a way that it remains 'The right aircraft, right now'. ■■■

ID for → Systems

Over its 20 years of existence, one of the leading fields in which the A330 Family has been incrementally developed, both in rhythm and scope, is systems.

During the first ten years of A330 operations, evolution in systems was mainly aimed at improving reliability, saving weight and consequently fuel, or allowing functional growth capabilities at architecture level.

It was in 1998 at the time of A330-200/300 "high growth weight" 230t certification that the first significant step was performed. A centre wing fuel tank was added to the A330-200 definition, increasing range capability, and both A330-200 and A330-300 were the first Airbus aircraft to be fitted with new navigation technologies as Multi-Mode Receiver (MMR), Flight Management FMS2, replacing former equivalent systems, and new FANS A (Future Air Navigation System) solution, supported by SATCOM communications, to improve oceanic and long range operations.



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Five years later in 2003, capitalizing on A340-500/600 technologies on-going development, a second significant step was achieved with the entry into service of the "enhanced" A330-200/300 bringing changes that improved reliability and reduced maintenance costs. Major upgrades were implemented, such as the introduction of LCD (Liquid Crystal Display) screens in the cockpit (replacing EIS1 Cathode Ray Tube displays), ISIS (Integrated Standby Instrument Systems) replacing a set of electro-mechanical standby instruments, a Fly-By-Wire rudder, as well as a new on-board maintenance data system.

During the last ten subsequent years, the A330 Family programme has continuously and increasingly invested in development, improving A330 systems definition, enabling the design office to certify complex and operations-oriented functions.

Using the latest certified techniques, the design office has delivered safety enhancements, fuel and cost savings, reliability improvements, or new capabilities to improve aircraft and cockpit operations and/or passengers' travel experience.

→ Major A330 developments on navigation and flight management systems

Airborne Traffic Situational Awareness (ATSAW)

(ATSAW), took advantage of Automatic Dependent Surveillance-Broadcast (ADS-B) by displaying aircraft information. It enhances the flight crew's knowledge of their surrounding air traffic situation, contributing to fuel savings by identifying the opportunity to climb and optimizing the flight level. In approach ATSAW increases runway throughput by improving identification and information of target aircraft and decreasing pilot workload. ATSAW was certified in 2011.

Traffic Collision Avoidance System Resolution Advisory (TCAS RA)

Prevention (TCAP)** aims to reduce the number of TCAS RA occurring during level-off manoeuvres in reduced separation airspaces. It reduces undesired RA by 95% and all RA by 50% and improves passenger comfort, with no fuel penalty for normal operation.

Autopilot/Flight Director Traffic Collision Avoidance System (AP/FD TCAS*) mode is an Airbus solution which combines the autopilot (automatic mode) /flight director (manual mode) and the TCAS to provide vertical speed guidance based on a TCAS target and an optimum avoidance manoeuvre in case of conflicting air traffic (TCAS RA). It avoids or reduces pilot overreaction, enhances safety and increases passenger comfort during manoeuvres. It also allows easier training and a more intuitive flying technique.

On-board Airport Navigation System (OANS)

Associated with enhanced Electronic Instruments System EIS2 (LCD displays with video capability, production standard since 2013), track-ball device and Flight Control Unit (FCU) upgrade, the system shows the aircraft's position on an airport map, to improve situational awareness, ease navigation around complex airfields or in low visibility conditions. It similarly helps prevent dangerous errors in surface navigation such as runway incursion or take-off from a taxiway or from the wrong runway.

Required Navigation Performance Authorisation Required (RNP-AR**)

The A330 was the first widebody aircraft to be RNP-AR approved. This system allows access to airports in mountainous areas with more flexible approaches and departures, thus enabling time and fuel savings. RNP-AR is certified with 2 levels of RNP-AR operations: 0.3 nm (certified in 2010) and 0.1 nm in approach (certified in 2014).

GBAS Landing System (GLS)

provides a state-of-the-art approach method for landing. It is based on differential corrections of GPS positions which are provided by a GBAS (Ground Based Augmentation System) station located at the airport. This function is in line with the ILS system and is fully integrated into the cockpit. GLS CAT 1 autoland was certified in 2014, with growth capability allowing evolution towards CAT II/III autoland. It is an advantage at airports by significantly reducing the effects of ILS signal reflection and providing flexibility for approach design.

FMS Landing System (FLS)

is currently a function provided by FMS Thales Release 1A. FLS allows flying a Non-Precision Approach (NPA) along a "virtual" beam computed by the Flight Management System (FMS) with similar display, guidance & alerts as those for precision approach operations (Instrument Landing System - ILS). FLS does not rely on ground assets and provides significant benefits in reducing pilot training time and costs. FLS that will be directly compatible with the Final APP mode and supporting RNP-AR procedures will be available on Honeywell FMS in 2016 and on Thales FMS in 2018.

Continuous Descent Approach (CDA)

Conventional Airbus descent procedure is designed to perform a major part of deceleration during level-off segments. The vertical profile of descent and approach complies with altitude constraints as defined in the navigation database or manually entered by the flight crew (from ATC clearance). Continuous Descent Approach (CDA) aims at removing level segment and uses idle thrust as much as possible, providing flight crew with energy management indications by defining flaps/slats configurations.

It is supported by the Flight Management System - FMS Release 2 - from Honeywell to be available early 2016.

Runway Overrun Protection System (ROPS*)

(ROPS*) is an Airbus-developed response to the growing occurrence of runway overrun incidents, which remain the main cause of aircraft accidents. ROPS provides significant safety enhancement allowing the reduction of insurance fees. (See FAST#55)

Soft go-around function aims at providing an easy way for the flight crew to achieve appropriate thrust for go-around in all cases, avoiding strong acceleration while ensuring a climb rate of approximately 2000 ft/min, vertical stability and pitch. It will be available for GE/PW engines by the end of 2016.

Weather radar

Improved definition of weather radar offers from both suppliers (Honeywell and Rockwell Collins) will be available by the end of 2015. These state-of-the-art technologies which include detection techniques, digital signal processing and weather data memory, improve crew awareness by improving weather threat assessment such as hail and lightning analysis and turbulence detection.

* AP/FD TCAS, TCAP and ROPS will be available early 2016

** RNP-AR FAA certification is expected in 2015.

Operational improvement

ETOPS 240 (Extended-range Twin-engine Operational Performance Standards)

ETOPS provides key operational improvement. In 2009 EASA approved A330 aircraft for ETOPS “beyond 180 minutes”, allowing diversion distance up to a maximum of 1,700 nm, i.e. the equivalent to an ETOPS diversion time slightly higher than 240 minutes.

On some “golden routes”, this can mean reduced distances of up to 500 nm, which is the equivalent of 1 hour of flight, or 10 percent of fuel.

ETOPS 240 certification by the FAA is expected by the end of 2015.



Cabin oxygen system

An Extended Duration Chemical Oxygen System (EDCOS) (generators/containers) will be introduced, providing significant weight saving and easing maintenance. It will enable our customers to change from the current gaseous oxygen system installation and will bring significant benefits to airlines requiring passenger oxygen supply up to approximately 60 minutes. Once this system has been qualified for the A330, it will also be adopted by other Airbus programmes.

Even in this field, the A330 is still “setting the standard” for other aircraft.

Communication systems

Swift Broad Band (SBB) SATCOM Derived from "Swift 64" (64kbps) SATCOM solutions and driven by cabin application needs, such as live internet, mobile phone use and email. Swift Broad Band SATCOM solutions by both Honeywell and Rockwell Collins were certified between 2009 and 2011 providing 2 channels at 432 kbps. They can both be operated with former SATCOM antenna or with the more recently certified antenna (July 2010) which is 25 kg lighter, easy to retrofit, and delivers fuel savings of approximately 100 kg for a typical A330 mission.

IRIDIUM cockpit SATCOM solution, certified in 2014, offers a low cost solution to equip in-service aircraft that are not yet SATCOM equipped, or to replace in-production current SBB (Swift Broadband) SATCOM that will become over-sized for cockpit operation when a powerful cabin SATCOM (Kx band) is selected. This solution provides worldwide coverage, and is easy to retrofit. Capability of the Electronic Flight Bag (EFB) connection will be certified by the end of 2015.

SATCOM voice for ATC communication (certified in 2011), offers increased reliability and better quality of voice communication. It also allows deletion of one High Frequency (HF) system. It does not need any hardware or software upgrade, but requires local ATC approval for long range communication.

A330neo systems ... and beyond

The A330neo has been designed to be fitted with all the above solutions, either as a basic configuration or as options depending on programme policy. It will also benefit from an electro-pneumatic bleed system, which has been the state-of-the-art for new programmes since the A340-500/600.

Beyond the A330neo, the A330 programme is still investing and preparations are being made in order to cope with up-coming regulations and/or new Air Traffic Management rules, such as:

- An upgrade Multi-Mode Receiver (MMR) development was launched mid-2015, as an Airbus cross fleet activity. It will provide architecture compliant with US ADS-B Out mandate by 2018/2019, with growth capacity to evolve to SBAS Landing System (SLS) approach capability and multi GPS constellations management by 2020/2025.
- Development of FANS A+C ATSU was launched in April 2015, to prepare for European ATM airspace (SESAR) operations requirements in 2018 (see FAST#53).

In the long term, as with other Airbus aircraft, new avionics and cockpit developments are being considered. These will consist of a new systems architecture associated with the integration of equipment resulting in less weight and cost while offering new functions.

GLOSSARY

ADS-B Out Automatic Dependent Surveillance - Broadcast Out

ATSU - Air Traffic Service Unit

ATM - Air Traffic Management

FANS A+C - Future Air Navigation System A+C

SBAS - Satellite Based Augmentation System

SESAR - Single European Sky ATM Research





FlySmart with Airbus

The ultimate goal for Airbus' Electronic Flight Bag (EFB) called "FlySmart with Airbus" is to improve airline operational performance by bringing information to the cockpit and tremendously reducing the use of paper documentation. It also provides integrated solutions for efficiently managing that information in-flight and on-ground.

FlySmart with Airbus was started in 2007 with the implementation of an "aircraft attached" EFB (Class 3), with integrated cockpit displays proposed in a front mounted or side mounted configuration, and usable in all flight phase conditions.

For operators preferring portable and connected EFB (Class 2), Airbus will soon propose new options based upon Wi-Fi in the cockpit to connect the pilot's own electronic devices (laptop or tablets) to the aircraft.

By the end of 2015 a Single Docking Station (SDS) solution, embedding a laptop as a Wi-Fi access point will be made available.

The second half of 2016 will bring the EFB Interface Communication Unit (EICU). Like the SDS, the EICU will provide avionics data to EFB, but it will also provide in-flight and on-ground communication capabilities through Aircraft Communications Addressing and Reporting System (ACARS) and Internet Protocol (IP). Both SDS and EICU solutions are the bridge between avionics and pilot electronic devices and are common with Airbus' A320 Family offer.

Head-Up Display

Head-Up Display (HUD) has been available on Airbus aircraft since 2006 (see FAST#46). This visual guidance system has been shown to significantly increase pilots' situational awareness, facilitates Instrument Meteorological Conditions (IMC)/ Visual Meteorological Conditions (VMC) transition, enhances stability of manual approaches and allows minima reductions during take-off and landing.

The HUD shows trajectory related symbols superimposed on a transparent screen in the pilot's forward-field view. Service experience confirms that the HUD provides a very good means to stabilize the aircraft during the approach phase.

The fully digital processing of the HUD system and the dual installation in the cockpit is compatible with future technologies: Enhanced Vision System (EVS) and a Synthetic Vision System (SVS).

Dual HUD function already available on the A320 Family, A350 and A380 was launched for the A330 in 2013. The long range HUD standard will be based on the latest certified single-aisle standard and proposes the latest functionalities to keep the highest symbology and operations' commonality throughout Airbus' fleet. Certification is expected beginning of 2018 (see FAST#56).

Systems hardware

When developing a function, its retrofit capability is a key driver of the design, and generally* these lead to favoured software solutions or simple Line Replaceable Unit (LRU) upgrades. For most functions, once they are certified, the necessary systems provisions become basic in production, and activation of the function is performed by pin-programming, pending RFC/RMO selection.

One key enabler of autopilot/FMS based functions is the last hardware of Flight Management Guidance and Envelope Computer (FMGEC), known as "GENEPI" hardware. It is capable of supporting the two last FMS standards and elaborate auto-pilot based functions:

FMS Release 1A Standards

This FMS standard contributes to several new functions, such as RNP-AR, FLS, GLS, fuel alerts for extended ETOPS, and Take-off Data Securing function. It supports an increased Navigation Database, and high speed A615A software loading.

FMS Release 2 Standards

This FMS standard is the current long term solution from Honeywell and Thales for A320/A330, that supports a worldwide Navigation Database, and a new FM card set with improved throughput performances. The Honeywell card set is basic if selected (since mid-2014). Honeywell FMS will be available first (early 2016) supporting CDA function, then Thales FMS expected in 2018, which will support the i4D function.

Auto-pilot based functions such as AP/FD TCAS, ROPS, Soft go-around, TCAP, FLS, GLS, HUD.

*A notable exception to this was EIS1 CRT displays. Their limited growth capabilities prevented upgrade to the targeted function and enhanced EIS2 LED displays were the right candidates for replacement.

GLOSSARY

AP/FD TCAS Auto-Pilot/Flight-Director Traffic alert and Collision Avoidance System

CDA - Continuous Descent Approach

CRT - Cathode Ray Tube

EIS - Electronic Instrument System

ETOPS - Extended-range Twin-engine Operation Performance Standards

FGE - Flight Guidance and Envelope

FLS - FMS Landing System

FMGEC - Flight Management Guidance Envelope Computer

FMS - Flight Management System

GBAS - Ground Based Augmentation System

GLS - GBAS Landing System

i4D - initial 4-Dimensions

LED - Light Emitting Diodes

MRTT - Multi Role Tanker Transport

MTBF - Mean Time Between Failure

OBRM - On-Board Replaceable Module

RFC/RMO - Request for Change/Retrofit Modification Offer

RNP-AR - Required Navigation Performance - Authorisation Required

ROPS - Runway Overrun Prevention System

TCAP - TCAS Alert Prevention

Airbus Upgrade Services has developed with Thales and Honeywell an attractive retrofit offer to evolve former FMGEC hardware to the GENEPI configuration, allowing the implementation of the above functions within the A330 fleet by OBRM (FGE) or software loading (FMS) upgrade.

Less visible than the above mentioned solutions, A330 programme investment also takes the opportunity to improve hardware MTBF during redesign or by certifying a more recent solution from another programme, increasing reliability and commonality. These incremental developments plus regular monitoring of fleet status, has meant that A330 dispatch reliability is steady at around 99.2 % for the whole A330 enhanced fleet and around 99.4% (rolling) for the last sixty delivered aircraft.

Cockpit evolutions depicted above are compatible with all A330 enhanced Weight Variant, A330-200F (Freighter) and the MRTT (with potential adaptation).

Most of the new cockpit functions and hardware mentioned above are retrofittable across the A330 fleet.



Flight Operations Commonality (FOC)

Cost-saving and better training

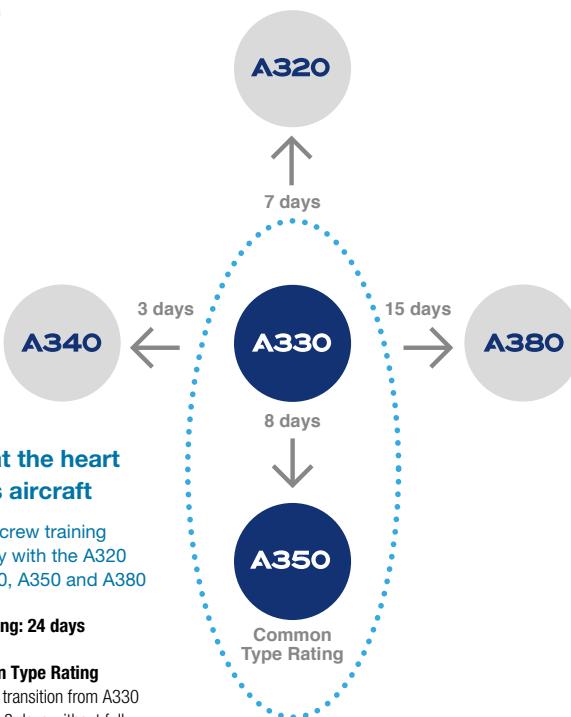
With the A330, Airbus' concept of a true aircraft family with a high level of commonality, comes into its own. Airbus operators may take advantage of shortened pilot training between Airbus aircraft types.

A pilot trained on one Airbus aircraft can control the flight path and handle the systems of any other aircraft with reduced training addressing differences called Cross Crew Qualification (CCQ).

Furthermore, Mixed Fleet Flying (MFF) allows an airline to operate multiple aircraft types requiring different licence endorsement by one pool of pilots.

A330 and A350 will benefit from Common Type Rating (CTR): A330 pilots can qualify on the A350 XWB in eight working days without full flight simulator time and then be able to fly both aircraft under a single license endorsement: Single Fleet Flying (SFF).

Training savings and productivity will be maximized with the possibility to practice A330/A350 and A340 (or A320 or A380) MFF, as MFF limits a pilot to two types of aircraft.



ID for the → Cabin

The A330 cabin – a business card for airlines and for Airbus

Since the A330 entered into service, air traffic has more than doubled. It has become a standard means of transportation and competition between operators grows while the number of alliances increases.

The cabin has become a business card for airlines, a major differentiator that influences the choice of passengers. This is why Airbus continuously invests to improve its cabins; retrofitting latest innovations as often as possible on all aircraft to ensure optimum passenger experience, while ensuring a smooth operation for the crew and reducing operating costs.

When an aircraft is developed for a life cycle of more than 30 years, the cabin life cycle significantly evolves. Around the year 2000 the cabin interior was to be renewed every 10 years, today outdated equipment is replaced every 5 years. This is a tendency that will continue.



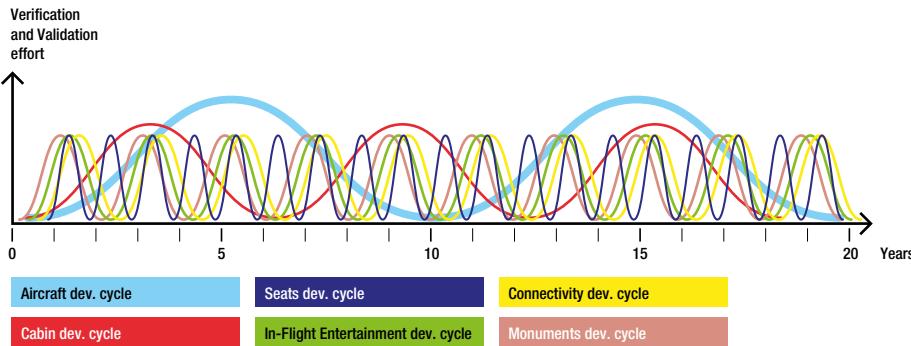
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Development cycles of the cabin and its systems



The A330 cabin evolves to follow trends in term of design, but moreover to benefit from state-of-the-art technologies that ensure passenger comfort and well-being while providing crew with a modern and efficient working environment. Airbus' cabin design office also delivers safety enhancements, reliability improvements and new design standards that contribute to airline cost saving.





Cabin seat rails

The A330 seat rails have been adapted to allow maximum flexibility for operators to meet changing market trends. They allow a wide variety of seating configurations from high comfort 4-abreast premium class to the most efficient higher-density 9-abreast configuration. Additional seat rails also allow nine abreast seating aft of door 3.

Wide seats

With a 222-inch width the A330 offers at least the standard 18-inch wide seat in economy class, now common to all Airbus aircraft, providing extra room compared to the previous 17-inch industry norm.

A modern, spacious and comfortable cabin

When boarding the latest A330 generation you discover a modern, spacious and comfortable cabin. This perception is given by the latest generation of sidewall panels. Brighter and lighter than the previous generation, they have also been improved to ease installation and reduce maintenance costs. They also optimize space and thermal comfort for outboard passengers.

Cabin mood lighting

Space and comfort perception is also reinforced by lighting. In the frame of the A330 enhanced cabin, airlines can choose from a variety of new mood light options. As LED lighting technology evolved, in place of the single colour fluorescence tubes, hybrid units carrying white fluorescence tubes were combined with coloured LEDs.

With the latest A330 242 tonne variant, a new full LED mood lighting inherited from the A350 XWB allows unlimited customization of colour and intensity.

Modernity in the details

To ease and simplify cabin operations the Passenger Supply Unit (PSU) underwent several redesigns with modern looking signage, LED reading lights, and pictograms were introduced wherever feasible.

The cabin is a fantastic vector of the airline brand image; this is why Airbus propose customizable window bezels and Gobo projections. A "Gobo" is a template in front of a lighting source, which controls the shape of the emitted light. It can be used to display special lighting effects such as airline logos or any other image and patterns on almost every surface in the cabin.



Spaceflex and Smart-Lav

The A330neo will adopt and adapt a rear lavatory and galley concept designed for the A320 Family. Called Space-Flex, this new system replaces full-width rear galleys with a smaller unit – along with two lavatories that were previously located left and right of the central aisle – making more efficient use of the aircraft's rear volume. This allows operators to install up to three additional revenue-generating seats or increase the area between seating rows for even higher levels of passenger comfort. Another concept adopted from A320 is Smart-Lav an optimized lavatory that offers more usable cabin length for A330 Family aircraft. The benefits of installing Smart-Lav depend on the operator and their chosen cabin configuration, but they can include improved seat pitch, more recline space for passengers, additional stowage capacity and in certain cases an operator can gain up to three to six seats, within the existing exit limitation.



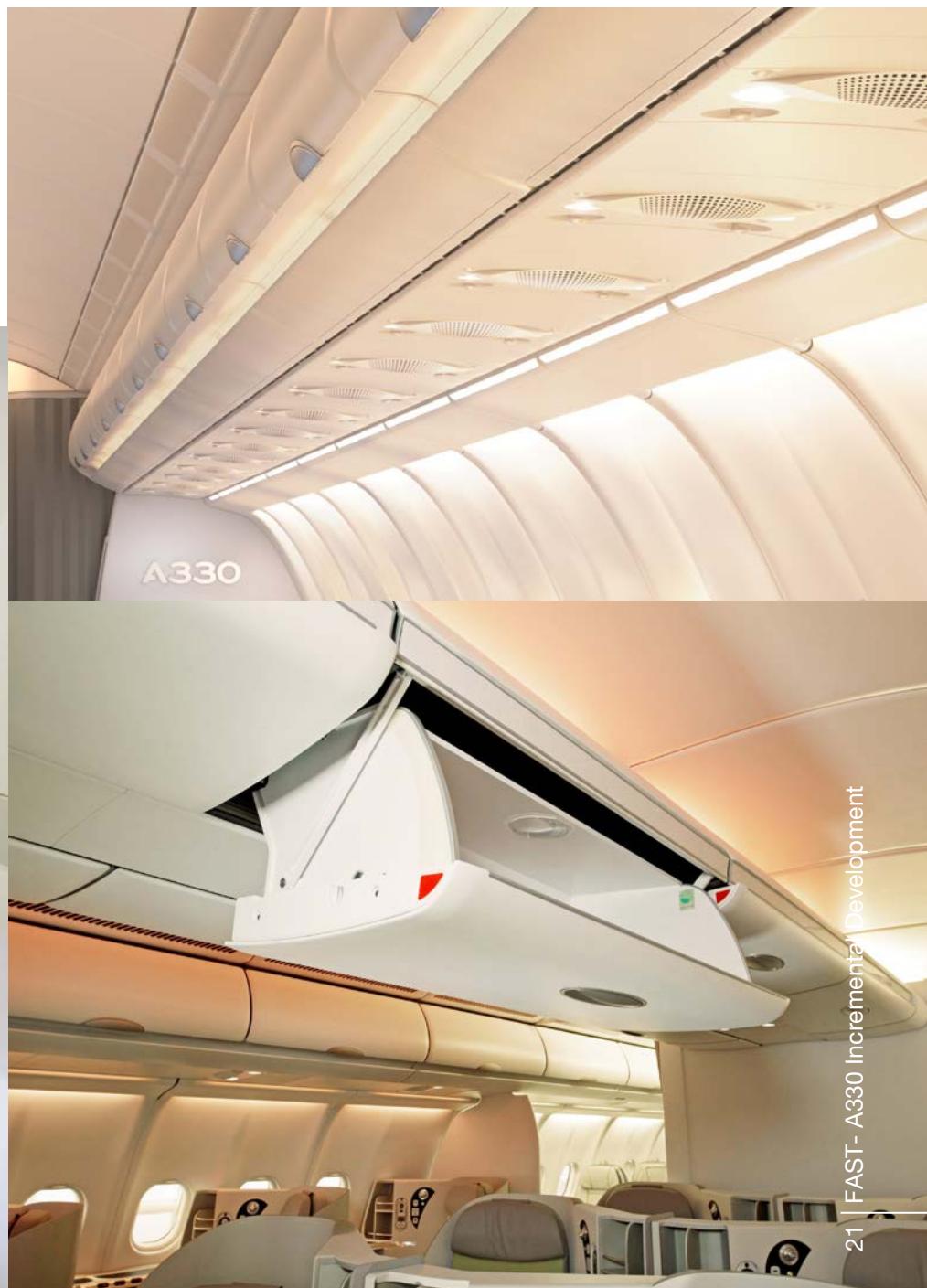
Cabin air systems

Derived from A340-500/600, an improved air management function has been certified on A330 242 tonne variant, ensuring an automatic adaptation of the Environmental Control System (ECS) pack flow depending on actual passenger numbers, while maintaining a constant ventilation rate and comfort in the cabin.

To increase passenger comfort and the airline's flexibility, new air condition temperature zones have also been introduced in the A330 enhanced cabin and were further improved with the 242 tonne variant. The cabin is divided into six individually controlled zones and air distribution is equal along the cabin.

Overhead stowage

The overhead stowage compartment (OHSC) has been enhanced with a new contour providing an increased OHSC volume to respond to latest carry-on luggage definitions. A330 cabins offer a choice of spacious fixed and articulated overhead bins designed to match the most popular "roller bag" sizes. Installation of stowage is adapted to airline needs and their resultant aircraft configuration.



Passenger experience

With the increase of non-stop long-haul flight capabilities of the A330, airlines are looking for higher passenger comfort in all classes and for sophisticated passenger infotainment (information, communication, audio & video entertainment) systems:

- In recent years First Class (F/C) seats have often been replaced by very complex mini-suites
- Business Class (B/C) seats are now very similar to former F/C seats
- In all classes the complexity of seat design has drastically increased with the integration of highly sophisticated infotainment systems

In-Flight Entertainment

To answer the demand for more individual In-Flight Entertainment (IFE) in all classes of the A330, Airbus introduced the 3rd generation IFE in 2007. Key features of which were:

- Full Digital Audio and Video on Demand (AVoD)
- Interface for personal electronic devices (power, audio/video re-direction to IFE, content download from IFE, etc.)

With the A330 242 tonne variant Airbus introduced the 4th generation IFE experience, originally developed for the A350 XWB.

Innovations in this latest generation include larger screens with full-HD capability, high bandwidth fibre optics, simplified installation, as well as weight and space saving. This last item means increased legroom, thanks to the reduced size and number of Seat Electronic Boxes (SEB).

A light IFE integration option is available for airlines adopting slim seats in their economy-class cabins. Providing the same features (individual AVoD, games, moving map) it is built on a seat centric technology where "Media Players" or "Tablet PCs" host and process content and applications locally. This can result in a weight reduction of over 300 kg. IFE maintenance costs are also reduced.

This new, lighter and simpler IFE platform was an enabler for an all-class Audio and Video on Demand. Airbus design drivers were performance, weight saving, and the family concept as well as downward compatibility for fleet wide retrofit.

Full connectivity

The A330 now offers full connectivity in line-fit. A330 operators are able to offer worldwide broadband connectivity services via internet and mobile telephony by using satellite communication. The Airbus platform, called Airline Network Architecture (ALNA) which was pioneered by the A330, is the first connectivity solution available as line fit on Airbus aircraft and can be retrofitted to all aircraft.

The scope of connectivity applications enables airlines to reach passengers personally in flight and to generate ancillary revenues. Thanks to its unique communication management, it also serves airline administrative and operational communications, as illustrated by crew mail, digital cabin logbook, documentation viewer, telemedicine, credit card authentication, on-board rescheduling of traveller flight connections, with more applications to be accessible wirelessly from cabin crew devices in the near future.

Of course the latest A330 cabin upgrade will also be prepared to accommodate the latest developments of connectivity system. The connectivity platform will be ready to support wireless content streaming to passenger owned devices and future broadband satellite communication technologies (e.g. KA-band). Furthermore the platform shall be open for 3rd party use (e.g. Panasonic) and ease installations and interfaces (e.g. new ARINC standards).

Step-by-step
the A330 Family
stays at the forefront
of technological
advancement,
shaping the future
of wide-body
aviation



Crew efficiency and well-being at work

Easy handling galleys

Continuous extension of flight duration has resulted in the need for more catering capacity, with more efficient cooling systems and a variety of electrical appliances (several types of oven, water boilers, coffee makers, waste disposal system, etc.).

Wet and dry galleys are located to provide optimum space for passengers and maximum space for cabin staff. They can be installed within the flexibility zones.

Airlines choose the equipment to be integrated into the galley frame according to their needs. The development of easy handling galleys, has allowed the A330 to continue to offer a "cabin crew friendly environment".

Galley Waste Disposal Unit

To ease cabin crew operation and improve galley maintenance, Airbus introduced the Galley Waste Disposal Unit (GWDU).

Previously food waste such as noodles, rice, coffee grounds and filters in the galley working area had to be disposed of in the toilet units. Cabin crew also often misused the normal galley sink which led to clogging of drain lines and 'black-brown' coloured marks on the aircraft fuselage aft of the drain mast.

These recurring and costly problems have been eliminated by using the GWDU which uses the existing vacuum system to safely dispose of soft galley food and liquid waste into existing waste tanks.

An improved galley floor attachment now protects seat tracks in the "wet areas" and this has played a major role in extending the A330's maintenance intervals.

Galley Waste Disposal Unit
photo courtesy of Zodiac



New galley inserts

The Electrical Galley Inserts named Multi Functional Unit (MFU) that have been developed for the A350 have been certified for use on A330. A330 Family operators can now benefit from galley commonality with their A350s or simply profit from weight and energy saving improvements.

The MFU provides flexible, improved meal preparation service, especially for the increasing expectations of Business and First Class passengers without impact on space or weight compared to traditional catering equipment.



Cabin Intercommunication Data System (CIDS)

The Cabin Intercommunication Data System (CIDS) operates, controls and monitors the main cabin systems and can perform system and unit tests.

The CIDS is designed to interface between cabin crew, cockpit crew and passengers. It also manages maintenance related functions such as central cab maintenance service, system programming features, configuration data loading and the service inter phone.

In 2000, for the A330 enhanced cabin, the software was entirely updated and the hardware was changed to include new touch screen technologies for the Flight Attendant Panel (FAP). New functionalities derived from the A340-600 were introduced, in the spirit of the Airbus aircraft family approach.

A new CIDS, inspired by that of the A350 XWB with a new Human-Machine-Interface (HMI) that includes enhanced functionalities such as LED light control and individual lavatory music, will be proposed.



CONCLUSION

The cabin and the cabin crew facilities are areas which have an immediate impact and are easily appreciable by customers. As such they are under constant review, have frequent development cycles, and quickly adopt proven solutions from other programmes.

With the latest A330 242 tonne variant having just been delivered to its first customers, the next A330 upgrade is under development - the A330neo.

For this new, highly efficient aircraft, the cabin will hugely contribute to reducing airlines' Direct Operating Cost (DOC) while providing up to 10 more seats with the same level of comfort.

Airbus is investing to ensure that the A330neo cabin has the flexibility to incorporate state-of-the-art technologies. With the passenger at heart and the airline in mind, we continuously develop the A330 cabin to be modern, proven and comfortable while offering the highest possible cost-efficiency.

Crew rest areas

Safe and comfortable travel is only possible if the crew is well rested and focused. For this purpose, Airbus offers two kinds of crew rest compartment aboard the A330:

- The Flight Crew Rest Compartment (FCRC) located between the cabin and the flight deck for easy and quick access.
- The Lower Deck Mobile Crew Rest (LDMCR) compartment located on the lower deck, in the aft cargo compartment. The spacious A330 lower deck mobile cabin crew rest offers up to eight comfortable bunks, separated from the main deck. It is mounted on a 96 inch pallet on the lower deck, accessible from the cabin by stairs, and can be removed in 50 minutes.



ID for the →Freighter

The A330-200F: a versatile, reliable and profitable freighter for every market



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Derived from the A330 passenger aircraft, the A330-200F is a new-generation freighter designed to meet operators' needs in the mid-size, long-haul segment. As a highly versatile aircraft the A330-200F is capable of serving the freight lift needs of diverse markets: it accommodates all industry-standard unit load devices, but also has the optimal design for carrying a large variety of special cargo, including live animals, flowers and perishables, as well as outsize goods. The operational reliability of the aircraft reaches 99.4%.

The A330-200F is capable of carrying 65 to 70 tonnes of payload, with a range that stretches from 3,200 nm up to 4,000 nm. At 70 tonnes, the A330-200F provides up to 35% lower operating costs per tonne compared to larger freighters.

Launched in January 2007 and certified in April 2010, the A330-200F freighter definition was based on a sound market survey and strong cooperation with customer focus groups. Since its launch the A330-200F has benefited from the continuous improvements brought to the A330 programme.



Added value through the Dynamic Mode

The freighter was developed from the A330-200 passenger variant and benefits from A330-300 higher design weights. The Maximum Zero Fuel Weight (MZFW) was improved for higher payload capability. Through these specific design weights the A330-200F can carry up to 70 tonnes of payload over 3,200 nm which is in line with general cargo market requirements.

The A330-200F was originally launched in two weight variants: Range Mode with 65t max structural payload and Payload Mode with 70t of max structural payload. These were later complemented by the Dynamic Mode based on a linear trade-off between a variable MZFW of 173-178t and the Maximum Take-Off Weight (MTOW). The Dynamic Mode translates into a variable structural payload of 65-70t, hence providing operators with improved flexibility in payload optimization. It also increases the payload capability of the aircraft by up to 2.5t on routes between 3,200 and 4,000 nm.

	A330-200F Range Mode	A330-200F Payload Mode	A330-200F Dynamic Mode
MTOW	233 tonnes	227 tonnes	233 tonnes
MLW	182 tonnes	187 tonnes	187 tonnes
MZFW	173 tonnes	178 tonnes	173 to 178 tonnes

MTOW = Maximum Take-Off Weight MLW = Maximum Landing Weight MZFW = Maximum Zero Fuel Weight

On-ground slope and cargo loading

A particular challenge to overcome was how to cope with the passenger aircraft's natural slope of 1.5° nose down and its unfavourable impact on manual cargo loading.

Easy manual loading was a crucial design criterion as the aircraft was intended to carry heavier cargo than previous Airbus freighters.

Tests confirmed that pushing heavy cargo units on such a slope requires significantly more effort and loading staff compared to an aircraft with a level floor.

A solution would have been to equip the freighter with a powered main deck cargo loading system, but the resulting added weight (around 650 kg), the increased maintenance costs and the additional fuel burn were not acceptable by the majority of operators.

The development team reviewed 13 technical solutions to bring the aircraft's on-ground slope close to zero degrees including lengthened nose gear, shortened main landing gear and external lifting devices.

The solution that was finally selected was to keep the same nose landing gear and lower it by 370 mm. The specific design of the lowered landing gear bay and nose fairing gave the freighter a unique touch and had a negligible impact on drag and fuel burn.

The nose landing gear was lowered by 370 mm, reducing the on-ground slope close to 0°



Loadability and loading flexibility

Transforming a passenger aircraft into a freighter lowers its empty weight (due to the removal of the cabin and cabin systems) but also moves the Centre of Gravity (CG) further forward as the courier area, barrier wall and cargo door are installed in the forward section, whereas heavy items like pax waste tanks and galleys are removed at the back end of the aircraft. This moves the resulting freighter aircraft's CG closer to its forward certified limits.

To provide appropriate loading flexibility the forward CG limits were extended and the fuel vector was changed.

In addition shear and bending limits were improved through structural reinforcements to cope with freighter specific loading and mass distribution.

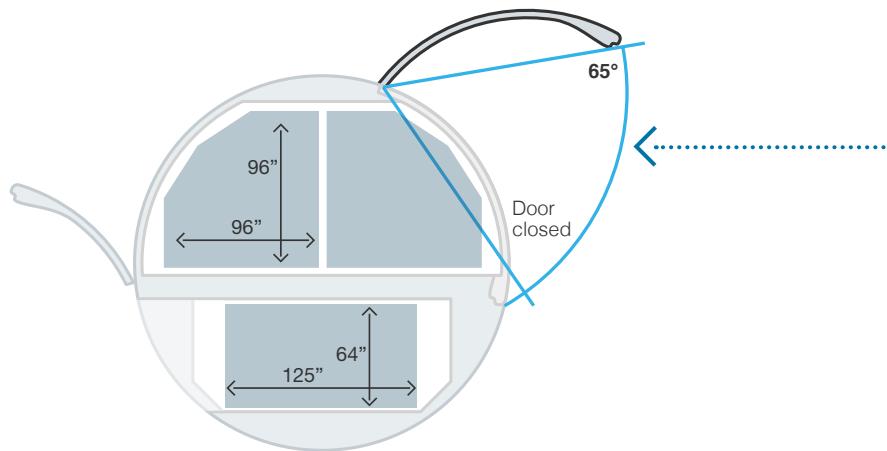
The aircraft loadability verification and optimisation was done through a loadability study simulating up to 100,000 random loading cases in different loading configurations and with different weight distributions and cargo densities.

The loadability study confirmed an excellent success rate in the various loading configurations, easing operators' load planning and providing maximal operational flexibility.

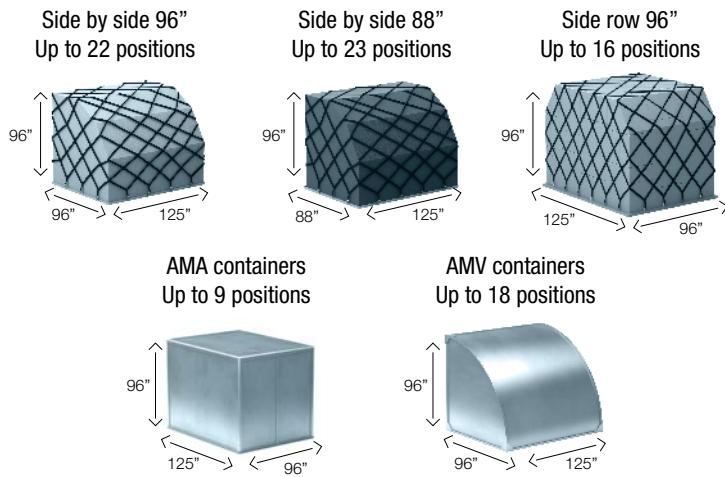
Cargo loading configurations

The main deck cargo loading configurations, cargo loading system and floor structure design was based on the proven principle of the in-service A300-600F. However with its longer fuselage the A330-200F can provide several more pallet positions.

Versatility and loading flexibility are achieved through a multiple choice all-in-one cargo loading system. The robust floor and system concept allows the operator to mix pallets or container configurations using side-by-side, single row lengthwise or crosswise latching positions.



Main deck cargo configurations



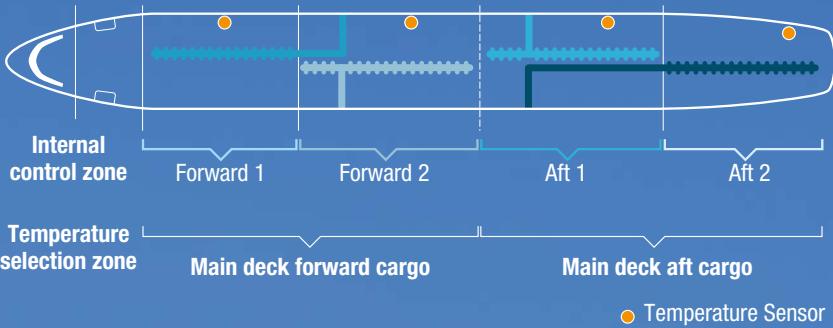
Lower deck cargo configurations



Main deck cargo door simplified for general freighter operations

Based on the A300-600F design and operators' feedback experience, the A330-200F main deck door was simplified to a single stage 65° operation. The new simplified actuation system reduces the cargo door weight.

Also the latching and locking systems have been optimized for better performance in cold weather conditions.



A330-200 Freighter stays cool...

With the development of the A330-200F, Airbus, for the first time, offered a baseline two-zone main deck cargo compartment Environmental Control System (ECS) that allows selecting temperatures from 5 to 25°C for each zone independently.

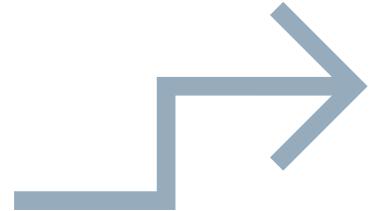
Temperatures on the lower end of this range are required for the transportation of perishable goods such as cut flowers, fruit and vegetables, whereas a lot of live animals travel best at temperatures around 20°C.

Combined with the lower deck forward cargo hold ventilation and temperature control system, the main deck cargo ECS provides the operator with full flexibility to control transport conditions to the optimum.

Besides the aspect of providing adequate temperatures as required for special cargo transportation, it is also important to assure sufficient ventilation to control the level of humidity in the cargo holds and to evacuate gaseous substances i.e. carbon-dioxide that develops from sublimation in case of dry ice carriage for cooling purpose.

On A330-200F with NORM flow selected, the empty main deck cargo hold's 466 m³ of air will be exchanged every four minutes, while minimizing the risk of drafts through an optimized piccolo duct air-distribution system.





Maximising container volume: AMV container

In order to exploit the benefits of the wide cross section of the main deck cargo hold, Airbus looked for a container solution that can be offered to operators who would like to combine maximum available volume with the loading comfort of a container.

Nordisk Aviation Products developed in partnership with Airbus a container (IATA 3 digit code AMV) that features a contour adapted to the cross section of A330-200F main deck. Volume-wise, the side-by-side loaded AMV is the optimum fit for the main deck cargo hold of A330-200F as well as A300/A310 freighters.

Incrementally
increasing
the freighter's
unmatched
flexibility

"Moving the big stuff": 16/20 ft pallet loading capability

Thanks to the wide cross section and large cargo door of the A330-200F, optional provisions can be installed on the main deck that accept heavy duty 16 and 20 ft pallets, to carry cargo such as vehicles, aircraft engines, machinery parts, etc.



Freighter courier area

The objective of a freighter aircraft is to carry a maximum of cargo but operators often also need to transport additional persons such as off-duty flight crews, cargo loading personnel and animal attendants to provide in-flight care (e.g. for horses). This is why Airbus proposed a customizable courier area concept. Located between the cockpit and the main deck cargo compartment, the courier area can be configured for business seat comfort or economy seating in high density layouts for up to 12 occupants.

Airbus also developed a specific rigid barrier wall that also separates and protects cockpit and courier area from load impacts, noise and cold temperatures.



CONCLUSION

The development of the A330-200F represents a significant step in building the A330 Family.

Based on the proven A330 passenger platform, the A330-200F has an optimized design to match the needs of cargo operations.

As a highly versatile freighter the A330-200F can carry a wide variety of different types of cargo.

In-line with Airbus' policy of commonality the A330-200F has and will be incrementally developed to accept proven technologies from other Airbus programmes, to remain the world's cutting-edge cargo aircraft.

ID for Maintenance

The original A330 was designed to minimize maintenance costs, for example:

- Centralized Maintenance System (CMS) for efficient trouble-shooting and real time monitoring allows continuous fault monitoring and automatic fault reporting. It also facilitates identification of failed components and minimizes unjustified removals. The CMS includes the printable Post Flight Report (PFR) which aids efficient and simple troubleshooting.
- Modern technology is implemented wherever possible in order to reliably reduce scheduled tasks, man-hours and complexity. A typical example is the Fly-by-Wire which is simpler and lighter than a conventional control system with approximately 50% less maintenance required.
- Multi-function Line Replaceable Units (LRU) associated to high component reliability also contribute to minimizing maintenance costs.
- Advanced materials (new alloys and composites) and production techniques improve resistance to fatigue.



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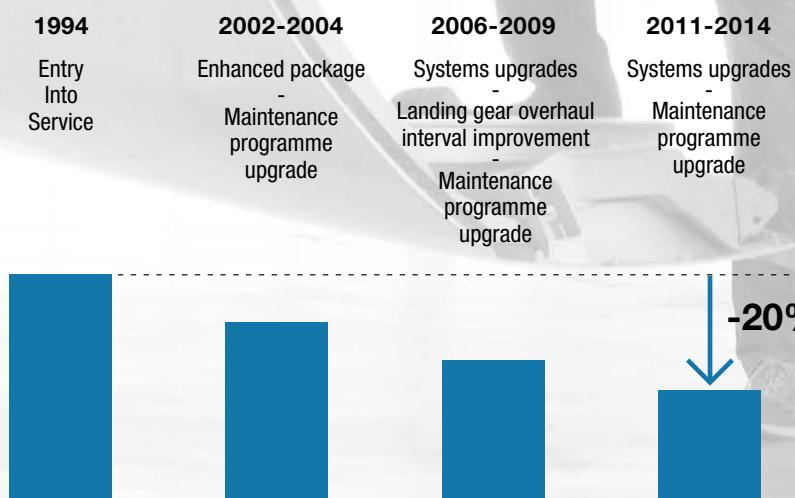
A330/A340 Technical Management
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The A330 benefits from continuous improvements that bring the latest technology aboard, making it a highly attractive aircraft for airlines and their passengers.

A major example was the 'enhanced' aircraft in 2004, which benefited from technology developed for the A340-500 & 600 aircraft, in addition to systems and upgrades reflecting the latest technology.

Thanks to its robustness and its proven reliability, maintenance programme intervals have been continuously lengthened based on experience since the A330's service entry, bringing significant maintenance cost reductions.

A330 Airframe Direct Maintenance Cost reduction since entry into service



Enhanced packages

The first enhanced A330s were delivered in 2004, with an upgraded flight deck, fly-by-wire rudder, new cabin design and a variety of structural and system improvements.

The main goals were to:

- Benefit from new technology
- Increase system reliability
- Improve component integration to reduce spares inventory
- Significantly reduce the maintenance costs

The enhanced modifications also benefited the maintenance programme leading to a reduction in complexity and in the number of tasks compared to previous versions.

Enhanced design for low maintenance costs

• Fly-by-wire rudder

- Replaces the former mechanical back-up
- Reduced complexity, lower maintenance cost

• LED Lights

- LED technology lights replace bulb lights
- Increased reliability

• Component integration

- Integrated standby system
- Electrical power control unit, etc.

• Smoke detection

- Second generation optical smoke detectors
- Lower repair costs, cheaper, more reliable

• LCD displays

- High reliability
- Less unscheduled maintenance

• Enhanced Cabin Intercommunication Data System (CIDS)

- New touch screen LCD Flight Attendant Panel
- Easy troubleshooting of cabin related systems

• Cargo panels

- More than 100% resistance improvement
- Less unscheduled maintenance (manhours) and lower material costs

• Redesign structural areas

- Improve fatigue resistance and damage tolerance
- Reinforced fuselage sections and frames

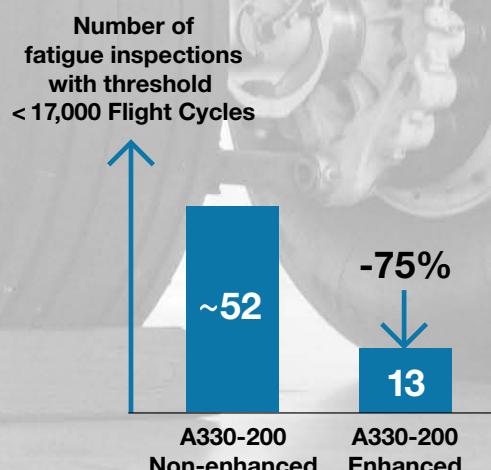
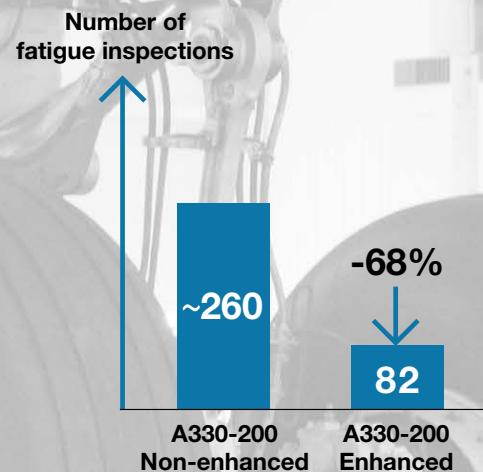
Systems upgrades

Systems upgrades have been incrementally introduced in the A330 fleet when newer technologies demonstrate an economic benefit. In particular, more integrated avionics components have led to higher reliability and reduction in spares inventory.

As an example the so-called T3CAS (Traffic Collision Avoidance System), integrates three systems, TCAS, ATC2 (Air Traffic Control Mode S) transponder and TAWS (Terrain Awareness and Warning System) in a single box, thus reducing weight, spares count and maintenance costs.

Another example of a systems upgrade is the Enhanced Electronic Instrument System (EEIS):

- New LCD module with LED backlighting
- New electronic board with higher reliability
- One Part Number (P/N) instead of two
- Current and enhanced display units are interchangeable and mixable
- Common to A320 and A330/A340



Engine improvement package

The manufacturers of all three jet engines offered on the A330 have introduced enhancements that lower the amount of fuel burned and reduce maintenance costs.



CF6-80E1 Tech CF6

- EIS: Q1 2008
- High Pressure Turbine upgrades with mature technology to improve fuel burn retention and durability
- No modifications to nacelle, pylon and wing
- Interchangeable with non-Tech CF6 engines
- Maintenance cost improvement: $\approx 5\%$



PW4000 Advantage 70

- EIS: Q2 2009
- Hardware changes to enhance performance and durability
- No modifications to nacelle, pylon and wing
- Interchangeable with non-Advantage 70 engines
- Maintenance cost improvement: $\approx 5\%$

Maintenance checks

A330 Maintenance Planning Document (MPD) check interval evolution

A330 Entry Into Service		A330 intervals (2008 -2009)	A330 Current intervals	Maintenance Review Board Report	A330 Future intervals
A-check	400 Flight Hours	600 Flight Hours	800 Flight Hours		800 Flight Hours*** 2000 Flight Hours** / 6 months**
C-check	15 months	18 months	24 months		24 months
2C-check	30 months	36 months	42 months	Future	48 months*
Intermediate check	5 years	6 years	6 years		6 years
Structures check	10 years	10 years	12 years		12 years

* Objective: one year before the first A330neo reaches its first 2C-check

** Applicable to A330neo redesign parts

*** Room for escalation

Maintenance programme upgrades

Airbus has regularly used A330 fleet experience (more than 1,200 aircraft in service) to optimize the A330 maintenance programme, leading to:

- Increased check intervals
- Reduced maintenance costs
- Higher aircraft availability





Trent 700 Enhancement Package (EP)

- EIS: Q1 2009
- Hardware changes to enhance performance
- No modifications to nacelle, pylon and wing
- Interchangeable with non-EP engines



CONCLUSION

The A330 is a mature and proven aircraft that has benefited from incremental development for over 20 years. From a maintenance perspective it benefits from an immense pool of data that has allowed Airbus to refine the aircraft for specific use (domestic to long-haul) and tailor the required maintenance accordingly.

Airbus is committed to continuously improve the A330 Family which benefits from the latest proven technology and has great potential for further developments.

ID for → Upgrades & retrofits



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As we have shown throughout this special edition of FAST magazine, new developments for the A330 have been incrementally included as standard over the last 20 years. Upgrades & retrofits are by definition the incremental development of aircraft already delivered.

Airbus Upgrade Services offer solutions aligned with new aircraft configurations which means that the customer is assured of a solution which meets their immediate need, but also best prepares them for any future growth potential. The vast majority of innovations driven by the A330 programme are suitable for retrofit across all or sometimes a portion of the In Service Fleet thus enabling harmonisation and the spreading of benefits. The drivers for retrofit are varied. The needs for avionics upgrade on older aircraft are often associated with the need to achieve new functions capability. Once embodied, the new standards are often more able to support other functions which can aid in justifying the investment. The need to ensure efficient operations in a changing Air Traffic Management environment means that some ATM related upgrades are mandatory by retrofit, dependent on the region of operation, e.g. ADS-B Out is already mandated in some regional airspace and will be mandated in Europe and the US in 2020 for retrofit.

The business case for retrofit is an important driver, particularly where operational performance, costs reduction and revenue generation are affected. Examples are MTOW, RNP-AR, ETOPS and even cabin reconfigurations.

In summary, wherever possible new developments are designed with retrofit ease in mind ensuring competitiveness of our aircraft in a changing and increasingly challenging environment.



Airbus Upgrade Services

Retrofit-ability is always an important consideration during the design of new solutions. This policy is very important and it means that aircraft can remain competitive for life, not just at aircraft delivery. The competitive aspect is important as the aviation world is truly dynamic. An investment in the aircraft may also be justified by operational optimisation, increase in the potential for revenue generation and enhancement of aircraft marketability and value.

To achieve a certain aircraft capability, some pre-requisites may be required for areas such as avionics or perhaps structural or electrical provisions. The level to which an aircraft is affected will depend on the configuration and often the age of the aircraft. For this reason a specific check is performed on each MSN as part of our response to an upgrade request. Once the retrofit proposal is accepted, the core activity of upgrades is delivery of the associated Service Bulletins and kits.

Since the entry into service of the A330, air traffic demands have changed dramatically, but so has the technology available and the commercial environment for the airline. Some aircraft capabilities or functions which may enhance "Communication, Navigation or Surveillance" may be retrofitted to meet the ATM related mandates imposed by local or regional authorities. Often the mandates are deemed necessary to ensure that all aircraft in the airspace are capable of operating to the required standard for the benefit of the overall aviation community. Examples may include the current drive for efficient communications as noted for ADS-B out and FANS.

GLOSSARY

ADS-B Out	- Automatic Dependent Surveillance-Broadcast Out
ATM	- Air Traffic Management
DMC	- Direct Maintenance Cost
ETOPS	- Extended-range Twin-engine Operation Performance Standards
IFE	- In Flight Entertainment
FANS	- Future Air Navigation System
MSN	- Manufacturer Serial Number
MTOW	- Maximum Take-Off Weight
RNP-AR	- Required Navigation Performance - Authorisation Required

Performance related upgrades:

- Payload and range - Take-Off Weight variants refined according to the operating scenario
- ETOPS - new efficiency on specific routes saving time and fuel
- RNP-AR - can enable efficient landing and take-off and ensure access at airports in challenging terrain
- Data Link and SATCOM upgrades – Efficient communications
- Reduced DMCs through use of new technology and increased reliability
- Fuel savings using light modern material and technology with the benefit of reduced emissions

Cabin and cargo - the revenue generators

In pure commercial terms it is primarily the cabin or cargo which provides the opportunity to generate revenues from the aircraft. The choice of cabin configuration chosen for entry into service on a new aircraft is normally judged to be the best at the time of delivery. However, it is unlikely to be the best cabin forever. The market will change and technology makes new cabin concepts available in terms of comfort, In-Flight Entertainment (IFE), seat design and space optimisation.

As well as the need for general cabin refurbishment every five to seven years, technology advances offer opportunities to modernise important aspects of the cabin which affect ambience and passenger appeal. Examples include mood lighting (see page 20), larger overhead stowage bins, modern connectivity and IFE which is increasingly an expectation.

The business model of specific airlines means that brand differentiation is important. Cabin ambiance and configuration affects the revenue generated. Adjustments are required to ensure the best potential for revenues in a specific market.

Through upgrades First Class, Business Class, Premium Economy or Economy can be refined to match the evolving demand.



To find out more about the multitude of performance and revenue generating upgrades or retrofits that the A330 can benefit from please contact:
upgrade.services@airbus.com
 for more information.

FAST

from the PAST

There wouldn't be any future without the experience of the past.

A long-haul career for an A330 pioneer



After 40 years at Airbus, Gerard ZUBER retired in September 2015; we reflect on his last 25 years presiding over the A330/340 Family.

As a qualified engineer starting at the Nantes facility (France), he gained manufacturing engineering and planning experience working at almost every French Airbus facility. In 1990, the long-range programme was starting up which brought Gerard to Toulouse, where he later became head of industrial activities overseeing the first A340 delivered to Lufthansa in January 1993 and the first A330 to Air Inter in December 1993.

In 2000 he became long-range programme manager for France, and took responsibility for Europe in 2005. This position put Gerard in charge of 150 people working in planning, configuration management, supply and industrial performance management activities. His team's international and multifunctional operational scope was central to supporting rate increases on the programme. Gerard's vision and ability to anticipate the market also played an important role in guiding the A330 Family's diversification strategy, which has seen the launch of the A330 freighter and MRTT, as well as the 242-tonne and regional versions over the last five years.

During his time as A330 Family programme manager, Gerard worked closely with Patrick PIEDRAFITA, now head of the A350 XWB programme. Speaking at Gerard's leaving do, Patrick congratulated him for pioneering the introduction of programme management at Airbus, as well as managing a production ramp-up to ten A330 Family aircraft a month. *"As an architect of the programme function you worked on making Airbus more integrated, with the unanimous support of everyone in the company, something that is a rare achievement,"* he said. *"You have always taken the time to share your values, passion and knowledge with both the A330 Family team and with Airbus as a whole, and many of us have benefited from this."*

Gerard describes himself as 'the memory of the long-range'. *"I have seen the A330 developed and 1,700 A330s and A340s including freighters and MRTTs delivered,"* he says. And while he will not be there for the first A330neo delivery, he will be there for its first flight.

Gerard credits his time on the A330 Family as having allowed him to translate his passion for aircraft into concrete achievements as well as being a personal satisfaction. *"After 25 years the story is not finished,"* he adds. *"to be successful, you must continually prepare for the future."*

The future of A330

"The success and the appeal of the A330 have always been its ability to adapt to different markets. This flexibility has largely been due to embracing Incremental Development. Step-by-step continuous improvement that will soon see the introduction over the next 15 years of developments such as a new cockpit design, hybrid laminar flow, riblets, as well as the huge potential for weight saving and efficiency that new structure technologies are making possible."

Due to its performance and positioning in terms of range and capacity, further Incremental Development is being planned through the Product Evolution Plan on A330neo, the A330 Family is here to stay for many years as a leader in its market".

Enjoy your retirement Gerard, the A330's future is assured!

We've got it covered

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