Seven new widebody aircraft from three different families are currently in development. The features designed to lower operating and maintenance costs, and improve the passenger experience, are examined here.

New widebody programmes assessment: 787-9/-10, 777X & the A350 family

The constant pressure from ever-increasing operating costs is driving airlines to demand more efficient aircraft. Seven new widebody types from three different aircraft families are currently in development: the 787-9/-10, the A350-800/-900/-1000 and the 777-8X/-9X.

The main requirements for new widebody airliners include lower fuel burn performance, and improved maintenance efficiencies, as well as new flightdeck and cabin connectivity options, and increased cabin comfort.

The technologies used to meet these requirements are assessed here for the 787, A350 and 777X aircraft under development.

787-9/-10

The 787 family is the only new widebody programme with an aircraft already in service. The first 787-8 was delivered to All Nippon Airways in 2011.

Of the three new widebody programmes under discussion, only the 787 family offers a choice of engines: the Rolls-Royce (RR) Trent 1000 or General Electric (GE) GEnx-1B.

The first 787-9 will be delivered in 2014. The 787-9 is slightly larger than the 787-8, and will have 250-290 seats. In a typical three-class layout, the 787-9 could accommodate about 280 seats *(see table, page 6)*. The 787-9 will have a maximum take-off weight (MTOW) of 553,000lbs and be capable of flying a full passenger payload 8,000-8,500 nautical miles (nm).

The first 787-10 will be delivered in 2018. More recently launched, it is a stretch of the 787-8/-9. The 787-10 will have more seats, but will have a shorter range. It will have 300-330 seats, or 323 in a typical three-class layout *(see table, page 6)*. This is about 25-30 seats more than the 777-200ER. The 787-10 will have the same MTOW as the -9, but a higher maximum zero fuel weight (MZFW) of 425,000lbs. This will allow the -10 to fly a full passenger payload up to 7,000nm.

A350 XWB

The A350 XWB family includes the A350-800, -900 and -1000. The only engine option for the A350 is the RR Trent XWB.

The A350-900 will be the first family member to enter service in 2014. It will have 315 seats in a typical two-class layout *(see table, page 6)*. The A350-900 will have an MTOW of 592,900lbs and a range of about 7,750nm with a full passenger payload.

Airbus claims that the A350-900 will have 7.5% lower fuel burn per seat than the 787-9, and 25% lower burn per seat than the 777-200ER.

The A350-800 will be the shortest A350 variant. The A350-800 is due to enter service in 2016. It will accommodate 276 passengers in a typical two-class layout *(see table, page 6)*. The A350-800 will have an MTOW of 546,700lbs and a range of about 8,250nm with a full passenger payload.

Airbus believes that the A350-800 will demonstrate fuel burn savings of 8% per seat compared to the 787-8.

The A350-1000 will be the largest A350 family member, and is due to enter service in 2017. It will accommodate 369 passengers in a typical two-class layout *(see table, page 6)*. The A350-1000 will have an MTOW of 681,000lbs and a range of 8,000nm with a full passenger payload.

Airbus claims that the A350-1000 will offer fuel burn savings of 25% per seat compared to the 777-300ER.

777X

The 777X programme was officially launched in 2013. The family will include the 777-8X and the -9X. According to Boeing's website, the aim is for the first 777X delivery in 2020.

There is currently little information available about the programme, and it is unclear whether the -8X or the -9X will be the first into production.

The 777-8X will be able to seat 350 passengers up to a range of 9,300nm *(see table, page 6)*, but it is not clear if this is a two- or tri-class configuration. This is similar to the 777-300ER's tri-class seat capacity.

The larger 777-9X will accommodate about 400 passengers, although again the configuration is unclear. The seat numbers are close to a 747-400's seat capacity. It will have a range of 8,200nm with a full payload *(see table, page 6)*.

The only engine option for the 777X family will be the GE GE9X.

Boeing claims that the 777X family will have 12% lower fuel consumption and 10% lower operating costs than the closest competition. It is not clear, however, which aircraft are regarded as the closest competition.

Competition

Airbus sees the A350-800 as competing most directly with the 767 and 787-8.

It believes that the A350-900's closest competition is the 777-200/-200ER and 787-9. The A350-900 is also a replacement candidate for A340-300.

The A350-1000 will compete with the 777-300ER and 777-8X, and is also a replacement option for the A340-600.

787-9/-10, 777X & A350 SPECIFICATIONS

	787-9	787-10	777-8X	777-9X	A350-800	A350-900	A350-1000
Typical Seating	280	323	350	400	276	315	369
Economy Layout	(3+3+3)	(3+3+3)			(3+3+3)	(3+3+3)	(3+3+3)
Cargo Volume (cu ft)	5,450	6,187			4,824	6,088	7,352
Engine Type	Trent 1000/GEnx-1B	Trent 1000/GEnx-1B	GE9X	GE9X	Trent XWB	Trent XWB	Trent XWB
Engine Thrust (lbs)					79,000	84,000	97,000
Fan Diameter (inches)	Trent 1000 = 112 GEnx-1B = 111	Trent 1000 = 112 GEnx-1B = 111	133.5	133.5	118	118	118
Bypass Ratio	Trent 1000 = 10:1 GEnx-1B = 9.7:1	Trent 1000 = 10:1 GEnx-1B = 9.7:1	10.2:1	10.2:1	9.5:1	9.5:1	9.5:1
MTOW (lbs)	553,000	553,000			546,700 (571,000)	592,900	681,000
MLW (lbs)	425,000	445,000			418,900 (425,500)	451,900	513,700
MZFW (lbs)	400,000	425,000			392,400 (399,000)	423,300	485,000
Range (nm)	8,000 - 8,500	7,000	9,300	8,200	8,250	7,750	8,000
Fuel capacity (USG)	33,384	33,384			36,456	36,456	41,211
Cruise Speed (Mach)	0.85	0.85			0.85	0.85	0.85
On Board MTCE system	Yes	Yes			Yes	Yes	Yes
EFB as standard	Class 3	Class 3			Class 2 plus	Class 2 plus	Class 2 plus
Fuel Burn Savings (% per seat)					8%	7.5%/25%	25%
compared to					787-8	787-9/777-200ER	777-300ER
NOx Margin to CAEP 6					40%	35%	25%
Noise Margin to Stage IV (EPNdB)					16	13.7	10
CO_2 Savings (% per seat)					8%	7.5%/25%	25%
compared to					787-8	787-9/777-200ER	777-300ER
Entry into Service	2014	2018			2016	2014	2017

Notes:
1). Typical seating figures are based on three-class layout in 787 and two-class layout in A350. 777x figures based on unknown layout.
2). Weight figures for A350-800 are basic operating figures with max potential weights in brackets.

Efficiency improvements

New technologies have been applied to a number of key areas, such as airframe design, engines and flightdeck commonality, in the next generation widebody designs in order to reduce fuel burn and improve operational efficiency.

Airframe design

Weight and aerodynamics are two important airframe design issues for reducing fuel burn.

There is a trend for new commercial aircraft designs to feature more composite materials in the airframe. These can be strong but lighter in weight than traditional aircraft manufacturing materials, such as aluminium. This helps to reduce weight and, consequently, fuel burn. Other benefits include reduced maintenance costs.

The use of carbon fibre allows modern construction techniques where the fuselage is composed of fewer, larger sections. This can also save weight by reducing the number of joints and rivets required.

Composite materials make up 50% of the weight of a 787 compared to 12% of a first generation 777. Most of the 787's primary structure is made of composites, including the fuselage and wing.

According to Boeing's website the 787's barrel fuselage section construction technique reduces weight by eliminating lap joints, doublers and skin overlap.

Composites will be used for about 53% of the A350's airframe, compared to about 11% for the A330. On the A350 the wings, centre wing box, tail cone, skin panels, frames, stringers and doublers and doors are made of Carbon Fibre Reinforced Plastics (CFRP).

Reduced weight metals are also part of the A350 design. Titanium is used in high load frames, door surroundings, the landing gear and engine pylons.

The majority of the A350's fuselage is constructed of three long sections, each composed of four large composite panels, joined together by longitudinal riveted joints. This technique reduces weight because it requires fewer joints than traditional manufacturing processes.

Information regarding the use of composite materials in the 777X family is not yet available. Composite materials will need to be more evident than in the first generation 777 fleet to reduce weight. Early indications are that the 777-8X and -9X will have a composite wing.

The 787's and A350's wing design also helps to improve their aerodynamic efficiency.

The A350 wing design features a tapered plan form, and variable camber and differential flap settings to increase aerodynamic efficiency.

Engines

There are two engine options for the 787 family: the GEnx-1B from GE Aviation (GE) and the Trent 1000 from Rolls Royce (RR).

The GEnx-1B has a 111-inch fan diameter and a bypass ratio of 9.7:1 *(see table, this page)*. In terms of physical materials, the GEnx-1B engines offered for the three 787 variants are identical. They can be rated at different thrust settings depending on the airframe variant they will be installed on. The GEnx-1B is certified up to 78,000lbs of thrust.

GE claims that the GEnx-1B burns up to 15% less fuel than its CF6-80C2 engines, which power the 767, 747, A300, A310 and MD-11. A number of features contribute to this improvement

While the 787-9 is positioned as a potential replacement candidate for the A330-200 and -300, and A340-300, the 787-10 will have a seat capacity to match the 777-200ER.

in fuel burn, including reductions in weight, and increased bypass and pressure ratios.

"The GEnx was the first engine in commercial aviation to use a composite fan case," claims John How, GEnx-1B program manager at GE Aviation. "This saves 350lbs in weight per engine or 700lbs per aircraft." More weight savings come from the low pressure turbine (LPT) blades. "These are made from titanium aluminide, a new material which is lighter in weight than the nickel-based super-alloy material used in previous engines," explains How.

Like the fan case, the fan blades of the GEnx-1B are made from composite materials. The strength of these materials allows for thinner blades with a larger chord width. This means that the GEnx-1B has only 18 fan blades, about half the amount used in the CF6, which reduces weight. The GEnx's lighter, thinner and wider composite blades also allow for a larger fan diameter than would be possible with older generation blades. This contributes to the engine's higher bypass ratio.

An aircraft's fuel burn performance is related to its engines' propulsive efficiency, which is determined by the ratio of the speed of the air mass leaving the engine to the speed of the surrounding air. This is the aircraft's forward speed. The lower the exit speed of the combined bypassed and core-exhausted air, the higher the propulsive efficiency and so the lower the fuel burn.

Propulsive efficiency is increased by increasing air mass and reducing the acceleration of the air mass. Increasing the fan diameter and bypass ratio will result in the acceleration of a larger volume and mass of air being accelerated to a lower exit speed.

An engine's fuel burn performance is also influenced by its core efficiency. The GEnx-1B has counter-rotating high-pressure turbines (HPT) and LPTs, as well as its high pressure compressor pressure ratio of 23:1.

The counter-rotating HP and LP turbines enable a weight and length reduction by eliminating LPT inlet guide vanes otherwise required to redirect the gas flow.

RR supplies the Trent 1000 for the 787 and the Trent XWB for the A350.

The Trent 1000 has a 112-inch fan diameter, a bypass ratio of 10:1 and is certified for thrust ratings of 58,000-78,000lbs *(see table, page 6)*. The Trent 1000-TEN is the latest variant, and will be available for all three 787 variants.

The Trent XWB has a 118-inch fan diameter and a bypass ratio of 9.5:1 *(see table, page 6)*. It will be certified for thrust ratings of 75,000-97,000lbs, depending upon the A350 variant it powers.

Both the Trent 1000 and Trent XWB have large fan diameters and high bypass ratios, which increase propulsive efficiency. "Improvements in component design, and investment in high temperature materials that allow the core to be shrunk, increase the overall pressure ratio and extract a greater amount of work from the core to drive the bigger fans," explains Tim Boddy, head of customer marketing, Trent XWB at Rolls-Royce.

Airbus claims that the Trent XWB will account for about one-third of the 25% reduction in fuel burn per-seat that the A350 is expected to demonstrate in comparison to current competing aircraft.

The engine cores of the Trent 1000 and Trent XWB have been designed using 3D aerodynamics to optimise airflow through the compressor. This creates higher pressure without increasing the number of stages required, therefore providing greater efficiency.

The Trent 1000 and Trent XWB are both based on the three-shaft architecture, which is unique to RR turbofans. "The three-shaft architecture allows us to balance work and shaft speeds to optimise the engine for efficient performance and operability as the overall pressure ratio increases," explains Boddy. "As a result three-shaft engines generally require fewer stages and are shorter and lighter than two-shaft ones."

The 777X family will have GE9X engines. These will have a 133.5-inch fan diameter and a bypass ratio of 10.2:1 *(see table, page 6)*. GE claims that the GE9X will provide a 10% improvement in fuel burn in comparison to the GE90 engine that powers the current generation of 777.

The GE9X will have a fan case made of similar composite materials to that of the GEnx for weight saving purposes. "The fan blades will be made from a newer generation composite material that will allow for fewer, thinner blades," explains Bill Millhaem, general manager of the GE90/GE9X at GE Aviation. "The GE9X will have 16 fan blades as opposed to 22 in the GE90."

The thin, wide chord blades are light enough to permit the large fan diameter and associated high bypass ratio of the GE9X. This helps to optimise the engine's propulsive efficiency.

The GE9X's fuel burn performance will also be improved by an 11-stage compressor providing a high pressure compressor pressure ratio of 27:1. "This is 20% higher than the GEnx and will be the highest pressure ratio in a commercial engine to date," claims Millhaem.

Flightdeck commonality

Flightdeck commonality is another consideration for airlines looking to improve operating efficiencies. Airlines can save on training costs if pilots can transition within a fleet from one aircraft type to another with minimal extra training.

The A350 family variants have size and range performances that will allow it to replace most current and older generation widebody types. The A350-1000 is unlikely, however, be able to compete head-on with the larger 777-9X.

The 787 and A350 have been designed to provide commonality with other aircraft in the respective Boeing and Airbus families.

Airbus has developed a cross-crew qualification (CCQ) concept for its various aircraft families. The idea is that pilots will only need to complete what Airbus calls 'differences training', rather than full type rating training, when transitioning between Airbus types.

Subject to approval, it is currently envisaged that pilots will need to complete five days of training to move from the A350 and A380, eight days to move from the A350 to the A330 and 11 to move from the A350 to the A320 family.

Maintenance improvements

The technologies and materials used in new widebody designs can lead to maintenance efficiency improvements and cost reductions. The potential maintenance benefits are analysed here in terms of maintenance programmes, on-board maintenance systems, rotable components and engines.

Maintenance programmes

The use of composite materials and new technologies means that the 787 and A350 are entering service with fewer maintenance tasks and longer task intervals than previous generation aircraft. This can reduce labour man-hours (MH) and associated costs.

Instead of pre-defining checks, the maintenance planning documents (MPD) for new aircraft, including the 787 and A350, will list the interval criteria for each maintenance task. Airlines can group tasks together to suit their particular operational needs. If required, Boeing and Airbus offer guidelines on how to group tasks into check intervals. The three main interval criteria are flight hours (FH), flight cycles (FC) or calendar time.

An aircraft's MPD can be considered in terms of systems, structural and zonal tasks. The 787 has 82% fewer structures tasks and 34% fewer systems tasks than the 767 *(see Aircraft Commerce, The 787's & A350's design & maintenance requirements, June/July 2010, page 42).*

One reason that the 787 has fewer systems tasks than previous generation aircraft, is that more complex mechanical components have been replaced with electrical systems, for example in the landing-gear door and gear lowering system, the brake control system, the anti-ice system and the engine start system. The 787 has no pneumatic components and fewer hydraulic parts than a conventional aircraft.

The reduction in systems and structural tasks can also be explained by the use of composite materials in the aircraft's construction. These materials are not susceptible to fatigue or corrosion, which contributes to the 787's extended task intervals.

The guidelines for check intervals in the of the 787's MPD recommend a light or 'A check' every 1,000FH. This compares to 600FH for the 767. The same guidelines recommend intervals of 12,000FH and 36 months for base or 'C checks'. This interval is one-and-a-half to twice that of the A330 and 777. It is unconfirmed whether the experience gained from the operational performance of the 787-8 will result in further task interval escalation for the 787-9 and -10.

The A350 also has longer task intervals than previous generation aircraft. "Airbus's overall target is to reduce the airframe direct maintenance costs of the A350-900 by 40% compared to the 777-200ER and by 10% compared to the 787-9," says Bert Stegerer, head of aircraft operations marketing at Airbus. "Our target with the A350 is to reduce MPD MH by 40% compared to current generation aircraft, such as the 767."

Stegerer highlights how the use of CFRP and titanium in the A350's construction is influential in reducing the number of tasks and extending maintenance intervals. "The CFRP is corrosion- and fatigue-free and the titanium is corrosion-free," he explains.

Jean-Francois Huix, A350 XWB maintenance programme manager at Airbus, explains that the A350's A Check target can be scheduled at 1,200FH and multiples thereof. This compares to a typical A Check interval today of 800FH for the A330. "There will only be a limited number of tasks to perform for the A350 during this check, and they will be straightforward.

"The base check interval will be every 36 months," continues Huix. "The traditional 'intermediate' six-year heavy check tasks will be split across several base checks. Each base check will involve a short grounding time of only four or five days. The 'Year 12' or '144-month' check is really the only large 'heavy' check which A350 operators will have. Comprising the 1C, 2C and 4C checks it will include the first landing-gear overhaul."

There has been a focus on simplifying systems and components in the A350. "With the A350, a number of design features have been put in place to reduce the maintenance cost and improve component reliability," says Stegerer. "The hydraulic system is one example. Like the A380, the A350 has only two hydraulic systems (running at 5,000psi), plus two electrical back-up systems, compared to three hydraulic fluid circuits for most other in-service airliners, including the 787. This reduces the number of hydraulic lines, connections and valves by one-third and lowers the potential for leaks, while at the same time benefiting overall system redundancy. Additionally, the accumulators and heat-exchangers are maintenance-free."

New generation widebodies should be able to offer some improvements in widebody comfort over current generation types. The use of carbon fibre in the airframe will allow for lower cabin altitudes in the A350 and 787. These aircraft should also have large cabin windows. These two factors will make appreciable improvements to cabin comfort.

It is too early in the development of the 777X programme to identify if it will provide maintenance cost and efficiency improvements over the first generation 777 fleet. If the design includes more composite materials there will probably be fewer maintenance tasks with longer intervals in the 777X's MPD.

On-board fault finding

The latest generation of commercial aircraft are equipped with increasingly sophisticated on-board maintenance systems. Their main function is to save line maintenance MH associated with fault identification by automatically identifying and analysing faults.

The 787 system contains 45,000 fault codes. When a fault is detected it is analysed and the engineers are directed to the relevant electronic manual and solution. The fault isolation manual (FIM), aircraft maintenance manual (AMM) and troubleshooting manual (TSM) are all electronically linked to the fault reporting system and the installed electronic technical log (ETL).

"The A350's on-board maintenance system (OMS) increases the monitoring of aircraft systems and allows maintenance staff to isolate any kind of fault," claims Stegerer. "They are directed to the appropriate troubleshooting solution via interactive links to the main maintenance manuals, including the AMM, Illustrated Parts Catalogue (IPC) and TSM. This reduces the time for fault finding and fault isolation. It also lessens the potential for non-routine work and reduces the no fault found (NFF) removal rate. Airbus estimates that the NFF removal rate can be reduced by 50% compared to current generation aircraft."

Rotables

The 787 and A350 have simpler system design than previous generation aircraft, which reduces the amount of components, and in turn reduces component repair and replacement time and costs.

The 787 uses more electrical systems, which has reduced the number of mechanical components.

Airbus highlights the A350's hydraulic system and the simplified design of the aircraft's main landing gear, which does not feature a shortening mechanism, as examples of system simplification.

Both aircraft feature integrated modular avionics (IMA). "The A350 IMA concept is based on standard computing modules running several applications in a partitioned environment providing full segregation between functions," explains Stegerer. Multiple line replaceable units (LRUs) that provide individual functions are replaced by fewer LRUs with multiple modules and associated applications. "These are line replaceable modules (LRM)," continues Stegerer. "In most cases they can be easily installed and replaced on-board the aircraft." In the event of a failure, this means that individual LRMs can be changed rather than whole LRUs. Aircraft with IMA will therefore have fewer LRUs in the avionics bay and the potential for more efficient fault-finding and rectification processes.

Engines

"The GEnx-1B is designed to have a 20% longer removal interval than previous generation engines," says How. "This can help reduce maintenance costs. The composite fan case is extremely damage-tolerant. In addition, the super alloys and coatings in the engine have high durability, which means longer time on-wing."

According to Boddy, the Trent 1000 and XWB were designed with maintenance in mind.

"External components such as the electronic engine controller (EEC), fuel pump, oil pump and accessory gearbox are mounted around the fan case rather than in the core," explains Boddy. "This provides easier and quicker access for maintenance. The external components also benefit from a cooler, more benign environment."

Through its Optimised Systems and Solutions (OSyS) subsidiary, RR provides prognostic services for its engines. "These monitor engine data and may be able to detect potential maintenance issues before a failure or performance degradation actually happens," explains Boddy. "This might allow engineers to intervene before the issue becomes too serious and thereby allow the engine a longer removal interval."

The GE9X for the 777X family will also provide benefits from a maintenance perspective. "Like the GE90, the composite material in the GE9X's fan module will be extremely durable to keep maintenance costs lower than those of engines with traditional titanium material," claims Millhaem. "The super alloys and coatings in the engine will further extend the engine's time on wing for additional savings."

The e-enabled aircraft

In recent years flightdeck and cabin connectivity options have been increased by developments in communication technologies.

Flightdeck

From the flightdeck perspective, the ability to transfer data from the aircraft to back office systems when in flight or at the gate can bring operational and maintenance efficiency benefits (see, *The applications of flightdeck connectivity systems, Aircraft Commerce, October/November 2013, page 13*).

Some of the main advances in

The 787 comes with dual, installed Class 3 EFBs as standard. The A350, however, will be provided with Class 2 plus EFBs as standard. Airlines can select a COTS-based laptop as part of this solution.

transferring operations and maintenance data have been associated with the growing sophistication of Electronic Flight Bag (EFB) solutions. These provide electronic versions of the content previously carried in paper format in a pilot's flight bag. Typical EFB software applications include electronic aeronautical charts, performance calculation tools and ETLs. Charts, documents and forms on the EFB can be updated electronically, saving costs and time associated with paper updates. Sending operations and maintenance data from the EFB to back-office systems can eliminate the time and labour required for manual data-entry. In the case of an ETL, maintenance personnel could be pre-warned of required fault rectification requirements.

The 787 comes with dual, installed Class 3 EFBs as standard.

The A350 will be provided with a Class 2 plus solution as standard. Airlines can select a consumer off-the-shelf (COTS)-based laptop as part of this solution. This device must adhere to the various requirements and specifications laid out by Airbus in a Service Information Letter (SIL) provided to the airline during entry-into-service (EIS) workshops.

Airbus claims that its Class 2 plus solution offers all the advantages of a Class 3 system while also providing the portability of a regular Class 2 device.

It is yet to be confirmed whether the 777X will be supplied with an EFB solution. Based on current trends, the best approach might be to supply the aircraft with mounting devices for portable EFBs that allow them to connect to aircraft systems for power and data transfer.

Cabin

In the cabin, the ability for passengers to access the Internet or make phone calls could be a service differentiator and a way for airlines to generate ancillary revenues.

The A350 will be delivered with Inmarsat Swift broadband (SB) satellite communication as standard. This will provide an on-off board connectivity channel that allows passengers to use mobile telephony and access the Internet using personal electronic devices (PEDs), such as smart phones and tablets. The cabin will feature the highest power available of any aircraft, per passenger, for PEDs. There will be full cabin wireless local area network (WLAN) provisioning for wireless Internet access.

Cabin interior

Passenger comfort is another area in which the new widebody programmes are introducing new technologies and solutions.

The 787 and A350 families both feature a lower cabin pressure altitude of 6,000 feet, compared to 8,000 feet on other aircraft. This is made possible by the use of CFRP in each aircraft's fuselage construction. CFRP can withstand higher cabin humidity levels because it is corrosion-resistant. The higher atmospheric pressure and moisture content at a cabin altitude of 6,000 feet can reduce the effects of jetlag and improve passenger comfort.

The 787 features the largest cabin windows used so far on a commercial aircraft.

Both the 787 and A350 will have a nine-abreast seat configuration in economy. Airbus claims that it offers a superior seat width of 18" inches compared to 17.2 inches for the 787.

In addition to PED connectivity, the A350 cabin will feature a fourth-generation in-flight entertainment (IFE) system. This includes the option of a Panasonic or Thales IFE system. The main features include an enlarged seat-back monitor of up to 12 inches in size and high definition (HD) TV capability for all passengers. There will also be five-times greater bandwidth per passenger due to fibre-optic technology and extra legroom through the elimination of under-seat IFE control boxes.

Few details are available regarding the planned cabin interior of the 777X, but Boeing plans to incorporate technologies that have been developed for the 787. Among the changes from the first generation 777 will be larger windows and new lighting.

Summary

The 787 and A350 have been designed to improve fuel burn performance, lower maintenance costs and provide better connectivity and comfort for passengers. The design of the 777X is also likely to be driven by these objectives.

Fuel burn performance has been improved by the use of composite materials lowering aircraft weight, and more efficient engines.

The use of composites also reduces maintenance costs. Their lack of susceptibility to corrosion and fatigue means that aircraft manufactured with these materials will have fewer maintenance tasks to be carried out and longer intervals between the tasks that remain. Simplified systems and IMA also help to lower maintenance costs by reducing the number of on-board components.

From the perspective of improved passenger comfort there is a continued drive to provide connectivity for PEDs. Lowering the cabin pressure altitude is another method for improving the passenger experience.