

BOEING 7E7

Launching a new generation

In issue 24 of October 2003 I wrote an article about Boeing's new 7E7. This article is a continuation of my article in issue 24 as more information is released on the 7E7. On the 16th of December 2003 the Boeing Board of Directors has given the company's Commercial Airplanes unit the go-ahead to begin offering for sale the new 7E7 passenger aircraft. This article will focus on the suppliers for 7E7 as well as technologies used in the 7E7 compared to current technologies. I have also done a small desk research of the current 767, 757, A330, A300, A310 worldwide airliner fleet to determine the market demand based on this information. The article is closed with a look ahead.

By Roger Cannegieter

Providing a new generation

Now that the 7E7 has officially been launched, Boeing is now able to go into detailed development of systems requirements, aircraft components and composite materials. The parts for the Boeing 7E7, also named the Dreamliner, will be supplied by several companies around the world, as mentioned in the first article. After evaluation of the final assembly proposals using criteria designed to find the final location that would best support the 7E7 business plan, Boeing has chosen Everett in the state of Washington to assemble the 7E7, where Boeing also assembles other aircraft models. Hamilton Sunstrad and Rockwell Collins have been chosen to provide selected portions of the systems for the 7E7. Hamilton Sundstrad will provide the auxiliary power units (APU), environment control systems, remote power distribution units, the electrical power generator and electrical start system, while Rockwell Collins will provide the displays and communications/surveillance systems packages. Another systems partner is Honeywell which will provide the navigation

package and health management/crew information systems for the Boeing 7E7. This includes the flight management function, which manages the navigation and aircraft performance, as well as an inertial reference system that determines aircraft location, the air data system that measures speed and altitude, and a multi-mode receiver that houses global and air-navigation sensors. The health management/crew information system monitors the performance of the airplane's systems and communicates findings to the crew and ground-based personnel. Dassault Systems is accelerating development with Boeing of the integrated



Boeing 7E7
Photo: The Boeing Company

Product Lifecycle Management platform. The enhanced PLM solutions will enable Boeing and its partners to implement the digital tools and processes necessary to meet the challenges of the 7E7. Boeing and Dassault are developing a virtual development workspace in which Boeing will design, build and test every aspect of the 7E7 and its manufacturing processes before actual production begins. The Dassault solutions will provide a fully distributed, worldwide collaborative workspace that integrates all 7E7 program partners into a single, seamless community. Smith's Aerospace of the United Kingdom will provide the common core systems which will replace the traditional dedicated signal wiring with remote data concentrators. The concentrators link sensors and effectors of each system to a shared modular computing resource through an advanced communications network, thereby reducing the aircraft's weight. This common core system helps the 7E7 achieve a 20 percent reduction in fuel use. Regarding the interior of the 7E7, Boeing has set up an Interior Responsibility Center. Together with the Seattle based design firm Teague, the Interior Responsibility Center designs, manufactures, assembles and integrates many of the production, aftermarket, and spares interior systems for Boeing commercial jets. As for the 7E7, they will oversee development of, and suppliers for, the interior sidewalls, ceilings, stowage bins, crew rests and closets. The program separately will select providers of items including lavatories, galleys, passenger seats, water system and escape slides. Those suppliers will be chosen by year's end. Goodrich will provide the fuel-quantity indicating system and fuel management software. The indicating system measures fuel in the aircraft's tanks while the software manages fuel supply during a flight

and controls refueling. FR-HiTemp of the United Kingdom will supply various fuel pumps and valves for the 7E7. FR-HiTemp will provide pumps to be used for engine fuel feed, fuel override and jettison, the auxiliary power unit, the center fuel tank and water scavenging. This equipment supports fueling and defueling the airplane, transfer of fuel from fuel tanks to the main engines and the auxiliary power unit (APU), and jettisoning of fuel when necessary. Thales of France has been selected to supply the Integrated Standby Flight Display (ISFD) for the 7E7. Thales has already been appointed to supply the Electrical Power Conversion System for the 7E7. The ISFD is a liquid crystal display located in the center section of the forward flight deck panel. It provides an integrated display of airspeed, altitude, pitch and roll attitude. In addition, the ISFD demonstrates heading and landing approach deviation data in a

format similar to primary flight displays. Messier-Dowty of France will provide the main and nose landing gear for the 7E7. United Technologies will provide the primary power distribution system for the 7E7.

Technological advances and breakthroughs

Aside from these suppliers Boeing has announced the two engine manufacturers for the 7E7 on April 6th. The 7E7 engines will be delivered by General Electric and Rolls Royce. Both engine models will be capable of providing a thrust between 55,000 and 70,000 lbs which allows all three 7E7 models to use the same engine. The new technologies used on these engines enable a fuel reduction of 20 percent compared to similarly sized aircraft types. Both engine types will use the same standard interface with the 7E7, allowing any 7E7 twinjet to be fitted with either engine type at any point in time. This engine inter-

changeability makes the 7E7 a flexible asset that can easily be moved among carriers, an attractive feature for financiers, leasing companies and airlines. Other 7E7 innovations include the elimination of traditional bleed air systems in favor of an efficient, more-electric architecture. Also, systems once powered pneumatically will use electricity, supplied by two 225-kilowatt generators attached to each of the 7E7's two engines. The auxiliary power unit, or APU, in the plane's tail will also have two of these generators. In the chart below, you can see a comparison between current hydraulically powered aircraft and the new technologies implemented on the 7E7. The chart was obtained from the Seattle Post Intelligencer.

Market demand

As the 7E7 is intended to replace airlines operating the 767, 757 and/or the A300, A310 and A330, I decided to do a small research of the number of these aircraft currently used in each continent. This will give you an idea of the potential the 7E7 can have. The data in the chart below was taken from the Flight International magazines of March 16th 2004 until April 5th of 2004. The chart doesn't include cargo airlines and/or integrators as Boeing hasn't announced a full freighter version of the 7E7 yet. These airlines are also more interested in second hand aircraft that can be converted to full freighters. For the time being, the 757, 767, A300, A310 and A330 are perfect aircraft for cargo operations in its class and don't need a replacement for the coming 5 to 10 years.

The current financial status of most U.S. airlines will probably not see any order for new aircraft being placed for the coming years. However, as most major U.S. airlines have large 757/767 fleets, we may expect these airlines to order or lease the 7E7 in the same numbers as their 757/767 fleets due to their close relationship with and the commonality with their other Boeing aircraft. This would mean a potential U.S. market for the 7E7 of approximately 796 aircraft according to the table. However, this number will also be determined by market forecasts, fuel prices and political relationships. In Europe Boeing is targeting European charter airlines, with Thomas Cook,

	EXISTING PLANES	NEW 7E7
POWER SYSTEM	A portion of high-temperature engine air, called bleed air, is redirected into the plane through ducts. The energy created by the bleed air is used to power various systems throughout the aircraft.	The bleed air system is eliminated and replaced by electric generators, making the plane and engines more efficient. Each of the two engines will have two 225-kilowatt generators to produce electrical power.
DUCTS	Titanium ducts carry bleed air through the plane.	Ducts will be eliminated, lowering the plane's weight and maintenance costs.
ENGINES	Neumatic power is used to start engines.	Electricity will be used to start engines.
BRAKES	Hydraulic-powered brakes.	Electrical-powered brakes.
DE-ICING	De-icing system on the leading edge of the wings powered by bleed air.	De-icing system will be electric.
LANDING GEAR	Bleed air is used to raise landing gear.	Landing gear will be raised electrically.
SECONDARY FLIGHT CONTROLS	Powered by hydraulics.	Powered by electricity. Improves safety in event of a complete loss of hydraulic power.
CABIN AIR	Cooled and filtered engine bleed air is circulated in the cabin.	Air from outside the plane will be circulated in the cabin.
OTHER IMPROVEMENTS THE 7E7 WILL OFFER:		
<ul style="list-style-type: none"> ▶ Fewer computers on board. 	<ul style="list-style-type: none"> ▶ As much as 40 miles less of copper wiring. The wiring will be of a smaller gauge. This will save on weight. 	<ul style="list-style-type: none"> ▶ Electronic signals will be distributed more efficiently using more fiber optics. The weight savings will be as much as 1,500 pounds.

Source: The Boeing Co.

SEATTLE POST-INTELLIGENCER

Boeing/Airbus statistics (2004)	757	767	A330	A300	A310
North America:					
United States**	517	279	51	33	0
Canada	6	42	10	0	7
Latin America:	26	40	8	3	0
Europe***	114	81	79	24	24
Asia****	41	126	146	84	32
Middle East & Africa****	17	34	91	48	23
Total:	721	602	385	192	86

* = Financial recovery expected.

** = 48 757s Thomas Cook & Britannia.

*** = Japan & Chinese markets biggest 767 share.

^^ = Germany market biggest A330 share.

^^^ = Japanese & Chinese markets biggest 767/ A300 share. 29 A310s from India & Pakistan.

^^^^ = 76 A330s from U.A.E. Saudi Arabian Airlines A300s.

First Choice and Britannia (TUI Group) having a total fleet of 60 757s and 19 767s. Besides these airlines, British Airways and Alitalia have a total 767 fleet of 32 767 aircraft. Even though these airlines are still restructuring, they can be seen as potential 7E7 customers due to their larger 767 fleets. In Asia the 767 and A300 are mostly operated in Japan and China. As some Chinese airlines already have placed orders for a number of A330-200s to replace their 767/A300 fleets, the forecasted market growth in the coming years makes China a country with more potential for both the 7E7 as well as the A330. The participation of Japanese companies in the 7E7-programme and the close ties between Japan and the United States, makes Japan a good 7E7 candidate with All Nippon Airways (ANA) already having placed the largest single order for any new airliner, a total of 50 7E7s to be delivered, replacing its current fleet of 767s.

According to the chart the A330 and A300 are still mostly used in Asia, followed by the Middle East, Europe and the United States. Asia and the Middle East will be the markets with the most potential for both Boeing and Airbus as the fastest air traffic growth is expected in Asia and the Middle East. Arab airlines based in the United Arab Emirates have big expansion plans in the coming years.

76 of the total of 91 A330s sold in the Middle East and Africa come from Arab airlines based in the United Arab Emirates. This is something worth keeping an eye on for both Boeing and Airbus. Emirates Airlines has already shown interest in the 7E7 to replace their current fleet of 29 A330-200s but no official order has been announced yet. Even though the A310 is also targeted by Boeing, it seems the A310 is already on its way out with a lot of airlines already



Boeing Launches 7E7 Dreamliner with ANA (All Nippon Airways) placing a firm order for 50 7E7 passenger jets on April 26, 2004
Photo: The Boeing Company

having replaced the A310 with the A330 or disposed of them entirely. The remaining major A310 operators will probably be Air India and Pakistan International Airlines, as these airlines are still looking for more A310s.

Looking forward

With Boeing coming to the final development stages and the 'design freeze' of the already well-known 'Dreamliner', Airbus is not revealing much about its strategy to counter the 7E7. Airbus has revealed a lighter version of its highly successful A330-200, named the A330 Lite. This aircraft will have improved engines with better economics to better compete against the 7E7, as well as the use of more composites than Airbus' current models. The latest information on this new model is the use of a composite wingbox and an improved wing design to further improve the A330s economics. As for the 7E7, Mike Bair, senior vice president for the 7E7 program noted at this year's Farnborough Air Show that the 7E7's shape and configuration will be finalized by mid-2005. The wings will be very similar to the concept images, although the tail is still being worked on through the configuration process and will most likely be changed to

achieve aerodynamic efficiency. With 62 announced orders from four carriers (ANA, Air New Zealand, First Choice, Blue Panorama) Boeing also claims to have deposits from about two dozen airlines for nearly 200 airplanes. In the meantime we have to wait on Airbus' reaction to Boeing's 7E7. Airbus will not let their market share slip away. As the A330 is still a very popular aircraft in both Europe and Asia, Airbus must do everything to keep their market share. The

chart shows a big market for medium to long haul aircraft in the 250-300 seat market. In any case Boeing and Airbus are targeting the U.S., European and Asian markets...

Sources

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Flight International magazine, issues from March 16, 2004 until April 5, 2004