DELTA AIR LINES, INC.
100- TO 150-SEAT LARGE CIVIL AIRCRAFT FROM CANADA:
POST-HEARING BRIEF

LIST OF EXHIBITS

DELTA AIR LINES, INC.
100- TO 150-SEAT LARGE CIVIL AIRCRAFT FROM CANADA:
POST-HEARING BRIEF

LIST OF EXHIBITS

Exhibit 1

Delta Air Lines, Inc.

100- to 150-Seat Large Civil Aircraft
Exhibit 1: Responses to Questions from the Commission

> **Every sale for importation, every sale that's made, doesn't change over the period between the order and delivery. Most of them go exactly as planned with maybe a little tweaking.**
>
> **COMMISSIONER WILLIAMSON: And in fact, that was gonna be my question. Maybe post hearing, anything you have... I was gonna say, post hearing, if you have any data readily available or something that you can substantiate -- 95%, 80% of the orders are, you know, or orders originally ordered, but it'd be helpful. I'm not asking you to create anything special, but if there's something that's --**

Hr'g Tr. 109:5 – 110: 8 (Williamson).

> **I don't know whether post-hearing you might be able to -- and I asked this from Boeing this morning about how often do airlines really change the original order. I mean it happens frequently, but I'm not sure what percentage of –**

Hr'g Tr. 254:12-16 (Williamson)

Response: At least for the course of the past few years, Delta is [

]. While it is possible that [

], as Greg May testified before the Commission "{C}hange is the rule not the exception."[1] Delta has provided examples of the materiality of these changes [ ][2] and demonstrating [

---

1 Hr'g Tr. 254:18 (May).

2 *See* Delta Pre-Hearing Brief, Exhibits 26, [ ] and 29 [ ]; *see also* Delta Pre-Hearing Brief, Exhibit 27 (side-by-side summary of changes to material terms); Delta Pre-Hearing Brief, Exhibit 28, Decl. of Daniel J. Pietrzak.

Delta Air Lines, Inc.

100- to 150-Seat Large Civil Aircraft
Exhibit 1: Responses to Questions from the Commission

].[3] These include a circumstance where [

].[4]

In addition to those examples, Delta testified at the hearing to the recent experience with a wide-body order from 2015 that has already been renegotiated.[5] Moreover, public reports in the press reflect the circumstance that purchase agreements are regularly and materially renegotiated.[6] For that matter, as the Commission noted elsewhere, United's order for 737-700s is now certain to result in delivery of exactly no 737-700s.[7]

But this should not be an issue in dispute—Boeing's order book strategy [

].[8] Boeing intentionally [

].[9] But even with this strategy, Boeing cannot accommodate all customers. At the hearing, Boeing testified that

---

3 Delta, Pre-Hearing Brief, Exhibit 28, Decl. of Daniel J. Pietrzak, ¶¶ 4-5; *See also* Delta, Pre-Hearing Brief, at 42-43.

4 *See* Delta Pre-Hearing Brief, Exhibit 27 (side-by-side summary of changes to material terms).

5 Hr'g Tr. 254:17-23 (May).

6 *See, e.g.*, "Malaysia Airlines is Buying 16 New Airplanes from Boeing," Fortune (Sept. 13, 2017), http://fortune.com/2017/09/12/malaysian-airlines-buying-airplanes/ (last accessed Dec. 26 2017), attached as **Ex. 24**; Victoria Moores, "Pegasus Airlines converts options on 25 A321neos," ATW Online (Dec. 21, 2017), http://atwonline.com/aircraft-orders-deliveries/pegasus-airlines-converts-options-25-a321neos (last accessed Dec. 26 2017), attached as **Ex. 25**.

7 Hr'g Tr. 91:6-10 (Schmidtlein).

8 *See* [ ] QR, at II-11d, II-11e.

9 *See Id.*

Delta Air Lines, Inc.

100- to 150-Seat Large Civil Aircraft
Exhibit 1: Responses to Questions from the Commission

it "focuses on winning every order and adjust capacity to meet demand."[10] That has not been Delta's experience. As noted by Mr. May at the hearing, Boeing did not compete for an order of 37 larger narrow-body LCA (737-900ER) because it informed Delta it had no production slots through 2020.[11]

There would seem to be no genuine dispute that purchase agreements are a poor guarantee, at best, of the what and when of any future delivery.

[10] Hr'g Tr. at 46:7-8 (McAllister).
[11] Hr'g Tr. at 200:7-20 (May).

Delta Air Lines, Inc.

100- to 150-Seat Large Civil Aircraft
Exhibit 1: Responses to Questions from the Commission

Page 31 to 32 of its brief, Boeing provides a list of examples of routes that are rightsized in their paper "for 100 to 150-seat large civil aircraft." Do you have any examples of airlines serving those routes with out of scope single aisle large aircraft?

Hr'g Tr. 221:15-20 (Schmidtlien).

Response: As noted at the hearing, Boeing listed these examples as BPI, as a result, Delta does not have access to them. As of this writing, Boeing has not revised its BPI designation, and so Delta itself cannot respond further to this request. However, we note that Delta, which has one of the broadest US networks, flew 100- to 150-seat LCAs exclusively on just 6 routes in 2016.[12] Delta flew out of scope single aisle LCA on 420 out of the 426 routes or 99 percent of the routes it flew a 100- to 150-seat LCA.[13]

[12] Hr'g Tr. 206:7-11 (Esposito).
[13] *See* Hr'g Tr. 206:5-11 (Esposito).

Delta Air Lines, Inc.

100- to 150-Seat Large Civil Aircraft
Exhibit 1: Responses to Questions from the Commission

> **Okay, thank you. No, there are public estimates that Delta purchased the CS100s for $19.6 million and $23 million for aircraft. Why wouldn't other airlines that compete with Delta, demand similar pricing? And I know this is statement about that they don't know, but if there's speculation out there, I'm sure there's no harm in asking for low price. So why wouldn't they?**

Hr'g Tr. 283:12-19 (Williamson).

Response: As addressed in Delta's post-hearing brief at 14, purchasers may well attempt to leverage rumors in negotiations, but the result is not a price effect attributable to Bombardier.

Regardless of acquisition price, airline fares are established based on supply and demand. Delta provides a declaration from Paul Baldoni, Delta's Managing Director for Domestic Revenue Management in **Exhibit 23**. As detailed in the declaration, Delta fares are based on dynamic pricing that takes into account supply and demand on each route.[14] The factors that are taken into account include: (1) passenger demand, (2) price sensitivity (leisure travel, business travel, etc.), (3) the supply of seats offered by Delta and competitors on the route, and (4) product quality between Delta and competitor airlines.[15] Delta also uses sophisticated inventory management software to manage the seats offered for sale and the fares associated with those seats. [16] Delta does not take the

---

[14] **Ex. 23**, Baldoni Decl., ¶ 3.
[15] *Id.*
[16] *Id.* ¶ 4.

acquisition cost of the aircraft into account when setting fares or as part of its inventory management process.[17]

Delta's approach is not unique. It is well documented that airlines use "increasingly-sophisticated software" in setting their fare prices to maximize their profits through revenue management.[18] Revenue management "has become increasingly complex and fiercely competitive."[19] Many factors play a role in this complicated and sophisticated calculation, such as route competition, route distance, seat demand, seat supply, day of the week of the sale, and day of the week or time of the day of the flight.[20]

---

17 *Id.* ¶ 5.

18 **Ex. 26**, Hugh Morris, "How airlines set their ticket prices - plus tips to beat them at their own game," The Telegraph (Sept. 21, 2016), http://www.telegraph.co.uk/travel/advice/how-airlines-set-the-price-of-flight-tickets-and-how-to-beat-them/ (last accessed Dec. 26 2017); **Ex. 27**, "Airline pricing secrets: How carriers come up with fares," CNN (June 16, 2017), http://www.cnn.com/travel/article/airline-pricing-secrets/index.html (last accessed Dec. 26 2017).

19 *Id.*

20 **Ex. 28**, "Understanding Airline Ticket Prices: Why a Seatmate's Airfare Costs More or Less than Yours," FARECOMPARE, https://www.farecompare.com/travel-advice/understanding-airline-ticket-prices-why-your-seatmates-airfare-cost-more-or-less-than-yours/ (last accessed Dec. 26 2017).

Delta Air Lines, Inc.

100- to 150-Seat Large Civil Aircraft
Exhibit 1: Responses to Questions from the Commission

> **So the question I'm asking is, is it possible, and I guess petitioners to comment on this, to get an impression of where the CS100 and 300 fit with basis to 737-700? In terms of relative cost -- the things that are important to the airline when they decide to –**

Hr'g Tr. 288:7-11 (Williamson)

Response: Attached as **Exhibit 4**, is a table breaking out the operating and other costs of the CS100 compared to the 737-700 and other aircraft in Delta's fleet. Of note, the 737-700 is burdened with the highest per-seat cost of any aircraft in the 1,300-aircraft Delta fleet, regardless of whether the purchase price of the aircraft is considered or not.

Quite simply, while the 737-700 has a limited utility in a handful of airports, it is an inefficient aircraft to operate and undesirable in most every circumstance for Delta's network.

Delta Air Lines, Inc.

100- to 150-Seat Large Civil Aircraft
Exhibit 1: Responses to Questions from the Commission

1. If the Commission decides to define the domestic like product as all single aisle large civil aircraft, it will need to assess conditions of competition in that market as opposed to the narrower 100-to 150-seat market.

Response: Delta urges the Commission to define the domestic like product as all single aisle large civil aircraft above 100 seats, and thereby remedy the artificial and counterfactual nature of the 150-seat limit Boeing urges. There are several aircraft, such as the A320 and Boeing 737-800, which are not much larger than 150 seats in standard configuration, so the domestic like product as all single aisle LCA above 100 seats avoids the artificial result of excluding these and other relatively close substitutes (such as used MD-88s and MD-90s) for carriers seeking a 140-160 seat aircraft.[21] Defining the domestic like product as all single aisle LCA with 100 or more seats accurately reflects the reality that there is in fact a continuum of products in this broader market—aircraft of increasingly larger size which all serve essentially the same function (i.e., passenger air transportation) and are generally substitutable with other single aisle LCA of roughly the same size, but generally not attractive substitutes for single aisle LCA which are significantly smaller or larger, when carriers seek to purchase aircraft to meet a specific mission profile. To suggest that a single aisle LCA like the A320, which is only slightly larger than 150 seats in standard configuration,[22] is in a totally different market than a single aisle LCA which has 149 seats in standard configuration, simply ignores reality.

[21] *See* Conf. Tr. 173:12-17 (Esposito).
[22] *See Id.*

Delta Air Lines, Inc.

100- to 150-Seat Large Civil Aircraft
Exhibit 1: Responses to Questions from the Commission

a. What key distinctions, if any, would you draw between the demand conditions in the market for in-scope 100- to 150-seat LCA and the market for all single aisle LCA?

Response: The market for all single aisle LCA generally corresponds to Delta's discussion of the demand conditions for what the 100- to 150-seat LCA market Commerce accepted as the scope of the investigations. Airlines that employ a diversified fleet strategy, such as Delta, go to market not just to purchase a single-aisle LCA, but one that meets their mission requirements.[23] Airlines are, of course, always on the lookout for a potential savings as to expected future needs, but a diversified fleet strategy, ultimately, requires the airline to secure from the market the aircraft that meets its needs at each of the market segments.[24] (For Delta, of course, that meant specifically needing aircraft in the 100- to 110-seat space.)[25] Overall, there is generally greater demand for larger aircraft (above the arbitrary 150-seat line) but that does not negate the specific demand Delta had for 75 109-seat LCA or that Boeing does not have an aircraft to offer at that size.

---

[23] Hr'g Tr. (196:15-16) (May) ("We go to market and launch a campaign to strengthen our fleet with aircraft to specific parameters."); *See also* Hr'g Tr. 207:17-208:2 (Esposito).
[24] *See* Hr'g Tr. 204:8-12 (Esposito).
[25] Hr'g Tr. 196:17-20 (May).

Delta Air Lines, Inc.

100- to 150-Seat Large Civil Aircraft
Exhibit 1: Responses to Questions from the Commission

b. What key distinctions, if any, would you draw between the supply conditions in the market for in-scope 100- to 150-seat LCA and the market for all single aisle LCA?

Response: The market for all single aisle LCA is probably better developed as a whole than what Commerce has defined as the 100- to 150-seat LCA market segment, which as defined has very few products currently in production. Overall, however, the key consideration is how very similar the supply conditions of the 100- to 150-seat space are to the market for all single-aisle LCA. One additional supply consideration is that Embraer's offerings would be included at the low end (100- to 110-seat) of the all single aisle LCA market. Presumably, that is why Boeing is now seeking to acquire Embraer.

Delta Air Lines, Inc.

100- to 150-Seat Large Civil Aircraft
Exhibit 1: Responses to Questions from the Commission

c. What conclusions should the Commission draw with respect to substitutability and the importance of price when looking at the market for all single aisle LCA?

Response: The conclusions would be very similar to those Delta has asked the Commission to draw as to the 100- to 150-seat portion of the market for all single-aisle LCA. Generally speaking, that means that, yes, these are all aircraft intended to carry passengers from one destination to another. Depending on the structure of a particular airline's network, the specific flight may have greater restrictions as to the specific capacity of aircraft the airline seeks to operate in that space. As a result, the price of larger aircraft makes sense if the airline needs a larger aircraft and believes the specific mission for which the aircraft is intended requires an aircraft of that capacity. Likewise, if the aircraft is too large for the mission, the airline would be burdened with the additional costs of the empty seats.[26]

[26] Petition, 44.

Exhibit 2

AIRLINES: INDUSTRY RANKINGS

INDUSTRY RANK	COMPANY
1	Delta Air Lines (/worlds-most-admired-companies/delta-air-lines/)
2	Air France-KLM Group (/worlds-most-admired-companies/air-france-klm-group/)
3	Cathay Pacific Airways (/worlds-most-admired-companies/cathay-pacific-airways/)
4	Singapore Airlines (/worlds-most-admired-companies/singapore-airlines/)
5	Lufthansa Group (/worlds-most-admired-companies/lufthansa-group/)
6	United Continental Holdings (/worlds-most-admired-companies/united-continental-holdings/)
7	Southwest Airlines (/worlds-most-admired-companies/southwest-airlines/)
8	ANA Holdings (/worlds-most-admired-companies/ana-holdings/)

Exhibit 3

Select a month: September 2017 ▼ Select a carrier: Delta Air Lines ▼ Submit

(The month selection does not apply to Revenue and Costs and On-Time Summary)

Carriers with annual operating revenue over $20M
Passenger Cargo

Delta Air Lines (DL)

Scheduled Services Only

BTS Data as of 12/26/2017

Summary Data (U.S. Airports, 12 Months Ending September)

	2016	2017	%Chg	Rank[1]
Passengers	118,169k	120,479k	1.95%	2
Departures	915k	917k	0.16%	2
RPM [2]	110,301m	114,260m	3.59%	3
ASM [3]	127,783m	131,198m	2.67%	3
Loadfactor	86.3%	87.1%	0.80 pts	4
Air Cargo [4]	407m	436m	7.21%	2
Markets Served	158	159	0.63%	
Share [5]	16.85%	16.91%	0.06 pts	3

1 Among 89 passenger carriers for 2017
2 Revenue Passenger Miles
3 Available Seat Miles
4 Air Cargo is the sum of Freight and Mail in pounds.
5 Market share based on Revenue Passenger Miles.

Top Domestic Markets* (October 2016 - September 2017)

Market	Passengers	Share**
Atlanta, GA	32.48m	72.90%
Minneapolis, MN	8.77m	51.94%
Detroit, MI	7.19m	47.20%
New York, NY	6.94m	25.83%
Salt Lake City, UT	5.72m	51.66%
Other	59.38m	9.59%

* Based on total enplaned passengers at all airports in a city.
** The table shows the carrier's share in each of the markets.
The pie chart shows each market's share in the carrier's total air passengers.

Monthly Flight Operations (ending September 2017)

Revenues and Costs

2016 vs. 2017 (4 quarters ending Q3 of each year)

	2016	2017	%Chg[1]
Operating Revenue (millions)	39,888	40,687	2.00%
Operating Cost (millions)	32,219	34,707	7.72%
Operating Profit/Loss (millions)	7,669	5,981	-22.01%
Net Income (millions)	4,764	3,676	-22.84%
Passenger Yield (cents)[2]	14.38	14.24	-0.97%
Revenue per ASM (cents)[3]	17.75	17.94	1.07%
Cost per ASM (cents)[4]	14.33	15.30	6.77%

1 When negative in profit or net income, P=Profit in latest period vs year earlier loss, L=Loss in latest period vs earlier profit, and ...=Not meaningful.
2 Calculated by dividing passenger revenue by revenue passenger miles.
3 Calculated by dividing operating revenue by available seat miles.
4 Calculated by dividing operating cost by available seat miles.

Top Domestic Origin-Destination City Pairs *

Delta Air Lines On-Time Performance Summary

Domestic Flights, 2012-2017*

% On Time	2012	2013	2014	2015	2016	2017	Rank**
Departure	87%	86%	85%	85%	86%	84%	3
Arrival	87%	85%	84%	86%	86%	85%	2
Avg Delay (min.)* **							
Departure	57.92	60.49	58.32	60.65	67.58	68.49	6
Arrival	55.34	58.63	56.87	61.26	68.59	69.86	8

% Cancelled							
Total	0.51%	0.32%	0.81%	0.44%	0.45%	0.75%	2
Number of Flights (000)							
Total	727	755	800	876	923	922	2

* Based on enplaned passengers of all airports for a city pair October 2016 - September 2017.

* November 2016 - October 2017.
** Ranked for November 2016 - October 2017
*** A flight is considered delayed when it arrived or departed 15 or more minutes later than the schedule. Average delayed minutes are calculated from delayed flights only.

BUREAU OF TRANSPORTATION STATISTICS
U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC 20590
855-368-4200

Sign up for Email Updates

Exhibit 4

Exhibit is Not Susceptible to Non-Confidential Summarization

Exhibit 5

MARKETS | DEALS

Boeing Confirms Takeover Talks With Brazilian Aircraft Maker Embraer

Boeing and Embraer have discussed a deal that would value Embraer at a big premium to its market value Thursday morning of some $3.7 billion

Boeing and Embraer have been discussing a deal that would involve a relatively large premium for Embraer. Shown, the new Embraer Phenom 300E corporate jet in an undated photo released Oct. 9. PHOTO: HANDOUT/REUTERS

By Dana Mattioli, Dana Cimilluca and Liz Hoffman

Updated Dec. 21, 2017 6:57 p.m. ET

Boeing Co. is in takeover talks with Brazilian aircraft maker Embraer SA, a move to fortify the U.S. aerospace giant against recent efforts by its greatest rival to move into the market for smaller passenger jets.

A deal would hand Boeing the largest maker of so-called regional jets that serve smaller airline routes, as well as access to Embraer's well-regarded engineering workforce.

It is the latest salvo in the global competition between Boeing and Airbus SE, which recently announced a similar deal to take a majority stake in a jetliner program run by Canada's Bombardier Inc., the second-largest maker of regional jets.

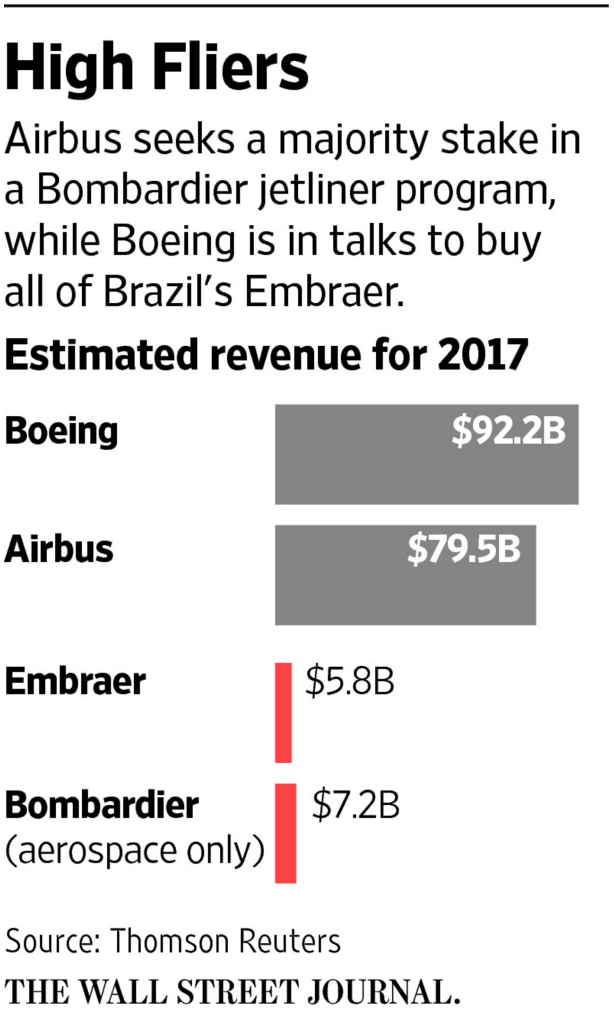
Boeing and Embraer confirmed the discussions Thursday after a Wall Street Journal report on the talks. The companies have been discussing a deal that would involve a relatively large premium for the Brazilian company, which had a market value of about $3.7 billion before it soared on the news, according to people familiar with the matter.

The parties are awaiting word from the Brazilian government on whether it would sign off on the combination, the people said. The government has a so-called golden share in Embraer that gives it veto power over such a transaction.

Embraer is a crown jewel of Brazilian industry, and it is far from guaranteed the government would sign off.

A deal would be the latest in a string of aerospace blockbusters that could remake the landscape for plane production around the globe.

In September, in the biggest aerospace deal in history, United Technologies Corp. agreed to buy airplane-parts maker Rockwell Collins Inc. for $23 billion. And Northrop Grumman Corp. agreed to buy rival defense contractor Orbital ATK Inc. for $7.8 billion in cash. Earlier this year, Rockwell closed on a deal to buy aircraft-seat maker B/E Aerospace.



To help entice the government, Boeing is willing to take steps to protect Embraer's brand, management and jobs, one of the people said. It is also ready to structure a deal in a way that would protect the government's interest in Embraer's defense business, which already has a joint venture with Boeing.

Embraer's U.S. shares soared on the Journal report Thursday—at one point rising by some 30%—and closed up 22%. Boeing was little changed.

Embraer, based in the city of São José dos Campos in the state of São Paulo, is the world's third-largest commercial-jet manufacturer by revenue and has some 18,000 employees. It is best known for making regional jets in the 70- to 100-seat range, which are heavily used on routes where demand doesn't warrant use of larger Boeing or Airbus planes. Its new E2 jet can carry up to 140 passengers.

Boeing's smallest jet has around 130 seats. The company hadn't previously indicated interest in smaller planes. Embraer's defense offerings include the A-29 Super Tucano

light-attack and advanced trainer aircraft and the KC-390 military cargo plane, which is marketed by Boeing as part of their joint venture.

Embraer also makes systems for border monitoring and surveillance.

Airbus recently announced plans to take a majority stake in Bombardier's single-aisle CSeries jetliner, a struggling program that the European company thinks could have big potential.

That proposed deal comes amid a trade dispute between the U.S. and Canada over alleged state subsidies to Bombardier and would intensify competition between Airbus and Boeing. Boeing opposed the Airbus move, calling it "a questionable deal between two heavily state-subsidized competitors to skirt the recent findings of the U.S. government."

The Commerce Department has proposed slapping Bombardier with a tariff that would quadruple the price of a CSeries aircraft in the U.S. after Boeing complained of predatory pricing and state subsidies. A final decision is expected next year. Brazil has also challenged Canada's support for Bombardier before the World Trade Organization.

Embraer was founded in 1969 with help from the Brazilian government. When the government privatized the company in 1994, Embraer was unprofitable and saddled with over $200 million in debt.

Boeing, based in Chicago, is the world's largest aerospace company with a market value of about $176 billion. It makes commercial jetliners and defense, space and security systems as well as military aircraft, weapons, satellites and helicopters.

Buying Embraer would also increase Boeing's exposure to the market for business jets, which has been under pressure from sluggish sales since the financial crisis.

Under Chief Executive Dennis Muilenburg, Boeing has been cutting costs, in-sourcing more manufacturing and reducing pension liabilities. Its shares have soared this year as it has boosted cash generation and pledged to return $18 billion to stockholders over the next two years via buybacks.

It is expected to be one of the largest beneficiaries of tax reform, with analysts forecasting its effective tax rate will drop 10 percentage points to the upper teens. Some deal makers have speculated that companies that benefit from tax reform could earmark the proceeds for mergers and acquisitions.

—Ben Dummett, Doug Cameron and Robert Wall contributed to this article.

Write to Dana Mattioli at dana.mattioli@wsj.com, Dana Cimilluca at dana.cimilluca@wsj.com and Liz Hoffman at liz.hoffman@wsj.com

Appeared in the December 22, 2017, print edition as 'Boeing Is In Talks To Buy Embraer.'

Exhibit 6

BUSINESS INSIDER

How the Boeing jet no one wanted became the plane airlines scour the planet for

BENJAMIN ZHANG
DEC. 3, 2017, 9:53 AM

A Delta Air Lines Boeing 717-200.

Flickr/Tomás Del Coro

- **The Boeing 717-200 went out of production in 2006.**
- **Only 156 of the planes have been built.**
- **A decade later, the airlines that operate the 717 want more of them.**

On May 23, 2006, Boeing delivered the last two 717-200 jetliners to customers at its Long Beach, California factory. It marked to the end of a program filled with promise but that had ultimately failed to capture the interest of airlines. Even Boeing's well-oiled sales operation could only manage to muster up 156 orders for the little 100-seat, short-haul-airliner.

Currently, the 717 is operated primarily by four airlines; Delta, Hawaiian, Qantas, and Spanish low-cost carrier Volotea. With 91 of the planes in its fleet, Delta is the by far the type's largest operator.

Incredibly, a decade after being axed from Boeing's lineup, airlines are scouring the planet looking for available Boeing 717s.

"These guys keep begging me to give them more 717s," Dinesh Keskar, Boeing's senior vice president of sales for the Asia Pacific and India, told Business Insider. "But that era over and it's not going to happen."

So how did a plane Boeing couldn't sell become an aircraft that airlines can't get enough of?

The difficult life of the 717

Well, there are several reasons, but first some background. Even though the 717 carries both the Boeing name and company's signature 7X7 naming scheme, it's not actually a Boeing. Rub on that Boeing logo with a brillo pad and some soapy water and you'll soon find the words McDonnell Douglas imprinted on the plane.

AP

In 1997, Boeing acquired its long-time rival McDonnell Douglas for $13 billion. At the time, McDonnell Douglas produced the MD-11 widebody and the MD-80/90 narrow-body. Soon after the merger, Boeing phased out all of MD's commercial airliners. But, it spared a new variant of the iconic DC-9 airliner called the MD-95 that was set to enter service in 1999. (The MD-80/90 were also variants of the DC-9.)

To make it fit better into the Boeing's portfolio of products, the MD-95 was rebranded the 717-200.

However, that wasn't enough to convince airlines to buy in.

Even though it carried the Boeing name, it was still a plane designed and engineered by a different company with differing thinking and philosophies. Thus, the 717 was an orphan that didn't belong to any of Boeing's product families.

"We have the 737MAX 7,-8,-9, and -10. We have a family," Keskar said. "You talk to others and they'll tell you that family has a lot of value."

For airlines, there's great financial incentive to have aircraft of varying sizes and roles being operated by the same crew and serviced by the same maintenance teams using the same spare parts.

Even though the McDonnell Douglas DC-9/MD-80/MD-90 still served as the backbone of many major US airlines like American, Northwest, and Delta, none of the big boys would take the bait. In fact, when American acquired Trans World Airlines in 2001, it sold off all of its 717s.

Wikimedia Commons

During the turbulent days of the early 2000s, the airline industry was reeling from the terrorist attacks on 9/11 and spiking fuel prices. Which meant many of the 717's potential customers were either in no financial position to buy any planes or were dumping its aging MD fleet in favor of more fuel-efficient planes like the Boeing 737NG or the Airbus A320.

Interestingly, the people who did buy the plane loves them.

"They're brilliant aircraft. Anyone who has them wants more of them," Qantas CEO Alan Joyce told Business Insider.

And Hawaiian Airlines CEO Mark Dunkerley echoed those sentiments.

"It's great little secret. For what we do here in Hawaii, there's no better aircraft built today or even on the drawing board."

Delta CEO Ed Bastian also praised the 717 for its durability and reliability during a recent interview with Business Insider.

The rebirth of the 100-seat airliner

As with many things in life, what is old is new again. As the airline industry recovered, demand for air travel boomed while investors ratcheted up the pressure to lower unit costs. The solution; upgauging to bigger planes.

Qantas

As a result, Boeing and Airbus both neglected the 100-150 seat market in favor of bigger, pricier, and higher margin models.

While this was happening, another little phenomenon happened in the airline industry, the regional jet. During the 2000s, Bombardier's CRJ and Embraer's ERJ made their presence felt in a big way by offering small 50-70 seat regional jets that allowed airlines and their regional partners to serve routes traditionally operated by turboprops with jets.

"Back in 2009 we had over 500 small aircraft," Bastian said. "The CRJ-200 was our predominant fleet type."

Over time, airlines began to upgauge their regional jets with mainline aircraft. That's where the 717 jumps back into the picture.

With around 100-130 seats, the 717 is the perfect size aircraft to take over for regional jets. In fact, Boeing used to market the 717 as the "Full-size airplane for the regional market."

A Delta Connection Bombardier CRJ.

AP

"The 717 is very much about how do we get out of the regional jets," Bastian said. "Customers hated the small regional jets, our employees hated them because they looked at it as an outsourcing of their jobs, and our [investors] hated them because they're fuel inefficient and their ownership costs were escalating."

"Even the regional operators didn't the like them cause they are losing money on it because we had the contracts screwed down pretty low," Bastian added.

With the addition of AirTran Airways' fleet of 88 717s following the low-cost carrier's acquisition by Southwest, Delta was able to drop 200 regional jets from its fleet.

Unfortunately, for Delta or anyone else looking to get their hands on a batch of 717s, they are pretty hard to come by. Delta currently operates roughly 60% of all 717s ever made while Qantas and Hawaiian, the second and third largest operators, have no plans to relinquish their planes anytime soon. And while Volotea's said that they will replace their 17 717s with Airbus A319s, there still aren't that many of the 100-seaters out there.

Flickr/redlegsfan21

Since discontinuing 717, Boeing has also stopped selling the smallest variant of the 737, the 737-600. As a result, the company has abandoned the 100-150 seat market.

That's where a plane like the Bombardier C Series, now under Airbus control, comes into the picture. The CS100 is of a similar size to the Boeing 717, but with much greater range and fuel efficiency.

According to Bastian, Delta's long-term plan is to eventually replace the airline's older 717s with the 75 CS100 jets it has on order.

Two decades after it first flew, the Boeing 717-200 is still going strong. Even though Boeing didn't sell many of them, those that did buy the 717 can't get enough of them. That's a sign of a great plane.

Get the latest Boeing stock price here.

×

Exhibit 7

Flight International

21-27 November 2017

flightglobal.com

DUBAI SHOW REPORT

Dream deal

Emirates opts for 787 over A350 – but what happened to extra A380s?

£3.70


Technology on
the cutting edge
Get the edge. BAE Systems' LinkEdge® provides pilots with tactile cueing thereby enhancing their situational awareness while reducing their workload. A perfect retrofit solution, LinkEdge enhances performance, even on non fly-by-wire aircraft, with minimal impact on systems, controls, and airframes.
Find out more about LinkEdge at www.baesystems.com/flightcontrols
BAE SYSTEMS
INSPIRED WORK

CONTENTS

Volume 192 Number 5613
21-27 NOVEMBER 2017

COVER IMAGE
This shot of Emirates' 100th A380 was provided by BillyPix. Speculation about a follow-on buy at the Dubai air show was short-lived, but it will get more Dreamliners P12

BEHIND THE HEADLINES
The *Flight Daily News* team was busy at the Dubai air show, producing three bumper issues and our 10-page show report (P12). Jon Hemmerdinger covered Air Transat's 30th birthday, in Montreal (P28)

NEXT WEEK TRAINING
We visit Canada's Hercules training facility at Trenton. Plus, don't miss our annual Military Simulators census

NEWS

THIS WEEK

DUBAI AIR SHOW REPORT

AIR TRANSPORT

DEFENCE

New livery for Air Transat on 30th anniversary P28

COVER STORY

FEATURES

REGULARS

Italy seeks partners in developing Mangusta replacement P30. Diamond debuts Dart-450 at Dubai P19

Image of the week

Bell Boeing's V-22 Osprey tiltrotor recently passed a combined 400,000 flight hours since service entry in 2007. Flight Fleets Analyzer records 258 MV-22s as in service with the US Marine Corps and US Navy, and 44 CV-22s (pictured) with the US Air Force Special Operations Command

View more great aviation shots online and in our weekly tablet edition:

flightglobal.com/flight-international

The week in numbers

28%

Flight Dashboard

Q3 operating profit surged to $107m – but Colombian carrier Avianca has warned a recent pilot strike will hit its Q4 results

$80m

Raytheon

Value of a Raytheon contract to supply a telemetry system for the US Navy's new G550 AEW-based range support aircraft

120

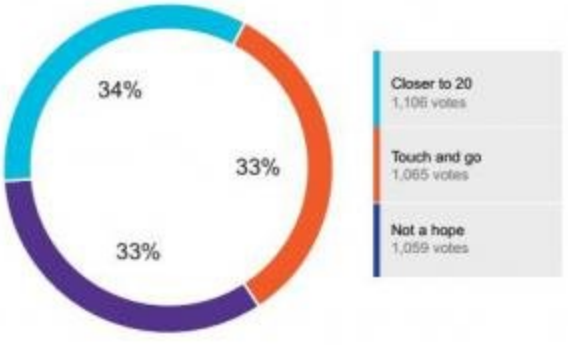
Flight Dashboard

Pratt & Whitney selected to supply PW1100G engines for 60 A320neos for Air China and its Shenzhen Airlines subsidiary

Question of the week

Last week, we asked: **Ten more years of A380 production?**
You said:

Total votes: 3,230



This week, we ask: **F-35 sale to the UAE?**
❑ Would cement closer ties ❑ Not if it buys Sukhois
❑ Israeli opposition will halt deal
Vote at flightglobal.com

Completely bespoke.

AMAC Aerospace is a world leader in Maintenance and Completion services for both narrow and wide-body VIP aviation. Our bespoke handling of VIP maintenance projects is world renowned and our "Return to Service" are world-class for completions.

AMAC's craftspeople and engineers are intelligent and discerning. No completion project is too small or too big. Whether your aircraft is a mid-size jet, narrow/wide-body, we are ready to cater for your every desire with every conceivable material and we welcome the opportunity to serve you.

AMAC AEROSPACE

www.amacaerospace.com

Aircraft interiors EXPO®
10-12 APRIL 2018
HAMBURG MESSE | GERMANY

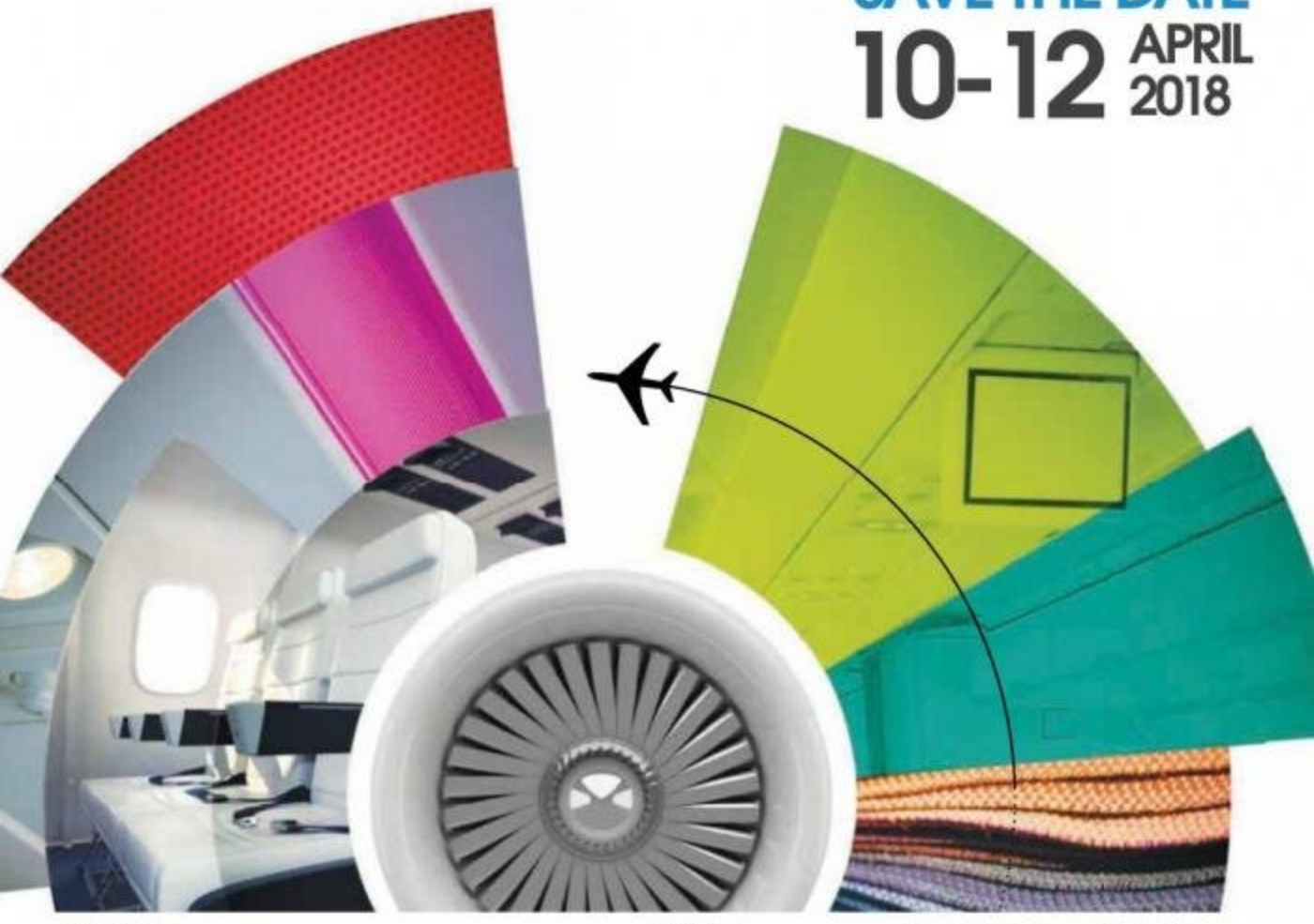
THE DESTINATION FOR THE AIRCRAFT INTERIORS INDUSTRY.

Aircraft Interiors Expo 2018
10-12 April 2018, Hamburg Messe, Germany

Aircraft Interiors Expo is the world's market leader event dedicated to airlines and the supply chain to source the latest innovations, technologies and products for the cabin interiors, inflight entertainment, connectivity and passenger comfort industries.

Register your interest today
www.aircraftinteriorsexpo.com

SAVE THE DATE
10-12 APRIL 2018



Co-located with:
World Travel Catering & Onboard Services EXPO

Organised by:
Reed Exhibitions

In co-operation with:
Hamburg Messe

Supported by:
apex

High stakes

No air show would be complete without a first-day order frenzy, but to concentrate on figures alone misses the underlying face-off taking place between Airbus and Emirates over the A380

To concentrate on the Emirates A380 order saga in anticipation of writing large figures in Dubai air show headlines is to ignore the fascinating high-stakes poker game being played in the background – one involving numbers far greater than a couple of dozen aircraft and a few billions of dollars.

Emirates satisfied those eager for a splash story on the opening day with an agreement for Boeing 787-10s and the unveiling of a luxurious cabin revamp for 777s. It even managed some publicity by proxy as the event began to close, through the huge 737 Max deal reached by partner Flydubai – adding to a sense that Airbus had been left back at the starting gate as far as Dubai's main carrier was concerned.

This is nonsense, of course, because air shows are transient and the absence of a showpiece is hardly evidence of failure when the airline in question has 100 A380s and has expressed, time and again, its devotion for Airbus's double-deck flagship.

At Dubai, Tim Clark appeared both exasperated and baffled over the weak take-up by other airlines

Emirates is passionate about taking the A380 and Airbus is desperate to sell the jet. From the outside, this looks like a shoo-in for both sides, with only the usual fine points to negotiate away.

That is why the real Emirates A380 story at Dubai is not a matter of how many, and how much, but about whether Emirates is calling Airbus's bluff.

Because the airframer has consistently defended the A380, boldly dismissing doubts over its longevity, in the face of an undeniable absence of orders, and asserting that the aircraft, born into the darkness of a global economic slump, is yet to have its dawn.

"I raise your 10 years"

By seeking a guarantee over A380 production for 10-15 years after completing its current orders – effectively the mid-2030s or beyond – the airline is asking Airbus whether the certainty it expresses to the press about future sales is echoed in its own boardroom.

At the Dubai show, Emirates president Tim Clark appeared both exasperated and baffled over the weak take-up by other airlines, and evoked Airbus's own reasoning about traffic forecasts and airport congestion by suggesting that reluctant carriers are engaged in dangerously short-term thinking. Clark has promoted the A380 relentlessly and argues, convincingly, that the airline has marketed the aircraft as much as Airbus – perhaps even more.

Airbus and Emirates, for now, are the only two realistic players seated at the A380 card table. That much is obvious. Less so is which of the two has greater faith in the jet. ■

See Show Report P12

35-alive

A Lockheed Martin F-22 Raptor and a Sukhoi Su-35 shared a common runway ramp for the first time at the Dubai air show.

As reports heat up of a budding competition between the Su-35 and the Lockheed F-35 for a United Arab Emirates air force contract, that unlikely pairing at Al Maktoum International seemed appropriate.

The UAE has long made known its interest in the capabilities that the F-35 brings to the table. More recently, Russia has claimed the Su-35 is under active consideration and in February signed an agreement with Abu Dhabi to study next-generation fighter concepts.

For its part, the US government appears uncomfortable with these developments. A top US Air Force commander bristled when asked about the possibility of the two jets operating side by side.

Since the apparent demise of a Russo-Indian pact to develop a variant of the Su-57, the F-35 has held a monopoly on exportable fifth-generation capabilities. No doubt, Washington would like to keep it that way.

What the UAE's true intentions with the Russians are is unclear. Is it simply a negotiating ploy to extract better terms from Washington? Or is it part of a larger geopolitical manoeuvre to offset Russia's Iran-centric approach to the region? Or perhaps a little of both?

In any event, the unfolding fighter competition in Abu Dhabi bears watching. ■

See Show Report P12

For insight and analysis of the latest developments in the defence sector, visit: flightglobal.com/defence

BRIEFING

INVESTIGATORS PROBE FLYBE NOSE LANDING

SAFETY One passenger received hospital treatment after a 10 November landing incident at Belfast International airport in Northern Ireland involving a Bombardier Q400 operated by UK carrier Flybe. The aircraft, with 57 passengers and crew, landed with its nose-gear not properly deployed, after an approach to runway 25. UK investigators are probing the incident.

EASYJET PICKS TUI CHIEF FOR TOP JOB

MANAGEMENT UK low-cost carrier EasyJet has appointed TUI Group executive Johan Lundgren as its chief executive, to succeed Carolyn McCall from 1 December. Lundgren has spent the past 12 years with the travel operator, serving as group deputy chief and chief executive for mainstream markets.

FIRST C919 ARRIVES AT XIAN TEST SITE

PROGRAMME Comac has flown its first C919 prototype to Xian, marking the start of the next phase in its flight-test and certification campaign. Aircraft B-001A departed Shanghai Pudong International airport on 10 November, completing the 700nm (1,300km) flight in 2h 24min at up to Mach 0.74.

EVA RECEIVES ITS FIRST 777 FREIGHTER

DELIVERY EVA Air has taken delivery of its first Boeing 777 Freighter, and will put the aircraft on services between Asia and North America from late this month, via a technical stop in Anchorage. The Taiwanese operator has another four GE Aviation GE90-powered 777Fs on order, for delivery by 2019.

STAFF SHAKE-UP SOLVES RYANAIR ROSTER ROW

OPERATIONS Ryanair insists it will not experience any further disruption to its operations because of a lack of available pilots, after implementing measures to fix its crew rostering scheme. It has reintroduced a four-week rota as standard, introduced new pay and conditions and is recruiting additional flightcrew.

KUCKO TAKES HELM AT GULF AIR

APPOINTMENT Ex-Croatia Airlines head Kresimir Kucko took the post of Gulf Air chief executive on 12 November, replacing Maher Salman Al Musallam, who left earlier this year. He will oversee the Bahraini flag-carrier's fleet renewal, with 29 Airbus A320neo-family jets and 10 Bombardier CS100s to arrive.

US NAVY DETAILS SUPER HORNET SHORTAGE

READINESS The US Navy's commander of naval air forces, Vice Adm Mike Shoemaker, says the routine "cannibalisation" of parts is affecting readiness. "At the beginning of October, in our [Boeing F/A-18E/F] Super Hornet community alone, only half of our total inventory of 542 aircraft were flyable. Only 31% were fully mission capable and ready to 'fight tonight'."

A400M GEARBOX FIX SLIPS INTO 2018

PROPULSION Work to clear a permanent propeller gearbox (PGB) fix for the Airbus Defence & Space A400M transport will take longer than expected, Europrop International confirms. The engine consortium had targeted approval for modifications to the TP400-D6's Avio Aero-supplied PGB in the third quarter, but is now aiming for certification "at the beginning of 2018".

See Feature P42

Gulf state's inventory of French-built type comprises 65 examples

PROCUREMENT **CRAIG HOYLE** LONDON

Modernisation for UAE's fighter fleet

Nation intends to upgrade its Mirage 2000-9s and F-16s as air force responds to new mission requirements in region

While its years-long search for a future fighter continues, the United Arab Emirates has revealed a plan to modernise its in-service fleet of French- and US-supplied combat aircraft.

During the Dubai air show on 14 November, Dassault confirmed that the UAE's armed forces "have announced their intention to sign a contract for the upgrade of their Mirage 2000-9 fleet".

The company declines to provide further information, but says it "welcomes this decision, and is grateful to the UAE authorities for their trust". It also points to the single-engined fighter's "high-quality participation in international coalition operations".

"The Mirage 2000-9 has proven through time it is one of the best aircraft there is in the operational field," the UAE defence ministry tells FlightGlobal. "The upgrade is to fulfil mission needs and requirements, which have changed based on what is going on in the [Middle East] area. It requires new technologies to be able to operate the aircraft."

Avionics supplier Thales stands to benefit from the prospective contract, having supplied equipment including its radar, mission computer, electronic warfare systems, cockpit displays and helmet-mounted cueing technology.

Flight Fleets Analyzer shows the UAE air force has an active fleet of 55 Mirage 2000-9s, including 14 trainers, plus 10 earlier-generation Mirage 2000s. The assets are aged between 13 and 28 years.

Also at the show, the UAE announced a $1.6 billion deal for Lockheed to upgrade the capabilities of its almost 80 F-16E/F combat aircraft. The potential modernisation activity was first detailed by the US Defense Security Cooperation Agency in January 2014, when the UAE was also considering the acquisition of 30 additional aircraft in a new Block 61 configuration.

Meanwhile, the UAE will also update its medium transport capabilities, with a new fleet of five Airbus Defence & Space C295s to enter service from the fourth quarter of 2018.

Flight Fleets Analyzer shows the service as currently using six of the earlier-generation CN235, with these aged between 23 and 24 years. ■

Additional reporting by Stephen Trimble in Dubai

See Show Report P12

777X maintains its progress, reaching key design sign-off
This Week P10

ANALYSIS **STEPHEN TRIMBLE** DUBAI

Orders fly on Dubai's penultimate day

Airbus claims victory over rival after flurry of narrowbody deals make up for failure to bag Emirates A380 commitment

Despite a reputation for calm, the biggest orders at the Dubai air show were saved for the usually quiet penultimate day, with Airbus and Boeing unveiling blockbuster commitments valued at a combined $76.5 billion at list prices.

Airbus struck first with a $49.5 billion tentative order from Phoenix-based US investment firm Indigo Partners for 430 A320neo-family aircraft to distribute to four airlines under its control.

Within an hour, Boeing had hit back, unveiling a $27 billion agreement with local carrier Flydubai for 175 737 Max aircraft, plus purchase rights for another 50. More than 50 of the first 175 aircraft will be 737 Max 10s, with the remainder -8s and -9s.

The last-minute splurge left some industry observers calling for perspective – and drawing attention to the non-contractual nature of the commitments and delivery timelines starting in four years and stretching nearly a decade into the future.

"It's nothing new to see very large orders," says Aengus Kelly, chief executive of Irish aircraft lessor AerCap. "However, the devil's in the details. Are they firm? Are they commitments? Are they memoranda of understanding? How many of them, when they go to contract, will be firm? And when will they be delivered? Some can be more than a decade away. So you're not necessarily looking at the marketplace today."

Indeed, the commitments announced by Airbus have scheduled deliveries to the four Indigo-linked carriers – Frontier Airlines, JetSmart, Volaris and Wizz Air – from 2021 to 2027.

The Dubai event marked possibly the final show appearance by Airbus chief operating officer for customers John Leahy, who plans to firm the Indigo order before he retires at year-end.

Indigo managing partner Bill Franke says Leahy's timeline sets an "aggressive" schedule, but it will try to meet the December target. Franke also highlights the dramatic scale of the commitment, as it dwarfs the existing 230-strong combined fleet of the four airlines, Flight Fleets Analyzer records. Prior to the new orders, the combined orderbooks of the four carriers totalled just 247 narrowbodies.

In one swoop, the Indigo deal allowed Airbus to claim that it won the orders and commitments race with Boeing in Dubai, a recovery of sorts after a bruising first day, when Emirates agreed to take 40 787-9s and failed to place an anticipated follow-on order for A380s. ■

See Show Report P12

> "Some [deliveries] can be over a decade away. So you're not necessarily looking at today's marketplace"
>
> **Aengus Kelly**
> Chief executive, AerCap

Duabi air show commitments

Customer	Aircraft	Quantity	Type
Indigo Partners	A320neo	430	MoU
Flydubai	737 Max	175	MoU
CDB Aviation Lease Finance	A320neo	90	Order
Emirates	787-10	40	Order
Golden Falcon Aviation*	A320neo	25	MoU
ALAFCO	737 Max	20	Order
EgyptAir	CS300	12	MoU
SCAT	737 Max	6	Order
Azerbaijan Airlines	787**	5	Order
Nordic Aviation Capital	Q400	2	Order
Air Senegal	A330neo	2	MoU
Total		**807**	

Source: Flight Fleets Analyzer Notes: *For Wataniya Airways **Variant to be determined

PROGRAMME **ELLIS TAYLOR** DUBAI

C-2 pitched to take up the labours of Hercules

Kawasaki Heavy Industries gave a Dubai air show debut to its C-2 tactical transport as it targets export sales of the twinjet.

Powered by a pair of GE Aviation CF6 engines, the aircraft has been developed as a successor to the Kawasaki C-1 for both strategic and tactical airlift missions.

With a 15.6m (51ft)-long cargo compartment, the C-2 is able to carry a maximum payload of 36t over 2,430nm (4,500km); its ferry range is 5,300nm.

"The C-2's capacity sits just in the middle of the [Lockheed Martin] C-130 and the [Boeing] C-17," says Col Tokukazu Omine, programme manager at Japan's Acquisition, Technology and Logistics Agency. "We are quite proud of its capability."

Development of the transport started in 2001, and was completed this March. Tokyo has contracted Kawasaki to produce 11 C-2s, of which four have been delivered to the Japan Air Self-Defence Force.

Omine says the four aircraft are now undergoing operational trials, including reliability tests, paradrops and tactical missions; full operational capability is expected in 2018.

With Japan's government clearing the way to start defence exports, Kawasaki is keen to tap into the market for C-130 replacements, or for countries requiring a larger strategic airlift capability.

New Zealand and the United Arab Emirates are expected to be strong prospects for sales. However, Omine declines to name specific nations.

He adds that a "variety of countries" have expressed interest in the type, including a number of C-130 operators. ■

Four examples of tactical transport are undergoing operational trials

For more show coverage, images and news from Dubai 2017 visit flightglobal.com/dubai

PROGRAMME **STEPHEN TRIMBLE** DUBAI

777X maintains its progress, reaching key design sign-off

Suppliers now in advanced stages of structure production, with Boeing having hit 90% engineering drawing release

First flight of the GE9X-powered widebody twin is scheduled for 2019

Boeing reached the 90% engineering drawing release milestone for the 777-9 on 7 November, vice-president and 777X general manager Eric Lindblad has disclosed.

The key event within Boeing's engineering system signals that suppliers are now in the advanced stages of production of the parts for the first aircraft.

As expected, progress on refining the design of the primary structure is outpacing that of the aircraft's systems.

Ninety-nine percent of the wing drawings and 98% of the fuselage drawings are now released, Lindblad says, while the systems drawings are on track to support Boeing's schedule.

So far, five GE Aviation GE9X engines have been run on test stands, and Boeing is "satisfied" with the propulsion system's performance to date, Lindblad says.

Boeing also unveiled the 777X flightdeck layout at the Dubai air show. As expected, the design is close to the cockpit of the 787, with head-up and large-format, head-down displays.

The differences between the 777X and the 787 flightdeck are few, but significant. The 787's cursor control devices are replaced by touchscreen displays.

The cockpit panels also include detents for raising and lowering the 777X's folding wingtips in automatic or manual modes, Lindblad says.

Separately, 777-9 launch operator Emirates Airline has begun detailing systems for its 150 widebody twins. In the cockpit, it will utilise Rockwell Collins' head-up guidance system, for both the pilot and co-pilot.

The carrier has also extended a pact with Thales to enable the addition of Inmarsat's GX Aviation high-speed broadband. ■

CABIN **DAVID KAMINSKI-MORROW** DUBAI

Life gets sweeter in first class, as Emirates upgrades -300ERs

Suites are to be added across Emirates Airlines' incoming fleet of Boeing 777-300ERs, effectively a precursor to the cabin which will feature on its new 777X from 2020.

Emirates has a single -300ER fitted with the cabin and will install the suites, six per aircraft, on around half a dozen of the 15 -300ERs still to be delivered, although the carrier has yet to decide the extent to which it might retrofit the current fleet.

Airline president Tim Clark says the suites were inspired by its private Airbus ACJ319, and follows a relaxing of criteria allowing the use of enclosed compartments.

"The regulators [initially] wouldn't let us do that," he says, adding that the airline has faced "multiple challenges" ensuring compliance with requirements on lighting and emergency evacuation. Such is the width of the suite that Emirates has adopted a 1-1-1 configuration, but the centre suite will feature artificial windows that will receive a live image transmission from external cameras.

Emirates is working to revamp the first-class suites on its Airbus A380s, but says first-class accommodation on the type would fall as a result. Clark describes the version as a "work in progress". ■

DEVELOPMENT **DAVID KAMINSKI-MORROW** DUBAI

Beluga XL preparing for power-on by year's end

Airbus is aiming to fly the first Beluga XL outsize transport in the third quarter of 2018, and achieve power-on before the end of this year.

It will undertake a 10-month flight-test campaign before entering service with the company's specialist Airbus Transport International arm.

Current work involves mating the aircraft's vertical fin and tailcone

Just a single aircraft will be used for the campaign. This initial airframe will be fitted with an assortment of flight-test instrumentation.

Airbus states that the attachment of the main freight door of the A330-based aircraft will begin in mid-November.

It says assembly of the Beluga XL is "progressing well" following the introduction of the major structures to the Toulouse line.

The manufacturer has been mating sections for the horizontal stabiliser – including its outboard vertical surfaces – as well as the vertical fin and tail cone.

> A single aircraft will be used for the campaign. This will be fitted with an assortment of flight-test instrumentation

Airbus says the initial airframe is also undergoing electrical and mechanical systems installation, while integration work on a second Beluga XL is set to begin "soon". ■

Dubai 2017
Show Report P12

PRODUCTION **STEPHEN TRIMBLE** DUBAI

Leap output jumps as recovery spins up

Engine manufacturer CFM accelerates deliveries to 20 per month while also battling high-pressure turbine coating issue

CFM International expects to close a delivery gap for the Leap-1 engine family by the second quarter of 2018 as the manufacturer works to address a spreading technical problem within the engine.

Executive vice-president Allen Paxson acknowledges that CFM is behind schedule on deliveries, slowing planned production ramp-ups for the Airbus A320neo and Boeing 737 Max families.

But the engine maker has started to recover lost ground in recent weeks, he says. CFM reached a delivery pace of 20 engines per week during October – an output level not scheduled to be achieved until the second quarter of 2018.

The acceleration is needed, however, for CFM to catch up with the planned rate of deliveries after falling behind earlier this year, as the 737 Max 8 entered service in May, about nine months after the debut of the Leap-powered A320neo.

As CFM races to catch up on Leap deliveries, it is also tackling a new problem with the coatings in the ceramic matrix composite (CMC) shrouds of the -1A's high-pressure turbine (HPT). So far, CFM has removed 12 engines from the operational fleet that exhibit signs of coatings peeling prematurely.

The problem is not a safety concern, but does increase the exhaust gas temperatures in the HPT module by more than 10%, Paxson says. Such temperatures fall within CFM's margin, but could cause the CMC materials to wear prematurely over several years.

CFM plans to introduce an improved coating for the shrouds into the production system starting in January.

Of the 12 engines already removed, five have been returned to service with a new application of the existing coating chemistry. ■

In total, 12 of the -1A powerplants have been removed for upgrade

DELIVERY

Polished performance from first BBJ2

Poland's government has taken delivery of the first executive Boeing 737-800 intended to serve as an official state transport. Three of the BBJ2 business jets are due to arrive by 2020 under a $523 million agreement. Polish defence minister Antoni Macierewicz attended the ceremony as the aircraft arrived at Warsaw Chopin airport. The ministry says the aircraft was manufactured in April, and its delivery follows that of two Gulfstream G550 business jets. Warsaw's BBJ2 features a VIP salon and business area for 12 passengers, and an economy section with 48 seats.

For more show coverage, images and news from Dubai 2017 visit flightglobal.com/dubai

DUBAI 2017

Flag-carrier Emirates may have suffered a small dip in its three decade-long ascent this year, as political and economic turbulence hit the big three Gulf airlines. However, Dubai remains an undisputed nexus of aviation, its airport the busiest international gateway in the world and its air show one of the big four in the biennial calendar. While Emirates dominated the headlines, there was an appearance of the CSeries from a rejuvenated Bombardier, speculation over the United Arab Emirates' fighter requirement, and plenty of kit on show – military, commercial and general aviation. Aaron Chong, Leigh Giangreco, David Kaminski-Morrow, Murdo Morrison, Niall O'Keeffe, Dominic Perry, Kate Sarsfield, Ellis Taylor and Stephen Trimble report. Images by BillyPix

WIDEBODIES

'Stellar economics' propelled Emirates to sign Dream deal

Dubai flag carrier orders 40 787-10s after engine performance concerns are overcome

Emirates Airline appears to have shrugged off initial concerns over the performance capabilities of the Boeing 787-10 in the hot-weather conditions of Dubai, after agreeing to take 40 of the type from 2022.

President Tim Clark had previously expressed doubts that the aircraft would be able to meet maximum take-off weights, and therefore be unsuitable for the airline's payload-range requirements.

"I think things have moved on," he says, indicating that the agreement is not conditional on technological performance enhancements to the engines. "I don't like thrust bumps anyway."

He had referred three years ago to an engine specification of 70,000-72,000lb-thrust (311-320kN), although GE Aviation's GEnx-1B76 for the 787-10, as well as Rolls-Royce's new Trent 1000-TEN, are rated at more than 76,000lb-thrust. No engine selection has yet been disclosed.

The early margins released when the 787-9 emerged subsequently transformed into "stellar economics", Clark points out, and he is confident the airline will not face operational limitations. He signals that the 787-10 would be used on 7-8.5h sectors where the carrier is looking to raise frequency.

Clark views the 787-10 as a successor to the carrier's R-R-powered 777-300s which, he says, had excellent seat-mile costs. "It was still a hugely profitable aircraft because [Boeing] got it right in the performance box," he says.

FLEXIBLE FUTURE

"We don't need maximum take-off weight to do the missions of the 777-8 and -9," he adds, referring to the future 777X deliveries. "We'll be able to operate at de-rates."

Emirates' commitment to the 787-10s – which includes flexibility on delivery dates, 787 variants and the possibility of additional aircraft – has effectively closed the window on the Airbus A350-900, which had been in contention, despite Emirates' high-profile cancellation of 70 A350s three years ago.

> "[The 777-300] was still a hugely profitable aircraft because [Boeing] got it right in the performance box"
>
> Tim Clark
> President, Emirates Airline

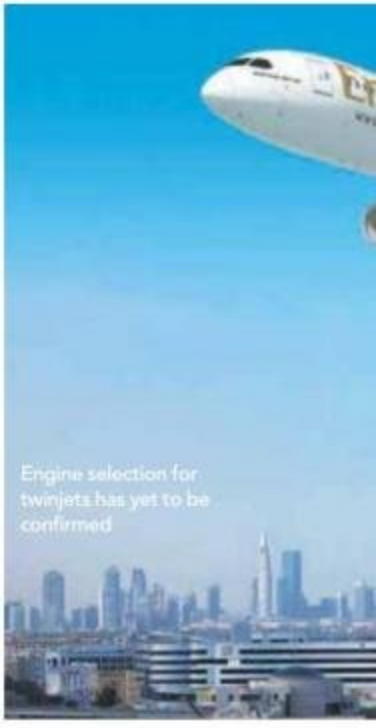
"Never say never," he says, in reference to the A350, but the expression strongly suggests the carrier does not foresee an opening for the twinjet.

Clark suggests Airbus missed an opportunity to improve the A350-900's chances of swaying the decision. He says he looked at the aircraft when Airbus was showing a 10-abreast economy layout, and observed several modifications to the interior – changes to the galley and movement of bulkheads – which opened additional space.

"It was quite a shock to me," he says, claiming he "didn't know about it" – even though the -900 was competing for the Emirates fleet deal – and had asked at the time: "Why didn't you tell me?"

By this point, says Clark, it was a "bit late" to change Emirates' analysis. But he says the -900 is a "more marketable aircraft" as a result, adding: "It's a pity they didn't get it out sooner."

Airbus still stands to gain a follow-on order for A380s from Emirates, but the two sides are continuing a chicken-and-egg wrangle over commitments to the double-deck aircraft's production line.



Engine selection for twinjets has yet to be confirmed

Emirates' owners have yet to be sufficiently assured that Airbus will keep building the A380 – even though the airline, which is virtually carrying the production line single-handed, naturally has substantial influence on the line's longevity.

In addition, Clark is not particu-

WE HAD IT COVERED

We published three editions of *Flight Daily News* during the show. To read the digital versions – which include items such as our Hall Highlights spreads and some stunning show photography – go to **flightglobal.com/dubai**

NEGOTIATIONS

Clark seeks A380 production guarantee

The fluidity of negotiations between Airbus and Emirates on a follow-on A380 deal became embarrassingly clear on the opening day of the show, when an event that was widely expected to focus on an order for the double-deckers instead turned into a Boeing publicity coup as Emirates chairman Sheikh Ahmed bin Saeed Al-Maktoum detailed only the 787-10 agreement.

This surprised onlookers – and a number of Boeing representatives, having attended in expectation of an Airbus revelation, expressing mild bewilderment as the event closed without a mention of their competitor.

Emirates president Tim Clark explains that the carrier is pressing for undertakings that the A380 line will continue for 10-15 years, adding that the airline's ownership is "concerned" that further commitments should "not be [put] at risk" if the line is discontinued.

"I don't believe that [commitment] would be difficult for Airbus to deliver," Clark says, adding that Emirates' backlog of 42 aircraft is already supporting the continuation of the line to the "middle of next decade".

"If it's an Emirates order that sustains the line, so be it," he says.

Airbus has 58 of the type on backlog from other customers, but for some 40 of these there is little evidence of any move towards manufacture.

The airframer has slashed production rates on the type and Clark indicates that the carrier's owners are sensitive to the overall perception of the A380's situation and prospects.

"It remains our flagship," he says. "It's a huge profit-earner for us – the loss of which would be significant." ■

larly enthused by the A380plus upgrades unveiled at the Paris air show this year, stating that while the aircraft offers "small percentages" of improvement, he is "not really" a fan – seeing little benefit to Emirates in the 11-abreast seating or redesigned staircase.

"We'd rather they just offer continuation of the line, flesh out the order, then went [back to] development," he says, adding that the A380 is a "fundamentally good" aircraft which Airbus needs to promote to carriers which have the "same aspiration" as Emirates.

SEATING CHOICES

He stresses that the aircraft's current configuration works for the carrier and suggests that additional seats only make sense if airline managers believe they can fill them. Clark says he has "not been impressed" by the choices some carriers have made for their A380 cabins, and adds that he believes Airbus specialists already know how to improve the aircraft without raising seat-counts.

> "We'd rather they just offer continuation of the [A380] line, flesh out the order, then went [back to] development"
>
> Tim Clark
> President, Emirates Airline

Emirates is currently taking delivery of Trent 900-powered A380s. While Clark says he "might contemplate talking to both sides" in the event of a follow-on order, he believes a "revitalisation" of the line would help bring the "big players" together and trigger efforts to improve the aircraft's capabilities.

Clark appears confident that the two sides will eventually reach an agreement. "We need to have that undertaking," he says. "I believe Airbus will deliver that undertaking." ■

For more show coverage, images and news from Dubai 2017 visit flightglobal.com/dubai

DEFENCE

F-35 sale could be scuppered by Russia deal

The US government is discussing the potential sale of Lockheed Martin F-35s to the United Arab Emirates, although a separate agreement between Abu Dhabi and Russia has raised doubts over any future Joint Strike Fighter acquisition.

After the Obama administration pushed back on a previous request from the UAE, the possibility of an F-35 sale appears to have gained renewed traction under President Donald Trump.

Gen Stephen Wilson, the US Air Force's vice chief of staff, speaking at a conference on the eve of the show, confirmed news reports that preliminary discussions with the UAE have taken place.

> "Discussions are ongoing on selling the F-35 to partner nations that need it"
>
> Gen Stephen Wilson
> Vice chief of staff, US Air Force

"As you look here in the Middle East, they share common threats and so we're looking at options on with whom we share those [F-35s] within the Gulf," Wilson says. "So the discussions are ongoing now with the new administration on selling F-35s to partner nations that need them and require them."

However, in February, Abu Dhabi signed a memorandum of understanding with Moscow to develop a fifth-generation fighter, potentially hindering any F-35 sale. In addition, Russia's United Aircraft remains hopeful over the sale of Sukhoi Su-35s to the UAE.

Wilson declines to comment on the issue, but at the same event, Lt Gen Jeffrey Harrigian, USAF head of Central Command, expressed doubts about the interoperability of the two aircraft types.

Israeli objections could also quash any potential deal with the UAE for the F-35. ■

MANUFACTURING

Cromer 'confident' that new US factory will not face tariffs

Head of Canadian airframer's commercial aircraft operation bullish on CSeries rescue plan

Bombardier intends to start building a $300 million aircraft factory in Alabama immediately after the CSeries programme's sale to Airbus closes – and CS100s delivered to US customers from that facility will not be subject to any import fees, predicts the president of the Canadian airframer's commercial aircraft unit, Fred Cromer.

His comments directly challenge Boeing's firm stance that all CS100s acquired by Delta Air Lines under a 2016 contract should be subject to any tariff imposed by the US Department of Commerce, regardless of where the aircraft are assembled.

"We're pretty confident that airplanes that are produced in the USA with the amount of US content that's already on the aircraft will give us access to that market without the tariffs," says Cromer.

In a thinly veiled jab at Boeing's globally distributed supply chain for aircraft such as the 787, Cromer notes that more than half of a US-assembled CSeries will come from local suppliers.

"I would challenge other aircraft programmes, even some of those built in the US, to demonstrate that they have that much US presence," Cromer says.

In early October, Airbus reached an agreement to acquire a majority stake in the CSeries. As part of the deal, Bombardier will fund a second CSeries assembly line alongside Airbus's A320 plant in Mobile, Alabama.

Bombardier received additional good news in Dubai, with Air Baltic committing to operate an all-CSeries fleet, as well as securing a letter of intent from EgyptAir for up to 24 CS300s, with the deal expected to be finalised by year-end. ■

Air Baltic plans to operate exclusively Bombardier narrowbody fleet

MODIFICATION

Armed C295 packs additional punch

Airbus Defence & Space is seeing strong interest from Middle Eastern and North African nations for a heavily armed variant of its C295 tactical transport.

The manufacturer will soon deliver the first two "light weaponised" versions of the C295 to an unnamed customer. In that guise, the twin-turboprop is fitted with a palletised mission console, multi-mode radar, machine guns mounted at the rear paratroop doors, and an electro-optical/infrared (EO/IR) turret.

At Dubai, however, Airbus showed off a range of weapons to be integrated on to the platform, including Roketsan Cirit rockets and L-UMTAS missiles, as well as Terber 82 laser-guided bomb kits. The munitions will be mounted on four hardpoints.

It also showed a Rheinmetall 27mm autocannon and door-gun system, which can be controlled from the fully integrated tactical system within the aircraft. A second EO/IR sensor will allow for both surveillance and weapons targeting.

Ground testing is set to begin before summer 2018, with the first flight tests due to start in October of that year. ■

Turboprop will carry range of munitions on four external hardpoints

Another landmark for China.

Congratulations, Air China, on becoming the first airline in China to introduce the LEAP-1B-powered Boeing 737 MAX to your fleet. We're proud to be under your wing.

www.cfmaeroengines.com

CFM International is a 50/50 joint company between GE and Safran Aircraft Engines

LEAP

Extraordinary together

cfm

For more show coverage, images and news from Dubai 2017 visit flightglobal.com/dubai

ORDERS

Going Boeing gives Emirates flexibility

In choosing the biggest 787, the carrier has revived plans to operate a sub-350-seat fleet to open fresh network options

The 40 Boeing 787-10s that Emirates Airline ordered at this year's Dubai air show will provide the carrier with an important new network-development tool when they enter service from 2022.

The Dubai carrier's decision to order the largest Dreamliner variant revives plans to operate a large fleet of sub-350-seaters that were suspended with the cancellation of its Airbus A350 order in 2014.

"We see the 787 as a great complement to our 777 and A380 fleet, providing us with more flexibility to serve a range of destinations as we develop our global route network," says Emirates chairman Sheikh Ahmed bin Saeed Al Maktoum.

The termination of the order for 50 A350-900s and 20 -1000s left the carrier with nothing smaller than the 777-300ER on backlog – an aircraft that seats 354-428 passengers in Emirates' various configurations.

The shift to higher seat-counts became more acute in 2016 when the last of its legacy fleet of A330-200s, A340-300s/500s and 777-200ERs retired. These aircraft seated 237-274 passengers, and their departure left the small sub-fleet of 10 ultra-long-range, 266-seat 777-200LRs as the only below-350-seaters in service with the Gulf carrier.

BEST OPTION

Almost immediately after cancelling its A350 order, Emirates reignited a mid-size widebody evaluation which pitched the A350 against the 787-9/10. Announcing the 787-10 selection, Al Maktoum described the Dreamliner as "the best option", stressing that Emirates' analysis did not focus simply on price.

Emirates says its 787-10s will operate a mix of two- and three-class configurations, seating "between 240 and 330 passengers", and the airline has the right to switch the order to the smaller 787-9 variant. This offers "additional flexibility for its future fleet and global network", Emirates says.

The fact that it highlights the option to switch is significant, as a move to the smaller 787 variant would indicate a return to the strategy of operating lower-capacity widebodies last pursued with its A330-200s.

When talking to FlightGlobal about the new competition in 2014, Emirates Airline president Tim Clark described the 787-10 as a "10h-capable" aircraft, and indicated the airline had a requirement for a widebody able to serve medium-range sectors from Dubai where the focus was on good economics rather than ultimate payload/range performance.

PAYLOAD PROBLEM

However, Clark raised concerns at the time that Dubai's harsh operating environment would prevent the 787-10 as then proposed from being able to carry sufficient payload on critical missions. "The engines are spec'd at 70-72 [thousand pounds thrust], but the conditions we're getting [operating from Dubai means] it can't take the payload," he said in 2014.

Crucially, Emirates is yet to announce its selection between GE Aviation and Rolls-Royce engines to power its 787s.

How Boeing and the engine manufacturers are proposing to tackle these concerns is not clear, but Emirates' decision to place a $15.1 billion commitment at the show indicates that Clark is satisfied now that solutions have been identified. ■

Al Maktoum says the Dreamliners will let Gulf airline access to new destinations as it expands globally

> "We see the 787 as a great complement to our 777 and A380 fleet, providing us with more flexibility"
>
> Sheikh Ahmed bin Saeed Al Maktoum
> Chairman, Emirates Airline

Emirates passenger fleet

	In service	On order	Total	Seating range
A380	100	42	142	489-615
787-10*	0	40	40	240-330
777-200LR	10	0	10	266
777-300	3	0	3	364
777-300ER	130	14	144	354-428
777-8*	0	35	35	350
777-9*	0	115	115	400
Total	**243**	**246**	**489**	

Source: Flight Fleets Analyzer. Notes: *787-10 is a commitment, not firm order, and can be switched to 787-9; *777-8/9 seating estimated

When efficiency matters.

Avanti EVO, a legend reborn.

PIAGGIO AEROSPACE

Experience pioneering efficiency without compromise.

With a single aerodynamic curve and an innovative three lifting surfaces concept, enjoy 30% lower operating costs than comparable jets.

So sit back and relax. You'll be there sooner than you think.

www.piaggioaerospace.it

For more show coverage, images and news from Dubai 2017 visit flightglobal.com/dubai

MANAGEMENT

ATR seeks flexibility from restructuring

Reshaping joint-venture manufacturer's corporate make-up will better prepare it for launch of next-generation turboprop

ATR's top executive has indicated that the Airbus-Leonardo joint venture could be restructured into a limited liability company (LLC) to increase management flexibility and financing options ahead of the potential launch of a larger next-generation turboprop.

The joint-venture partners are now considering a complicated legal restructuring aimed at clarifying ATR management's overlapping relationship with its shareholders, which are also primary suppliers for the ATR 72-600 and 42-600, says chief executive Christian Scherer.

It would also create a legal framework for ATR to accept new investors if a development programme for a larger turboprop moves forward, Scherer notes.

"We do want to run a normal business at the pace of a normal business," he says. "That's what I'm proposing to our shareholders should happen with ATR."

The proposal remains in its infancy. Airbus and Leonardo approved ATR's proposal to study converting the corporate structure from a French business consortium, or GIE, to an LLC. The study has found several complications – including tax and accounting issues – that must be overcome, Scherer acknowledges.

"I cannot say this will take six months [or] a year," he adds. "It takes the time it takes for people to agree. It's certainly not overnight."

For the moment, ATR has time on its side. The manufacturer has lowered output of the turboprop family to 80 deliveries in 2017, although an assembly bottleneck – caused by an undisclosed supplier which is running behind schedule after converting to a new industrial system – threatens to prevent ATR from hitting that target this year, Scherer says.

Regional sales success has come with large commitment from Iran Air

As the manufacturer works its way through that backlog, ATR's joint-venture partners have been at odds over what to do about launching a larger turboprop with a target capacity of 90-100 seats.

Leonardo has a preference for a clean-sheet aircraft featuring new propulsion systems, wing designs and cockpit technology that are available today or in a few years' time.

But Airbus favours a slower approach, with an eye to medium-term introduction of a regional turboprop featuring disruptive technologies, such as a hybrid-electric propulsion system, and new structural materials. ■

SALES

E-Jet E2 will hold its own, says Slattery

Embraer is convinced that its sales team needs no external help to win orders for its re-engined E-Jet E2 line, even when faced with the likely marketing might of Airbus behind rival Bombardier's CSeries.

"Nose to nose, the E2, from an operating perspective, is a superior machine," says John Slattery, chief executive of Embraer Commercial Aviation.

Slattery cites the operating economics of the Embraer 190-E2 and E195-E2 versus the CS100 and CS300, which he argues are better on both a per-seat and per-trip basis. "Under those metrics I believe the E2 will win and maintain, if not grow, its market share," he says.

In fact, argues Slattery, Airbus's reinvigoration of the sales effort for the CSeries – once granted US anti-trust clearance – will stimulate the market, giving the E2 more opportunities in the sub-150-seat sector.

Commercial aircraft boss confident on type's operational advantages

"Once [Airbus] starts marketing that aircraft, my expectation is that the number of campaigns will increase for Embraer."

In the majority of cases, airlines seek multiple bids when acquiring new aircraft, and Embraer is the only credible rival for the CSeries, he says.

Slattery expects orders for the E2 – which have been stuck at 285 units – to "pick up in a meaningful fashion" immediately after certification of the E190-E2 in early 2018. He says more than 80% of that process is complete. ■

AGREEMENTS

Collaborations bring Western firms to region

CAE is partnering with the Saudi National Company of Aviation to open a pilot training centre in Dammam, in one of a number of announcements at the show of collaborations between Western and regional companies.

Qinetiq revealed a joint venture with Middle East General Enterprises to produce two of the UK defence contractor's target drones in the United Arab Emirates, and provide training to operators.

Abu Dhabi's Mubadala is teaming with Honeywell to establish maintenance, repair and overhaul capabilities in the emirate for the US firm's auxiliary power units.

Thales is to set up a "defence service centre" in Abu Dhabi to support its products in use with the UAE armed forces. ■

Bell takes heart from Valor's progress
Show report P20

SUPERSONIC

Boom seeking a power partner

As it works towards service entry in 2023, Boom Supersonic hopes to pick an engine next year to power its developmental 55-passenger airliner and eyes an annual build rate of 100 aircraft.

Company founder and chief executive Blake Scholl says there are "a couple of options in front of us for the production engine".

The start-up is "working through" several possibilities, including a derivative of a current commercial engine or a clean-sheet powerplant for the supersonic airliner.

However, he says it is unlikely that an existing military engine would be selected for the mission. "Certainly that is not our Plan A – there is a level of complexity with export controls," he notes.

Plans disclosed by the company indicate that it will use three non-afterburning, medium-by-pass turbofan engines for the Mach 2.2 airliner.

In addition, Boom will in early 2018 issue a request for proposals covering the location of its future production facility.

The factory will be sized for assembly of up to 100 aircraft per year, says Scholl, against a forecast market of 1,000-2,000 examples over a 10-year period.

Scholl says the operating economics of the supersonic passenger jet will allow a ticket price of about $5,000 on the New York-London route – competitive with current business-class fares.

Boom is hoping to fly its XB-1 one-third-scale demonstrator in 2018 to validate the design and control laws of the full-size airliner. ■

The one-third-scale XB-1 demonstrator is expected to fly next year

Developed as a trainer, Dart-450 could also have a suveillance role

PROGRAMMES

Quartet of Diamonds in sparkling show debuts

Diamond Aircraft had a quartet of aircraft on its Dubai static display – all making a first appearance at the show.

Taking pride of place in the Austrian airframer's line-up was a Dart-450 single-engined turboprop, the first of two examples built so far. Chief executive Christian Dries expects the third prototype to make its debut before year-end. The lead pair are powered by the Ivchenko-Progress/Motor Sich AI-450S engine, while the next aircraft will use a 550hp (410kW) GE Aviation powerplant.

Diamond will deliver its first Dart-450 to an undisclosed buyer shortly in a non-certificated kit version, and plans to hand over the first fully certificated aircraft in 2018.

The tandem-seat aircraft is developed as a civilian and military trainer, and with an endurance of up to 8.5h, Dries also sees a role for the Dart-450 in the surveillance and reconnaissance markets. "We have had so much interest in this product," he says. "We expect it to be Diamond's most successful model ever."

Also making a show debut were the DA50-V five-seater, DA62 piston-twin and MPP multi-mission variant. ■

PRODUCTION

Rostec MC-21 plan is surprise for Irkut

State-owned firm discloses pact to build largest variant of new narrowbody in UAE, despite questions over jet's future

Russian state technology firm Rostec has entered initial discussions over possible joint production, with the United Arab Emirates, of a civil aircraft based on the Irkut MC-21-400.

United Aircraft, Irkut's parent, declines to comment on the deal, but FlightGlobal understands that it was not consulted prior to the announcement.

The -400 is the largest proposed version of the Russian twinjet, which Irkut has envisioned as addressing the 240-seat sector.

But the airframer has concentrated on the -300 variant – the first of which flew in May – and appeared to have backed away from developing the -400 in recent years, citing lack of demand.

Irkut publicly lists the MC-21 family as comprising two versions: the -300 with 163-211 seats and the -200 with 132-165 seats.

But the preliminary UAE pact disclosed at Dubai could involve the resurrection of the -400, with production taking place in the Gulf state; Rostec describes the -400 as a 250-seat aircraft.

"We will create a working group to discuss it further," says Rostec chief executive Sergei Chemezov.

Rostec aircraft leasing subsidiary Aviakapital-Servis is a customer of the MC-21, with orders for up to 85 of the type. But the diversified state firm also has interests in several suppliers to the programme, such as Technodinamika, Khimkompozit, KRET and United Engine, which is developing the Aviadvigatel PD-14 as an alternative powerplant for the twinjet.

Rostec disclosed the initial UAE discussions over the MC-21 partnership following a 12 November meeting with Abu Dhabi crown prince Sheikh Mohammed bin Zayed al-Nahyan, the brother of UAE president Sheikh Khalifa bin Zayed Al Nahyan. ■

For more show coverage, images and news from Dubai 2017 visit flightglobal.com/dubai

PROGRAMME

Bell takes heart from Valor's progress

New tiltrotor on course for maiden sortie within weeks, as airframer prepares for US Army's Future Vertical Lift contest

Although Bell Helicopter's immediate attentions at Dubai were centred on the sale of AH-1Z attack helicopters in the region, back at its Amarillo, Texas facility the focus remains on achieving first flight of its latest rotorcraft.

The airframer plans to perform a maiden sortie of the V-280 Valor tiltrotor before "the end of the autumn", says Vince Tobin, vice-president military business at Bell, ushering in a frantic period of test activity as part of a broader US Army-led effort.

Initially to fly as part of the joint multi-role technology demonstrator programme, Bell hopes the V-280 will then form the basis for the multiservice future vertical lift (FVL) initiative, initially as a replacement for the army's fleet of Sikorsky UH-60 Black Hawks.

Ground runs of the Valor's GE Aviation T64 powerplants have been taking place for the past two months; recent trials have also seen the aircraft rotate its engines between 75°-95°.

"It is restrained on the run stand, so we have actually had both engines turning simultaneously with greater than take-off power through the rotor system," says Tobin. "We like to say that it's actually sling-loading the Earth at the moment."

Initial flights will be confined to low hover manoeuvres, before moving to transitions into airplane mode, and then an expansion of the envelope in airplane mode "by the spring of 2018", says Tobin.

Although the V-280 faces competition for the FVL contract from the co-axial-rotor Sikorsky-Boeing SB-1 Defiant, first flight of the latter has been pushed back into 2018.

While confined by the timeline of any potential future contract, Bell believes it could be in a position to begin the engineering, manufacturing and development phase of any programme of record by 2021, says Tobin.

He says some of the technologies being developed for the Valor, notably the manufacturing processes for the wing, could be adapted for its existing V-22 Osprey tiltrotor if the US Department of Defense chose to launch an upgrade programme for the type. The V-22 is built in partnership with Boeing. ■

Tobin says Osprey could incorporate technologies from the V-280

SALES

Viper could thrive in Middle East's heat

Bell Helicopter is confident that the Middle East can deliver a sales boost across its military product line, with a number of campaigns currently active centred on the AH-1Z Viper attack rotorcraft.

Doug Wolfe, Middle East regional director for military business development, says the AH-1Z is the "most capable, most modern attack helicopter flying today" and is gaining "significant interest" across the Middle East.

The Viper is already in operation with the US Marine Corps, and Bell is hopeful that the Middle East can generate additional sales. So far, Pakistan is the sole export customer for the type, with an order for 12 helicopters.

Wolfe cites the in-built levels of marinisation – "it's built to live on a ship", he says – as a key selling point for the region, where that protection "also works very well in desert environments".

While Wolfe declines to name potential buyers, Bahrain is one obvious sales prospect, and the United Arab Emirates could be another possibility. ■

ROTORCRAFT

Cutillo inherits headaches at Leonardo Helicopters

With five years as the chief financial officer of parent company Leonardo under his belt, Gian Piero Cutillo is now facing up to a new challenge as managing director of its helicopter division.

Cutillo was appointed just five weeks ago and the Dubai show marked his first major exhibition in the new role.

As well as having to deal with a flatlining market for helicopter sales, Leonardo has been battling its own internal problems, which have seen the rotorcraft division – home to the AgustaWestland brand – singled out for poor performance in the company's recent third-quarter financial results.

Although Cutillo concedes that the division needs to improve in some areas to "better answer to the challenge of the market", he believes there is still a strong underlying business.

Leonardo Helicopters will show a year-on-year delivery decline in 2017, he says, as the operation battles not just a segment-wide slump, but production issues driven by "a lack of visibility" in its backlog. "It doesn't allow you to plan production correctly," he says.

That issue has been compounded by "teething troubles" with the production and in-service reliability of its new AW169.

Nonetheless, the Pratt & Whitney Canada PW210A-powered medium-twin has continued to pull in orders, scoring a three-unit deal at the show from Abu Dhabi's Falcon Aviation Services. ■

New managing director spent five years as group finance chief

IL-76MD-90A

A new chapter in the history of military transport aviation in Russia

IL-76MD-90A, which made its maiden flight in 2012, is the latest and most advanced version of the IL-76 family of military transport aircraft. The new IL-76MD-90A is distinguished from its predecessors in modified wing design, advanced avionics suite, PS-90A-76 turbofan engines with a thrust of 16 tons each, reinforced landing gear, upgraded fuel system and dozens of other innovations.

The IL-76MD-90A has become even more powerful, reliable and fuel-efficient. It carries more, flies farther and more accurately. And, it is always ready to perform the most challenging missions anywhere in the world as before.

Max payload - **60 tons**
Range:
with 40 ton payload – **6500 km**
with 60 ton payload – **4000 km**

Approved ICAO CAT II landing conditions
Compliance with the ICAO Annex 16
Chapter 4 noise and emission

more info at
ROE.RU/ENG/

ROSOBORONEXPORT
Russian Defence Export
27 Stromynka str., 107076,
Moscow, Russian Federation
Phone: +7 (495) 534 61 83
Fax: +7 (495) 534 61 53
www.roe.ru

Rosoboronexport is the sole state company in Russia authorized to export the full range of defense and dual-use products, technologies and services. Rosoboronexport accounts for over 85% of Russia's annual arms sales and maintains military-technical cooperation with over 70 countries worldwide.

For more show coverage, images and news from Dubai 2017 visit flightglobal.com/dubai

DEVELOPMENT

TAI jet plan could be trouble for rival

State-run manufacturer proposes 100-seat regional aircraft, but development may cast doubt on SNC's ongoing effort

Turkish Aerospace Industries (TAI) has unveiled ambitious plans for the launch of an all-composite regional airliner within five years as part of a decade-long masterplan.

However, the proposal floated by TAI chief executive Temel Kotil risks scuppering a separate Turkish regional aircraft programme being driven by US firm Sierra Nevada (SNC).

Speaking at the show, Kotil confirmed TAI's interest in the sector. It is examining the potential for a "100-seat-plus" aircraft to be launched in about five years' time, once its existing development programmes have transitioned to serial production and the company has gained sufficient design expertise.

"At that time I'm planning to start a passenger aircraft programme, but not today – I am too busy with defence programmes," says Kotil.

"So there is no room for a passenger machine, but five years later in my hand I will have several hundred well-trained people. And that time, under our 10-year masterplan, we will [start] the passenger aircraft also."

Describing it as a jet-powered aircraft, made from "full composite" material – potentially thermoplastic, rather than thermoset – Kotil says it "should be more efficient than existing narrowbody aircraft, maybe as efficient as the 787 in terms of seat-kilometres".

He adds: "But this is a future project and we cannot start before five years."

TAI's ambitions in the segment may spell the end for plans, outlined by SNC over the past three years, for the development of a family of Turkish-built regional aircraft.

SNC had proposed a dual-track approach to the market following its February 2015 acquisition of 328 Support Services, the type certificate holder for programmes under the Dornier 328 banner.

SNC – via its TRJet subsidiary – intended to develop modernised versions of the Do328 turboprop and jet. It had gone as far as to select Pratt & Whitney Canada as the engine supplier. Further out, it plans bring to market a clean-sheet aircraft with 50-70 seats for service entry in about 2023. But despite great initial fanfare, there has been little further detail released. ■

Airframer intends to build next generation of T129 attack helicopter

STRATEGY

New chief Kotil locks on to growth target

After only a year in post following his October 2016 appointment, Turkish Aerospace Industries' (TAI) chief executive Temel Kotil is targeting ambitious growth to turn the company into a major international player.

Along with its ongoing T129 ATAK attack helicopter, Anka unmanned air vehicle and Hürkuş turboprop trainer, TAI has a number of developments on the go.

These include the T625 intermediate twin-engined helicopter, as well as a number of more ambitious efforts.

TAI recently unveiled its advanced trainer and light attack concept, the Hürjet, and plans to make a decision early next year on the engine for its indigenous fifth-generation fighter, the TF-X. It is also working on the ATAK 2, a heavier variant of its T129, and a 10t general purpose helicopter.

"This will be enough income to turn us into a global player," Kotil says.

The Hürjet trainer is based on the Hürkuş and is designed to serve as a developmental stepping stone towards TF-X. ■

DEFENCE

Calidus joins light-attack fray with B-250 turboprop

Calidus, based in the United Arab Emirates, unveiled its B-250 light-attack aircraft, designed for close-air support and counter-insurgency missions.

The all-new aircraft, powered by a Pratt & Whitney Canada PT6A-68 engine, has been developed over only a two-year period, in conjunction with Brazilian aerospace company Novaer.

Using a carbonfibre airframe, it also features a Rockwell Collins Pro Line Fusion avionics suite.

Bearing a similarity to the Embraer Super Tucano, the B-250 has been designed from the ground up as a strike aircraft, rather than a platform adapted to the role, which Calidus says gives it a major advantage.

Aircraft was developed with Brazilian aerospace company Novaer

The aircraft can be equipped with seven weapons mounted on external hardpoints, along with a podded electro-optical sensor.

Sources close to the company say the aircraft has already generated significant interest. Production is in its early stages at Calidus's facility in Al Ain. ■

FARNBOROUGH
INTERNATIONAL
AIRSHOW
16-22 JULY 2018

The future starts here

Farnborough International Airshow, where a long history rich in pioneering heritage meets cutting edge innovation.

We bring the very best of the aerospace industry together under one roof to support international trade and facilitate business. The show offers unique networking platforms to a wide range of sectors connecting professionals from across the globe.

To book your space visit
www.farnboroughairshow.com/trade

For more show coverage, images and news from Dubai 2017 visit flightglobal.com/dubai

SOME LIKE IT HOT

As temperatures soared at the Al Maktoum International airport site, the world's aerospace industry gathered under the scorching sun to deliver the usual shimmering spectacle

(*From left to right*): Saudi-backed An-132D; Unusual F-22/AWACS combination; V-22 Osprey; gilded Bombardier Global 6000; Beriev Be-200 waterbomber; Leonardo's M-346FA; Su-35 hunting for local sale

FLEET **JAMIE BULLEN** LONDON

Pre-owned A380s prove tempting, as initial retiree lands

Dr Peters discussing sale of ex-SIA superjumbos to British Airways, with first aircraft now in storage at Tarbes facility

BA is interested in adding several second-hand examples to its fleet

German asset manager Dr Peters is in talks with British Airways and other prospects on the potential sale of Airbus A380s as it prepares to receive four of the jets back from lessee Singapore Airlines (SIA).

"We are in discussion with a number of potential buyers, including British Airways and a number of other European flag carriers as well as Asian low-cost airlines," Anselm Gehling, Dr Peters' chief executive, tells FlightGlobal.

"A number of freight companies are also showing interest for freighter conversion, including one of the world's largest cargo shippers." Portuguese wet-lease specialist Hi Fly, which has indicated an interest in the double-deck type, is "also welcome to have discussions with us", Gehling says.

BA declines to comment, but at an Airline Economics Growth Frontiers conference in January 2016, IAG chief executive Willie Walsh raised the prospect of subsidiary BA adding "five or six" second-hand A380s to its 12-strong fleet of new-build examples.

Additionally, Gehling, in a repeat of the comments made by Emirates Airline president Tim Clark at the Dubai air show, calls on Airbus to show clear support for the A380's future.

"I echo his words and think Airbus needs to commit to producing it for a another 10 to 15 years at least, to ensure not only new orders but a secondary market for this aircraft."

Tarbes-Lourdes airport recently received the first Dr Peters A380 (MSN3), which is being placed in storage following its withdrawal from SIA's fleet.

As an interim solution until a buyer is found, Rolls-Royce is paying Dr Peters a fee for the use of the Trent 900 engines, Gehling says.

"We expect this arrangement can be rolled out for the other three SIA A380s we have under management. When we find a buyer, the aircraft will go through a shop maintenance visit and have fully updated engines attached for the new user."

Teardown of the aircraft also remains a possibility, he says, but admits this would be a "sad" outcome.

Dr Peters has nine A380s: Air France is leasing five, while the remainder are operated by SIA. ■

See Show Report P12

PROGRAMME **DAVID KAMINSKI-MORROW** DUBAI

Irkut starts next MC-21 and second waits in wings

Irkut has commenced final assembly of the third prototype MC-21-300, as it prepares to transfer the second to the manufacturer's flight-test arm.

The Russian airframer is expecting to carry out about 1,000 flights during the certification campaign for the Pratt & Whitney PW1400G-powered twinjet.

Irkut says that it is aiming for Russian type certification in mid-2019 and similar approval from the European Aviation Safety Agency in mid-2020.

The MC-21 has been undergoing operational tests for nearly six months, following its maiden flight on 28 May.

Irkut says 20 flights were conducted for early development analysis at its Irkutsk plant, before the aircraft was flown to the flight-test institute at Moscow's Zhukovsky airfield.

Airframer is modifying assembly lines to prepare for serial production

It began test flights from Zhukovsky two weeks later, on 2 November. The aircraft is being housed in a new hangar at the Yakovlev flight-test complex, which features ground-testing and information-exchange capabilities. "Systems are being tested and software is being debugged," says Irkut.

The second aircraft is being prepared for handover to the flight-test division and the third will follow in 2018, it adds.

Irkut is also carrying out certification work on test benches, with testing completed at 22 of the 56 benches in operation.

It is modifying its Irkutsk assembly lines with additional stations to cope with serial production, putting capacity of the line at 20 aircraft per year, and will also complete construction of an MC-21 logistics centre at the plant next year. ■

New livery for transformed Air Transat
Air Transport P28

FLEET **GHIM-LAY YEO** WASHINGTON DC

Azul E-Jet sales fuelling Neo transition

Carrier accelerates disposal of Embraer types to capitalise on A320's greater fuel efficiency for upgauging domestic routes

Brazilian carrier Azul is progressing talks to accelerate the sale of its Embraer E-Jets, in a bid to pull forward deliveries of Airbus A320neos.

David Neeleman, the airline's founder, told investors on an earnings call on 9 November that he hopes to deliver "good news" on that front at the time of its full-year results, scheduled during February 2018.

"We are moving aggressively," says Neeleman, adding that the airline has seen strong demand in the market for used E-Jets. The carrier is in talks with "different entities to sell them quicker and bring on the A320neos quicker", he confirms. "Our commitment is to stay metal-neutral, but we want the more efficient aircraft in our fleet."

The airline should have 17 re-engined narrowbodies by end of 2018

Azul has repeatedly praised the performance of the A320neo since it began revenue service with the type in November 2016. Chief executive John Rodgerson has described the re-engined narrowbody as an "unbelievable fuel machine". The carrier says it has observed a 29% advantage in unit costs on the A320neo over the Embraer 195. The airline is using the A320neo to upgauge domestic routes that were previously operated with the E-Jet.

Azul operates eight A320neos, and will add another three in the fourth quarter of this year. Neeleman says it will introduce seven of the type between November and January, just in time for the high travel season in Brazil. Azul's fleet plan shows that it will be operating 17 A320neos by the end of 2018.

The carrier flies 10 E190s and 60 E195s, and will be the launch operator for Embraer's re-engined E195-E2, which is scheduled for delivery in 2019. ■

MRO **AARON CHONG** SINGAPORE

Ameco Beijing gears up to provide Max support

Air China took delivery of the first of its eight 737-8s early this month

Maintenance, repair and overhaul operator Ameco Beijing has been approved to maintain the Boeing 737 Max 8, and has started work on China's first example.

The company says it is supporting Air China's new 737-8, after receiving approval from the Civil Aviation Administration of China to provide line maintenance, scheduled checks, modifications, engine changes and auxiliary power unit replacements on the re-engined narrowbody.

Ameco's training centre is also the first in China to provide 737 Max training. A first course began at its Beijing headquarters on 6 November, with an intake of 24 mechanics.

Flight Fleets Analyzer shows that Air China operates a fleet of 388 aircraft, including 139 737s and 59 Airbus A330s. The carrier early this month took delivery of its first 737-8, from an initial eight-unit order. ■

TRANSITION **JON HEMMERDINGER** MONTREAL

New livery for transformed Air Transat

Design unveiled on A330-200 is part of major renewal programme launched following investments by Canadian rivals

Canadian leisure carrier Air Transat unveiled its new livery in a ceremony marking the company's 30th anniversary on 13 November in Montreal.

The new design, painted on an Airbus A330-200, comes as the Montreal-based carrier embarks on a major fleet transition where it will retire ageing A310s and acquire new A321LRs.

Newly-painted C-GTSN has a white fuselage bearing the airline's name in blue, and a light blue tail emblazoned with the carrier's star logo, which is also shown on the winglets. It was painted in Rio de Janeiro, with decals added after its return to Canada. The design marks a change from the previous livery, which had a darker tail and a blue star emblem.

The airline – a division of tour company Transat AT – will now begin the process of repainting the other A330s in its fleet.

Air Transat made its inaugural flight on 14 November 1987, from Montreal to Acapulco.

Speaking prior to the anniversary event, chief executive Jean-Marc Eustache described Air Transat as having evolved into an integrated tour operator that owns an airline, hotels and a wide distribution network.

Carrier revealed updated look in 30th anniversary ceremony

He describes Canada's aviation industry as increasingly competitive, but says Air Transat is adapting by updating its fleet with new A321LRs. In July 2017, the carrier announced that it had signed an agreement to lease 10 of the long-range type from AerCap, with deliveries due between early 2019 and the third quarter of 2020.

It later signed a fleet-sharing deal with Thomas Cook whereby the Canadian company will operate some of its partner's A321s during winter, while the latter will use at least one of its A330s.

Air Transat primarily operates two distinct route networks: one connecting major Canadian cities to European leisure destinations, and the other linking Canada to warm-weather destinations in the USA, the Caribbean, Central America and Mexico. It faces competition from rapidly-expanding Air Canada, as well as WestJet, which has announced orders for Boeing 787s as part of an international growth plan. ■

See Feature P32

FLEET

Cockpit commonality drove selection of A321 over new 737s

Pilot commonality led Air Transat to choose Airbus A321s over Boeing 737s, says the carrier's president, Jean-François Lemay.

"The main challenge for an airline is to optimise the utilisation of its heavy assets. So we decided to go with an all-Airbus fleet," he says.

The carrier's fleet includes 14 A330s, seven A310s and a mix of 10 737-700/800s, Flight Fleets Analyzer shows.

Earlier this year, it announced plans to replace the A310s and 737s with a mix of A321s and A321LRs. The A321s could arrive from March 2018, while the first of 10 A321LRs are scheduled for delivery in early 2019.

Lemay says the airline's current mixed fleet of Airbus and Boeing types limits efficiency. Because pilots cannot switch easily between Airbus widebodies and 737s, it typically cannot schedule them to fulfil their full allowable monthly flying hours. Seasonal demands also require some pilots to undergo substantial crossover training, he adds.

By contrast, pilots switching between the A330 and A321 will benefit from cockpit commonality, requiring less intensive "cross-crew qualification". This means Air Transat could schedule pilots to operate both types during a single trip, Lemay notes. ■

RETIREMENT **GHIM-LAY YEO** WASHINGTON DC

Allegiant bids farewell to 757s and Hawaii service

Operator's last example flew from Las Vegas to Honolulu in October

Las Vegas-based Allegiant Air has phased out its final Boeing 757-200s, marking an end to the carrier's Hawaii service.

"Both 757s are retiring as part of the ongoing fleet transition," the carrier says, confirming that the type's final service was operated on 28 October, between Las Vegas and Honolulu.

Allegiant is in the process of replacing its MD-80s with Airbus A320-family aircraft. The airline acquired six 757s in 2010 to launch services to Hawaii from 2012. However, it cut most of the flights one year later, citing insufficient demand and the high costs of operating the Boeing twinjets.

The carrier initially planned to halt services to Hawaii in August 2016, but extended this by a year after experiencing better-than-expected performance on the Las Vegas-Honolulu route. Flight Fleets Analyzer shows Allegiant's last two 757s were parked in October and November. ■

FlightGlobal

Tracked Utilization

A new elite dataset to power your analysis of aircraft and engine flying hours and ground events

Integrating reliable insight into one single source:

Flight Schedule

- Flight number
- Operator
- Departure/arrival airports
- Published schedule

Flight Status

- Actual gate and runway departure/ arrival times
- Calculated turn/taxi/flight times and delays vs schedule
- Cancellation/diversion/aircraft type change information
- Terminal/gate information (where available)

Fleet Data

- Aircraft/engine types and minor variants
- Scheduled seats/classes vs actual flown
- Aircraft weight/age/ownership

Power your analysis of aircraft and engine utilization by accessing tracked hours and cycles information

Find out more at www.flightglobal.com/products/tracked-utilization/

For insight and analysis of the latest developments in the defence sector, visit: flightglobal.com/defence

MARKETING **STEPHEN TRIMBLE** DUBAI

Boeing steps up Middle East tanker campaign

Boeing

Tanker variant of 767 still needs to overcome refuelling boom issue

Boeing's troubled KC-46A tanker development programme is nearing resolution, as the company steps up its efforts to promote the 767-based type to potential customers in the Middle East.

Leanne Caret, chief executive of the company's Defense, Space and Security unit, expects only one outstanding deficiency in its development activity for the US Air Force to remain after this month. Boeing is continuing to work with service officials to find a solution for the issue, which concerns the remotely-operated refuelling boom.

Caret says the Middle East is a critical piece of Boeing's export strategy for the new tanker, and is already marketing the KC-46A to potential buyers.

"There's almost never enough [tanking capability], and assets are being used and shared across the region," says vice-president of global sales Gene Cunningham. "In many cases I think customers will be trying to add capability and not substitute." ■

PROGRAMME **ELLIS TAYLOR** DUBAI

KC-390 nearing return after stall testing incident

The Embraer KC-390 protoype involved in a stall speed incident on 12 October has not been significantly damaged and is set to return to flight testing soon following minor repairs.

Embraer says that the aircraft, 001 (PT-ZNF), "experienced an event beyond the planned limit" during a simulated icing test, which took the aircraft beyond its airspeed and load factor operating limitations. That forced the crew to apply recovery procedures, and the aircraft returned to the company's test base at Gavião Peixoto. It has not been flown again since the incident.

The airframer says a detailed inspection showed that there was no damage to the primary aircraft structure, but that some external fairings and access hatches will be replaced before it can resume flight testing.

"The KC-390 certification schedule is not affected, and entry into service is confirmed for 2018, with the delivery of the first production aircraft to the Brazilian air force," the airframer confirms.

The service is expected to take its first two of an eventual 28 of the transport/tankers next year. ■

PROPOSAL **DOMINIC PERRY** DUBAI

Italy seeks partner nations to join in AW249 development

Leonardo Helicopters says proposed new attack rotorcraft can be "basis for collaboration"

Leonardo Helicopters is looking for additional partners on its new attack rotorcraft programme, now designated the AW249.

In January 2017 Italy awarded the company a €487 million ($515 million) contract to develop a successor to its army's AW129 Mangusta fleet. But speaking at the Dubai air show, Leonardo's group chief commercial officer Lorenzo Mariani said the helicopter is "not only for Italy".

"It is a basis for collaboration – we believe other nations can join this project," says Mariani, confirming the AW249 designation.

"We have the contract, we have the design, we have the idea and we have started the development – we are open for other nations to join that."

Mariani's comments raise the possibility that Leonardo could once again partner with Turkish Aerospace Industries, which has already signalled an intention to develop a successor to the T129 ATAK, a helicopter derived from the Mangusta.

Further details on the AW249's proposed specification have also emerged. A presentation given by the Italian army at a conference in Kracow, Poland, indicates that the helicopter will have a maximum take-off weight of 7-8t: significantly higher than the 5t AW129. This increase is partly driven by a more than doubling of the aircraft's weapons load, from 800kg (1,760lb) to almost 2,000kg.

Cruise speed, operating ceiling and endurance figures on the AW249 would all increase compared with the Mangusta, and Leonardo proposes examining the new helicopter's radar and heat signatures to give it more stealthy characteristics.

No decision has been made on the AW249's engines, but it is likely to be a two-way fight between the GE Aviation T700 and the Safran Helicopter Engines Aneto, recently selected to power the commercial AW189K.

The development contract runs until 2025 and will see Leonardo produce a total of five aircraft. Italy projects an eventual requirement for 48 helicopters, with its Mangusta fleet to be retired from 2025. ■

Leonardo Defence Agency

Rome wants its Mangusta replacement to be available from 2025

Airbus twin still peaking
A330 Anniversary P32

PROCUREMENT **CRAIG HOYLE** LONDON

Home skies debut for Norwegian F-35s

Arrival of trio marks milestone in Oslo's programme to make the fifth-generation fighter fully combat ready by 2025

The Royal Norwegian Air Force has conducted its first domestic flights with the Lockheed Martin F-35A, after a trio of the fifth-generation type touched down at its Ørland air base early this month.

Oslo's lead arrivals from an eventually 52-strong fleet were formally welcomed during a 10 November ceremony, following their acceptance by its Defence Materiel Agency.

The F-35As had landed at Ørland on 3 November, after a 9h 22min delivery flight from Lockheed's Fort Worth plant in Texas conducted by US pilots. They were met on entering Norwegian airspace by a pair of Lockheed F-16s – the type they will be replacing in service.

Norway has so far received 10 F-35s, including four that will remain permanently at the US Air Force's Luke AFB in Arizona to support multinational pilot training activities. The jets flown to Ørland early this month are its most recent examples, carrying the tail numbers 5148-5150.

Royal Norwegian Air Force

New type is due to achieve initial operational capability during 2019

"This marks the start of reaching the next milestone: making the aircraft combat-ready," says Royal Norwegian Air Force chief of staff Maj Gen Tonje Skinnarland. The new type is scheduled to achieve initial operational capability status with the service during 2019, and to be declared fully operational in 2025.

"From 2018, Norway will receive six aircraft annually up until, and including, 2024," the nation's defence ministry says. Maj Gen Morten Klever, its F-35 programme director, notes that Oslo's acquisition is "delivering on all key criteria: time, cost and performance".

Lockheed recently delivered a full-mission simulator for the F-35 to Ørland. It will support "pilot qualification, continuation and mission-rehearsal training".

Meanwhile, a braking parachute modification developed to support Norwegian operations on short and icy runways will be tested at Eielson AFB in Alaska later this year, Lockheed says. Oslo's aircraft will also be equipped with the internally carried Kongsberg Defence Systems Joint Strike Missile, which will be capable of attacking land and maritime targets from a range of up to 150nm (277km). ■

REQUIREMENT **GREG WALDRON** SINGAPORE

Malaysia eyes options to buoy maritime capability

Kuala Lumpur appears to have taken a step closer to obtaining a maritime patrol aircraft (MPA) capability, following a recent budget allocation.

State news agency Bernama reports that the Royal Malaysian Air Force has set up a team to evaluate MPA candidates, following a provision made in the government's 2018 budget for the acquisition of four aircraft.

The report, quoting air force chief of staff Gen Affendi Buang, notes that the participation of local industry will be a key factor.

Located in a vast littoral region riven with competing territorial claims, Malaysia has a clear need for long-range patrol aircraft, with the mission currently performed using four Beechcraft King Air twin-turboprops.

Kuala Lumpur's maritime patrol needs have been a common theme at the biennial LIMA defence exhibition in Langkawi, most recently in March 2017. Airbus Defence & Space, Boeing, Indonesian Aerospace, Leonardo and Saab have all promoted potential solutions at the biennial event. Leonardo chose this year's iteration for the public debut of its ATR 72MP, while Airbus demonstrated a maritime surveillance derivative of its C295 in the country after June's Paris air show. ■

Airbus Defence & Space

Airbus has demonstrated a surveillance variant of C295 turboprop

Airbus twin still peaking

Toulouse's redoubtable A330 has undergone a remarkable evolution over the last 25 years and, as tests begin of an upgraded variant, is showing no signs of slowing down

MAX KINGSLEY-JONES LONDON

Whisper it, but the recent first flight of a second-generation Airbus A330, the re-engined -900, was tantalisingly close to the 25th anniversary of the twinjet's maiden sortie on 2 November 1992. Understandably, Airbus has not made much of this historic milestone, but the fact is that the aircraft's continuing appeal in a market of much younger competitors is a credit to the A330's original concept, which dates back to the 1980s.

"Like a human, today's A330 is very different to how it was 25 years ago. The yesterday and today are very different," says Airbus's A330 marketing chief, Crawford Hamilton.

The A330-900 that kicked off the Neo flight-test programme on 19 October may have the same dimensions as the original A330-300, but the twinjet has evolved considerably. The major difference centres on Rolls-Royce Trent 7000 engines, key to delivering a double-digit percentage improvement in efficiency. But the other changes go more than skin-deep, covering revised aerodynamics and sharklets, higher weights and the latest A350-derived passenger cabin (*see graphic*).

Hamilton is confident that the latest variants can enjoy similar success to the v1.0: "We've always reckoned there's a market for over 1,000 A330neos. And given that we've sold over 1,400 of the current A330, there should be at least a 1,000 out there," he says.

The arrival of the A330-300 in 1992 was significant in itself, being Airbus's first "big twin" and conceived as a larger-capacity, longer-range (but not long-range) successor to the original "air bus", the A300B. In parallel, Airbus developed the long-range quad A340 family as a sister design based on the same fuselage, wing and related systems. The two models were developed side by side because during the pre-launch phase in the 1980s, potential customers could not decide whether they wanted two or four engines.

TWIN OR QUAD?

"North American operators were clearly in favour of a twin, while Asia wanted a quad. In Europe, opinion was split between the two," the now-retired Adam Brown told *Flight International* back in 1998 when he was Airbus vice-president strategic planning.

Brown said Airbus chief engineer Jean Roeder enabled the two designs to effectively become one, by creating a common wing structure. "The [development] cost savings this presented enabled us to do both aircraft."

Studies crystallised around the A330/A340 designations in 1986 as the next Airbus types after the A320 single-aisle. Customer interest meant the quad led the development programme, which resulted in an amusing debate about the designations.

As lead variant, the quad was initially dubbed the A330, while the twin became the A340. "Then our salesmen came back and said that airlines would never get their brains around a twin having a 'four' in its name and the quad not... so we reversed the designations," said Brown in 1998.

While the A330 moved forward with GE Aviation CF6 power, Airbus adopted a version of the A320's CFM International CFM56-5 for the quad. A330 engine options were quickly expanded to include the Pratt & Whitney PW4000, and in a first for Toulouse, an engine from Rolls-Royce, the Trent 700.

Full go-ahead came just before the 1987 Paris

A330neo specifications

	A330-800	A330-900
Length (m)	58.8	63.7
Wingspan (m)	64	64
Height (m)	17.4	16.8
MTOW (t)*	242	242
MLW (t)	186	191
MZFW (t)	176	181
Fuel capacity (l)	139,010	139,090
Seating (2-class)	257	287
Powerplant	R-R Trent 7000	R-R Trent 7000
Thrust (lb)	72,000	72,000
Range (nm)	7,500	6,550
Orders	6	206

*251t option in development
Source: Airbus

When the longer-range A330-200 arrived in 1998, it gave Airbus a true rival to the 767-300ER

The A330 was first pitched as a medium-range aircraft, but has been developed by Airbus into a successful long-range twin

Airbus

air show and the programme quickly moved into its stride. The A340 took to the air in October 1991 and the A330 testing began just over a year later, on 2 November 1992. At the time, Airbus had secured 270 orders for the two types, about half of which were for the twinjet.

French domestic carrier Air Inter was the first to introduce the A330, starting services in January 1994 between Paris and Marseille with its aircraft configured in a very high count for a twinjet at the time – 412 seats.

The A330 was initially seen as the medium-range sister to the long-range quad. But the advent of long-haul twin-engined operations changed perceptions and any lingering doubts about twins' suitability to fly across oceans and empty landmasses. This meant that range development of the A330 was crucial if Airbus was to challenge its US rival in the sector.

Cue the A330-200 "shrink", which entered service in 1998 and finally provided Airbus with a direct competitor to the Boeing 767-300ER. The little sister was an instant hit, leading the way to establishing Airbus as a genuine player in the long-range twin sector.

Hamilton says the A330 "is now on a trend to becoming the preferred entry-level widebody – we knocked the 767 off its perch about four or five years ago".

In 2000, Airbus briefly flirted with an even longer-range double-shrink derivative, the A330-500, before concentrating on developing the existing family. This led to the introduction of tanker and freighter variants, as well as an ACJ corporate version. And in 2008, 10 years on from the -200's debut, A330 orders passed the 1,000 mark.

Weight development had turned the larger A330-300 into a more capable machine as the sun set on the A340. Despite stretching and re-engining the quad, the world's airlines had moved on from four engines in that sector.

In the meantime, Boeing – which was seeing the A330 trounce its once-dominant 767 in the marketplace – responded aggressively with the launch in 2004 of the all-new 787 family. Airbus could be forgiven for believing this signalled the end of the original A330, and set about creating a major derivative equipped with new engines and upgrades.

It was dubbed the "A350", but after initial sales success, Airbus was persuaded that this warmed-up A330 did not go far enough to be a true long-term 787 challenger. So the project was shelved in 2006 as the all-new "A350 XWB" emerged. Then a strange thing happened. Boeing ran into production delays on the 787 and Airbus found customers – both old and new – turning to its venerable A330.

"The launch of the 787 was the best thing that happened to the A330," says Hamilton.

Flight Fleets Analyzer data illustrates his point – since 2004 when the 787 was launched, Airbus has sold over 1,000 of the original A330-200/300 variants – a number that surprises Toulouse as much as Seattle.

With production being sustained well into the A350 era, Airbus found itself re-evaluating its decision not to re-engine the A330. It realised that a cost-effective competitor to the 787 could be created that could also solve the headache its smallest A350 variant was creating: the now defunct -800.

And so at Farnborough 2014, eight years after Airbus replaced the Mark 1 A350 with an all-new design, a second-generation A330 was launched as the Trent 7000-powered A330neo. The original schedule called for flight-testing to start in spring 2017, to allow deliveries to begin before year-end to launch customer TAP Portugal. But development delays, largely due to hold-ups at R-R, prevented the start of testing as A330neo airframes sat in Toulouse awaiting engines.

With flying now under way, Airbus and R-R face a challenging development programme to start deliveries under the revised schedule of mid-2018. But Hamilton is confident: "Things have happened outside of our control," he says. "But we've always been in close consultation with Rolls. They had the

"The launch of the Boeing 787 was the best thing that happened to the A330"

Crawford Hamilton
A330 marketing chief, Airbus

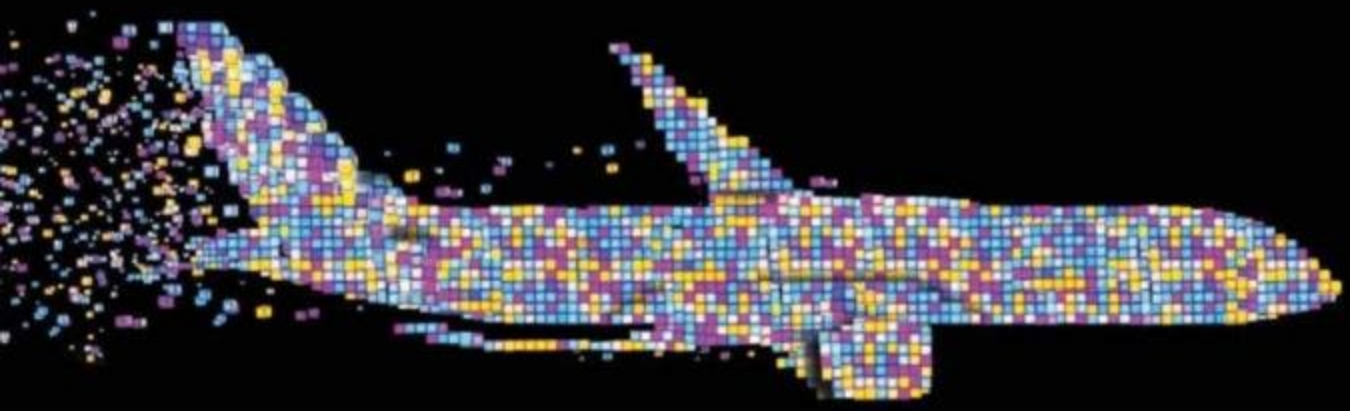
»

A330neo key features

Source: Airbus

FlightGlobal

Pioneering Aviation Insight



Aerospace Big Data

6-7 December 2017 | London, UK

Aerospace manufacturers and MROs have seen the future and are investing heavily in Big Data analytics, but why should airlines share their data? Join us to debate:

- Transformation of commercial aviation operations
- Available efficiency gains
- Investing in predictive analytics

Secure your place today: Flightglobal.com/bigdata

Silver sponsor: BOEING

Delegate enquiries:
+44 (0)20 8652 3233
Event.registration@rbi.co.uk

Sponsor enquiries:
+44 (0)20 7911 1490
Rebecca.covey@flightglobal.com

FlightEvents

www.flightglobal.com/bigdata

» block on resource. We've now got the aircraft flying… we'll make sure it happens."

From a sales perspective, the A330neo has had a strong start, securing 212 orders. Hamilton says sales are on track, despite a slow 2017 so far (to the end of October), with just two new orders announced (and four cancelled after TransAsia ceased operations).

HAWAIIAN HIATUS

One area of potential concern is the poor showing so far for the A330-800 variant, which has just six orders. These are all from one customer – Hawaiian Airlines – which has indicated it could review the order (itself a replacement for an earlier A350-800 contract).

But Hamilton is confident about the -800's potential, which is derived from the A330-200 airframe: "The A330-200 category has been doing well over the past few years. It's the most popular widebody [in operator terms] – we have 95 operators and 600 aircraft, and that's a heck of a base to have," he says.

"The A330 has good [cabin-configuration] versatility, good range, low trip-cost and from a financial point-of-view, it's low risk. For airlines that are growing, the logical first [widebody] step is the A330," adds Hamilton.

The future may be all about the A330neo, but Airbus is still building and selling the current variant. With over 100 -200/300s still to deliver from existing orders, Hamilton says Airbus "can still do the current aircraft, no problem. We've still got the MRTT, which is the most popular tanker. And we still have the A330-200 Freighter. They are aircraft that are still powered by the current engine, and we'll do them as long as anyone wants them."

The one cloud on the A330's horizon is the prospect of an all-new competitor from Boeing: its New Mid-market Airplane (NMA).

"We've got to be prepared," says Hamilton, who remains to be convinced that a market opportunity exists for an all-new aircraft.

"Boeing goes on about there being a gap in the market. But we don't see any 'gaps' because the A330 is filling them," he says. "The A330 has the versatility to do anything that any NMA can do, and more. Which gives it a very large appeal worldwide."

In other words: Boeing, bring it on. ■

First A330 took to the air on 2 November 1992

Royal Australian Air Force took the first A330 MRTT from Airbus in June 2011

Commonwealth of Australia

DEFENCE **CRAIG HOYLE** LONDON

Steady flow of orders for tanker adaptation

At the start of this century, the then-EADS began exploring the potential for its A330 widebody to deliver air-to-air refuelling (AAR) services for military operators. In doing so the company replicated its strategy for the airliner market by going head to head for international sales with Boeing, which held a virtual monopoly in the tanker sector.

Airbus had previously modified a handful of A310s for the tanker role, adapting the widebody to carry underwing hose-and-drogue refuelling pods. Flight Fleets Analyzer shows the air forces of Canada and Germany as still having two and four examples in use, respectively.

The convoluted future strategic tanker aircraft competition to replace the UK Royal Air Force's Lockheed TriStars and Vickers VC10s eventually led to success for the A330-200-based Voyager – although a 2004 selection of the AirTanker consortium did not lead to a contract award until four years later, and first delivery in September 2011. Three months earlier, the Royal Australian Air Force (RAAF) formally accepted its first locally designated KC-30A, under a five-unit acquisition.

Canberra's selection involved the integration of an Airbus-developed, fly-by-wire-controlled aerial refuelling boom system. After significant delays with development and service acceptance, the RAAF debuted the boom capability on deployed operations in November 2015.

At one point it appeared as though Airbus had succeeded in its most audacious of sales pitches, when its partner Northrop Grumman was selected for the US Air Force's KC-X tanker deal in February 2008. After the decision was quashed following an appeal by Boeing, EADS North America led a second bid, before its rival's 767-based KC-46A was selected for the 179-aircraft requirement in February 2011. Boeing is due to deliver its first operational examples next year.

Flight Fleets Analyzer shows 24 A330 multi-role tanker/transports (MRTT) as being in active service, with Australia (6), Saudi Arabia (6), the United Arab Emirates (3) and the UK (9). A further five Voyagers were modified for use by the RAF and can be called on if needed to support "surge" operations.

The A330 MRTT can carry 111t of fuel, up to 300 passengers and under-floor cargo, and Airbus says the global fleet has amassed more than 125,000 flying hours.

Airbus has a healthy production backlog, with orders from France (9), Singapore (6), South Korea (4) and a group of NATO nations, which will field the type as a pooled capability via a European Defence Agency initiative. Germany, Luxembourg, the Netherlands and Norway have so far committed to seven aircraft, ordering two of these. The fleet could grow to 11 if more partners join.

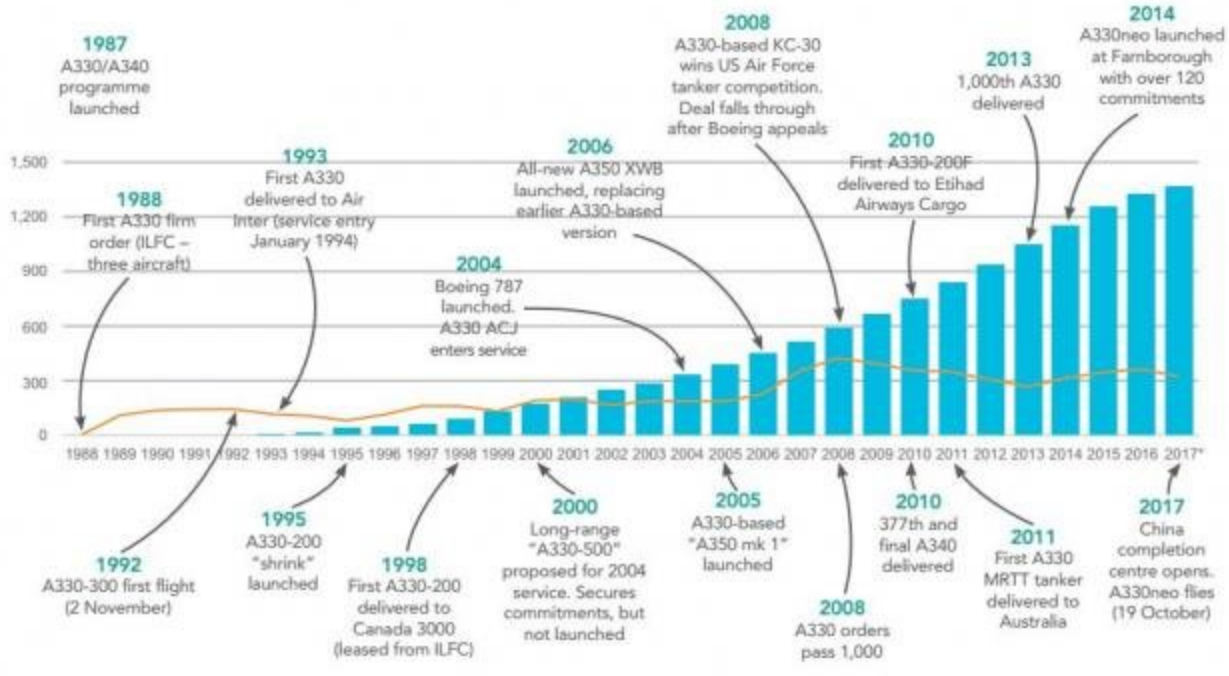
India chose the A330 MRTT for a six-strong tanker deal, but is to stage a fresh competition, and Qatar has yet to advance a deal for two after a selection in 2014.

Future deliveries will be made in an enhanced configuration, which includes updated avionics equipment and aerodynamic improvements. The first such aircraft was flown in October 2016 and will be delivered to the Republic of Singapore air force. A lead example for France got airborne in September 2017 and will be delivered next year. ■

Staying power

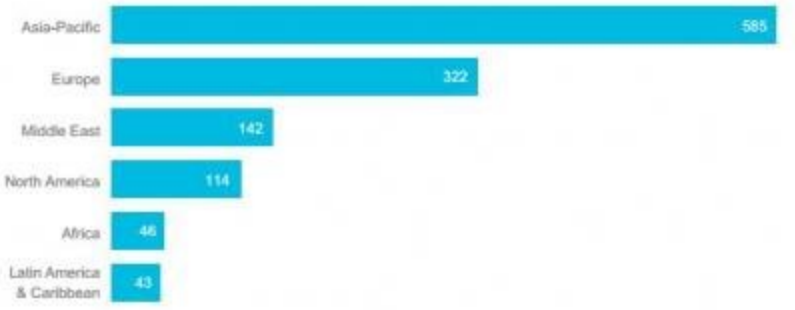
As the Airbus A330 marks a quarter of a century, the twinjet is still going strong, with a second-generation, re-engined Neo variant now in flight-test. To mark the milestone, we examine the programme's key metrics with data from Flight Fleets Analyzer

A330 backlog and cumulative deliveries



Source: Flight Fleets Analyzer
Notes: Year-end backlog, *To October

A330 fleet by region



Data for in-service aircraft only (all operators, including military)
Source: Flight Fleets Analyzer

62

Of the 1,252 A330s in service, Turkish Airlines is the largest operator, with a fleet of 62 aircraft

KING TWIN
Since its 1992 debut, Airbus has developed the A330 into a multi-variant family that comprises two sizes, passenger and cargo (*left*) versions as well as a military tanker and corporate jet. All the "big three" engine makers have participated on the programme, but Rolls-Royce leads, with a 63% share of the in-service fleet

A330neo customers and operators

AirAsia X
Variant: -900
Backlog: 66

Iran Air
Variant: -900
Backlog: 28

Delta Air Lines
Variant: -900
Backlog: 25

Avolon
Variant: -900
Backlog: 21

Air Lease
Variant: -900
Backlog: 19

TAP Portugal
Variant: -900
Backlog: 18

Garuda Indonesia
Variant: -900
Backlog: 14

Hawaiian Airlines
Variant: -800
Backlog: 6

Azul
Variant: -900
Backlog: 5

Wow Air
Variant: -900
Backlog: 4

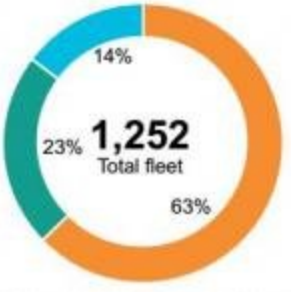
Air Mauritius
Variant: -900
Backlog: 2

Arkia
Variant: -900
Backlog: 2

AirCalin
Variant: -900
Backlog: 2

Lessor orders that have been placed are shown against operator Source: Flight Fleets Analyzer (October 2017)

A330 fleet by engine maker



Data for in-service aircraft only (all operators, including military)
Source: Flight Fleets Analyzer (October 2017)

Rolls-Royce	GE Aviation	Pratt & Whitney
786	284	182

A330 deliveries by variant

Source: Flight Fleets Analyzer (October 2017)

-200	-300	-200F	MRTT
582	715	38	33

A330 order backlog

Data for all operators, including military. *Includes -200F/MRTT
Source: Flight Fleets Analyzer (October 2017)

-200*	-300	-800	-900
43	70	6	206

Succession plan

Singapore Airlines is one of 32 existing A330-200/300 operators (with five or more aircraft) that is also a customer for the A350-900

Richard Evans, senior consultant at Flight Ascend Consultancy, considers replacement strategies for first-generation Airbus A330s

The Airbus A330 has proven to be one of the most successful twin-aisle types ever. A quarter of a century on from its first flight, and with the second-generation A330-900neo now in the air, how are operators deploying the twinjet and what types might replace the existing fleets?

The first aspect to consider is that, despite 25 years of production, more than half of the current "A330ceo" (-200/300) passenger fleet was built after January 2010, and will not be retired for many years to come. However, many operators have already placed orders for newer types and others have leased aircraft that may exit their fleets once the initial 10- to 12-year leases expire. Flight Fleets Analyzer shows that about 150 known leases are due to expire between 2018 and 2022, an average of 30 a year.

There are just short of 1,200 A330s operating in passenger roles with 106 airlines worldwide. This includes 530 of the smaller A330-200 variant and 660 of the -300. The latter overwhelmingly consists of high gross weight aircraft, with just 36 of the original shorter-range A330-300s remaining.

The A330 reached its peak production rate of 10 per month only in 2013, with the type receiving a major boost from the delays suffered by the Boeing 787, which led to a number of airlines selecting A330s to fill the capacity gap.

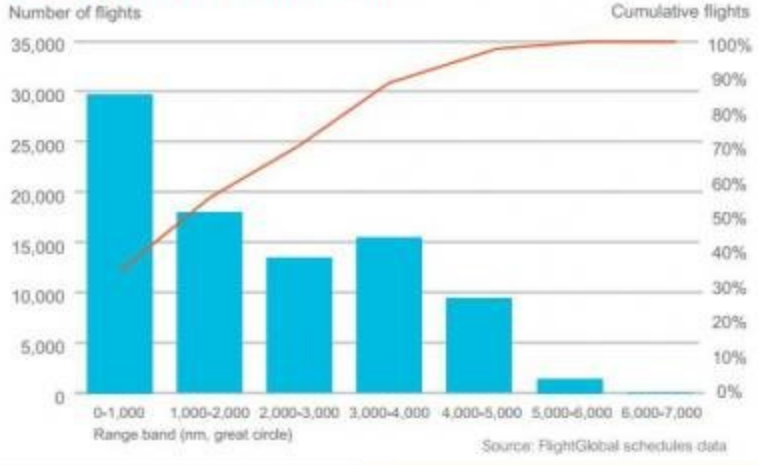
However, all good things come to an end, and the ramp-up of the 787 to 12 aircraft per month, together with the entry into service of the A350-900, saw production of the A330ceo being reduced to six per month in 2016. While the 787 rate is increasing to 14 per month by 2019, the A330 rate looks unlikely to change after Airbus initially planned an increase back up to seven per month by 2019, during the transition to the re-engined A330neo.

Both versions of the original A330 are used over a wide variety of missions and market sectors. The initial low gross weight A330-300s were primarily used on intra-Asian routes up to about 2,700nm (5,000km), as Airbus had pursued a strategy of offering the A340 for longer, intercontinental markets. The A330-200 "shrink" marked the first move of the type into long-haul operations and was successful at replacing the smaller 767-200/300 at several airlines. It has also seen widespread use among leisure carriers, often in a high-density layout with more than 300 seats. Until the advent of the 787-8, the A330-200 became the default type to launch new long-haul routes, or for those with thinner demand.

Airbus has steadily increased take-off weights for the A330-200 and -300, which, combined with engine and aerodynamic improvements, means the larger -300 now has sufficient range to fly many Asia-Europe and transpacific routes. A case in point is the use of A330-300s on many China-Europe flights, which were beyond the payload-range capability of the -300 until recent years and instead were flown by -200 variants.

However, analysis of FlightGlobal schedules data reveals that the A330's average sector

A330 flights by range band



Airbus

length is about 2,000nm. This is well within the capability of the latest single-aisle types, including the largest variants – the A321neo and 737 Max 10. Therefore, for some airlines, these could also be considered potential replacements.

Smaller carriers will tend to look for a single type to replace their current fleets of A330s but, as airlines grow, the option of splitting a replacement across two types to better match aircraft sizes to market demand, and to reduce overall operating costs, becomes possible. In terms of pure cash-operating-cost per seat, it is very difficult for a twin-aisle type to better the cost of a large single-aisle type.

POTENTIAL REPLACEMENTS

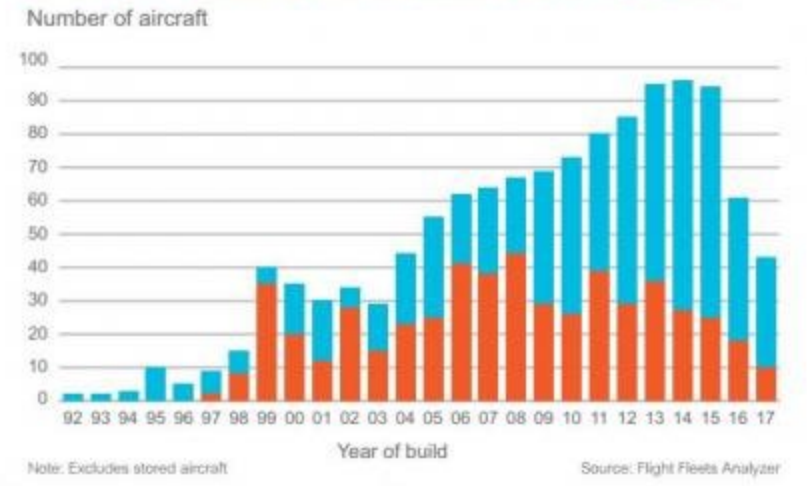
With regards to the in-service fleet, the top 29 operators of the A330 account for about two-thirds (800 aircraft) of the current airline fleet. Although there are several airlines with average stage lengths well below 2,200nm, all except Thai have at least one route that is beyond the realistic capability of large single-aisle types (around 3,000nm).

As illustrated below, the operator base includes many airlines that have already placed orders for types that could potentially replace their current A330 fleets. For the purposes of this article, this includes the 787-8 and -9, the A350-900 (with assumption that the A350-800 is not proceeding), and the A330-800/900.

There are 11 current A330 operators that have ordered 787s, and a further 13 that have ordered both 787s and A350-900s. This suggests that the 787 will play a significant role in the A330 replacement market. For many operators, the A350-900 may be seen as overly capable in terms of size and range. This includes several major Asian operators, who generally use the A330-300 on routes up to 3,800nm. Their fleet plans are weighted towards growth as well as replacement, but this region would appear a key battleground for the A330neo. If the A330neo is not seen as the optimal replacement for medium-haul A330-200s and -300s, then the current operator base could be very influential in determining the timing and design requirements for a new middle-of-the-market aircraft.

Of course, Airbus will be hoping that the only replacement for an A330 is another A330, but it appears that the 787, the A321neo and any new programme from Boeing will also be strong contenders in the 2020s. ■

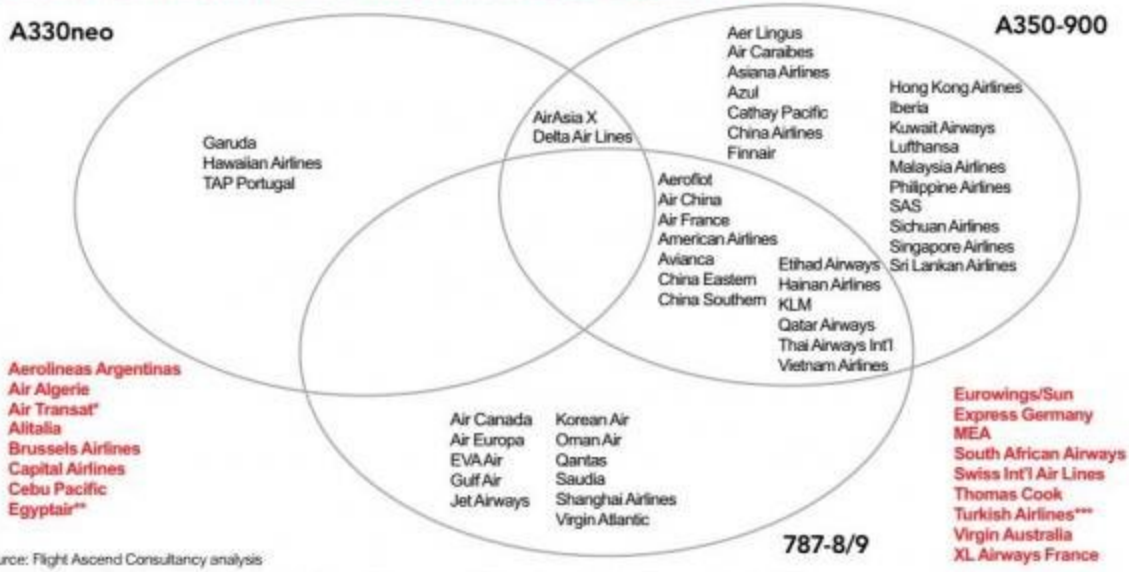
Build-year profile of A330-200/300 passenger fleet



Note: Excludes stored aircraft

Source: Flight Fleets Analyzer

Orders of airlines with fleet of five or more A330-200/300s



Source: Flight Ascend Consultancy analysis

Note: Airlines listed in red are yet to place firm orders for any of above types. *Air Transat has ordered A321neos to replace its A310s

**Egyptair announced lease deal with AerCap at Dual air show for six 787-9s ***Turkish Airlines intends to order 40 787-9s, but deal not yet firm

Sparking off a revolution

A technology race is on to manage unprecedented levels of electricity for onboard systems, weapons and propulsion

STEPHEN TRIMBLE WASHINGTON DC

Two of United Technologies' (UTC) competitors, Rolls-Royce and Honeywell, teamed up in 2015 to design and build the 1MW-class hybrid-electric propulsion system for Aurora Flight Sciences' XV-24A Lightning Strike, in a pioneering unmanned air system study funded by the US Defense Advanced Research Projects Agency.

Another rival, GE Aviation, came out last August with a new white paper describing an intense effort over several years to harness extreme amounts of electric current to power future military payloads and propel hybrid-electric aircraft.

In a largely behind-the-scenes race to fulfil the US military's expanding appetite for vast quantities of onboard electric power, only UTC's three business units – Pratt & Whitney, United Technologies Aerospace Systems (UTAS) and the United Technologies Research Center (UTRC) – remained quiet.

But UTC's silence is over. A new P&W white paper – released exclusively to FlightGlobal – opens a window into a wide-ranging effort to meet the military's demand for more-electric and all-electric aircraft.

"Research efforts in electrification of aircraft are likely to drive innovation that could have broad impacts across aviation," P&W says. UTC's divisions "are closely tracking trends in more electric and hybrid electric propulsion and power, and also working in key areas that we believe will be important".

The most modern US military aircraft already generate and consume vast amounts of electric power on board. Electricity is used to power increasingly sophisticated sensors, such as active electronically scanned array radars. Electric power also serves as a back-up for activating the control surfaces of the Lockheed Martin F-35. And, electricity is looked upon as a propulsion option for small UAS and large experimental drone projects, such as the XV-24A.

But US military officials already envision a future fleet of combat aircraft with even greater needs for onboard power. A new class of directed energy weapons, including lasers and high-power microwaves, is emerging as an option for the next generation of manned tactical fighters. So suppliers have to find new and creative waves to generate, store and distribute ever-escalating amounts of electricity, while managing unwelcome by-products such as waste heat.

Meanwhile, the same requirements are pushing existing technology up against the stubborn limits of the laws of physics. Certain phenomena – including the Corona effect, which turns air surrounding high-power cables into conductive plasma – threaten to prevent highly electrified aircraft from reaching the normal cruising altitudes of today's jet-powered aircraft. To overcome these and other obstacles, industrial players have made up long-term technology develoment plans. UTC can draw on expertise from all three divisions: P&W (engines), UTAS (electric power) and UTRC (experimental innovation).

This Lockheed Martin laser weapon concept needs plenty of power

The Lightning Strike's electric propulsion system is a challenge

Aurora flight sciences

Aircraft propulsion and power systems are often overlapping capabilities in the supply chain. In UTC's portfolio, UTAS already supplies the 1.4MW onboard power system for the Boeing 787, which uses electricity instead of hydraulics and pneumatics to pressurise the cabin and prevent ice from forming on the wing's leading edge. That electricity is generated by feeding compressed air from the engine to an accessory gearbox, which drives four variable-frequency starter generators; an auxiliary power unit remains on standby.

For military purposes, that is just the start. "Additional power will be needed as aircraft become more electrified," P&W says.

In GE's recent white paper, the company revealed a nearly two-year-old project that

Lockheed Martin

demonstrated an ability to generate 1MW of electric power from a single fighter engine – the F110 – while continuing to produce thrust. To achieve that feat, the company could not take power solely off the high-pressure turbine module. In what appears to be an industry first, GE also extracted 750kW of power from the low-pressure turbine.

IN-FLIGHT BREAKTHROUGH

If the ground demonstration could be replicated in flight, it would be a breakthrough. While the high-pressure turbine is used to generate 250kW to serve a fighter's normal electric needs, the surplus 750kW from the low-pressure turbine could be used to supply power for lasers, high energy weapons and powerful new radars.

But P&W's newly released white paper is evidence that GE is not the only company pursuing such a capability. In an undated, joint demonstration with UTAS, P&W successfully extracted electric power from the low-pressure turbine of a mid-sized business jet engine, a market segment that describes the thrust range of the PW500 and PW600 engine families.

"The programme established performance and operability trends on a typical high bypass turbofan engine for low spool power extraction at sea level and high altitude operation," P&W writes in the white paper. "Testing demonstrated the capability to produce significantly (~4X) more electrical power than possible from the high-pressure spool alone, with no impact to engine operability and minimal impact to engine performance and fuel consumption."

Meanwhile, UTC's business units are also working to solve other problems posed by higher electrification in aircraft. As power generation demands escalate, so too does the requirement to store power in a primary or back-up device such as a battery or storage module. State-of-the-art lithium ion batteries fall short of the energy density needed to serve in this role, so the industry is experimenting with alternatives.

P&W's white paper reveals that the company partnered with Lockheed and the US Air Force Research Laboratory (AFRL) to design and demonstrate a hybrid energy storage module (HESM). Such devices use several possible components, including supercapacitors, secondary batteries and flywheels, for storing high-density energy loads.

The white paper says: "The UTC team performed requirements definition, trade studies, technology surveys and design, leading to fabrication and test of a HESM laboratory demonstrator. A prototype HESM was delivered to AFRL for testing at the end of the current effort, and plans are under way for additional development."

Finding ways to more efficiently store huge amounts of energy on an aircraft is only one of the challenges confronting the industry. By definition, a megawatt-sized generator that operates with 95% efficiency loses 50kW – 5% of its power – to, principally, heat. This will drive the industry to find new ways of managing the heat, which can overwhelm electrical components.

"P&W and UTAS are working on technologies to address cooling through UTAS's experience in air management and P&W's experience in propulsion system integration," its white paper says.

To generate megawatts of power on the ground is relatively simple. There are few constraints on the size and weight of generators, inverters, batteries and cables. One of GE's research goals is to develop a power inverter that can handle megawatts of electricity, yet weigh a fraction of similar ground-based devices while operating in harsher conditions and providing better reliability.

The biggest obstacle remains the Corona effect. This occurs when power cables are charged with extreme voltages at high altitudes. In those conditions, the air around the cable becomes a conductive plasma, creating the conditions for a dangerous short circuit. Modern aircraft routinely fly at altitudes above 30,000ft, where the Corona effect becomes most pronounced. Hybrid electric vehicles will need power in the megawatt range, meaning they will need to distribute power from the generator to the motor along cables carrying hundreds of thousands of watts.

No solution to this problem yet exists, but development of lightweight insulation materials is one promising approach. ■

GE Aviation

GE has pulled 1MW of electric power from its F110 engine, while maintaining thrust

Lead operator France now has 11 of its eventual 50 A400Ms

Renewed thrust

The A400M's TP400-D6 engines are distinguished by their power output and a string of technical troubles, but with apparent resolution the airlifter programme looks set to soar

CRAIG HOYLE LONDON

Eight years ago, the first A400M took to the sky from Airbus Defence & Space's Seville final assembly site, powered by a quartet of Europrop International (EPI) TP400-D6 engines.

A consortium formed by the propulsion system champions of France, Germany, Spain and the UK to deliver the Western world's most powerful turboprop ever, EPI has faced multiple and complex challenges, since even before aircraft MSN001 soared over Spain on 11 December 2009. But with a key modification now awaiting approval, could the collaboration between ITP, MTU Aero Engines, Rolls-Royce and Safran Aircraft Engines finally be poised to rise clear of the turbulence experienced during more than a decade of development and operational activities?

Partner nations Belgium, France, Germany, Luxembourg, Spain, Turkey and the UK signed a combined development and production-phase contract for the A400M in May 2003 via the OCCAR defence procurement agency. Deliveries of the tactical transport were targeted to begin in October 2009, but eventually commenced in August 2013, when the French air force took the first of a combined 170 aircraft on order for the European operators.

The outcome of a selection decision made by the partner nations, the 11,600shp (8,650kW)-output TP400-D6 was among the factors behind the almost four-year slip in service introduction.

It is more than a decade since the TP400 entered testing, with the design having undergone its first ground run on a test stand in March 2006. Flight trials using a Lockheed Martin C-130K testbed commenced in the UK during December 2008; only one year before first flight aboard the programme's lead "Grizzly" test aircraft.

Challenges facing the EPI partners and Airbus have included the need to achieve civil type certification of the TP400 by the European Aviation Safety Agency – a milestone achieved in May 2011. Problems ranging from in-flight shutdowns to cracking within the propeller gearbox (PGB) affecting Avio Aero-supplied equipment on some engines due to excessive vibration served to disrupt operations and affect the A400M's delivery rate.

This remains a clear source of frustration for Airbus Group chief executive Tom Enders. Speaking on the eve of this year's Paris air

show, he referred to his company's past decision to accept full liability for the A400M's propulsion system – leaving it open to paying liquidated damages in the event of delivery delays – as "an incredible blunder".

Despite its ongoing challenges, the A400M has enjoyed some positive headlines recently, including delivery of a 50th production example – to the Luftwaffe on 29 September – and the in-service fleet having passed a combined 100,000h of engine operating time.

With a distinctive, 5.3m (17.4ft)-diameter propeller, the TP400 features a three-shaft architecture, with full authority digital engine control from Safran Electronics and Defense. It can be operated at up to 40,000ft, gives the Atlas a maximum range potential of 4,800nm (8,900km), and total payload capacity of 37t.

GAINING BACKBONE

"The A400M is steadily becoming the backbone of the European transport fleet," says Airbus. Deliveries have been made to the air forces of France, Germany, Spain, Turkey and the UK, plus export user Malaysia. Earlier this year, it handed over its first example with much-needed tactical performance, including an initial self-protection suite.

While its tactical functionality continues to evolve, the Atlas is becoming an increasingly relied-upon logistical transport asset. The UK uses the type to transfer equipment to the Royal Air Force's Akrotiri base in Cyprus, as coalition activities continue over Iraq and Syria. The RAF has also this year deployed the Atlas to countries including Australia, Malaysia and New Zealand, and delivered humanitarian relief supplies to the Caribbean following two devastating hurricanes. The French air force, meanwhile, uses its aircraft to fly logistics missions to locations including in Africa and Latin America.

EPI had delivered more than 210 TP400s by July 2017, and says its project employs 2,500 people around Europe. Safran has the largest stake, at 32.2%, followed by R-R (25%), MTU (22.2%) and ITP (20.6%). Final assembly of all engines is performed by MTU at its facilities near Munich, Germany.

In-service support for the operational TP400 fleet is being provided by EPI partner companies at Orléans, France, Wunstorf, Germany, Zaragoza, Spain, Kayseri, Turkey, RAF Brize Norton in the UK, and at a Royal Malaysian Air Force facility near Kuala Lumpur.

Such on-base maintenance capabilities are backed up by dedicated facilities capable of working on the powerplant in Chatellerault (Safran), Munich (MTU), Madrid (ITP) and Bristol (R-R), and by Safran's Global Turbine Asia (GTA) joint venture in Subang, Malaysia.

MTU on 10 October announced its receipt of a five-year support deal from the German air force, describing this as an "all-encompassing maintenance concept". "We are the first certified company to maintain the TP400-D6 based on civil maintenance, repair and overhaul procedures," it notes.

Europrop International hopes to leave TP400's troubles behind with permanent gearbox fix

Under the arrangement, Luftwaffe personnel will perform on-wing maintenance and repair work, while MTU will deliver more complex, off-wing support services. "The aim of the maintenance concept is to guarantee the German armed forces receives efficient maintenance services tailored to their operational requirements," the company says.

LOCAL KNOWLEDGE

Ahead of the March 2017 LIMA air show in Langkawi, Safran announced a new in-service support arrangement with the Royal Malaysian Air Force, which has received its full complement of four A400Ms. The second phase of this deal came into effect on 1 November, with GTA assuming the role of prime contractor. The contract will "ensure that the Royal Malaysian Air Force continues to receive timely support for its engines" via a "successful partnership", Safran says.

Meanwhile, EPI is working towards a permanent fix for a cracking issue affecting the Avio-supplied PGB on some right-hand gearboxes only, due to the A400M's use of a so-called "handed" configuration for its TP400s.

A400M orders and deliveries

Nation	Active	Ordered
Belgium		7
France	11	39
Germany	13	40
Luxembourg		1
Malaysia	4	
Spain	1	26
Turkey	5	5
UK	18	4
Total	52	122

Source: Flight Fleets Analyzer

A "truncated plug solution" developed as an interim fix was certificated in July 2016 and has since been retrofitted to all in-service aircraft and installed on new engines since the start of this year. EPI says this is providing "strong relief to the operators", by removing the need to conduct on-wing inspections of the gearbox after every 20 flying hours. "This configuration is performing as expected on the fleet in service," it adds.

Work to develop a permanent fix through a "Pack 2" series of enhancements had been targeted for certification by EASA during the third quarter, but the consortium confirms that this schedule has been extended.

EPI says it wants to provide "a fully mature PGB configuration, which requires extensive analysis, rig and full engine tests. Consequently, we plan to achieve certification at the beginning of 2018."

The enhancements mainly consist of modifications to reduce vibration levels, and will "reinforce endurance and reliability".

For Airbus, the resolution of engine issues and the introduction of contractually promised tactical capabilities can only serve to boost its chances of securing fresh export interest in the A400M.

OCCAR has previously outlined a plan for deliveries of the Atlas to conclude during 2024 under Europe's 170-aircraft production commitment, but Airbus remains in discussion with its customers about this schedule and easing the pain of financial penalties currently being borne by the company.

Speaking during a third-quarter results briefing in late October, Airbus chief financial officer Harald Wilhelm indicated that output this year would be in line with the number of shipments made in 2016. This adjustment will allow the company to focus on delivering the type to the programme's core nations, and "gives a bit more time to catch the export orders in the outer years". ■

Power players

When it comes to the effectiveness of air forces, aircraft numbers tell only a small part of the story – performance matters above all and, as this dip into the Flight Fleets Analyzer database highlights, it is no surprise to find that the big names in aero engines have built substantial market share positions in the world's military fixed-wing and helicopter fleets

Enduring appeal of Mirage 2000-series fighters keeps Safran's M53 engine flying high

Military helicopters: world fleet by engine supplier

Manufacturer	Aircraft in service	Market share
GE Aviation	5,430	25.7%
Klimov	4,138	19.6%
Safran	3,367	15.9%
Honeywell	2,605	12.3%
Rolls-Royce Allison	2,541	12.0%
Pratt & Whitney Canada	918	4.3%
Klimov (Isotov)	624	3.0%
Safran (Turbomeca)	474	2.2%
Zhuzhou	284	1.3%
Rolls-Royce	212	1.0%
Other	535	2.5%
Total	**21,128**	

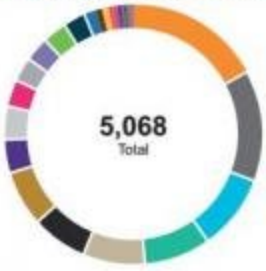
Source: Flight Fleets Analyzer

Military fixed-wing aircraft in service, by engine maker: USA

Source: Flight Fleets Analyzer

- GE Aviation
- Pratt & Whitney Canada
- Pratt & Whitney
- Rolls-Royce Allison
- CFM International
- Rolls-Royce
- Honeywell (Garrett)
- Textron Lycoming
- Ivchenko (ZMKB Progress)
- Rolls-Royce Deutschland
- Turbomeca-Safran

Military fixed-wing aircraft in service, by engine maker: Europe*



Source: Flight Fleets Analyzer
*Excluding aircraft in service with Russia

- GE Aviation
- Rolls-Royce
- Pratt & Whitney Canada
- Pratt & Whitney
- Eurojet Turbo
- Textron Lycoming
- Safran
- Rolls-Royce Allison
- Honeywell (Garrett)
- Volvo Aero Norway
- Soyuz
- Ivchenko (ZMKB Progress)
- Turbomeca-Safran
- Klimov
- NPO Saturn
- WSK-PZL Rzeszow
- Europrop International
- CFM International
- Honeywell
- GE Business & GA
- Omsk (Mars)
- Aviadvigatel (Soloviev)
- Motor Sich
- Teledyne Continental
- Rolls-Royce Deutschland
- Rotax
- Lotarev (ZMKB Progress)
- ZMKB Progress

Military helicopter engines: top types

Manufacturer	Type	Aircraft in service	Market share
GE Aviation	T700	5,016	23.7%
Klimov	TV3-117	3,797	18.0%
Rolls-Royce Allison	250	2,074	9.8%
Honeywell	T53	1,763	8.3%
Safran	Arriel	1,047	5.0%
Honeywell	T55	813	3.8%
Pratt & Whitney Canada	PT6T	744	3.5%
Safran	Astazou	540	2.6%
Safran	Makila	457	2.2%
Safran	Arrius	451	2.1%
Klimov (Isotov)	TV2-117	383	1.8%
Safran (Turbomeca)	RTM322	336	1.6%
Safran	Artouste	328	1.6%
Safran	Turmo	303	1.4%
GE Aviation	T64	280	1.3%
Rolls-Royce Allison	AE 1107	244	1.2%
Klimov (Isotov)	GTD-350	241	1.1%
Rolls-Royce Allison	T63	223	1.1%
Klimov	VK-2500	176	0.8%
Zhuzhou	WZ-8	175	0.8%
	Others	1,737	8.2%
Total		**21,128**	

Source: Flight Fleets Analyzer

Military fixed-wing aircraft: world fleet by engine supplier

Manufacturer	Aircraft in service	Market share
GE Aviation	5,758	18.3%
Pratt & Whitney Canada	4,503	14.3%
Pratt & Whitney	3,354	10.7%
Rolls-Royce	2,044	6.5%
NPO Saturn	1,919	6.1%
Rolls-Royce Allison	1,842	5.9%
Soyuz	1,431	4.6%
Ivchenko (ZMKB Progress)	1,356	4.3%
AVIC Guizhou Liyang	1,083	3.5%
Honeywell (Garrett)	999	3.2%
Klimov	985	3.1%
Safran	870	2.8%
Textron Lycoming	854	2.7%
AVIC Shenyang Liming	615	2.0%
CFM International	565	1.8%
Aviadvigatel (Soloviev)	490	1.6%
Eurojet Turbo	463	1.5%
Turbomeca-Safran	278	0.9%
AVIC Xian	220	0.7%
Volvo Aero Norway	208	0.7%
Others	1,548	4.9%
Total	**31,385**	

Source: Flight Fleets Analyzer

Eurofighters, including this Italian example, all fly on a pair of EJ200s

AL-31s from NPO Saturn power Sukhoi's Su-27 fighter, along with China's Chengdu J-10

Black Hawk-series helicopters rely on GE T700s

Pratt & Whitney Canada's PT6A turboprop gives Beechcraft's armed AT-6 plenty of bite

Military fixed-wing aircraft engines: top types

Manufacturer	Type	Aircraft in service	Market share
Pratt & Whitney Canada	PT6A	3,944	12.6%
Pratt & Whitney	F100	2,414	7.7%
GE Aviation	F110	1,587	5.1%
NPO Saturn	AL-31	1,443	4.6%
GE Aviation	J85	1,350	4.3%
Rolls-Royce Allison	T56	1,144	3.6%
GE Aviation	F404	1,096	3.5%
Shenyang	WP-7	1,081	3.4%
Rolls-Royce	Adour	875	2.8%
Klimov	RD-33	821	2.6%
GE Aviation	F414	683	2.2%
Ivchenko (ZMKB Prog)	AI-25	660	2.1%
CFM International	CFM56	565	1.8%
Soyuz	R-13	528	1.7%
Soyuz	R-195	498	1.6%
NPO Saturn	AL-21	476	1.5%
Aviadvigatel (Soloviev)	D-30	475	1.5%
Eurojet Turbo	EJ200	463	1.5%
Honeywell (Garrett)	TPE331	450	1.4%
Honeywell (Garrett)	TFE731	444	1.4%
Safran	M53	422	1.3%
	Others	9,966	31.8%
Total		**31,385**	

Source: Flight Fleets Analyzer

From yuckspeak to tales of yore, send your offcuts to murdo.morrison@flightglobal.com

Asterisk management

Airbus limited its A350 presence at last week's Dubai air show to the -900, rather than the soon-to-be-delivered -1000 with which it hopes to wrest the "big-twin" crown from Boeing's 777-300ER.

There could, of course, be all sorts of reasons for this. But it's worth noting that the first delivery – due next month – is going to ***** Airways, currently linea caeli non grata in the United Arab Emirates.

Since the UAE is rather sensitive over the whole ***** issue, to the point of being prepared to jail and heavily fine sympathisers, we're going to restrict our mentions of the carrier concerned. Although we should probably point out that this isn't what ***** Airways means when it calls itself a "five-star airline".

Al inclusive

Talking – or not – about the airline that shall not be named, in Dubai at least, we hear that a certain Doha-based chief executive may take advantage of his Abu Dhabi rival's problems with its overseas investments by rebranding his latest subsidiary Meridiana as Al Italia.

Under the blanket ban

At Dubai, Emirates chief Sir Tim Clark found himself having to address queries as to whether the new first-class suites on its Boeing 777-300ER contained sleeping arrangements capable of accommodating more than one occupant.

"Are you being Victorian about it?" came the question from the floor.

Sir Tim pointed out that the size of the suite was sufficient for travelling companions to enjoy one another's company. "But I don't think the bed is big enough for two," said the, er, good knight.

Etihad Airways is pictured *Cezanne* the opportunity to add its own touch of glamour to the opening of the new Louvre Abu Dhabi art museum. Visitors were able to *Marval* at the sight of the aircraft as its crew *Rodin* for a low-level pass, underlining the carrier's official partnership agreement with the institution, before *Gauguin* back to base. The Toulouse-built A380 involved in the flyby – a sort of *Toulouse low trek*, if you like – carries the Jean Nouvel-designed museum's logo on each of its four Engine Alliance GP7200 engines as part of the promotion. Abu Dhabi's government apparently paid hundreds of millions of dollars for the right to adopt France's world-famous Louvre name – clearly putting the emirate's *Monet* where it thinks it really *Matisse*.

Alarm Bells

The Donald's recent trade mission to China paid dividends for US manufacturer Bell, with a further 50 orders for its 505 light single. All good for President Trump's America First policy.

Mind you, perhaps the celebrations will be more vigorous elsewhere: the Textron subsidiary manufactures the 505 in Montreal, Canada, using Arrius 2R powerplants supplied by France's Safran.

Height International

A few years back we published a photo of Alan Rickard enjoying his favourite aerospace weekly on Africa's highest peak.

He has gone one better with this, taken at Mt Everest base camp, 17,500ft above sea level. "You were good enough to publish a similar picture while I was at the summit of Kilimanjaro," he says. "It would be good to do the double."

Christmas get-together

The venue for Bombardier's traditional press festive lunch in London is Dartmouth House, which bills itself as an "events, conference and wedding venue in the heart of Mayfair" – an apt location given the upcoming nuptials with Airbus.

A mountain of reading

US war chest

100 YEARS AGO

The Aero Club of America has passed a resolution urging Congress to appropriate not less than £200 million for building an emergency air fleet of huge warplanes as an offset to the mobility of the Germans on interior lines of communication.

Call the cavalry

75 YEARS AGO

The overwhelming nature of the disaster which has befallen Field-Marshal Rommel's Afrika Korps has been mainly due to the "cavalry" tactics of the Allied air squadrons in the pursuit.

Counting the cost

50 YEARS AGO

Devaluation will increase the already heavy cost of importing American aircraft and equipment. Overnight the cost of BOAC's second order for 747s goes up by the equivalent of one aircraft, and the planned defence cut of £100 million will be more than swallowed up by the increased cost of F-111Ks and Phantoms.

ILFC's big deal

25 YEARS AGO

International Lease Finance is planning the biggest civil aircraft order since GPA placed a $17 billion contract for 300 aircraft in 1989. The Los Angeles-based company is negotiating with Airbus Industrie and Boeing on a combined order for as many as 90 new aircraft for delivery from 1996 onwards.

100-YEAR ARCHIVE
Every issue of Flight from 1909 onwards can be viewed online at flightglobal.com/archive

FlightGlobal
Pioneering Aviation Insight

Global Flight

2018

Loyalty programs have swiftly become standard practice - an integral feature of your sales and marketing.
Join us to discover new solutions and initiatives to achieve customer retention.

5 - 7 Feb 2018, Bangkok, Thailand

2017 saw:

80+
unique airlines and partners

230+
airline and partner attendees

300+
attendees

Find out more at loyalty-conference.com

Enquiries

Sponsorship - sarah.green@flightglobal.com
Registrations - events.registration@rbi.co.uk

READER SERVICES

EVENTS

6-7 December
Aerospace Big Data
London, UK
flightglobal.com/bigdata

8-12 January 2018
AIAA SciTech Forum
Kissimmee, Florida, USA
scitech.aiaa.org

23-25 January
Annual Global Airfinance Conference
Dublin, Ireland
euromoneyseminars.com/global-airfinance-dublin

5-7 February
Loyalty 2018
Bangkok, Thailand
flightglobalevents.com/loyalty2018

6-11 February
Singapore Airshow
Changi, Singapore
singaporeairshow.com

13-15 February
Routes Americas
Quito, Ecuador
routesonline.com

26 February-1 March
HAI Heli-Expo
Las Vegas, Nevada, USA
heliexpo.rotor.org

3-10 March
IEEE Aerospace Conference
Big Sky, Montana, USA
aeroconf.org

13-15 March
IATA World Cargo Symposium
Dallas, Texas, USA
iata.org

18-20 March
Routes Asia
Brisbane, Australia
routesonline.com

10-12 April
Aircraft Interiors Expo
Hamburg, Germany
aircraftinteriorsexpo.com

18-21 April
Aero Friedrichshafen
Friedrichshafen, Germany
aero-expo.com

25-29 April
ILA Berlin Air Show
Berlin, Germany
ila-berlin.com

8-10 May
AIAA Defence Forum
Laurel, Maryland, USA
defense.aiaa.org

29-31 May
EBACE
Geneva, Switzerland
ebace.aero

13-15 July
Royal International Air Tattoo
RAF Fairford, Gloucestershire, UK
airtattoo.com

16-22 July
Farnborough International Airshow
Farnborough UK
farnboroughinternational.co.uk

For a full list of events see flightglobal.com/events

EDITORIAL, ADVERTISING, PRODUCTION & READER CONTACTS

EDITORIAL +44 20 8652 3842

Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS, UK
flight.international@flightglobal.com

Editor Craig Hoyle
+44 20 8652 3834 craig.hoyle@flightglobal.com
Deputy Editor Dominic Perry
+44 20 8652 3206 dominic.perry@flightglobal.com
Head of Strategic Content Murdo Morrison FRAeS
+44 20 8652 4395 murdo.morrison@flightglobal.com
Features Editor Dan Thisdell
+44 20 8652 4491 dan.thisdell@flightglobal.com
Business & General Aviation Editor Kate Sarsfield
+44 20 8652 3885 kate.sarsfield@flightglobal.com
Consulting Editor David Learmount
+44 7785 901787 david.learmount@ntdworld.com
Magazine Enquiries
flight.international@flightglobal.com

AIR TRANSPORT TEAM

Editor Flightglobal Premium News Graham Dunn
+44 20 8322 6858 graham.dunn@flightglobal.com
Managing Editor Niall O'Keeffe
+44 20 7911 1316 niall.okeeffe@flightglobal.com
Managing Editor – Flight Airline Business
Lewis Harper +44 20 7911 3105
lewis.harper@flightglobal.com
Air Transport Editor David Kaminski-Morrow
+44 20 8652 3909
david.kaminski-morrow@flightglobal.com
Aerospace Editor Michael Gubisch
+44 20 7911 1311 michael.gubisch@flightglobal.com
Senior Reporter Oliver Clark
+44 20 7911 1313 oliver.clark@flightglobal.com

AMERICAS

Americas Managing Editor Stephen Trimble
+1 703 836 8052 stephen.trimble@flightglobal.com
Deputy Americas Editor – Air Transport
Ghim-Lay Yeo
+1 703 836 9474 ghimlay.yeo@flightglobal.com
Americas Finance Editor Edward Russell
+1 703 836 1897 edward.russell@flightglobal.com
Senior Reporter Jon Hemmerdinger
+1 703 836 3084 jon.hemmerdinger@flightglobal.com
Aviation Reporter Leigh Giangreco
+1 703 836 7442 leigh.giangreco@flightglobal.com

ASIA/PACIFIC

Asia Editor Greg Waldron
+65 6780 4314 greg.waldron@flightglobal.com
Asia Air Transport Editor Mavis Toh
+65 6780 4309 mavis.toh@flightglobal.com
Asia Finance Editor Ellis Taylor
+61 498 878 583 ellis.taylor@flightglobal.com
Reporter Aaron Chong
+65 6780 4851 aaron.chong@flightglobal.com
Reporter Firdaus Hashim
+65 6780 4313 firdaus.hashim@flightglobal.com

EUROPE/MIDDLE EAST

Israel Correspondent Arie Egozi

FINANCE

Global Finance Editor Sophie Segal
+1 212 448 2253 sophie.segal@flightglobal.com
Europe Finance Editor Jamie Bullen
jamie.bullen@flightglobal.com

FLIGHTGLOBAL.COM

Editorial Content Manager
Rebecca Springate
+44 20 8652 4641
rebecca.springate@flightglobal.com

EDITORIAL PRODUCTION

Global Head of Design & Production
Alexis Rendell
Chief Copy Editor, Europe Dan Bloch
Layout Copy Editors Sophia Huang, David Mawer, Tim Norman
Global Production Editor Louise Murrell
Deputy Global Production Editor Rachel Warner
Global Digital Producer Damion Diplock
Deputy Global Digital Producer Andrew Costerton
Senior Designer Christine Zhang
Designers Coco Li, Lin Ning, Lucy Xiao, Shirely Xiao, Vera Yang, Sonja Ye
Consulting Technical Artist Tim Hall

DISPLAY ADVERTISEMENT SALES

Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS, UK

EUROPE

Global Sales Manager Mark Hiller
+44 20 8652 8022 mark.hiller@flightglobal.com
Key Account Manager Grace Hewitt
+44 20 8652 3469 grace.hewitt@flightglobal.com
Display Sales Executive Chris Pilkington
+44 20 8652 8130 chris.pilkington@flightglobal.com
Sales Support Gillian Cumming
+44 20 8652 8837 gillian.cumming@rbi.co.uk

NORTH & SOUTH AMERICA

Vice-President, North & South America
Rob Hancock +1 703 836 7444
robert.hancock@flightglobal.com
Regional Sales Director
Warren McEwan +1 703 836 3719
warren.mcewan@flightglobal.com
Sales Executive Kaye Woody
+1 703 836 7445 kaye.woody@flightglobal.com
Reed Business Information, 333 N.Fairfax Street, Suite 301, Alexandria, VA 22314, USA

ITALY

Sales Manager Riccardo Laureri
+39 (02) 236 2500 media@laureriassociates.it
Laureri Associates SRL, Via Vallazze 43, 20131 Milano, Italy

ISRAEL

Sales Executive Asa Talbar +972 77 562 1900
Fax: +972 77 562 1903 talbar@talbar.co.il
Talbar Media, 41 HaGiva'a St, PO Box 3184, Givat Ada 37808, Israel

ASIA/AUSTRALASIA

Key Account Manager Jay Ee
+65 6780 4301 jay.ee@flightglobal.com
Fax: +65 6789 7575
1 Changi Business Park Crescent, #06-01 Plaza 8 @ CBP, Singapore 486025

RUSSIA & CIS

Director Arkady Komarov
komarov@worldbusinessmedia.ru
Tel/Fax: +7 (495) 987 3800
World Business Media, Leningradsky Prospekt, 80, Korpus G, Office 807, Moscow 125190, Russia

CLASSIFIED & RECRUITMENT

Business Development Manager Katie Mann
+44 20 8652 3074 katie.mann@flightglobal.com
Sales Manager Sophie Wild
+44 20 8652 4239 sophie.wild@rbi.co.uk
Classified Sales Executive Chris Pilkington
+44 20 8652 8130 chris.pilkington@flightglobal.com
Recruitment Sales Executive Chris Harding
+44 20 8652 4900 recruitment.services@rbi.co.uk

ADVERTISEMENT PRODUCTION

Production Manager Sean Behan
+44 20 8652 8232 sean.behan@rbi.co.uk

MARKETING

VP Marketing Justine Gillen
+44 20 8652 8031 justine.gillen@flightglobal.com
Group Marketing Manager Jo Goodwin
+44 20 7911 1366 jo.goodwin@flightglobal.com

DATA TEAM

Director of Data Trevor Mountford
trevor.mountford@flightglobal.com
Fleet Research Manager John Maloney
+44 20 8564 6704 john.maloney@flightglobal.com

PUBLISHING MANAGEMENT

Chief Operating Officer
Philippa Edward
philippa.edward@flightglobal.com
Executive Director Content
Max Kingsley-Jones
max.kingsley.jones@flightglobal.com
Commercial Director Publishing & Conferences
Stuart Burgess
stuart.burgess@flightglobal.com

READER SERVICES

Subscriptions
Jenny Smith
Flight International
Subscriptions, Reed Business Information,
PO Box 302, Haywards Heath,
West Sussex, RH16 3DH, UK

Subscription Enquiries
From UK: 0330 333 9533
From overseas: +44 1444 475 682
Fax +44 1444 445301
flightinternational.subs@quadrantsubs.com

Subscription Rates
1 Year: £145/$229/€179
2 Years: £246/$389/€304
3 Years: £348/$549/€429
Only paid subscriptions available. Cheques payable to Flight International

Flight International welcomes unsolicited contributions from readers but cannot guarantee to return photographs safely.

Registered at the Post Office as a newspaper. Published by Reed Business Information Ltd, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS, UK. Tel: +44 20 8652 3500.

Newstrade distributed by Marketforce (UK), 2nd Floor, 5 Churchill Place, Canary Wharf, London, E14 5HU, UK. Tel: +44 20 3787 9001.

Classified advertising prepress by CCM. Printed in Great Britain by William Gibbons and Sons Ltd

Flight International published weekly 49 issues per year. Periodicals postage paid at Rahway, N.J. Postmaster send changes to Reed Business Information, c/o Mercury International Ltd, 365 Blair Road, Avenel, NJ 07001

ISSN 0015-3710 (Print) ISSN 2059-3864 (Online)

Part of rbi reed business information

recycle

Aircraft leasing

General

Courses and tuition

Do you want to be one of the future leaders in aviation?
MBA Aviation Management.

A Masters in Business Administration (MBA) is acknowledged as the top degree qualification in business. The new MBA Aviation Management combines the best of a professional qualification in the core areas of general management with specialist aviation units.

It has been developed, and is taught, by experienced business and aviation experts. It is designed for anyone employed directly in aviation by an airline or an airport or any of the supporting businesses such as in-flight catering, fuel companies, air charter broking, air taxi operators, aircraft cleaning, air traffic control, insurance etc.

The qualification is open to anyone who has five years' managerial or supervisory experience, or two to three years' experience if you already have a UK bachelor's degree or equivalent. It will diferentiate you from others and boost your career in whatever direction you want.

The programme is delivered online through video lectures and reading material coupled with support from module tutors and your personal tutor. You therefore study when it is convenient and it will normally take one year to 15 months to complete.

There are six modules plus a business research project. The project will give you a detailed knowledge of an area in aviation which will benefit you and your employer. The modules are on:

- Accounting and Finance for Managers
- Leadership and Strategic Management
- People and Organisations: Principles in Global Contexts
- Marketing, Marketing Communications and Operations
- Airline and Airport Management
- Aviation Regulation, Policy and Planning
- Business Research Project

All six modules are assessed by assignments. In addition there are extra (non-assessed) short briefing sessions on a wide range of aviation topics to broaden your industry knowledge.

The MBA Aviation Management is awarded by London Metropolitan University (awaiting validation) and delivered by Magna Carta College, Oxford's independent business school.

Go to (short URL) https://goo.gl/zJHD4Y for more details
Phone: +44 1865 988372
Email: mba@magnacartacollege.ac.uk
www.magnacartacollege.ac.uk

MAGNA CARTA COLLEGE

Equipment, maintenance and service

General

Business services

TEL +44 (0) 20 8652 8130 EMAIL chris.pilkington@flightglobal.com

City of Derry AIRPORT

Air Traffic Controller

City of Derry Airport has been operating commercial and private flights since 1978 and has developed as the main gateway to the entire North West region of Ireland for both business and leisure traffic, making it a central piece of infrastructure for the area.

Role

Performing the functions of the ADI/TWR and APP Licence and Meteorological Observing Certificate in accordance with the relevant CAA documentation, the Controller will provide a safe and expeditious ATC service in a manner which gives priority to safety compliance with regulatory and statutory requirements.

Qualifications and Experience

- Applicants must hold a valid European Union Air Traffic Controller Licence issued by the UK Civil Aviation Authority and a European Class 3 Medical Certificate
- Ratings in ADI/TWR and APP with previous validations at a unit are essential
- Possession of a Certificate in Aeronautical Meteorological Observing issued by the UK Met Office is desirable

Consideration may be given to those applicants who do not hold a UK Civil Aviation Authority Licence.

Application details can be obtained from the Human Resources Department by contacting liz.hughes@cityofderryairport.com or visiting www.cityofderryairport.com

City of Derry Airport is an Equal Opportunity Employer

ICAO

The International Civil Aviation Organization (ICAO) is seeking highly qualified candidates for the position of

Deputy Director, Monitoring and Oversight, Air Navigation Bureau,

located in Montreal, Canada.

If you have an advanced university degree and extensive experience in aviation safety, air navigation or related area in a public or private sector organization, ICAO would like to hear from you. Female candidates are strongly encouraged to apply.

For more details, including the selection criteria and how to apply, please go to the ICAO Careers website at:

http://bit.ly/2z5LUr3

Deadline for applications: 24 November 2017

Inspector ATS (Operations)

Civil Aviation Authority

Competitive reward package is available

The Role

Reporting to and advising the Principal Inspector, you will take on responsibility for the regulatory oversight of the provision of air traffic services at Air Traffic Service Units within your region, working closely with the Air Navigation Service Provision industry. The role requires extensive travel across the northern half of the UK and Northern Ireland and options for area working will be considered to suit the successful candidate's circumstances.

You will plan and conduct a programme of audits and inspections, as well as undertaking the assessment of competence of Air Traffic Controllers and Flight Information Service Officers.

There will be opportunities for you to participate in varied and diverse Air Traffic Management related tasks, including the delivery of presentations and training material, sometimes outside the UK.

The role also has a broader influence, as you will participate in a range of discussions on the development of policy and procedures aimed at achieving effective regulation in a manner that is proportionate to risk. In doing so, you will be helping to shape the future of civil aviation throughout the UK.

The Ideal Candidate

Able to appreciate and meet the needs of service providers, you should have a confident, approachable manner and a flair for briefing both technical and non-technical audiences.

You will have a detailed understanding of the safety regulatory requirements associated with the planning, provision and operation of Air Traffic Management systems and services in the UK. As such, it is essential you have a good knowledge of EC Requirements and pertinent CAPs as well as a sound understanding of the principles of Safety and Quality Management.

Holding a civil ATCO licence with APS and ADI ratings, the successful candidate will have practical experience of the use of a Safety Management System in the provision of Air Traffic Services. You will have experience in the use of risk management techniques and ideally hold an Assessor licence endorsement.

For further details and to apply please visit www.caacareers.com/current-vacancies

Closing Date: Tuesday 28th November 2017
Interview Date: w/c 18th December 2017

Committed to Equality of Opportunity


Hello Tomorrow
Emirates
Our Pilots find new places across Dubai to take off
For First Officer Benjamin, flying with Emirates is more than a career opportunity - it's a lifestyle opportunity too. You could earn a tax-free salary flying a modern fleet across our extensive network, while enjoying the year-round sunshine of dynamic Dubai, with living expenses taken care of.
Adventure Awaits
Apply now at emirates.com/pilots

الهيئة العامة للطيران المدني
CIVIL AVIATION AUTHORITY

We are hiring

Job title: Flight Operations Inspector

Qualifications, Experience and Skills

- **Fully trained Inspector with 2 years of CAA experience as Inspector in one of EASA member states or fully trained Inspector with 5 years of experience as Inspector in one of the ICAO member states with an ICAO CMA implementation rate above 75%**
- **Hold an Airline Transport Pilots licence with at least 5000 hours as Pilot in Command on a performance Class A (CS25) Aircraft**
- **Experience as Flight Instructor or Flight Examiner is an advantage**
- **Civil or Military aviation management is an advantage**
- **Fluency in writing and spoken English is required**
- **Well-developed communication, interpersonal and presentation skills**
- **Willingness and aptitude to work in a multi-disciplinary and multi-cultural environment**

Terms and conditions

- Excellent tax-free salary and benefits, including healthcare, housing and schooling
- Fast-pace, rapidly expanding business environment
- Superb career opportunities

PO Box 3000 Doha, State of Qatar
Email: Hr.safety@caa.gov.qa Fax: 00974/44557142

WORK EXPERIENCE DAWIT LEMMA

Building the big picture in Ethiopia

Working at Ethiopian Airlines, Dawit Lemma realised he did not want to limit his horizons to one role, and so launched Krimson, where he is also active in developing the nation's business aviation sector

How did you get into aviation?
I distinctly remember that at aged seven my best friend and I decided we would be either pilots or cowboys, as adults. My parents suggested being a cowboy was not a "career choice" and encouraged my love and passion for airplanes, with a Lego Technic aviation set. This awakened my engineering and technical interest for aircraft, which I eventually developed at Purdue University, where I studied aeronautical engineering and flight technology. I also received a Federal Aviation Administration commercial pilot licence and airframe and powerplant mechanic licence. I rounded out my education with a Master's degree in aviation management.

What does your career in aviation look like to date?
My first job was as an operations intern at Detroit-Metro International airport, where I worked on the parallel runway design team. Since then I've spent time working for Landrum & Brown at Chicago O'Hare, supporting humanitarian flights for NGOs in Afghanistan, and working with maintenance teams at TAG Aviation in Geneva. A pivotal moment came when I was recruited by Ethiopian Airlines. When asked, "Do you want to be a pilot, a mechanic or a manager?", I replied: "All the above." They replied: "Choose one." I realised that only business aviation would allow me to fly the aircraft on Monday, fix it on Tuesday, and manage the company from Wednesday to Sunday. So I set up Krimson Aviation in 2015. The first thing I did was call the African Business Aviation Association (AfBAA), to say that Krimson would be the first Ethiopian member.


Lemma says AfBAA membership has raised government awareness

Why did you get involved with the AfBAA?
In Ethiopia, there was no real understanding of business aviation, therefore it was imperative to create awareness to grow the sector. The 2015 regional symposium, held in Addis Ababa, successfully opened the eyes of government and regulatory bodies. In 2016, we launched the AfBAA Ethiopia Chapter.

What does your working week look like?
A typical week for me includes supervising business aviation flights for our clients; as Bole airport is 24h, it is not uncommon to find myself, caffeine-infused, on the ramp at 02:00 waiting for an aircraft to arrive/depart for its technical stop and then returning home at 04:00 before starting a full day at the office. In addition to Krimson, as AfBAA director of membership and events, I also spend a healthy portion of my week working with the executive committee, planning events such as the African Business Aviation Conference and Exhibition.

What is the most challenging part of your work?
Working in Africa is not easy. However, that is part and parcel of why I started Krimson – to make change. We face policy changes, lack of adequate infrastructure and an absence of corporate governance. Communication and time management are other issues that hamper progress.

What is the future for business aviation in eastern Africa?
Economies in the region are rapidly developing, therefore demand for business aviation as a tool and economic driver is high. There is also increased activity in other non-traditional business aviation sectors, such as tourism and medical evacuation. A factor that will help sustain growth is the strong commercial airline sector, which supports a culture of aviation.

What do you enjoy most about life at Krimson?
Developing and cultivating a business aviation sector in Ethiopia. This "big picture" approach has allowed me to engage with senior government officials, operators, media, and other stakeholders to create awareness and drive innovative ideas. My involvement with the AfBAA fulfils my desire to participate and contribute in the advancement of business aviation on the continent, through the relationships and networks I have forged, or by sharing my global experience with my African counterparts. ■

If you would like to feature in Working Week, or you know someone who does, email your pitch to **kate.sarsfield@flightglobal.com**

MISSIONS CHANGE FAST.
SO SHOULD YOUR ISR AIRCRAFT.

Responding quickly to ever-changing mission requirements is crucial to our defense customers. That's why we integrate the very latest ISR sensors and systems into our small tactical aircraft. L3 Technologies' modular sensor payloads with our patented RAPDS™ (Rapid Aircraft Payload Deployment System) enable a wide range of capabilities from a single aircraft. This helps ensure the ability to rapidly reconfigure for multiple missions on a moment's notice. Depend on L3 to keep you one step ahead, at all times.

L3 Technologies

L3T.COM
AEROSPACE SYSTEMS
ELECTRONIC SYSTEMS
COMMUNICATION SYSTEMS
SENSOR SYSTEMS

Exhibit 8

AVIATION

United changes up big Boeing 737 order

BY JERRY SIEBENMARK
jsiebenmark@wichitaeagle.com

NOVEMBER 15, 2016 02:15 PM
UPDATED NOVEMBER 15, 2016 05:03 PM

United Airlines will convert the bulk of two orders for Boeing's best-selling narrowbody jetliner to the planemaker's newest variant.

The Chicago-based airline is changing its orders for 65 Boeing jets from all 737-700s to four 737-800s and 61 737 Maxes.

Just more than two-thirds of the 737 is made in Wichita.

United said in a Securities and Exchange Commission filing Tuesday that it expects to receive the 737-800s next year while delivery dates for the 737 Max jets are "to be determined."

"These changes will allow United to take advantage of the superior fuel efficiency of the MAX aircraft while also reducing capital expenditures by approximately $1.6 billion through 2018," the airline said in its filing.

Shares of Boeing ended 1.25 percent lower on Tuesday to $148.11 on speculation that the order change will mean less revenue for the company in the short term.

The order conversion means Boeing won't be getting as much cash as quickly as it would have under the original orders. Boeing hasn't even begun delivering its Max variant.

The order change also comes before Boeing planned to increase its monthly production rate on the 737 from 42 aircraft a month to 47.

Teal Group analyst Richard Aboulafia said United's order conversion "doesn't do any favors" to bridge the gap between production of the 737 Next Generation and Max. He also thinks this could be signaling the peak of the 737 production cycle and any plans by Boeing to further increase its monthly production rate of the plane.

"That whole onward and upward to 60-rate thing doesn't look real," Aboulafia said.

Boeing spokesman Doug Alder said in an e-mail the conversion will not affect its production rate plans.

"We're excited that United will be adding even more MAXs to its future fleet, and we appreciate their confidence in the airplane," Alder said. "We constantly work with our airline customers to meet their evolving needs, and our healthy 737 backlog of 4,321 airplanes gives us the flexibility to meet those needs."

Spirit AeroSystems in Wichita manufactures 70 percent of the current 737 Next Generation aircraft and will do the same for the new Max variant.

United is a major carrier at Wichita Eisenhower National Airport, operating daily flights to Chicago, Denver and Houston.

Jerry Siebenmark: 316-268-6576, @jsiebenmark

Exhibit 9

Forbes / Logistics & Transportation / #BigBusiness
OCT 17, 2017 @ 11:45 AM 45,250 EDITOR'S PICK

Winners And Losers As Airbus Bails Out Bombardier's C-Series

Richard Aboulafia, CONTRIBUTOR
I cover aircraft markets, industry dynamics and strategies. FULL BIO
Opinions expressed by Forbes Contributors are their own.

A Bombardier CS300 jet performing a flying display in 2015. Photographer: Jasper Juinen/Bloomberg

We all value time, and this is a time-sensitive moment. Let's keep this simple: the winners and the losers in the new Airbus C Series Aircraft Limited Partnership deal.

Biggest winner: the C Series. There was always the feeling that Bombardier had bitten off way more than it could chew, but this is a very fine jet; it just needed help. Actually, the C Series needed a deus ex machina — specifically, a company with all the resources to bring it to market, an elaborate sales and product support infrastructure, and a manufacturing base and supply chain that would allow it to be

built in line with Airbus and Boeing single-aisle-jet production costs. Airbus gives it all of that. Most of all, customers needed to feel they weren't buying an orphan jet; Airbus provides that security, too. Teal Group is raising our C Series forecast by 50%; it may go higher.

Big winner: Airbus. The company gets to co-opt the C Series, which John Leahy had spent the last 10 years loathing. The C Series is the reason Airbus had to re-engine its single aisles. And now, Airbus is the majority owner of the thorn in its side, and it got the C Series for very little cost. Airbus now has a better 130-seat jet than Boeing's 737 MAX 7, along with a better 180/200-seater than the MAX 9/10. On the single-aisle front, Boeing is being boxed into the 150-seat niche, with the MAX8 as its only big seller. Oh, and Airbus now has improved prospects in the Canadian defense market. It can thank Boeing for much of this.

Winner: Bombardier. The company no longer owns a majority share of the C Series, but 31% of a likely big winner sure beats majority ownership of an ulcer. Bombardier no longer has a mountain of risk weighing on it, and it can manage itself like a normal aerospace company, not spending every moment wondering if it will be able to survive in one piece to see the break of dawn. It can focus on large business jets, revive the Dash8Q and reap the rewards as Airbus sells hundreds of C Series jets. Bombardier may even be able to update the CRJ with new engines.

Winner (maybe): Embraer . The world has two top-tier airframers and two second-tier airframers. Airbus and Bombardier are now allies. This greatly increases the likelihood of a stronger Boeing-Embraer alliance as a response.

Big winner: defensive globalization. This subject deserves its own letter. Globalization is not dead. It merely needs workarounds to deal with protectionism. The Airbus-Bombardier deal includes building Delta's C Series jets at the Airbus factory in Mobile, Alabama, a perfect example of this kind of workaround. As a superb Wall Street Journal article about General Electric put it in June, "This is GE in the age of localization — the company's survival strategy for an era of slowing global trade, rising protectionism and increasingly powerful foreign customers, all of which is forcing manufacturers to put down deeper local roots to win business."

Boeing should learn from this. It has been playing checkers with its ill-advised and self-destructive resort to protectionism while companies like GE (and now Airbus and Bombardier) have learned to play three-dimensional chess. Fascinating, as that great three-dimensional chess player Mr. Spock would say.

That brings us to our losers list.

Biggest loser: Boeing BA -0.1%**.** The new deal destroys Boeing's trade case. It (and the Commerce Department) can try to persist, but the new Alabama C Series line makes that futile. As I've written in previous columns, Boeing has pandered to the protectionist wing of the Republican party. The epicenter of that wing is in Alabama, which loves factory jobs, even from foreign companies. Most likely, the Commerce Department will rule that it has no authority on jetliners shipped from Alabama to Georgia. Since this whole trade complaint thing has been absurdly politicized from the start, it is dulce et decorum that Boeing will be undercut by the very politicians to whom it appealed.

Oh, and remember when Boeing dominated Canada's defense market, with F/A-18s, C-17s and CH-47s, and with F/A-18E/Fs, CH-47Fs and P-8s to come? Those days might be over, whether the Canadians go with Lockheed Martin or Airbus, or both. And there's no guarantee that Canada and the UK don't start anti-dumping trade actions against the 737. As I pointed out last month, the MAX 7 has three customers, and two are Canadian. The UK Labor party has already demanded action against 737s sold to now-dead Monarch.

Losers: two overlap victims. The CS300 was always better than the A319neo; now that Airbus is in charge, I expect the latter plane will follow the A350-800 into the great hall of feeble and dead shrunken jets. Meanwhile, the long-rumored 150-seat CS500 will be buried under a rock since Airbus doesn't want to help create an A320neo competitor.

Loser: the Chinese aerospace industry. Over the past 10 years, China signed several cooperation deals with Bombardier and was widely rumored to be looking at an acquisition (of the C Series, or of the company). China was going to be the deus ex machina that the C Series so badly needed. My pal Kevin Michaels coined the term "Combardier" for what looked like a natural alliance or merger between Comac and Bombardier. Several times, China could have swooped in to rescue what looked like a doomed program, paying just pennies on the dollar and scooping up tons of intellectual property that would have been incredibly valuable in its own jetliner development efforts. Yet China did nothing, even when it would have been the only bidder. This reinforces my conviction that all this talk of China's becoming the next great aerospace power is 98% talk. The Airbus-Boeing duopoly is alive and well.

Loser: government support for industry. I may have been appalled by Boeing and the Commerce Department's complaint, but ironically, they had a point. Canada, Quebec and the UK may have set a new record for market distortion with all their C Series support. And what did it get these governments in return? A new Airbus jet.

Lastly, one final winner: Donald Trump. Once again, his administration has helped create a problem (a politicized trade complaint) and then taken credit for solving it. I predict an Official Trump Tweet taking credit for bringing Airbus factory jobs to Alabama. If Boeing's leaders expected loyalty from Trump, they were mistaken.

Exhibit 10

United continues to evaluate 100-seat mainline aircraft

21 AUGUST, 2017 | SOURCE: FLIGHT DASHBOARD | BY: EDWARD RUSSELL | WASHINGTON DC

United Airlines continues to evaluate adding a 100-seat aircraft to its mainline fleet, less than a year after it cited the aircraft category's poor economics for the conversion of its Boeing 737-700 order to larger variants.

"There does seem to be an opportunity and fit for an aircraft with around 100 seats to fill that gap in our network, but on the other hand the problems with the complexity cost for a new fleet type is a big concern," said Howard Attarian, senior vice-president of flight operations at the Chicago-based carrier, in a letter to employees on 18 August.

There is a 42-seat gap between United's largest regional aircraft, the 76-seat Embraer 175, and its smallest mainline narrowbody, the 118-seat 737-700.

That gap is smaller at both American Airlines and Delta Air Lines, both of which have 100 seaters in their mainline fleets. American has 20 Embraer 190s with 99 seats, though it will retire the type in 2019, and Delta has 91 Boeing 717-200s with 110 seats. Both carriers have 76-seat regional jets in their feeder fleets.

"It's our responsibility to look at every option and thoughtfully weigh all of the associated factors before we arrive at any decision, and that's what we're doing as part of our ongoing fleet plan analysis," says Attarian on the evaluation of a 100-seat aircraft at United.

A spokesman for the airline affirm's his comments, saying it is always looking at ways to "fly more efficiently and make the best use of our fleet".

United upgauged and deferred all of the 65 737-700s it had on order in November 2016, converting them to four 737-800s and 61 737 Max. It cited a preference for the latest technology and desire for more seats to defray unit costs for the decision.

The carrier continues to send mixed messages about the possibility for a 100-seat mainline aircraft. In January, United president Scott Kirby told employees that the economics of such an aircraft "just don't work" for the airline due to higher operating costs.

However, prior to Kirby's joining the company in August 2016, airline executives maintained that there was a need for a small mainline aircraft, a fact that prompted the 737-700 order in early 2016.

“There is a natural need for a small mainline narrowbody,” said Gerry Laderman, treasurer of United and then acting chief financial officer, in November 2015.

The airline, whose 100-seat aircraft evaluation dates back to at least 2014, was considering both the Bombardier CSeries and Embraer E2 family before it placed the 737 order.

Delta has been the most successful at adding a 100-seat aircraft to its fleet. It used the addition of the 717 in 2013 as a carrot to pilots in exchange for more large regional jets in its feeder fleet.

The Atlanta-based carrier will continue this upgauge strategy with the up to 125 CS100s that it ordered in April 2016.

United has a similar clause in its pilots agreement. If it adds a new small mainline narrowbody, including either the CS100 or E190-E2, it can add up to 70 more 76-seat regional jets to its feeder fleet.

The carrier has engaged in a similar fleet upgauge cascade as Delta. It has shifting 50-seat regional jet flying to 76-seat aircraft, large regional jet routes to Airbus A319s and 737s and on upwards to its small fleet of domestic Boeing 777-200s.

United will continue this upgauge strategy when it begins taking 737 Max 10 in 2020. Attarian says in the letter that the majority of these aircraft will replace 737-800s and -900ERs in domestic markets.

Related Content

United again puts the kibosh on possible 100-seat aircraft

United says 787-9 is right jet for Singapore-LA route

United aims for Q3 completion of fleet review

Economics of 100-seaters 'don't work' for United: president

United defers, converts 737 order in fleet shake-up

United rules out CSeries order for next three years

United orders more 737-700s and adjusts 787 deliveries

United still considering a CSeries or E2 order

United Airlines Data Snapshot

$36556M Total Revenue (2016)

738 In Service Fleet

DATA SOURCE: FG DASHBOARD

United Airlines Ownership

1

Exhibit 11

Historical Snapshot

In 1965, the Boeing name was synonymous with big multiengine jet airplanes, so when the company announced its new commercial twinjet, the 737, it quickly earned the nickname “Baby Boeing.”

The first 737 was the last new airplane to be built at Plant 2 on Boeing Field in Seattle, with a production run that included the legendary B-17 Flying Fortress, B-52 Stratofortress and the world’s first large swept-wing jet — the XB-47 Stratojet. While the old assembly building at Plant 2 seemed cavernous, it still wasn’t tall enough for the 737’s tail, which was attached using a crane in the parking lot. The plane was then rolled down to a nearby plant known as the Thompson Site, where Boeing had set up the first production line for the 737.

At a ceremony inside the Thompson Site on Jan. 17, 1967, the first 737 was introduced to the world. The festivities included a christening by flight attendants representing the 17 airlines that had ordered the new plane.

In 1967, the smaller, short-range 737 twinjet was the logical airplane to complement the 707 and the 727. There was increasing demand for transports in its category, but the 737 faced heavy competition from the Douglas DC-9 and the British Aircraft Corp. BAC 1-11.

To save production time, and get the plane on the market as soon as possible, Boeing gave the 737 the same upper lobe fuselage as the 707 and 727 so that the same upper deck cargo pallets could be used for all three jets. The 737 later adopted the 727’s cargo convertible features, which allowed the interior to be changed from passenger to cargo use in the 737-200 series.

The 737 had six-abreast seating — a selling point, because this way it could take more passengers per load (the DC-9 seated five abreast). The number of seats in the 737 also was increased by mounting the engines under the wing. This engine placement buffered some of the noise, decreased vibration and made it easier to maintain the airplane at ground level. Like the 727, the 737 could operate self-

sufficiently at small airports and on remote, unimproved fields. The plane's performance in these conditions led to orders in Africa, Central and South America, Asia and Australia.

At first, the 737 was called the "square" airplane because it was as long as it was wide. The new technology made the position of flight engineer redundant; the 737's two-person flight deck became standard among air carriers.

On Dec. 28, 1967, Lufthansa took delivery of the first production 737-100 model, in a ceremony at Boeing Field. The following day, United Airlines, the first domestic customer to order the 737, took delivery of the first 737-200. The last 737-200 was delivered Aug. 8, 1988.

By 1987, the 737 was the most ordered plane in commercial history. In January 1991, 2,887 737s were on order, and Models 737-300, -400 and -500 were in production.

By 1993, customers had ordered 3,100 737s, and the company was developing the Next-Generation 737s — the -600, -700, -800 and -900. Boeing certified and delivered the first three Next-Generation models in less than one year.

The 126- to 149-seat 737-700 was launched in November 1993 and first delivered in December 1997. The 162- to 189-seat 737-800 was launched Sept. 5, 1994. The 110- to 132-passenger 737-600 was first delivered in 1998, and the 177- to 189-passenger 737-900 was first delivered in 2001. Customers began ordering the -900's replacement, the higher capacity, longer range 737-900ER, in 2005.

The Boeing Business Jet (BBJ), launched in 1996 as a joint venture between Boeing and General Electric and designed for corporate and VIP applications, is a high-performance derivative of the 737-700. The BBJ 2, announced in October 1999, is based on the 737-800 and has 25 percent more cabin space and twice the cargo space of the BBJ.

The 737 serves as a platform for military derivatives, including airborne early warning and control (AEW&C). Nineteen 737-200s, modified as T-43 navigator trainers, served with the U.S. Air Force. The 737 also provides a platform for the U.S. Navy P-8A Poseidon, a long-range maritime patrol and reconnaissance aircraft. The Navy C-40A Clipper is certified to operate in an all-passenger configuration, an all-cargo variant, or as a "combi" that accommodates both cargo and passengers on the main deck. The Air Force C-40B provides safe, comfortable and reliable transportation for U.S. combatant commanders and other senior government officials to locations around the world.

The 737 MAX is Boeing's newest family of single-aisle airplanes. The family includes the 737 MAX 7, 737 MAX 8 and 737 MAX 9. The program has also launched the 737 MAX 200, a new variant based on the 737 MAX 8.

The 737 MAX's more efficient structural design, lower engine thrust and less required maintenance are designed to give customers substantial cost savings. The 737 MAX will incorporate the latest quiet engine technology to reduce the operational noise footprint, and emissions will be approximately 50 percent below the International Civil Aviation Organization's (ICAO) Committee on Aviation Environmental Protection (CAEP)/6 limits for nitrogen oxides (NOx).

In July 2012, the 737 became the first-ever commercial jet airplane to surpass the 10,000 orders. By 2014, Boeing was building 42 737s at its Renton, Wash., factory every month, and planned to increase the rate 52 per month in 2018 to meet continuing demand.

The number one 737 was a prototype used for flight test and certification and never went into revenue service. In 1974, the plane turned in its Boeing house livery of dark green and cream for the sporty white and blue colors of NASA. For the next two decades, the plane was based at the NASA Langley Research Center in Virginia and

had an outstanding career as a flying laboratory. Today, the plane is on display at the Museum of Flight in Seattle surrounded by its bigger family members from the early 7 series and parked just a few hundred feet from where it first took to the air 40 years ago.

Technical Specifications

737	
First flight	April 9, 1967
Model number	737-100/-200
Classification	Commercial transport
Span	93 feet
Length	93 feet 9 inches
Gross weight	111,000 pounds
Cruising speed	580 mph
Range	1,150 miles
Ceiling	35,000 feet
Power	Two 14,000-pound-thrust P&W JT8D-7 engines
Accommodation	2 crew, up to 107 passengers

Exhibit 12

#BUSINESS NEWS

DECEMBER 11, 2017 / 4:59 PM / 15 DAYS AGO

Boeing lifts dividend by 20 percent, sets new $18 billion share buyback

Reuters Staff

(Reuters) - Boeing Co (BA.N) said on Monday it would raise its quarterly dividend by 20 percent and replace its existing share buyback program with a new $18 billion authorization.

The Boeing Company logo is projected on a wall at the "What's Next?" conference in Chicago, Illinois, U.S., October 4, 2016. REUTERS/Jim Young

The company's shares, the best-performing Dow component this year with an 84 percent surge, were up 1.2 percent at $286.51 in after-market trading.

The world's biggest maker of jetliners said the raised dividend and the new buyback program were not in response to a Republican tax overhaul, which seeks to cut corporate taxes to 20 percent from 35 percent.

Other U.S. corporations have said they would use the windfall from the tax overhaul to buy back shares, retire debt and other shareholder-friendly moves.

The cash deployment plans reflect ongoing confidence in our financial strength and the long-term outlook of our business, Boeing Chief Financial Officer Greg Smith said in a statement.

Boeing's dividend increase comes at the high-end of analysts' estimates of 15 percent to 20 percent, Robert W Baird & Co analyst Peter Arment wrote in a note.

The company said on Monday the new quarterly dividend would be $1.71 per share, up from $1.42.

Boeing Co 294.91
BA.N NEW YORK STOCK EXCHANGE -0.19 (-0.06%)

confidence in generating strong free cash flows over the next few years, analyst Arment said.

Boeing said it expected to complete the new buybacks in the next 24-30 months.

Reporting by Uday Sampath in Bengaluru and Alwyn Scott in New York; Editing by Sriraj Kalluvila

Our Standards: *The Thomson Reuters Trust Principles.*

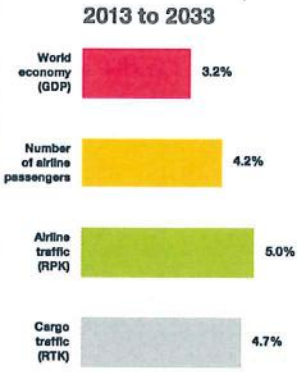
Exhibit 13

BOEING

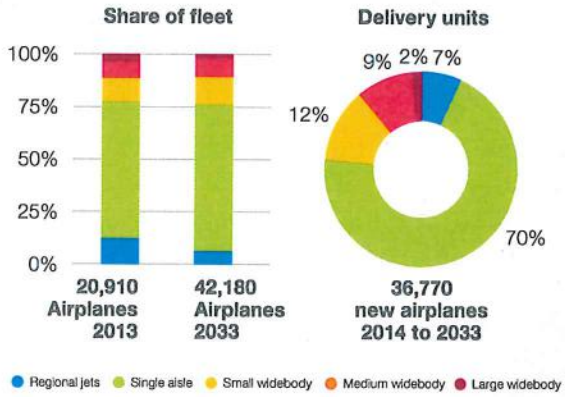
Current Market Outlook
2014–2033

Outlook on a page

World regions
Market growth rates



World regions
Market value: $5.2 trillion



World regions
Key indicators and new airplane markets

Regions		Asia Pacific	North America	Europe	Middle East	Latin America	CIS	Africa	World
World economy	(gross domestic product [GDP])%	4.4	2.5	1.9	3.8	3.9	3.3	4.7	3.2
Airline traffic	(revenue passenger-kilometers [RPK])%	6.3	2.9	3.9	6.4	6.2	4.4	5.9	5.0
Cargo traffic	(revenue tonne-kilometers [RTK])%	5.5	3.4	3.5	5.9	5.3	4.0	6.1	4.7
Airplane fleet	%	5.2	1.6	2.9	5.4	4.8	2.2	3.6	3.6
Market size									
Deliveries		13,460	7,550	7,450	2,950	2,950	1,330	1,080	36,770
Market value	($B)	2,020	870	1,040	640	340	150	140	5,200
Average value	($M)	150	120	140	220	120	110	130	140
Unit share	%	37	21	20	8	8	4	3	100
Value share	%	39	17	20	12	7	3	3	100
New airplane deliveries									
Large widebody		210	20	60	300	0	30	0	620
Medium widebody		1420	510	590	790	40	60	50	3460
Small widebody		1940	630	810	460	360	90	230	4520
Single aisle		9,540	4,820	5,870	1,360	2,360	990	740	25,680
Regional jets		350	1570	120	40	190	160	60	2490
Total		**13,460**	**7,550**	**7,450**	**2,950**	**2,950**	**1,330**	**1,080**	**36,770**
Market value (2013 $B catalog prices)									
Large widebody		80	10	20	120	0	10	0	240
Medium widebody		480	170	190	270	10	20	20	1160
Small widebody		490	140	220	120	90	30	50	1140
Single aisle		960	490	600	130	230	80	70	2560
Regional jets		10	60	10	<5	10	10	<5	100
Total		**2,020**	**870**	**1,040**	**640**	**340**	**150**	**140**	**5,200**
2013 fleet									
Large widebody		290	100	180	100	0	60	10	740
Medium widebody		520	320	360	280	20	20	60	1,580
Small widebody		710	730	350	220	120	180	80	2,390
Single aisle		3,820	3,790	3,120	520	1,160	740	430	13,580
Regional jets		130	1,710	340	60	80	180	120	2,620
Total		**5,470**	**6,650**	**4,350**	**1,180**	**1,380**	**1,180**	**700**	**20,910**
2033 fleet									
Large widebody		270	80	110	270	0	60	0	790
Medium widebody		1,500	560	640	770	50	90	70	3,680
Small widebody		2,250	920	980	570	430	160	260	5,570
Single aisle		10,850	5,950	5,830	1,680	2,840	1,350	1,000	29,500
Regional jets		350	1,610	150	70	210	160	90	2,640
Total		**15,220**	**9,120**	**7,710**	**3,360**	**3,530**	**1,820**	**1,420**	**42,180**

Market values above 5 have been rounded to the nearest 10.

Long-term forecast

Purpose of the forecast

The *Current Market Outlook* is our long-term forecast of air traffic volumes and airplane demand. The forecast helps shape our product strategy and guide long-term business planning. We have shared the forecast with the public for more than 50 years to inform decisions by airlines, suppliers, and the financial community.

We start fresh every year, factoring the effects of current business conditions and developments into our analysis of the long-term drivers of air travel. The forecast details demand for passenger and freighter airplanes, both for fleet growth and for replacement of airplanes that retire during the forecast period. We also project the demand for passenger-to-freighter conversions.

Effects of market forces

The aviation industry continually adapts to market forces. Key among these are fuel prices, economic growth and development, environmental regulations, infrastructure, market liberalization, airplane capabilities, other modes of transport, business models, and emerging markets. Fuel is now the largest component of airline cost structure. This fact has spurred manufacturers to produce more efficient airplanes, such as the 787 and the 737 MAX, and encouraged airlines to optimize other cost and revenue centers to maintain profitability in the face of high fuel prices.

Our long-term forecast incorporates the effects of market forces on the development of the aviation industry. Economic growth, as measured by gross domestic product (GDP), is a primary contributor to aviation industry growth. GDP is forecast to rise 3.2 percent over the next 20 years, which will drive passenger traffic to grow 5.0 percent annually and cargo traffic (which also depends on global trade) to grow 4.7 percent annually.

Shape of the market

We forecast long-term demand for 36,770 new airplanes, valued at $5.2 trillion. We project that 15,500 of these airplanes (42 percent of all new deliveries) will replace older, less efficient airplanes. The remaining 21,270 airplanes will be for fleet growth, which stimulates expansion in emerging markets and development of innovative airline business models. Single-aisle airplanes continue to command the largest share of the market. Approximately 25,680 new single-aisle airplanes will be needed over the next 20 years. Fast-growing low-cost carriers and network carriers pressed to replace aging airplanes drive single-aisle demand. The widebody fleet will need 8,600 new airplanes. The new generation of efficient widebody airplanes is helping airlines open new markets that would not have been economically viable in the past.

Current Market Outlook
2014 – 2033

Randy Tinseth introduces the 2014 **Current Market Outlook**

Airplanes in service
2013 to 2033

Size	2013	2033
Large widebody	740	790
Medium widebody	1,580	3,680
Small widebody	2,390	5,570
Single aisle	13,580	29,500
Regional jets	2,620	2,640
Total	**20,910**	**42,180**

Demand by size
2014 to 2033

Size	New airplanes	Value ($B)*
Large widebody	620	240
Medium widebody	3,460	1,160
Small widebody	4,520	1,140
Single aisle	25,680	2,560
Regional jets	2,490	100
Total	**36,770**	**5,200**

*$ values though out the CMO are catalog prices.

Key indicators
2013 to 2033

Growth measures (%)	
World economy GDP	3.2
Airplane fleet	3.6
Number of passengers	4.2
Airline traffic RPK	5.0
Cargo traffic RTK	4.7

Demand by region
2014 to 2033

Region	New airplanes	Value ($B)
Asia Pacific	13,460	2,020
Europe	7,450	1,040
North America	7,550	870
Middle East	2,950	640
Latin America	2,950	340
CIS*	1,330	150
Africa	1,080	140
Total	**36,770**	**5,200**

*Commonwealth of Independent States.

Business and market environment

Global economic growth lagged the long-term average rate for the second straight year in 2013. However, signs of acceleration appeared in the second half of 2013, boosting confidence in predictions that better performance in North America and Western Europe will lead a gradual upward trend during 2014 and 2015. Recent data on US jobless claims, retail sales, industrial production, new home sales, and household finances support forecasts for a return to the long-term growth average. The European economy began to grow again in the second half of 2013, following five quarters of recession. Rising consumer and business confidence, low interest rates, improving export markets, and pent-up demand for durables are projected to extend the strengthening trend through 2014 and into 2015.

Emerging markets

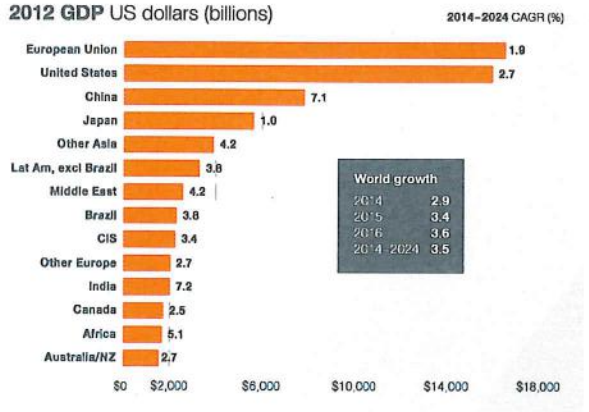
Growth in many emerging markets continues to outpace that in developed economies. Momentum has slowed, however, in recent quarters, with weakened demand from developed economies and withdrawal of government stimulus. Strengthening demand in Europe and the United States is expected to boost exports from emerging economies. Economic prospects in Asia will be shaped by capital rotation out of emerging markets, key elections in several countries, and the pace of domestic macroeconomic reforms. Rapid credit expansion in China has created vulnerabilities in real estate, banking, and local government, but government spending and fiscal policies support near-term growth. Elections in India and Indonesia should help resolve policy uncertainties, which will support stronger economic growth. The outlook for consumer spending in Asia is bright, thanks to robust income growth and deepening financial markets. In emerging markets outside Asia, commodity prices, political stability, and government response to inflationary pressures driven by weakening currencies will be key watch items.

IHS Economics forecasts an extended period of strong performance. There is a growing chance that pent-up business and household demand and idle production capacity in many parts of the world will fuel above-trend growth over the next several years, resulting in an upside growth surprise. Structural reforms will be key to sustaining these prospects.

Airline passenger traffic sustained a growth rate slightly above 5 percent during 2012 and 2013, despite consecutive years of weak global GDP growth. The global airline industry grew at or above the long-term growth rate on sound fundamentals. Productivity continues to increase, with historically high airplane utilization and passenger load factor. In 2013, load factor was 79 percent, showing that airlines are matching demand without oversupplying capacity. Unit revenue (passenger revenue per available seat-kilometer) was stable at the global level in 2013, indicating that airlines did not cut fares to fill seats. Unit cost was downslightly Better unit revenue, combined with reduced unit cost indicates a more profitable industry.

Business and market environment
Global economic growth accelerating

Source: IHS Economics

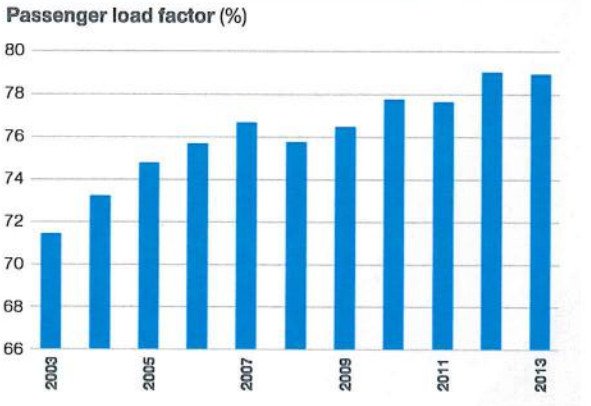


Business and market environment
Emerging markets

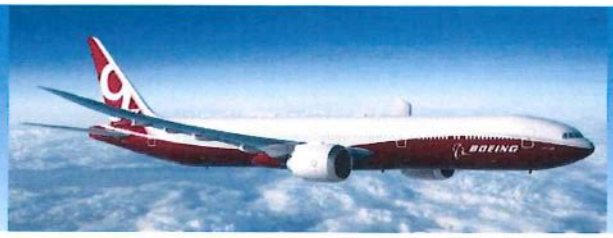
Source: IHS Economics

Business and market environment
World passenger load factors at historic highs

Source: ICAO/ IATA



Business and market environment, continued



Airline traffic in developed economies grew at a respectable pace in 2013, although mature markets generally lag the world average. Economic growth was flat in Europe, but the region's passenger traffic increased nearly 4 percent from 2012. Profitability was sluggish, however, as network carriers restructured to compete with low-cost carriers in short-haul markets and sixth-freedom carriers in long-haul markets. In North America, consolidation and capacity discipline held growth to about 2 percent, but airline earnings in the region lead the global industry with an estimated $7 billion net profit. Their performance is expected to climb to $9 billion in 2014, representing approximately half the entire industry's projected profit.

Overall, emerging markets, led by China and the Middle East, continue to grow faster than the global average, with double-digit traffic growth. Some emerging markets, however, such as Brazil and India, have seen slower growth owing to recent economic softness and volatile exchange rates that reduced traveler purchasing power. Weakening currencies in many emerging markets have also quickly and materially raised airline costs, such as jet fuel and financing, which are generally priced in US dollars. These higher costs, combined with growing competition, have led to near-term profit challenges for many emerging market airlines. Longer term prospects remain bright, however, as a result of the strong demand outlooks associated with growing middle classes and liberalizing air travel markets.

Air cargo traffic

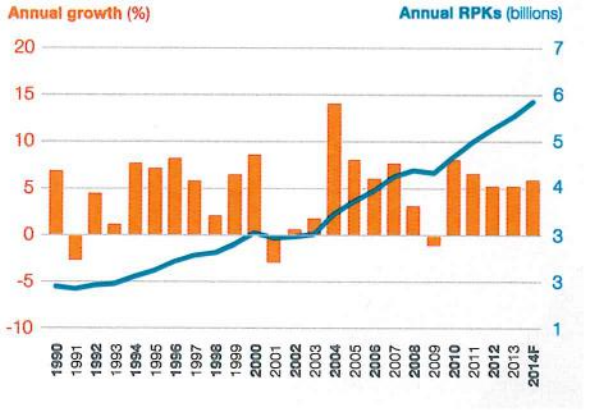
From 1993 to 2008, air cargo traffic averaged 5.4 percent annual growth. Annual growth has slowed to about 1 percent since 2008, however. The deep recession followed by a weak recovery in developed economies strongly curbed trade and air cargo growth. Although some countries took protectionist measures during the downturn, very few became more closed. Opportunities for trade liberalization are not exhausted. There is little evidence to indicate that supply chains are becoming less global. High-value merchandise trade is forecast to expand approximately 5 percent per year through 2030, which should bolster air cargo traffic. Traffic began to accelerate during the fourth quarter of 2013 and first quarter of 2014, which may herald a long-awaited recovery in air cargo.

Returning profitability

Global airline industry net profits were an estimated $10.6 billion in 2013, up from $6.1 billion in 2012. Net profit for 2014 is forecast to improve further to $18 billion as economic growth accelerates and fuel prices remain stable. Brent oil prices have generally traded in the range of $110 plus or minus $5 per barrel since mid-2012. The broad trend has been relatively stable, with only very short-term volatility in response to specific events such as Middle East unrest or economic news from Europe or the United States. Inflation-adjusted price forecasts are largely stable into the middle of the decade, reflecting increased projected supply,

Business and market environment
Passenger traffic is resilient

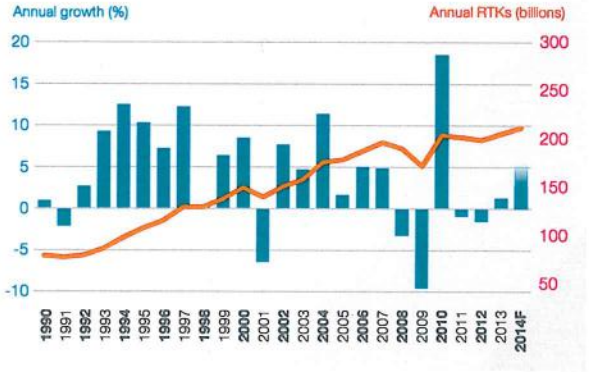
Source: ICAO



Business and market environment
Cargo market slowly starting to rebound

Source: IATA / ICAO

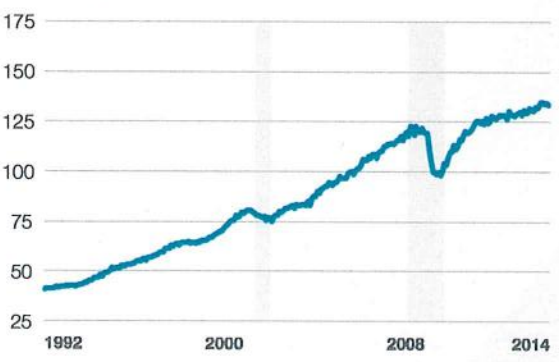
Air cargo traffic



Business and market environment
Momentum slow after 2010 may be picking up

Source: CPB

Volume Index (s.a. 2005 = 100); indicator of world merchandise trade



Business and market environment, continued

based on US oil shale production and prospects. Although forecasts anticipate upward price pressure from supply-and-demand dynamics in the longer term, the trajectory has moderated from forecasts made just a few years ago.

Airlines continue to focus on boosting revenue through alliances and partnerships and by raising fees and charging for ancillary services. Sources for ancillary revenue include fees for baggage, ticket change, extra amenities, annual subscriptions to premium services, frequent flyer programs (FFP), and even onboard duty-free sales. Some of the more innovative sources (such as annual subscriptions and FFP products like branded credit cards) generate handsome margins for the airlines and promote brand loyalty. US carriers lead the industry in ancillary revenue, earning about 5 percent of total passenger revenue from ancillary services. Among LCCs, the share of ancillary revenue far surpasses the US industry average. Nearly 40 percent of Spirit Airlines operating revenue comes from ancillary services. Such strategies helped the airlines improve profitability in 2013, despite below-average global economic growth.

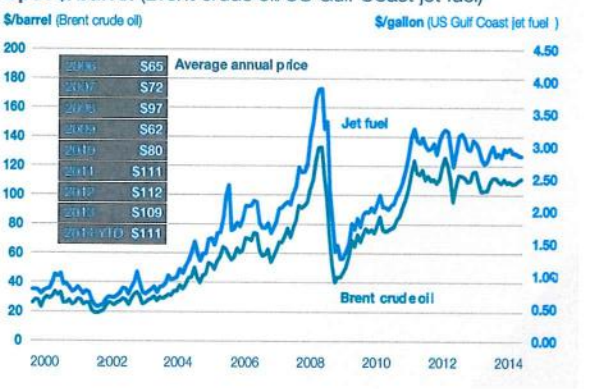
Improved profitability is allowing airlines to increase strategic investment for future growth. Airlines are boosting investments to enhance their customer product offering and operating efficiencies. For example, in addition to new airplanes, airlines are investing in new information and mobile technology, upgraded cabin interiors for higher levels of service, and additional seats to improve unit costs. Some airlines are increasing equity investment in other airlines and cross-border partnerships to solidify and expand networks. Reinvestment of profit into airline products enhances the long-term growth prospects for the industry.

Business and market environment
Airlines managing economic uncertainty

Source: ICAO IATA

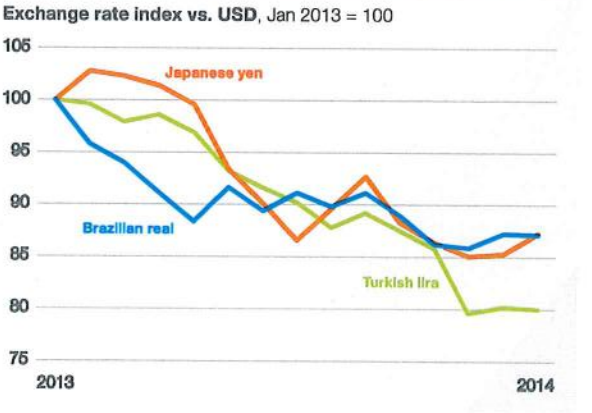
Business and market environment
Oil prices to remain elevated, but stable

Source: EIA



Business and market environment
Exchange rate fluctuations affect profits

Source: Pacific Exchange Rate Service



Airline strategies and business models

Airline strategies and business models

Strategic planning is a continual process for airlines. Plans must take into account the challenging and ever-changing competitive environment as well as how passengers define value. For example, business travelers are sensitive to flight times and expect a high level of service. Short-haul business travelers tend to be more sensitive to ticket prices than long-haul business travelers. Leisure travelers are more sensitive to price but less demanding about service levels.

Deregulation has had a significant impact on airline strategies during the past several decades. As regulations on commercial aviation relax, airlines gain freedom to vary fares in response to competition and demand, develop network and schedule planning, and manage other key aspects of airline business. Deregulation has helped stimulate traffic and network growth, and the resulting competition provides increased choice to travelers. Airline business models continue to evolve in order to adapt to the dynamic marketplace.

Low-cost carrier business model

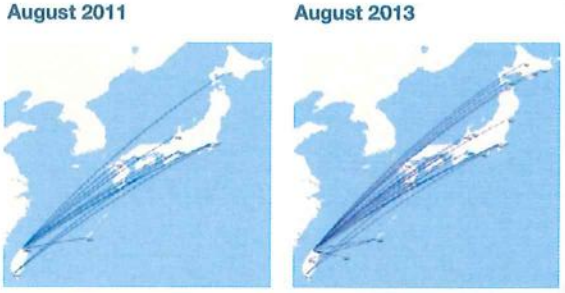
The low-cost carrier (LCC) business model has grown tremendously over the past two decades. Successful LCC pioneers include Southwest Airlines in the United States and Ryanair in Europe. The LCC model focuses on business and operational practices that drive down airline costs. Typical cost-saving practices include operating at secondary airports, flying a single airplane type, increasing airplane utilization, relying on direct sales, offering a single-class product, avoiding frequent-flyer programs, and keeping labor costs low. Such tactics helped LCCs reduce unit cost by 20 percent to 40 percent compared with network carriers. Their lower cost structure allows LCCs to reduce fares, which significantly stimulates traffic. Thus, the LCC model has proved successful throughout the world and has driven the growth of air travel.

Recently, many LCCs have diverged from traditional LCC tactics. Customer expectations, regional variations, and competition have forced LCCs to adapt to new challenges. In today's market, it is not difficult to find an LCC flying multiple airplane types, operating at primary airports, or offering frequent-flier programs. Other variations include using global distribution systems, offering more frills to passengers, or even flying medium- to long-haul routes. Despite these developments, the LCC model and LCC profitability continue to grow.

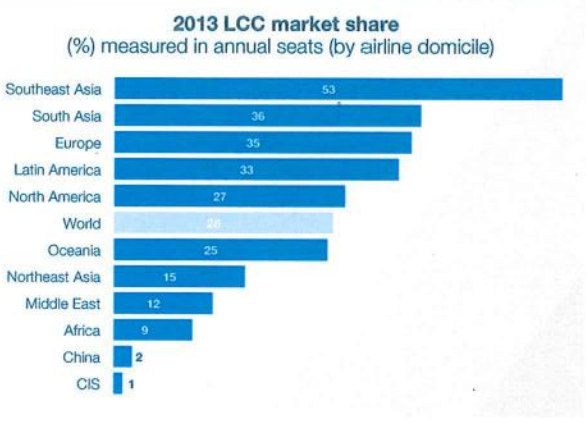
Network carriers

At the other end of the spectrum, network carriers include the largest airlines in the world, such as United, Air France, and JAL. Network carriers tend to have major hub operations for domestic, regional, and international services; large, complex fleets; airline alliances; and a broad array of service offerings, such as airport lounges, onboard meals, and multiple cabin classes. Hub operations significantly increase network reach and allow carriers to offer convenient one-stop connections around the globe.

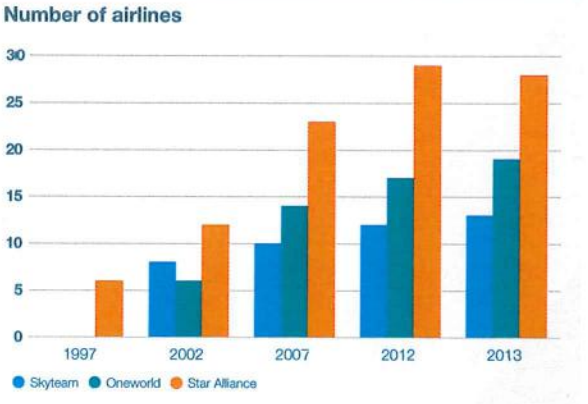
Airline strategies and business models
Destinations doubled since Japan-Taiwan Open Skies*
Source: Diio Innovata



Airline strategies and business models
LCCs provide a large share of capacity
Source: Diio Innovata 2013, jet only



Airline strategies and business models
Airlines continue to find benefits with alliances
Source: OAG



Airline strategies and business models, continued

Some carriers use the geographical advantage of their location to funnel both short- and long-haul traffic through their hubs. Examples include Emirates in the Middle East and Copa Airlines in Latin America. These carriers have grown strongly in recent years and plan continued expansion in the coming decade.

Less common business models include airlines that specialize in charter or inclusive tour operations. Some regional carriers operate smaller airplanes to serve airports that are unserved or underserved by major airlines.

Cargo models

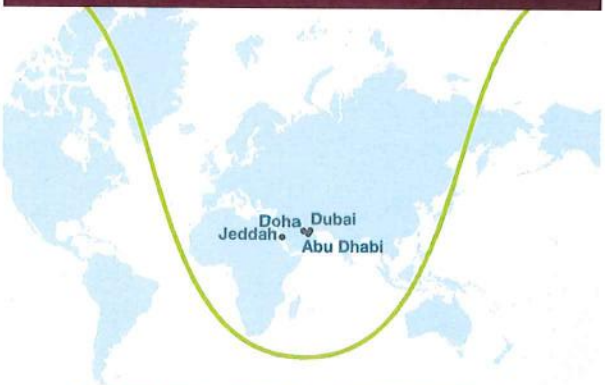
Carrying freight and mail gives airlines revenue opportunities beyond transporting passengers. Air cargo is commonly used for shipments of high-value, time-sensitive, or perishable goods that are not well suited for surface transportation. Many airlines carry cargo in the lower hold of passenger jets. Some operate dedicated freighters in addition to passenger airplanes. And a handful of airlines, including express carriers that provide fully integrated logistic services for businesses and consumers, focus exclusively on air cargo. The air cargo business differs in many respects from the passenger business. In particular, air cargo flows are more directional than passenger flows: passengers generally travel round trip, but air cargo does not. Therefore, network strategies for cargo operations differ significantly from passenger network strategies.

Partnerships and alliances

Airline partnerships, either full alliances or other cooperative arrangements, have become powerful tools for expanding networks, enhancing revenue, and reducing costs. Code sharing is a common partnering tactic, and code-sharing routes have grown nearly 8 percent annually during the past decade. The three major alliances (Star Alliance, SkyTeam, and oneworld) now provide more than 60 percent of global capacity. Many airlines have also entered joint ventures, some with antitrust immunity that allows them to operate more closely on applicable routes.

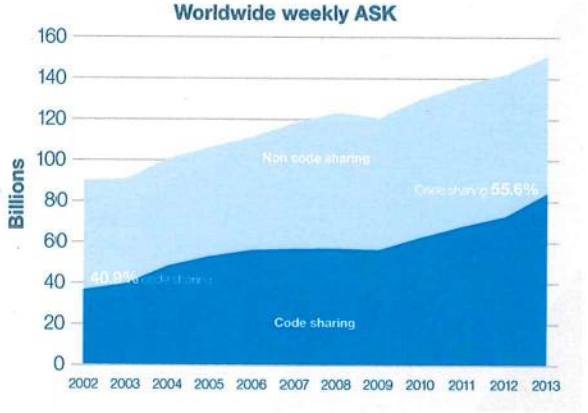
Airlines are also taking equity stakes in other airlines as a growth strategy. Partial acquisitions, full mergers, and cobranded subsidiaries are typical examples. These strategies are effective for opening new markets, obtaining new traffic, and rationalizing costs. Airline mergers have catalyzed industry consolidation and enabled participants to remain competitive. Creating subsidiaries has allowed airlines to expand their brands to foreign countries and to stay within foreign-ownership regulation limits. All of these tactics have contributed to the profitable growth of the industry.

Airline strategies and business models
Middle East hubs are well situated geographically
Source: IATA

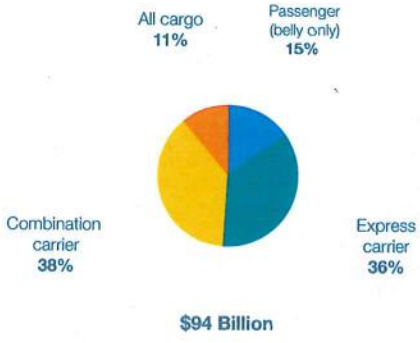


*80% of population is within an 8 hour flight from Middle East hubs

Airline strategy and business models
Codeshare growth outpaces overall growth
Source: August OAG



Airline strategies and business models
85% of cargo revenue by freighter operators
Source: ATI, US DOT



Network and hub analysis

Network and fleet planning

Airline networks constantly evolve as airlines strive to compete effectively and grow efficiently in the dynamic air transport market. Key network growth strategies include the increase of frequencies, expansion into new markets, and development of hubs. Each of these strategies enables airlines to capture greater market share and serve a broader traffic base.

Frequency growth

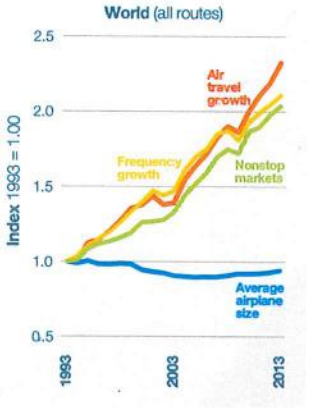
Frequency is a key driver of network growth, particularly in the competition for business travelers. Daily service is crucial to gaining a foothold in a market. Established airlines can generate incremental market share by increasing frequencies because offering additional opportunities to fly makes an airline's network more attractive to schedule-conscious business travelers. Increased frequency also boosts connectivity within hub networks, thereby multiplying the number of city pairs that can be linked. For example, over the past decade, increasing frequencies in existing markets has driven 60 percent of domestic market growth in China.

Frequency growth has begun to slow in some maturing networks as markets reach saturation, where nearly every available time slot is covered by nonstop flight options. In these networks, there is a modest trend toward increasing the number of available seats in particular markets by substituting a larger member of an airplane family for a smaller one. For example, airlines around the world are using larger 737-800 airplanes where 737-700 or 737-400 airplanes had served, as they leverage the versatility and efficiency of these fleets across stage lengths and makre types Airlines are also boosting the seat count of existing airplanes by installing new-technology seats that require less room and so allow additional seat rows. Over the past 20 years, the average capacity of single-aisle airplanes has increased by about 20 seats, to approximately 160 seats per airplane. We project that trend will continue during the next decade as airlines optimize airplane configurations for unit cost efficiency and demand for seats, while also preserving flexibility for cyclical demand and competitive dynamics

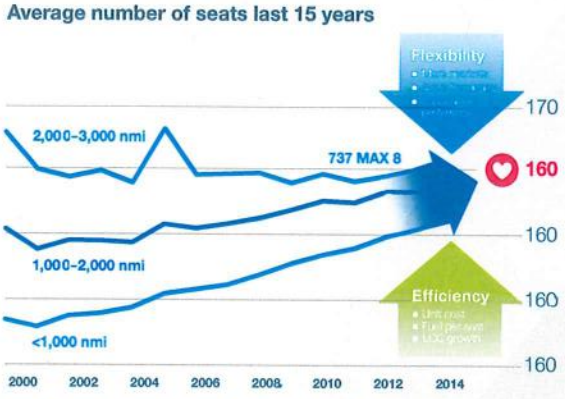
Growth strategies

Expansion into new markets has the greatest impact on network growth. Adding new destinations to an airline's network provides access to new revenue streams and often accelerates economic development in the newly connected markets. The development of new domestic and regional routes in emerging aviation markets stimulates economic growth within the region as a result of the commerce that increased passenger traffic generates. The delivery of new, more efficient long-range airplanes in an array of sizes is enabling airlines to match airplane capacity to market demand much more precisely, which in turn, makes it possible to serve new long-distance city

Network and hub analysis
Growth met by increased frequencies and nonstops



Network and hub analysis
Average airplane converging on 160 seats
Source: Flightglobal Ascend Online Database



Network and hub analysis
787 opening new markets around the world

Network and hub analysis, continued

pairs that were not economical in the past. In fact, more than 21 new nonstop routes, including Tokyo-to-Dusseldorf, London-to-Austin, San Francisco–to-Chengdu, and Beijing-to-Boston, have been launched in the past 3 years alone, using the 787.

These growth strategies play a role in the development of hub-based and point-to-point networks. Airlines borrow freely from both models in the continual effort to optimize schedules for maximum revenue and operational efficiency. Airlines with global networks are strengthening schedule connections to maximize traffic and revenue as the trend toward smoothing traffic peaks at hubs, which took hold during the past decade, softens. Airlines, such as the Gulf carriers that take advantage of sixth-freedom connecting power, continue to expand their hubs and networks. Similarly, point-to-point airlines are connecting more city pairs in their networks with nonstop links to maximize airplane utilization and increase both point-to-point and connection traffic moving through their systems.

Structural and competitive challenges

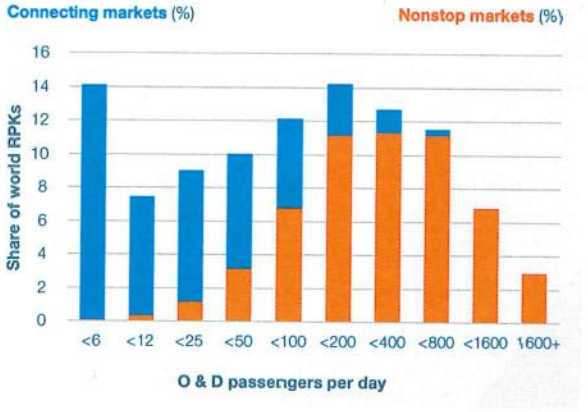
In addition, airlines continuously react to structural and competitive challenges. Short-haul networks in some regions, including China and Europe, face pressure from high-speed rail alternatives, which sometimes requires rebalancing of capacity and redeployment of the fleet to support market expansion in sectors with longer routes. Networks also constantly adapt to pressures from the expansion of competitor networks and from mergers, acquisitions, or alliance partnerships among competing airlines. The most successful airlines blend frequency growth and network expansion to develop and compete profitably.

Strategic planning

To succeed, network strategies must be accompanied by effective fleet plans. Historically high airplane manufacturer backlogs, for single-aisle and widebody airplanes alike, make proactive planning essential to long-term competitive advantage. Airlines link their network strategies to their long-term requirements for airplane replacement and fleet growth to create the most efficient, capable, and flexible fleet. The global leased fleet has now surpassed 40 percent of the total fleet as airlines seek to increase fleet flexibility, obtain near-term growth capacity, and balance their capital expenditures.

The dynamics of the marketplace keep airline networks in a constant state of flux as they adjust to economic conditions, new capabilities of the latest generation of airplanes, and the evolving air transport industry. Airlines will rely increasingly on proactive strategic planning that links network development goals with airplane procurement requirements to realize long-term competitive advantage and achieve optimal network development potential.

Network and hub analysis
Networks are best for serving small markets



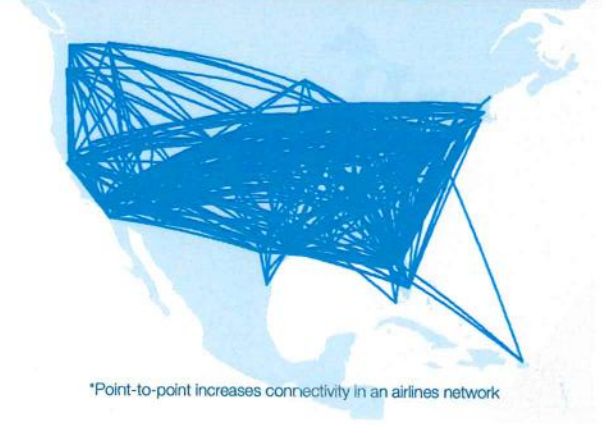
Network and hub analysis
Maximize passengers in networks*

Source: OAG August 2013

*Network carriers use hubs to maximize passengers in their networks

Network and hub analysis
Point-to-point service*

Source: OAG August 2013



*Point-to-point increases connectivity in an airlines network

Technology and capabilities

Development of commercial aviation technology is aimed largely at improving airplane operating economics, which directly affect airline profitability. Fuel is expected to remain the largest component of airplane operating cost, so technology development efforts focus strongly on reducing fuel consumption. The latest generation of Boeing airplanes, including the 787, 747-8, and the upcoming 737 MAX and 777X, reduce fuel consumption by double-digit percentages compared with earlier-generation airplanes.

Developments in engine technology made possible by advances in materials, aerodynamics, and manufacturing techniques drive much of the improvement. Advances in wing design also contribute to better fuel efficiency. The use of composites in the 787 and 777X wings permitted aerodynamic improvements that could not be achieved using conventional materials. The Boeing Advanced Technology Winglet on the 737 MAX optimizes the performance of the single-aisle airplane's wing. Improved engines, aerodynamics, and systems also reduce noise by as much as 30 percent in the case of the 747-8.

Many developments that reduce fuel use also improve range and payload capabilities. Increased range capability enables airlines to expand the connectivity of their global networks. Increased payload capability allows airlines to carry additional passengers and revenue cargo, which improves profit potential on a given route. For example, a growing number of airlines are increasing passenger revenue by taking advantage of the flexibility of the 777-300ER interior configuration to install 10-abreast economy class seating.

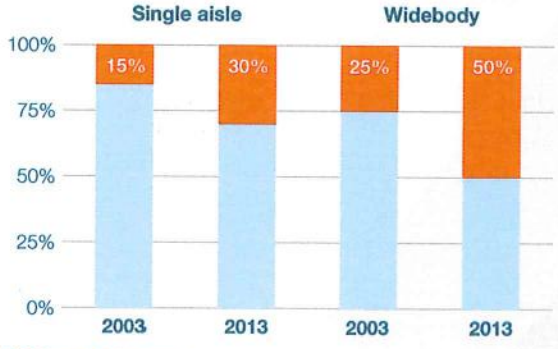
Innovative interiors enable airlines to carry more passengers while improving passenger experience. For instance, larger and higher windows, sculpted sidewalls, and higher ceilings give a cabin interior a more spacious feel. Larger bins that are easier to open and close are more convenient for the crew and enhance passenger experience. The 787 maintains cabin pressure equivalent to that at 6,000 feet of altitude, with improved air purity and more comfortable cabin humidity than earlier airplanes. Developments such as the innovative, flexible lighting on the 787 help airlines differentiate their brands in creative ways that make flying more enjoyable.

Airlines are also increasingly looking to information technology (IT) solutions to improve operational efficiency, decrease costs, improve customer service, and increase safety. Increased communications connectivity and improved mobile technologies are helping IT solutions penetrate every aspect of airline operations, including maintenance and engineering, ground, and in-flight operations.

Technology and capabilities
Reduced costs, improved performance

Evolving and **innovative technologies** are reducing costs and **improving performance** and operations.

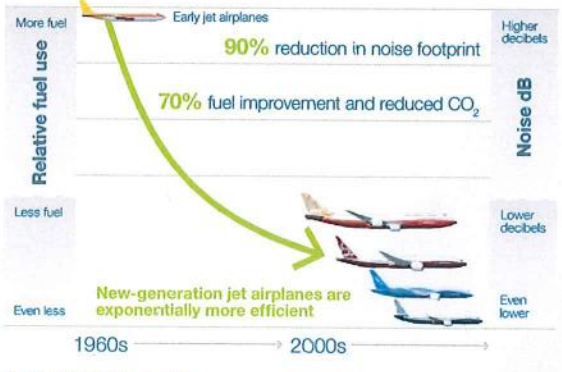
Technology and capabilities
Fuel has doubled as a percentage of airline costs



Cash operating cost, typical rules, representative aircraft

Technology and capabilities
Track record of significant progress

Source: US DOT



Noise footprint based on 85 dBa

Technology and capabilities, continued

Maintenance and engineering

Airlines are seeking airplane and engine health management solutions that provide better prognostic capabilities. The ability to predict maintenance events and connect with maintenance operations during flight can minimize the number and duration of flight disruptions. Improved disruption management solutions can reduce the systemwide effect of delays and cancellations. Digital delivery of maintenance manuals and other technical information, updates, technical authoring tools, and data conversion technologies all improve the efficiency and accuracy of airline maintenance operations. Supply-chain solutions using optimized inventory management and parts procurement solutions can also reduce operating costs. In some cases, new aircraft technology is driving airlines to improve their own technology and capabilities. The latest airplanes, such as the Boeing 787, use vastly more loadable software airplane parts (LSAP), but the traditional method of using floppy disks to load LSAPs is becoming obsolete, pushing airlines to upgrade technology on the ground and in the air.

In-flight operations

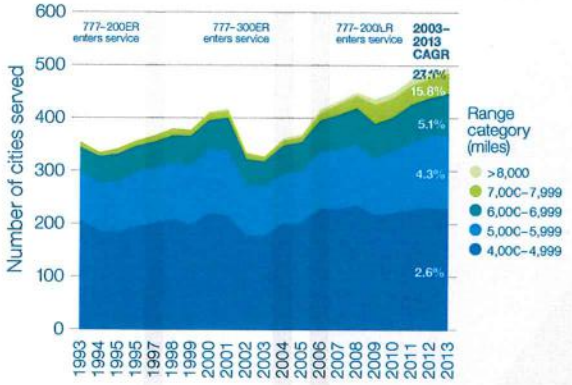
The trend toward in-flight connectivity is evident in the rapidly increasing use of mobile devices such as tablets and smart phones by the flight crew and cabin crew. Electronic flight bags have been in use for decades, but improved connectivity now allows pilots to quickly upload the latest navigation charts to their devices and monitor weather in flight, adjust flight plans to optimize fuel use, use moving runway and taxiway maps for improved situational awareness, and use a wide variety of applications to improve crew productivity and enhance safety. Cabin crew members use mobile devices with in-flight connectivity for onboard sales (including verification of credit cards to eliminate fraud), passenger services, and crew communication and to access crew reporting tools. The growing prevalence of personal electronic devices among passengers could eventually allow airlines to eliminate costly and weighty in-flight entertainment systems in favor of streamed content as onboard Wi-Fi speeds improve.

Airline planning and ground operations

IT advances can touch all parts of the airline planning cycle. Airline planners and ground operations suppliers can take advantage of new technologies that allow airlines to react quickly to ever-changing situations, including crew legality, weather, and airport traffic congestion. IT solutions help airlines optimize activities in real time as the operational environment changes. Mobile solutions that connect applications that assist baggage handlers, gate agents, caterers, fuel providers, and passengers on the ground will become more important as airlines strive to reduce flight disruptions and maximize airplane utilization to gain the greatest return on their investment.

Technology and capabilities
Increased capabilities allow airlines to grow

Source: August OAG



Technology and capabilities
Connecting with innovation and technology

Transforming data into actionable solutions to drive effective and efficient airline operations

Leveraging airplane technology and Boeing expertise to enhance integration with airline systems

Creating the right tools for the right people, by partnering with you to create innovative, integrated IT products and professional services

Delivering on the promise of **enabling a Digital Airline**

Technology and capabilities
Improving operational efficiency

Maintenance and repair services to improve operational efficiency

Modification services to improve airplane performance and increase residual value

Digital tools for airplane troubleshooting and managing the entire maintenance process.

e-Enabled solutions to improve airplane availability and reliability.

Technology and capabilities, continued

Opportunities

IT infrastructure and connectivity can present challenges in developing economies. As these challenges are resolved, a greater number of airlines in developing economies will enter the market for IT solutions. The resultant improvements in operational efficiency, safety, and cost will allow carriers in these regions to compete more effectively with larger global carriers.

Original equipment manufacturers, regulators, and IT vendors must work together to better understand the risk of cyber attacks and develop solutions that reduce the risk. As airports, airplanes, and airlines become more connected, security risks increase. Airlines will seek integrated, robust, secure, and connected mobile solutions for application throughout their operations.

High-speed rail

Our long-term forecast considers how other technologies, such as high-speed rail (HSR), affect air travel. Railways are well suited for carrying passengers and cargo over relatively short distances (terrain permitting), whereas aviation excels for longer journeys. In addition, aviation is effective for creating large transportation networks without heavy investment in ground infrastructure.

In 2007, the world's first privately run HSR line, developed under a build-operate-transfer model, started operating in Taiwan. Even with an annual ridership of more than 40 million passengers, the HSR is heavily in debt. Taiwan's government is looking into recapitalizing and possibly nationalizing the private business venture. On the other side of the Taiwan Strait, China has seen tremendous HSR network growth. By the end of 2013, nearly 10,000 kilometers of HSR network was in operation in China, more than in the rest of the world combined. Yet according to Boeing analysis, only a handful of shorter air routes have ceased operations or reduced seat capacity significantly. The overall impact of HSR on aviation is estimated to be less than 1 percent of China's pre-HSR domestic aviation capacity.

HSR could compete with some airlines in high-volume, high-yield markets. Yet the relatively short routes where HSR excels represent only a small portion of the market that commercial aviation serves. Airline assets are highly flexible because airplanes can easily be redeployed to more lucrative markets. In addition, the infrastructure investment for a comprehensive aviation network is much lower than for ground modes of transport. Aviation's network connectivity simply cannot be replicated by ground-based modes. Opportunities to develop intermodal solutions have the potential to combine the advantages of HSR and aviation.

Technology and capabilities
Improving flight operations

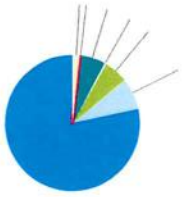
Optimization services
- Flight planning
- Crew scheduling

Flight operations
- Flight documents
- Airplane performance tools
- Airport technology
- Performance engineering training
- Technical support

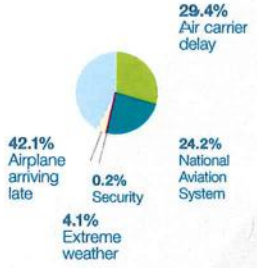
Air Traffic Management
- Airspace design and transformation
- Performance-based navigation
- Optimization

Technology and capabilities
Causes of delays

Source: US DOT



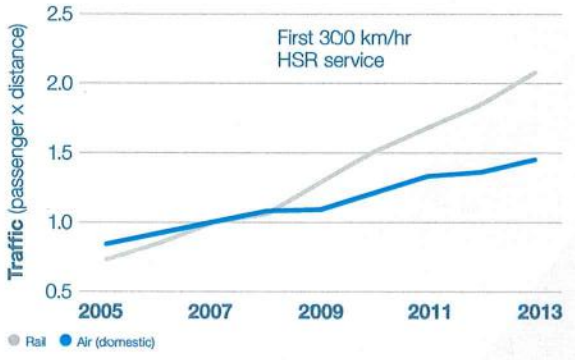
US Airline Disruptions by Cause as a Percentage of Flights



US Airline Delays by Cause as a Percentage of Total Delay Minutes

Technology and capabilities
Air travel growing, even with high-speed rail

Robust air travel in China since introduction of HSR



Traffic and market outlook

Methodology

Boeing's Current Market Outlook is a long-term, noncyclical forecast that looks beyond short-term shocks to address underlying trends in the aviation industry. In this forecast, we examine travel demand for 63 intraregional and interregional traffic flows. Key indicators include

- Gross domestic product (GDP) development.
- Population.
- Labor force composition.
- International trade (as a share of GDP).
- Emerging technology (e.g., new airplanes with improved economics and capabilities).
- Business model innovation.
- Quality of service (e.g., new nonstop city pairs, greater frequencies).
- Travel attractiveness.
- Industry competitiveness.
- Openness of air services and domestic airline regulation.

Different flows have different drivers and are therefore modeled differently. Flows touching emerging markets may emphasize GDP per capita, while mature markets may be driven more by time-series trends.

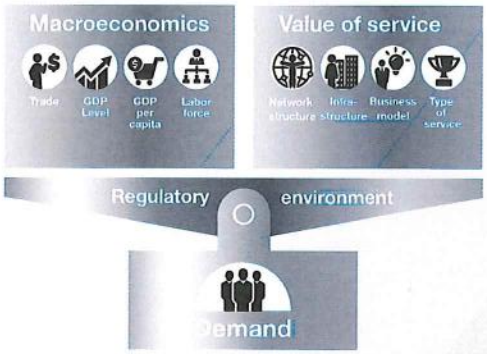
Forecasting requires more than just data because the future of a market is more than an extension of past performance. While some factors driving demand, such as GDP, are easily quantified, other factors that may have an even greater effect on market performance (e.g., liberalization) are more difficult to quantify. Where such factors are present, forecasting demand requires greater judgment than when the same factors are absent.

Short-term effects

Although the air transport industry is subject to occasional shocks, demand for air transportation is resilient, as services are often seen as essential, and discretionary trips, such as vacations or family events, are often high-priority items. Over the last 30 years, the aviation industry experienced recessions, oil price shocks, near-pandemics, wars, and security threats, yet traffic continued to grow, on average, at 5 percent annually.

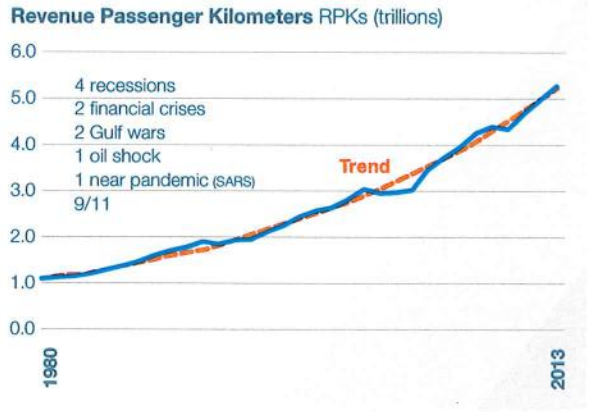
Changes in industrial structure can also result in short-term effects. For example, after consolidating, the U.S. airlines have been focusing on matching demand with capacity. Although traffic growth (expressed in revenue passenger-kilometers (RPK)) has been minimal, airline profitability has improved. Conversely, low-fare carriers in other markets, and the competitive responses they provoke, led to falling fares and traffic stimulation, thereby supporting more rapid RPK growth than those same markets might have achieved in the past.

Traffic and market outlook
Drivers of air travel demand



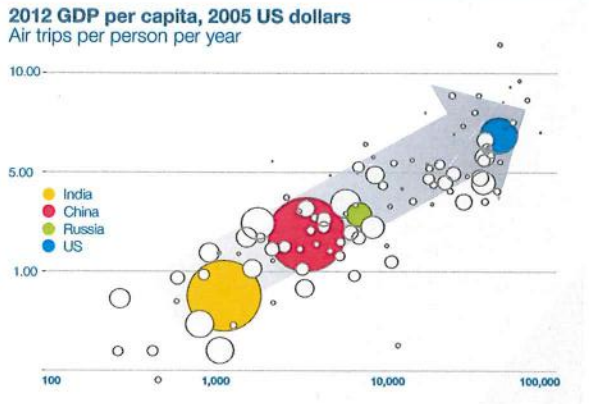
Traffic and market outlook
World air travel has grown 5% per year since 1980

Source: ICAO skd traffic



Traffic and market outlook
Propensity to travel increases with income

Source: IHS Economics Sabre



Traffic and market outlook, continued

Evolving air travel demand

Demand dynamics are different for various levels of a country's economic development. Emerging markets throughout the world have shown that air travel is a discretionary expenditure, but it is one of the first discretionary items to be added as consumers join the global middle class. As emerging market demand begins to develop, it may take the form of nonscheduled services to leisure destinations. Later on, the same demand may migrate to scheduled services of low-fare carriers, or to the network airlines.

In developed markets, demand for essential travel has been met, leaving growth to come from discretionary travel. GDP per capita matters less in these contexts. Factors such as availability of financing (for funding vacations), consumer confidence, service pricing, service quality (e.g., availability of nonstop flights), and vacation entitlements will tend to have a greater impact.

Propensity to travel, measured in trips or RPKs, generally increases with per capita income within any given region. The amount of this increase varies considerably. Generally, markets that are more open will be more responsive to changes in per capita income, as airlines are freer to add routes, frequencies, and seats to capture demand. In a more regulated environment, demand (i.e., desire to travel) may increase with GDP per capita, but lower service quality and higher pricing may restrain travel growth. Geography may also influence a region's propensity to travel, with island geographies or poorly connected land areas resulting in somewhat more air travel than might otherwise be the case.

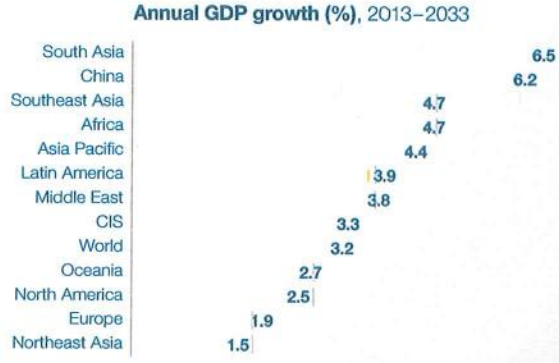
Key indicators

As discussed in our methodology section, gross domestic product (GDP) is a strong indicator for the Current Market Outlook. IHS Economics forecasts GDP to grow at 3.2 percent over the next 20 years. Emerging economies are expected to grow at 5.2 percent per year, outpacing the established economies, which will average 2.2 percent growth. Emerging and developing economies will grow from 27 percent of total GDP in 2013 to 40 percent by 2032. The fastest growing economies are those in Asia Pacific (with a projected growth of 4.4 percent), Latin America (with a projected growth of 3.9 percent), and Africa (with a projected growth of 4.7 percent).

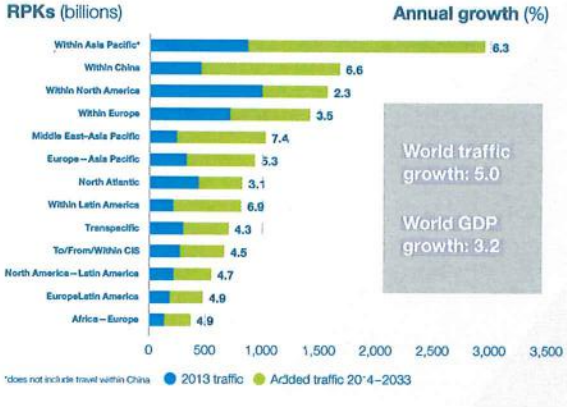
Based on the expected 3.2 percent growth in GDP, we project airline passenger traffic to grow at 5.0 percent and air cargo traffic at 4.7 percent. Passenger traffic within China will be the largest travel market, expected to grow at 6.6 percent annually. Travel within North America and Europe, while growing below trend, will be the second and third largest markets, with growth rates at 2.3 percent and 3.5 percent. Traffic to and from the Middle East and Asia Pacific, within Asia Pacific (excluding China), and within Latin America will be among the fastest to grow.

Traffic and market outlook
Emerging markets are driving growth

Source: IHS Economics

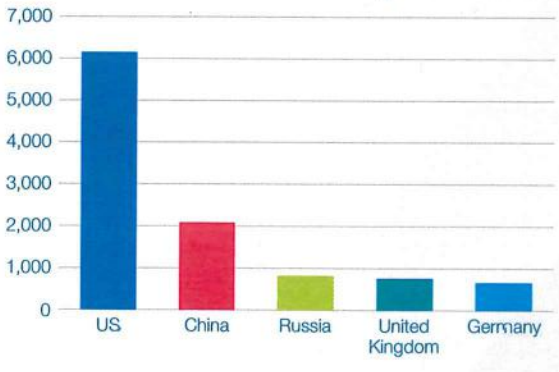


Traffic and market outlook
World traffic varies by market



Traffic and market outlook
In-service fleet of 20,910

Source: Flightglobal Ascend Online Database



Traffic and market outlook, continued

Passenger's options for air travel will continue to evolve. Twenty years ago, passengers were most likely to fly on an airline from Europe or North America. Over the next 20 years, passengers will see greater diversity among the world's airlines, with 62 percent of traffic being carried by an airline outside of North America or Europe. Trends in passenger traffic growth are similar to those of GDP. Emerging markets will grow faster than established markets. Regions growing above trend are Asia Pacific (at 6.3 percent), Middle East (at 6.4 percent), and Latin America (at 6.2 percent), while European (at 3.9 percent) and North American markets (at 2.9 percent) will be below trend.

Fleet developments

Today, nearly 21,000 jet airplanes are in commercial operation. The world's largest fleets are in the United States, China, Russia, the United Kingdom, and Germany. Over the next 20 years, the world's fleet will grow at an average rate of 3.6 percent annually, driving a need for more than 36,700 new airplanes, valued at $5.2 trillion. Of these new airplanes, more than 30 percent, 13,000 airplanes, have already been sold. The countries with the largest backlog are the United States, China, Indonesia, Russia, and India. With this demand, along with the current fleet, the world's jet fleet will more than double to a size of more than 42,000 airplanes over the next 20 years.

Forty two percent of these new airplanes will be for replacement and 58 percent will be for growth. The replacement market tends to be driven by the more mature aviation markets, such as Europe and North America. Growth is being driven by the emerging markets, such as Latin America and Asia Pacific, and by the low-cost carrier and sixth freedom business models.

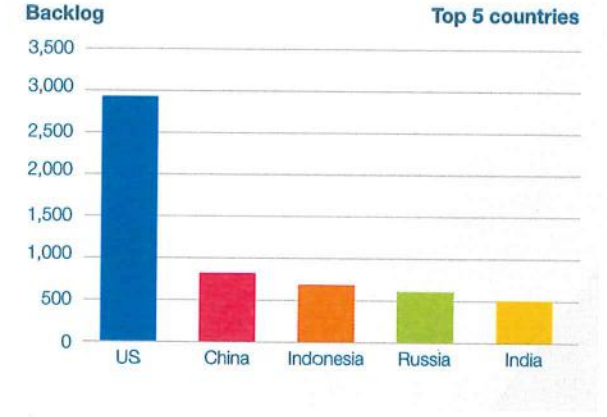
Business models

Airline business models continue to evolve. What was once a clear division between network, low-cost, and charter models is now less clear, with network carriers operating low-cost, short-haul subsidiaries; low-cost carriers providing frequencies and services to attract business passengers; and charter carriers venturing into single-seat sales. Low-cost carriers are even starting long-haul service, competing with network carriers on point-to-point routes.

The trend toward growth of the low-cost model is clear. Low-cost carriers have grown from 7 percent of the world market in 2003 to 16 percent today and are projected to capture 21 percent by 2033. Charter carriers are hardest hit by this transition, declining from 9 percent in 2003 to 3 percent today and in 2013. Broad network carriers also suffer declines, from 66 percent in 2013 to 62 percent today and 56 percent in 2033. The shift to a low-cost model is even more dramatic when we take growing low-cost subsidiaries in many broad network carriers into consideration.

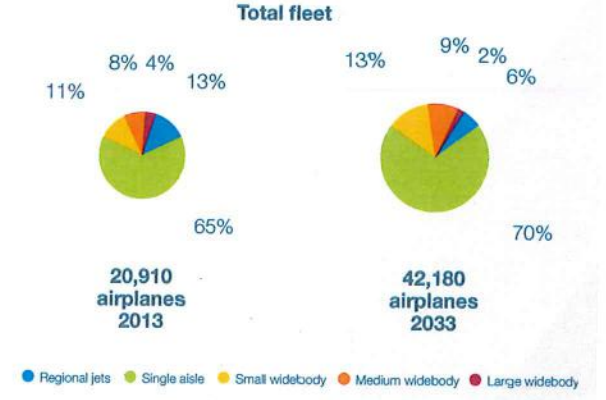
Traffic and market outlook
Backlog of 13,000 airplanes

Source: Flightglobal Ascend Online Database

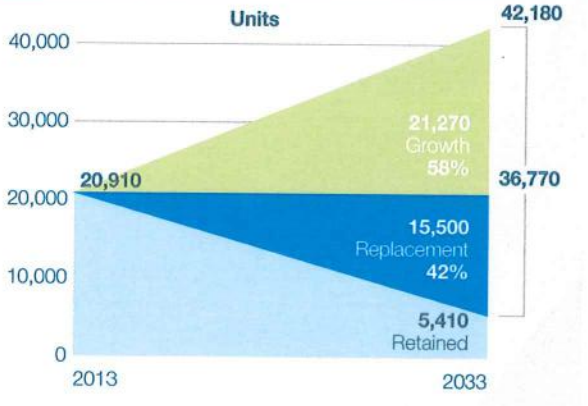


Traffic and market outlook
World fleet will double by 2033

Source: Ascend



Traffic and market outlook
58% of new deliveries are for growth



Traffic and market outlook, continued

160-seat-size aircraft remains heart of the single-aisle market

Single-aisle airplanes continue to dominate the world's fleet. In 2013, the single-aisle category comprised 65 percent of the fleet. By 2033, we estimate that share to rise to 70 percent. Of the forecast demand for 35,680 new single-aisle airplanes, valued at $2.5 trillion, 38 percent will replace older airplanes, while 62 percent will expand the fleet. Emerging markets drive demand for single-aisle airplanes. Asia Pacific airlines are expected to take the largest share of new deliveries and will need 9,540 new airplanes to expand their single-aisle fleets from 3,820 to 10,850 airplanes by 2033. Low-cost carriers, whose business models focus on fleet commonality, also drive demand for single-aisle airplanes and are expected to take 40 percent of single-aisle deliveries.

Over the past 20 years, average aircraft size across short, medium, and long regional routes have been converging to 160 seats as the flexibility of today's single-aisle aircraft allows airlines to fly more directly, more often, and more efficiently. In the short sectors, increases in fuel price drove carriers to larger aircraft to achieve lower unit costs in a challenging sector of the market, and a similar trend is seen in the medium (1,000 to 2,000 mile) segment. On the longer haul regional markets, such as those with transcontinental missions, airplane size flattened over the past 15 years, right at 160 seats, as the capabilities of airplanes such as the 737-800 allowed for more point-to-point services and greater frequencies for passengers. This size category (737-MAX8 size) continues to be the heart of the market today and going forward over the next 20 years. In today's backlog, approximately 75 percent of airplanes to be delivered are in this size category, and over the next 20 years, 70 to 75 percent of new deliveries to airlines will be of this size.

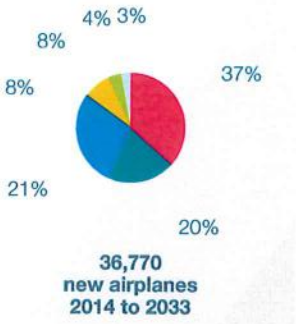
New widebodies providing more direct, more frequent service

The widebody fleet continues to grow as airlines expand their international footprint and open new markets. We forecast that 8,600 new widebody airplanes will be needed to meet this demand. Of these, 4,520 will be in the 200- to 300-seat size category (787-8 and 787-9), 3,460 will be in the 300- to 400-seat size category (787-10, 777, and 777X); and the remaining 620 will be in the greater than 400-seat size category (747-8i). As with the single-aisle airplanes, 38 percent of deliveries will be for replacements and 62 percent of deliveries will be for growth. Europe and North America tend to be more of a replacement market, while Asia Pacific and Middle East are a growth market. Nearly 60 percent of all new deliveries will go to Middle Eastern and Asia Pacific airlines.

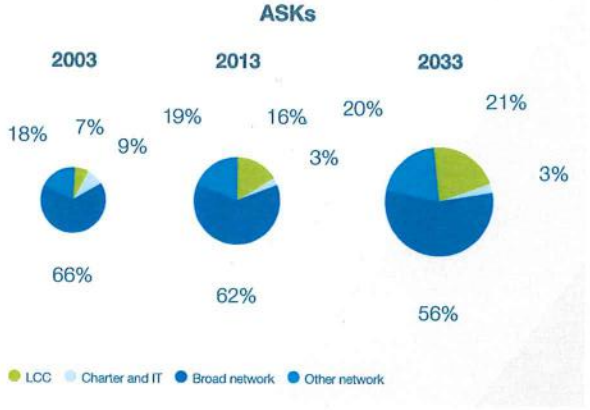
Since the 777 came to the market, the top 25 long-haul markets have expanded and capacity has increased by 60 percent. This increase in capacity has been met by an increase in frequencies (up 60 percent) and with the addition of new cities being served (up 46 percent), while

Traffic and market outlook
Delivery demand is becoming more diversified

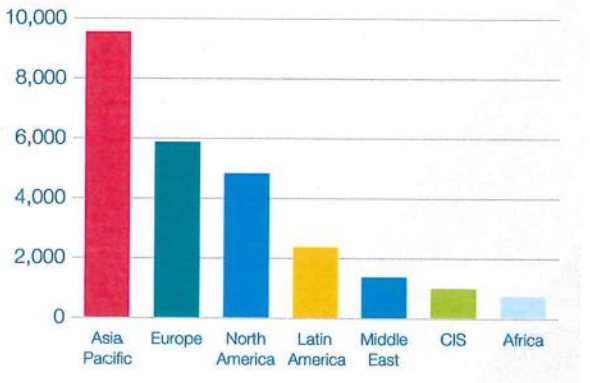
Region	New airplanes
Asia Pacific	13,460
Europe	7,450
North America	7,550
Middle East	2,950
Latin America	2,950
CIS	1,330
Africa	1,080
Total	36,770



Traffic and market outlook
Airline business models continue to evolve



Traffic and market outlook
Airlines will need 25,680 new single aisle aircraft



Traffic and market outlook, continued

the number of seats per airplane has decreased slightly (down 2 percent). This market flexibility will continue as the 787 family and 777X come to market. The 787 is allowing airlines to provide customers the ability to fly where they want to, when they would like to fly, as in the cases of London Heathrow to Austin, Texas, San Francisco to Chengdu, and San Jose to Tokyo. Airlines are also announcing how they will be using the 787-9 in conjunction with the 787-8 to provide the right-size airplane on the right day.

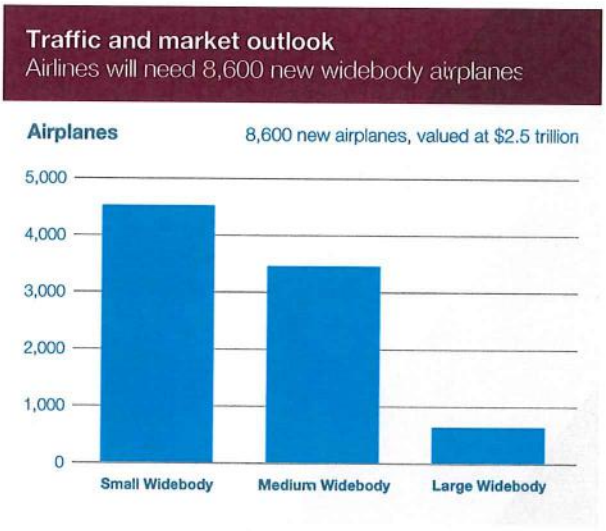
The new twin-engine airplanes coming to market are also helping airlines to evolve airline business models. The 787-8 allows low-cost carriers to move from the traditional short-haul flight into more medium-haul flying, expanding their customer base while using an aircraft with lower operating costs. The range and efficiency of the 777-300ER allow airlines to take advantage of their geographical locations.

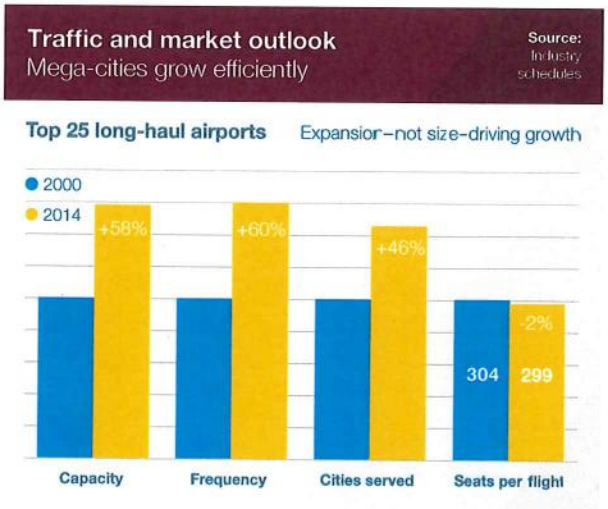
Asia Pacific, Europe, and the Middle East account for more than 90 percent of large-airplane demand in the 20-year forecast. These aircraft will serve as passenger jetliners on high-traffic trunk routes and as dedicated commercial freighters. We forecast 620 deliveries, comprising 5 percent of total delivery value, will be required. The Asia Pacific region will receive 34 percent of these deliveries, while Europe will take 10 percent and the Middle East 48 percent. Although their share of long-haul traffic will diminish over the next 20 years, large airplanes remain an important part of the commercial airline fleet.

Air cargo traffic stagnation amid market challenges

An unusually challenging environment over the past several years left traffic levels relatively flat and resulted in persistent overcapacity and weak yields. Nevertheless, air cargo remains indispensable for a variety of industries that require transport of time-sensitive and higher value commodities. These commodities include perishables, consumer electronics, high-fashion apparel, pharmaceuticals, industrial machinery, and high-value intermediate goods such as auto parts. The unparalleled speed and punctuality advantages of air freight ensure that it will continue to play a significant role in the global economy despite improving surface modes that can offer a cheaper transportation alternative.

Dedicated freighters and passenger airplane lower holds both carry air cargo. Cargo capacity on passenger flights has expanded as airlines deploy new jetliners, such as the 777-300ER, that have excellent cargo capability. Dedicated freight services, however, offer shippers a combination of reliability, predictability, and control over timing and routing that passenger lower hold cargo operations cannot often match. Thus, we expect freighters to continue to carry more than half of global air cargo traffic and market capacity balance to be restored within a few years, as world trade recovers.





Traffic and market outlook, continued

Air cargo traffic, as measured in revenue tonne-kilometers (RTK), is projected to average 4.7 percent growth per year over the next 20 years as global GDP and world trade growth accelerate. In spite of multiple exogenous shocks arising from economic and political events and natural disasters, this is slightly below the 5 percent average annual rate achieved over the past three decades. Replacement of aging airplanes, plus the industry's growth requirements, will create a demand for nearly 2,200 freighter deliveries over the same period. Of these, 1,330 will be passenger airplane conversions. The remaining 840 airplanes, valued at $240 billion, will be new. The freighter fleet will increase by more than half, from 1,690 airplanes in 2013 to 2,730 in 2033.

All standard-body freighters will be conversions from passenger airplanes

We forecast a need for 960 standard-body freighters, all of these passenger conversions, which are attractive for standard-body operations due to their low capital cost. Demand has recently been and will continue to be especially strong in emerging markets.

Express carriers drive medium widebody demand

Two hundred and fifty medium widebody purpose-built freighters will be delivered during the forecast period. This freighter market is driven by express carriers that mitigate the lower economic efficiency of medium widebodies with higher yields. Competition from less expensive surface transport and passenger airplane lower hold capacity constrains the use of medium widebody freighters in regional markets.

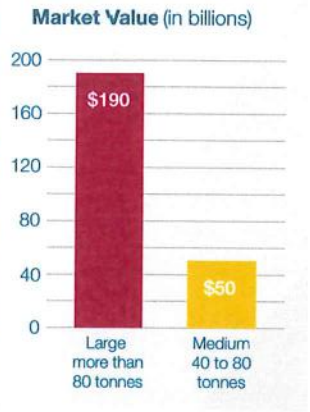
Widebody conversions

While the performance, efficiency, and reliability of new, purpose-built freighters are valued in many applications, the lower purchase prices for converted freighters often offer opportunities for carriers where very high utilization and more market-dependent demand are more significant considerations. Thus, nearly 400 widebody conversions will be needed over the forecast period.

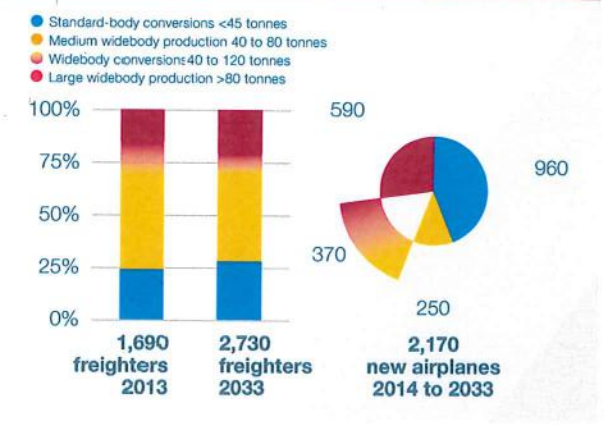
Intercontinental operations favoring new, large freighters

Nearly 600 new, large freighters will be required where high cargo density, larger payloads, and extended range are crucial.

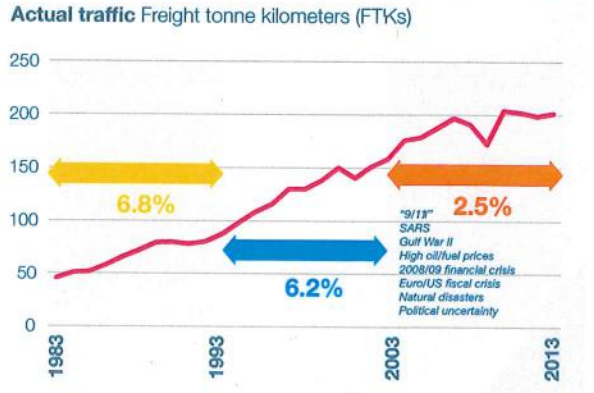
Traffic and market outlook
Freighter market value: $240 billion



Traffic and market outlook
840 new and 1,330 converted freighters



Traffic and market outlook
Annual growth over 5% since 1983



World Regions

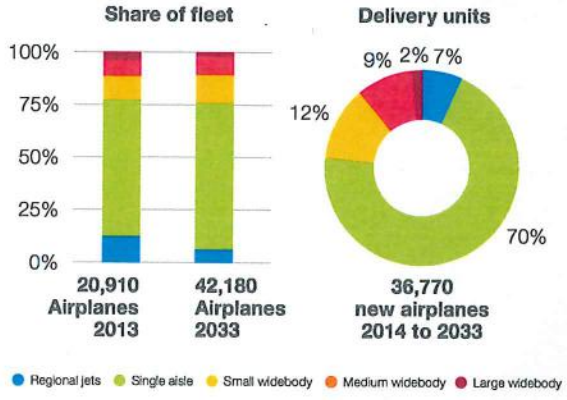
World regions
Market value: $5.2 trillion

Globalized demand
As aviation continues to become an integral part of life, it is bringing people closer together. As emerging markets continue to grow and new business models expand, airplane manufacturers are seeing greater geographical diversity in their customer base. In 1993, more than 73 percent of all traffic was carried by airlines in Europe or North America. By 2033, that proportion will shrink to 38 percent. Asia Pacific and Middle East airlines are becoming prominent in global aviation. The low-cost business model is becoming a viable option in emerging markets, offering consumers access to a wider range of destinations and the opportunity to choose the speed and convenience of flying over traditional modes of transportation. In addition, modern twin-aisle airplanes enable smaller operators in developing economies to compete on longer routes traditionally dominated by foreign carriers. Rapidly evolving aviation services in these regions are broadening the geographical balance of airplane demand, spurring a worldwide requirement for 36,770 new jet airplanes, valued at $5.2 trillion.

Regional focus
Different regions will still have varying conditions with specialized requirements. Middle Eastern airlines will still favor twin-aisle airplanes and premium passenger services to take advantage of the area's centrality and prominence in business travel. European and North American airlines respond to growing competition from low-cost carriers by replacing older, fuel inefficient airplanes with larger, more economical single-aisle models. In Asia, rising demand across the board will require a mix of single- and twin-aisle airplanes.

All regions will face similar challenges of fuel price volatility, emission control regimes, and ever-increasing airport congestion as the growing world fleet tries to keep pace with swelling international and local demand for air travel.

World regions
Market value: $5.2 trillion



World regions
Market value: $5.2 trillion

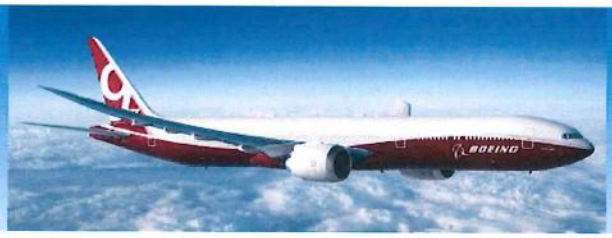
Growth measures (%)	
Economy (GDP)	3.2
Traffic (RPK)	5.0
Cargo (RTK)	4.7
Airplane fleet	3.6

Market size	
Deliveries	36,770
Market value	$5,200B
Average value	$140M

	New airplanes	Share by size (%)
Large widebody	620	2
Medium widebody	3,460	9
Small widebody	4,520	12
Single aisle	25,680	70
Regional jet	2,490	7
Total	**36,770**	

	2013 fleet	2033 fleet
Large widebody	740	790
Medium widebody	1,580	3,680
Small widebody	2,390	5,570
Single aisle	13,580	29,500
Regional jet	2,620	2,640
Total	**20,910**	**42,180**

Asia Pacific



Today's market

Asia Pacific economies continue to have strong growth. In 2013, regional GDP rose 4.8 percent, driven both by the region's fast-growing, emerging economies and by the mature economies, which were lifted by recovery from the global recession. Passenger traffic grew 3.9 percent, slightly faster than capacity at 3.7 percent year-over-year growth. Despite high oil prices and fluctuating currency valuations, Asia Pacific airlines are estimated to have earned a net profit of $3.0 billion in 2013 and are forecast to earn $3.7 billion in 2014.

Continued liberalization

The structure of the Asia Pacific airline industry is changing as regulations liberalize and carriers expand beyond national boundaries. Cross-border cobranded subsidiary agreements and direct investment in foreign airlines allow established airlines access to new markets and promote expanded air service to small markets. The growth of air travel as low-cost carriers (LCC) reduce fares and open new markets testifies to the effects of liberalization. Improved affordability and accessibility will stimulate demand for air travel in established markets and meet the emerging travel needs of the growing middle class.

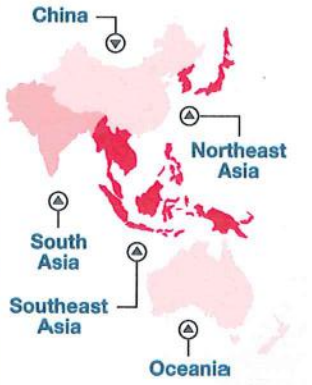
Strong demand

Continued economic growth is expected in the region over the next 20 years, with GDP averaging 4.4 percent growth annually. As income levels rise, Asia Pacific is set to become the largest air travel market in the world. In 2033, approximately 48 percent of global traffic will be to, from, or within the region. More than 100 million new passengers are projected to enter the market annually. By way of perspective, London Heathrow handles 70 million passengers and Atlanta 95 million annually.

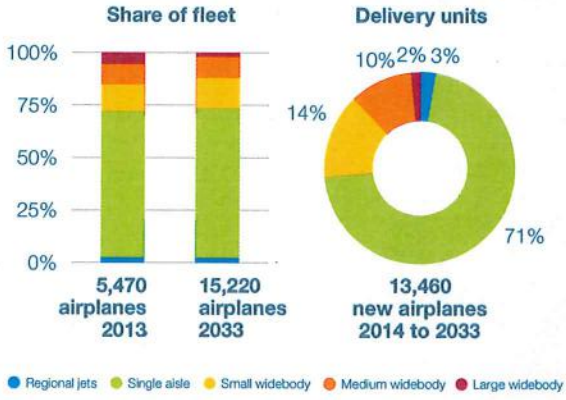
To accommodate growing demand, the region will need 13,460 new airplanes, valued at $2,020 billion. By 2033, the fleet will be three times larger than it is today. Fast-growing LCCs and rapid traffic growth within the Asia Pacific region drive a need for 9,540 single-aisle airplanes. LCC market share in Asia is expected to grow from 15 percent today to 24 percent in 2033. Network carriers, the mainstay of international long-haul air transportation, will help drive demand for 3,570 widebody airplanes.

Air cargo also plays a crucial role, transporting goods over difficult terrain and vast stretches of ocean. Many of the world's largest and most efficient cargo operators are located in Asia. The region's air cargo will grow 5.5 percent per year. Carriers in the region are expected to take 360 new production freighters and 530 converted freighters.

Asia Pacific
New airplanes: 13,460



Asia Pacific
Market value: $2.02 trillion



Asia Pacific
Key indicators and new airplane markets

Growth measures (%)	
Economy (GDP)	4.4
Traffic (RPK)	6.3
Cargo (RTK)	5.5
Airplane fleet	5.2

Market size	
Deliveries	13,460
Market value	$2,020B
Average value	$150M

	New airplanes	Share by size (%)
Large widebody	210	2
Medium widebody	1,420	10
Small widebody	1,940	14
Single aisle	9,540	71
Regional jet	350	3
Total	**13,460**	

	2013 fleet	2033 fleet
Large widebody	290	270
Medium widebody	520	1,500
Small widebody	710	2,250
Single aisle	3,820	10,850
Regional jet	130	350
Total	**5,470**	**15,220**

China

China continues to be one of the fastest growing aviation markets

China's aviation market, one of the world's fastest growing, is going through dramatic changes. Regulatory and policy reforms, low-cost carrier (LCC) and other innovative business models, new technology airplanes, and evolving consumer behaviors are driving airlines to launch additional direct flights and develop more point-to-point networks.

We project that the current growth trend will continue over the next 20 years, with passenger traffic increasing 6.9 percent and air cargo traffic increasing 6.7 percent annually. The majority of the growth, approximately 65 percent, will be within China. About 16 percent of the growth will be international traffic to destinations within the Asia Pacific region. The remaining 19 percent will be long-haul international traffic. To support this growth in demand, China will need 6,020 new airplanes valued at $870 billion.

Domestic markets shifting toward single-aisle airplanes

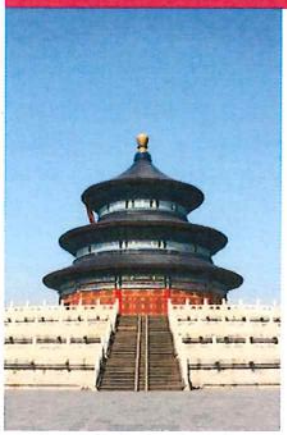
Over the past 20 years, airlines in North America and other aviation markets have moved from flying widebody airplanes to flying single-aisle airplanes on domestic routes. In 1993, widebody airplanes supplied approximately 20 percent of capacity in North America. Today, that number has dwindled to 5 percent. We have also seen this trend in China, where almost 30 percent of capacity was on widebody airplanes in 1993, compared with 9 percent today.

Single-aisle airplanes, such as the 737-800, provide the efficiency and network flexibility airlines need to be competitive in short-to-medium-haul markets, where quick turnaround and airplane utilization are essential. LCCs and new entrants will stimulate traffic growth in China, as they have around the world. The LCC business model depends heavily on passenger demand for point-to-point service, which avoids connections at hubs and shortens travel time. Point-to-point service will help alleviate congestion at major hubs, such as Beijing, Shanghai, and Guangzhou. New LCCs, coupled with increased growth in established airlines, will drive a need for 4,340 new single-aisle airplanes.

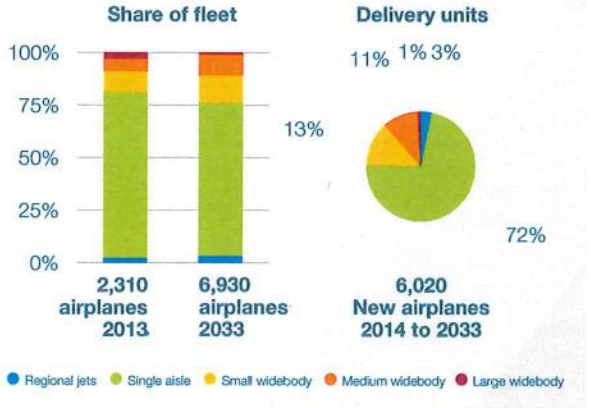
New widebody airplanes opening new markets

New-technology widebody airplanes, such as the 787 and 777, are helping Chinese airlines expand their global networks and compete more effectively with international carriers. In 2013, Chinese airlines opened 10 new long-haul markets. Over the next 20 years, this expansion is expected to continue as traffic to Europe grows 6.1 percent; to North America, 6.3 percent; to Oceania, 6.6 percent; and to Africa, 7.4 percent. China will need 1,480 new widebody airplanes to support this market growth.

China
Traffic varies by market



China
Market value: $870 billion



China
Key indicators and new airplane markets

Growth measures (%)	
Economy (GDP)	6.2
Traffic (RPK)	6.9
Cargo (RTK)	6.7
Airplane fleet	5.6

Market size	
Deliveries	6,020
Market value	$870B
Average value	$140M

	New airplanes	Share by size (%)
Large widebody	60	1
Medium widebody	640	11
Small widebody	780	13
Single aisle	4,340	72
Regional jet	200	3
Total	**6,020**	

	2013 fleet	2033 fleet
Large widebody	60	80
Medium widebody	130	660
Small widebody	230	910
Single aisle	1,840	5,080
Regional jet	50	200
Total	**2,310**	**6,930**

Northeast Asia

Economic forecasts project modest growth

The Northeast Asia region encompasses Japan, North and South Korea, and Taiwan. The region's GDP is forecast to grow 1.5 percent over the next 20 years. Japan will grow moderately as it recovers from long-term stagnation. However, an aging and declining population will challenge that growth over the long term. Although Japan will remain the dominant economy in the region, South Korea and Taiwan currently provide almost one-third of the base and will generate much of the projected economic dynamism.

Fleet growth and modernization continues

Despite modest economic growth, air travel in Northeast Asia is forecast to grow 2.7 percent annually over the next 20 years. The region's major airline fleets are among the world's most modern and efficient. To maintain the resulting competitive edge, the region's airlines will require 1,340 new airplanes, valued at $280 billion. About 64 percent of these (860 airplanes) will be for replacement and 36 percent (490 airplanes) will be for growth.

Small and medium widebody airplanes will account for just under half of all deliveries. Single-aisle airplanes will account for 40 percent. Both the number of new regional jets and the number of large airplanes are projected to decline slightly. The requirement for new cargo airplanes is flat.

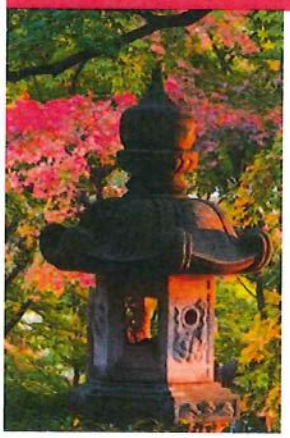
Low-cost carriers thrive

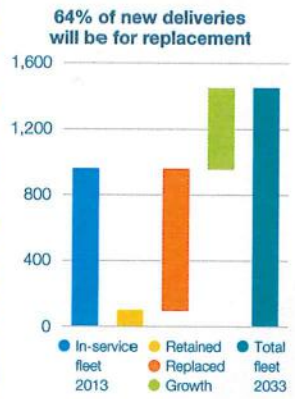
Northeast Asia was initially slow to adopt the low-cost model, but the emergence of low-cost carriers (LCC) is now a major driver of growth in the region. Whether as subsidiaries of the major network carriers or as independent startups, LCCs are competing with the established airlines and among themselves to provide new, affordable opportunities for air travel. The strength and popularity of these new carriers are forcing the major international airlines of the region to reconsider their domestic strategies. The short distances between many of the destinations in the Asia Pacific region give the LCCs access not only to markets within Northeast Asia but also to locations in China and Southeast Asia.

Major airport expansion is proceeding

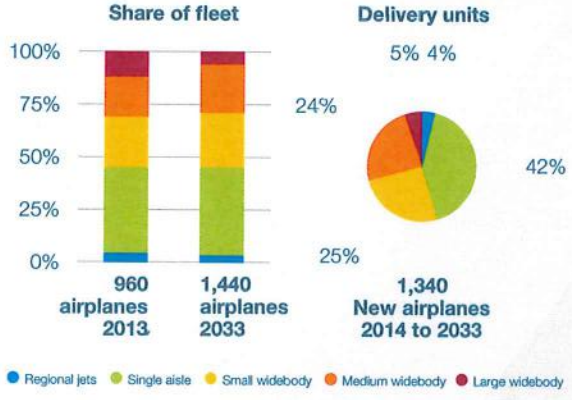
All the region's major airports have been modernized recently. Tokyo's Haneda has been upgraded to support expanded international operations and Narita to accommodate the new LCCs. Seoul's Incheon is being redesigned to create a major international hub that will serve all of Asia Pacific. Taiwan is improving its major airports to facilitate traffic across the straits in anticipation of relaxed travel restrictions with mainland China.

Northeast Asia
Airline fleets will grow by more than a third





Northeast Asia
Market value: $280 billion



Northeast Asia
Key indicators and new airplane markets

Growth measures (%)	
Economy (GDP)	1.5
Traffic (RPK)	2.7
Cargo (RTK)	4.3
Airplane fleet	2.0

Market size	
Deliveries	1,340
Market value	$2,80B
Average value	$210M

	New airplanes	Share by size (%)
Large widebody	70	5
Medium widebody	320	24
Small widebody	340	25
Single aisle	560	42
Regional jet	50	4
Total	**1,340**	

	2013 fleet	2033 fleet
Large widebody	120	90
Medium widebody	180	330
Small widebody	230	370
Single aisle	390	600
Regional jet	40	50
Total	**960**	**1,440**

South Asia

Robust traffic growth projected

South Asian air travel is expected to grow 8.3 percent per year over the next 20 years. Domestic, regional, and interregional travel to the Middle East and Southeast Asia will be the largest flows.

South Asia's demographics are favorable to air transportation growth. The region's population totaled 1.6 billion in 2013, and a growing share of this population is entering the workforce. The region's real GDP is forecast to grow an average 6.5 percent per year through 2033.

The 2014 elections of business-friendly candidates raised optimistic expectations for India's economy. If current economic policy liberalization, market reform, and investment trends continue, India's economy is projected to become the world's fourth largest.

New partnerships abound

Reform of foreign direct investment rules in 2012 allowed foreign airlines to acquire up to 49 percent of an Indian airline. Abu Dhabi's Etihad Airways promptly acquired 24 percent of Jet Airways. The partnership immediately strengthened the Jet Airways balance sheet and promises long-term benefits from network synergies with Etihad and its equity partners.

Air India joined Star Alliance in June 2014, becoming the first Indian airline to enter a global alliance. Air India's membership adds more than 400 daily flights connecting more than 50 destinations to the alliance's network. Increased global connectivity could boost Air India's revenue by about 5 to 6 percent in the near term.

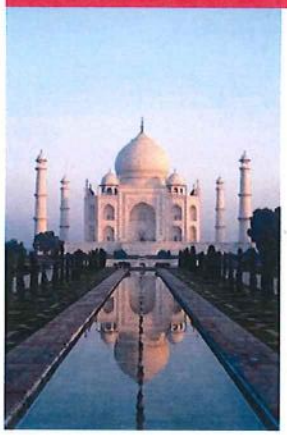
The Tata Group also moved swiftly to partner with foreign airlines, announcing tie-ups with AirAsia and SIA. Both links are structured as joint ventures, with the foreign airlines owning 49 percent and Indian partners owning 51 percent. AirAsia started India operations in June 2014; the venture with SIA, named Vistara, is expected to launch in the third or fourth quarter.

Market reforms support further growth

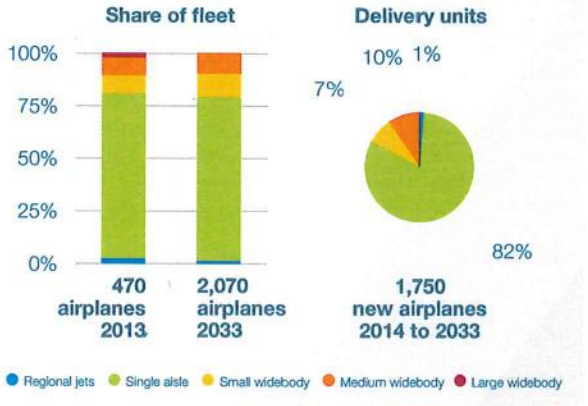
The Directorate General of Civil Aviation recently moved toward easing regulation of the Indian aviation market. A new startup airline (Air Costa) was approved in 2013 and several new operators gained Air Operators Permits and No Objection Certificates in 2014.

Also helpful is the expansion in 2014 of the visa-on-arrival program from 11 countries to 180, offering 30-day visas at 26 ports of entry. Under consideration are taxation reforms, including rationalization of aviation fuel taxes, which can currently reach 35 percent; reduction of taxes on maintenance, repair, and overhaul, which encourage Indian airlines to outsource MRO to neighboring regions; and reduction of duties on engine spare parts.

South Asia
Airlines are forecast to have world-leading growth



South Asia
Market value: $230 billion



South Asia
Key indicators and new airplane markets

Growth measures (%)	
Economy (GDP)	6.5
Traffic (RPK)	8.6
Cargo (RTK)	8.3
Airplane fleet	7.7

Market size	
Deliveries	1,750
Market value	$230B
Average value	$130M

	New airplanes	Share by size (%)
Large widebody	—	—
Medium widebody	170	10
Small widebody	130	7
Single aisle	1,430	82
Regional jet	20	1
Total	**1,750**	

	2013 fleet	2033 fleet
Large widebody	10	
Medium widebody	40	200
Small widebody	40	230
Single aisle	370	1,620
Regional jet	10	20
Total	**470**	**2,070**

Southeast Asia

Airlines expand operations

Southeast Asia's airlines are growing rapidly as the region continues to develop economically. Low-cost carriers (LCC) are expanding and gaining market share, stimulating passenger demand with attractive fares and new routes. Some Southeast Asia LCCs have launched subsidiaries or franchises to expand their operations into other countries or regions. A few LCCs have even ventured beyond single-aisle operations to provide widebody services that connect to destinations that exceed the range capabilities of single-aisle airplane. Network carriers have restructured to expand their product offerings for growth and increased competitiveness in the quickly developing marketplace. The heightened competition has increased the availability and affordability of air travel within the region.

Regional markets will continue to grow rapidly as ties within the Association of Southeast Asian Nations (ASEAN) strengthen, stimulating business and leisure travel. New, efficient airplanes with improved capabilities and lower operating costs are integral to carriers' business strategies. Southeast Asian airlines have dramatically increased their airplane orders to meet growing demand and to open new, direct, long-range markets. In fact, more than half of the region's forecast 2,460 single-aisle airplane deliveries over the next 20 years are already on order.

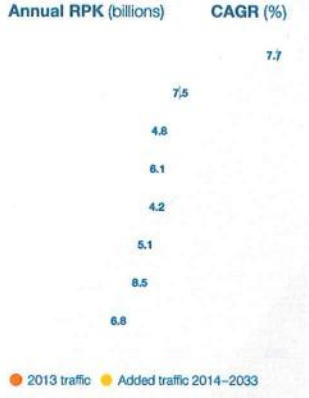
Liberalization opens routes

Regulatory changes and infrastructure improvements are crucial to air travel expansion. Relaxation of market regulations among ASEAN countries has removed many traditional barriers to growth. And flights among ASEAN capital cities have increased, marking an intermediate step in the path to a unified regional aviation market. Several carriers are aggressively expanding into new markets by acquiring or partnering with other carriers in Southeast Asia and surrounding regions. Governments and airport authorities in the region are eager to expand their aviation infrastructures and capitalize on increased trade and tourism.

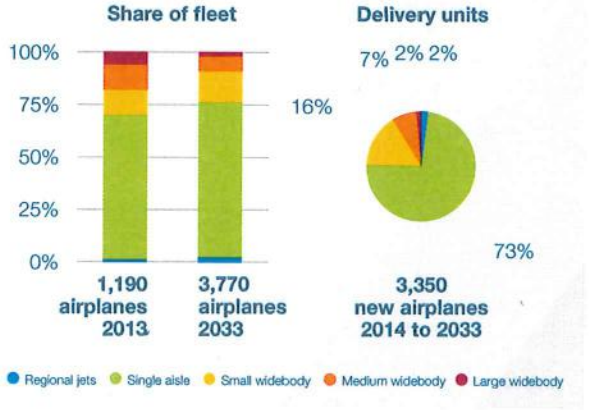
Airlines bolster economic growth

International economic relationships and collaboration within the region continue to strengthen. Air transportation plays a vital role in the region's projected 4.7 percent annual GDP growth over the next 20 years. For example, affordable air travel options have stimulated growth in the region's services sector, including tourism and financial services. The region's strong air cargo operations enable efficient shipment of manufactured goods. Overall, air travel to, from, and within the region is projected to grow an average 6.6 percent annually over the next 20 years. Air travel within the region will lead with 7.7 percent annual growth, driving single-aisle airplane deliveries to reach 73 percent of total deliveries within the region.

Southeast Asia
Traffic varies by market



Southeast Asia
Market value: $500 billion



Southeast Asia
Key indicators and new airplane markets

Growth measures (%)	
Economy (GDP)	4.7
Traffic (RPK)	6.6
Cargo (RTK)	5.0
Airplane fleet	5.9

Market size	
Deliveries	3,350
Market value	$500B
Average value	$150M

	New airplanes	Share by size (%)
Large widebody	50	2
Medium widebody	240	7
Small widebody	530	16
Single aisle	2,460	73
Regional jet	70	2
Total	**3,350**	

	2013 fleet	2033 fleet
Large widebody	70	60
Medium widebody	140	250
Small widebody	140	580
Single aisle	830	2,810
Regional jet	10	70
Total	**1,190**	**3,770**

Oceania

The market continues to thrive

Oceania is a dynamic region of roughly 40 million people. Total air traffic is forecast to continue to grow at the annual rate of 4.8 percent over the next 20 years as connections to the neighboring Asia Pacific region and other world regions improve. Traffic growth within Oceania will slightly lag the overall rate, at 4.7 percent. Capacity between Oceania and Southeast Asia, the primary gateway to other world regions, is forecast to increase 5.1 percent per year. In addition, continued expansion of trade and tourism will spur the opening of more flights and new markets to North America, the Middle East, and China. Middle East airlines, bridging Oceania to Europe and Africa via stops in the Middle East, are forecast to spur the Middle East traffic flow to increase 6.5 percent. Traffic between China and Oceania will grow a robust 6.6 percent per year.

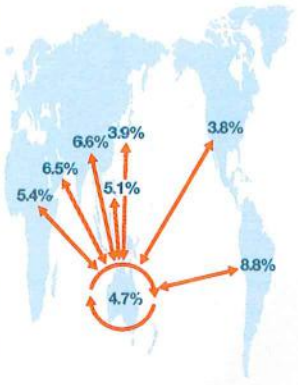
The region's airlines continue to evolve

Airlines within Oceania continue to evolve in response to economic conditions and competition. Airlines based in the Middle East, China, and Southeast Asia continue to rapidly increase their capacity to and from Oceania. The Qantas-owned low-cost carrier (LCC), Jetstar, continues to expand its cobranded subsidiaries throughout Asia. In 2013, Qantas entered a 10-year partnership with Emirates to collaborate on routes, pricing, scheduling, and other important aspects of operations. Virgin Australia acquired a major share of Tigerair Australia. Etihad Airways, Singapore Airlines, and Air New Zealand acquired ownership shares of Virgin Australia. The first 787s in the region arrived at Jetstar in 2013, allowing the airline to begin medium-haul LCC operations.

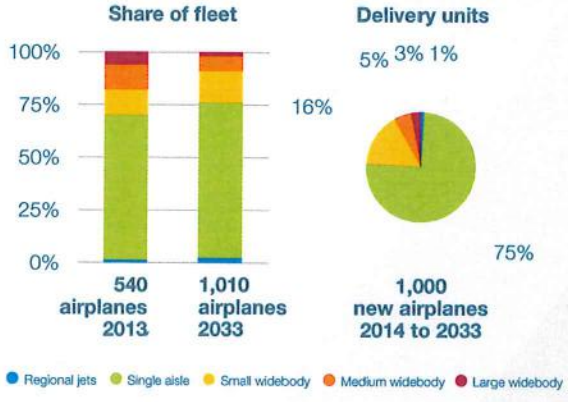
New airplanes are needed in the region

There will be a continual need for new airplanes in the region as traffic increases and airlines evolve. Over the next 20 years, Oceania is expected to need 1,000 new airplane deliveries, of which 760 will be single-aisle airplanes to transport people within the region or to nearby Southeast Asia. To meet demand for travel across the globe, 240 widebody airplanes will be required, of which approximately 160 will be small widebodies, 50 will be medium widebodies, and 30 will be large widebodies.

Oceania
Strong annual capacity growth on traffic flows



Oceania
Market value: $140 billion



Oceania
Key indicators and new airplane markets

Growth measures (%)	
Economy (GDP)	2.7
Traffic (RPK)	4.8
Cargo (RTK)	4.5
Airplane fleet	3.2

Market size	
Deliveries	1,000
Market value	$140B
Average value	$140M

	New airplanes	Share by size (%)
Large widebody	30	3
Medium widebody	50	5
Small widebody	160	16
Single aisle	750	75
Regional jet	10	1
Total	**1,000**	

	2013 fleet	2033 fleet
Large widebody	30	40
Medium widebody	30	60
Small widebody	70	160
Single aisle	390	740
Regional jet	20	10
Total	**540**	**1,010**

Europe

Strong growth despite uncertainty

The European aviation market remained strong in 2013 despite recessions in some economies and sluggish recovery in others. Europe's GDP grew 0.4 percent in 2013 and is forecast to grow 1.9 percent annually through 2033. The Association of European Airlines reports that member airlines carried 0.2 percent more passengers in 2013 than in the previous year. Members of the European Low Fares Airline Association reported a 6.7 percent increase in passengers over 2012 levels. European airlines acquired more than 180 new airplanes in 2013, of which 78 percent were single aisle.

Aviation growth is expected to continue over the next 20 years, with European airlines forecast to acquire 7,450 new airplanes valued at $1,040 billion. Single-aisle airplanes will account for the majority of deliveries, representing a 79 percent share of total deliveries.

Although European aviation growth is not as rapid as aviation growth in the world's emerging economies, the region's large installed base of more than 4,300 airplanes supports a substantial demand for replacement airplanes. Replacement demand will account for 54 percent of Europe's total market for new airplanes.

Continued strategic change

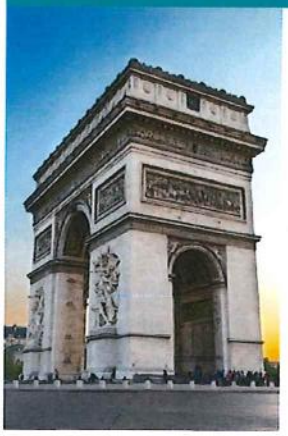
Airline operations continue to evolve with the launch of new ventures and new business models. Long-haul service by European low-cost carriers (LCC) became a reality in 2013 with the delivery of the 787 to Norwegian Air Shuttle. The next 20 years are expected to bring additional mergers and acquisitions, along with increased collaboration with alliance partners around the world.

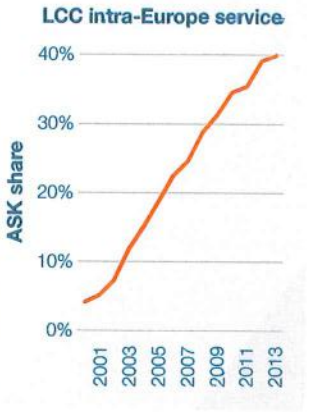
Large Middle East carriers have captured significant long-haul share from European network carriers by providing one-stop service from Europe to markets such as India, Australia, and Southeast Asia. These carriers are also changing the way that they compete for European business. One airline entered a global alliance, another acquired an equity stake in a European carrier, and another formalized a cooperative agreement with a non-European partner.

Large network airlines are tending to shift away from short-haul traffic, which is targeted by LCCs, and toward flowing passengers through their hubs on longer itineraries. LCCs have continued to add service in short-haul markets, with LCCs providing 40 percent of capacity on intra-Europe flights in 2013. Smaller flag carriers and charter airlines will be challenged to compete in an environment where LCCs dominate short-haul, point-to-point service, and large network carriers and their alliance partners exploit the cost advantages of megahubs for long-haul traffic.

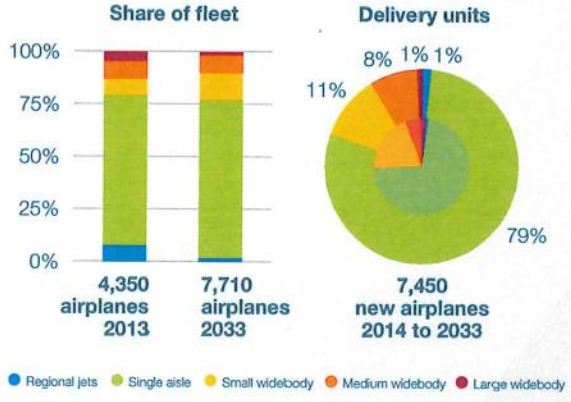
Europe
LCC share continues to grow

Source: OAG





Europe
Market value: $1.04 trillion



Europe
Key indicators and new airplane markets

Growth measures (%)	
Economy (GDP)	1.9
Traffic (RPK)	3.9
Cargo (RTK)	3.5
Airplane fleet	2.9

Market size	
Deliveries	7,450
Market value	$1,040B
Average value	$140M

	New airplanes	Share by size (%)
Large widebody	60	1
Medium widebody	590	8
Small widebody	810	11
Single aisle	5,870	79
Regional jet	120	1
Total	**7,450**	

	2013 fleet	2033 fleet
Large widebody	180	110
Medium widebody	360	640
Small widebody	350	980
Single aisle	3,120	5,830
Regional jet	340	150
Total	**4,350**	**7,710**

North America

Continued traffic growth and financial stability
Passenger traffic, as measured in revenue passenger-miles, continues to rebound from the lows of the 2008/2009 downturn. Overall US passenger traffic has averaged 2 percent growth per year since 2009, ahead of capacity growth, which ranged from 1 to 2 percent per year over the same period. Capacity growth of the low-cost carriers (LCC) continues to outpace network carriers, averaging 4 percent in 2013, compared with 1 percent for network carriers. Total fleet capacity increased 2 percent in 2013, rebounding to pre-2008 levels. The average passenger load factor for 2013 was 83 percent, an all-time high for the US airline industry. Canada's two largest airlines outpaced the US airline traffic and capacity growth, posting 5 percent and 4 percent growth, respectively.

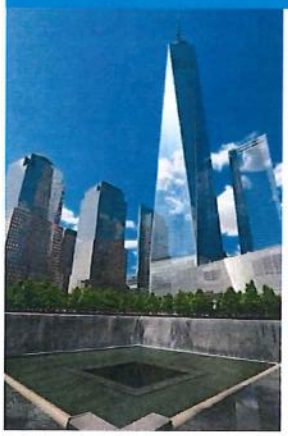
With the consolidation of the US airline industry over the past six years, a commanding 75 percent of both traffic and capacity is concentrated with the Big 3 network carriers: American, United, and Delta. Consequently, capacity growth slowed as the recently merged airlines continued to impose capacity discipline and to realign their networks to maximize profitability. LCCs accounted for a 20 percent share of traffic and capacity, a gain of half a percentage point compared with 2012.

Capacity growth rates varied by regional flow. For the Big 3 US airlines, capacity growth within North America increased 1 percent during 2013. When regional jet operations are included, network-carrier capacity growth drops to 0.5 percent per year, as available seat-miles on regional jets declined 1 percent. Regional jet operators continue to replace smaller regional jets with larger regional jets or small single-aisle commercial airplanes with better fuel economy and lower trip costs. Among individual flows, the Latin America flow grew the fastest, with capacity and traffic up 5 percent and 6 percent, respectively. Load factor remained constant at 81 percent. The transatlantic flow recorded the largest load-factor increase, rising 2 percentage points to 83 percent as traffic grew 1 percent and capacity declined 0.5 percent.

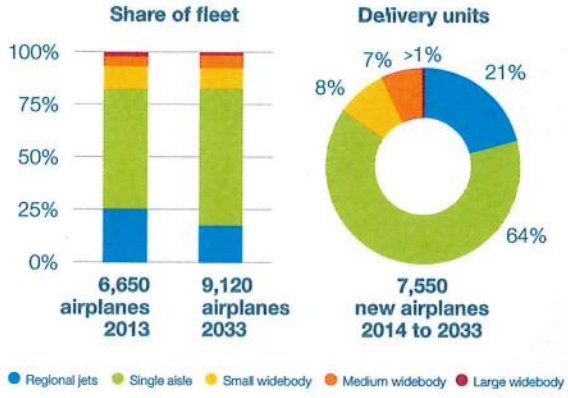
Five major airline mergers since 2008 have made the US airline industry the beacon of profitability for the global airline industry. US airlines are expected to report record net income of $5.5 billion for 2013, and IATA forecasts net income of $8 billion for 2014. Profit margins before interest and taxes are also forecast to increase 1.5 percentage points to slightly more than 6 percent.

North America
US Airline industry profitability: 1968-2012

Source: airlines.org



North America
Market value: $870 billion



North America
Key indicators and new airplane markets

Growth measures (%)	
Economy (GDP)	2.5
Traffic (RPK)	2.9
Cargo (RTK)	3.4
Airplane fleet	1.6

Market size	
Deliveries	7,550
Market value	$870B
Average value	$120M

	New airplanes	Share by size (%)
Large widebody	20	>1
Medium widebody	510	7
Small widebody	630	8
Single aisle	4,820	64
Regional jet	1,570	21
Total	**7,550**	

	2013 fleet	2033 fleet
Large widebody	100	80
Medium widebody	320	560
Small widebody	730	920
Single aisle	3,790	5,950
Regional jet	1,710	1,610
Total	**6,650**	**9,120**

Latin America

Economic growth slow but improving

The economic outlook for Latin America and the Caribbean is fairly upbeat. The World Bank predicts that growth in the region will strengthen steadily from 2.9 percent in 2014, to 3.2 percent in 2015 and to 3.7 percent in 2016. The region's expected growth is up significantly from last year's modest 2.5 percent growth. The top growth performers for 2014 are expected to be Panama (7.3 percent) and Peru (5.5 percent), while the region's economic powerhouses, Brazil and Mexico, are projected to grow 2.4 and 3.4 percent, respectively. Other countries in the region are also expecting robust growth rates, likely between 3 percent and 5 percent in 2014.

Air traffic growing with middle class

Political and macroeconomic stability, solid growth, poverty reduction, and a fairer income distribution buoyed regional growth in the 2000s. According to the World Bank, the region's middle-class population now outnumbers the poor population for the first time, a sign that Latin America is becoming a middle-class region. A robust aviation sector is crucial to sustaining this growth. Brazil, the world's seventh-largest economy, has the fourth-largest domestic aviation industry. By 2017, Brazil's total domestic passenger load will grow to 122 million (from 90 million in 2012), which will make Brazil the world's third-largest market.

Airline industry stabilizing

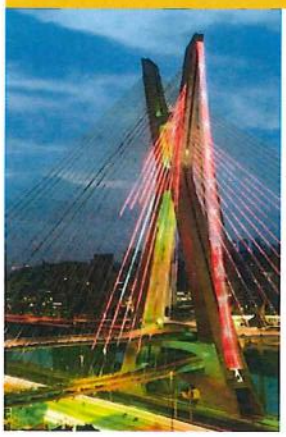
On the heels of significant consolidation, including the mergers of LAN with TAM, Avianca with TACA Airlines, GOL with Webjet, and Azul with TRIP, the region's airline industry is focusing on growth and profitability. By 2033, the region's airlines will need 2,950 new airplanes with a value of $340 billion. Although some of these airplanes will replace retiring jets, more than 70 percent will be for fleet growth, pushing the region's fleet to 3,530 airplanes, compared with 1,380 today. As airlines added new airplanes over the past decade, the average age of the region's fleet has plummeted from 14.8 years to 9.7 years. In addition, major carriers are cutting unprofitable routes and reducing capacity to achieve a more sustainable business environment.

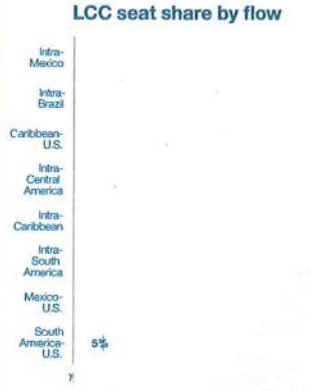
LCC opportunities continuing

LLCs have seen rapid growth in Latin America's two largest markets, Brazil and Mexico, where they now have penetration rates of 46 and 63 percent, respectively. Significant opportunities still exist for LCCs to penetrate the markets of the other countries in the region. Existing LLCs are accordingly planning for growth, through expansion and through partnerships.

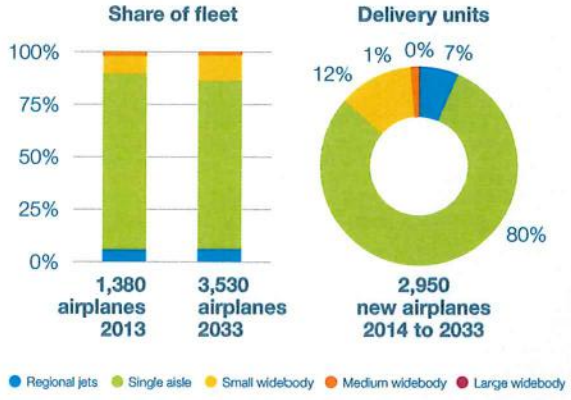
Latin America
LCC seat share is mixed across regional flows

Source: Innovata





Latin America
Market value: $340 billion



Latin America
Key indicators and new airplane markets

Growth measures (%)	
Economy (GDP)	3.9
Traffic (RPK)	6.2
Cargo (RTK)	5.3
Airplane fleet	4.8

Market size	
Deliveries	2,590
Market value	$340B
Average value	$120M

	New airplanes	Share by size (%)
Large widebody	0	–
Medium widebody	40	1
Small widebody	360	12
Single aisle	2,360	80
Regional jet	190	7
Total	**2,950**	

	2013 fleet	2033 fleet
Large widebody	0	0
Medium widebody	20	50
Small widebody	120	430
Single aisle	1,160	2,840
Regional jet	80	210
Total	**1,380**	**3,530**

Middle East

Growth strategies

At the crossroads between Asia, Africa, and Europe, the Middle East is well positioned to compete for traffic connecting these regions. Total airline capacity in the Middle East grew 11 percent in 2013, led by Emirates, Qatar Airways, Etihad Airways, Saudia, and the region's low-cost carriers (LCC).

Booming demand in neighboring regions, plus local demand development, work together to drive the Middle East market. Hub aggregation is a key to enabling growth, because the region's central hubs allow carriers to serve hundreds of routes that have insufficient traffic to warrant point-to-point service. Alliances, partnerships, and equity stakes in airlines of neighboring regions also feed the Middle East hubs.

Business model innovation supports growth in the region as LCCs reduce short-haul fares, set up cross-border subsidiaries, and institute mobile booking portals to improve access to air transport services. Some LCCs are expanding their networks into previously underserved areas, such as the Commonwealth of Independent States. The LCC business model is evolving as carriers such as flydubai develop hybrid concepts that combine low-fare operations with business-class offerings.

Liberalization advances

There remains significant untapped potential for liberalization within the region. The Kingdom of Saudi Arabia is taking steps toward opening its underserved domestic markets. Two new airlines are expected to begin operations in 2014: SaudiGulf, an independent based in Dammam, and Al Maha, an offshoot of Qatar Airways. State-owned Saudia is expected to be privatized, although perhaps not quickly. Commentators note the opportunity for the relaxation of price controls on domestic flights in Saudi Arabia, which would support industry health and service quality.

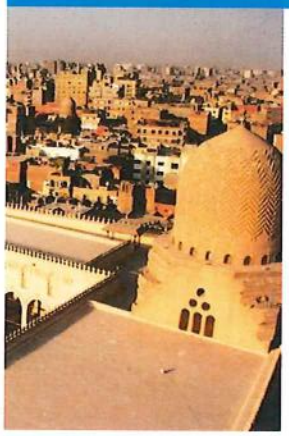
Infrastructure and airspace development

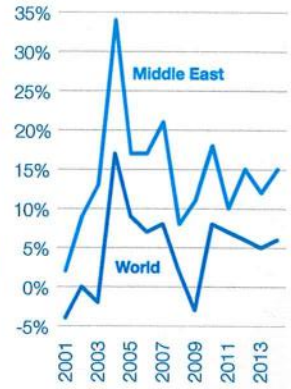
Infrastructure investment tends to target new runways and terminals, focusing on the region's main hubs. New airports opened in Jebel Ali (Dubai) and Doha, runways were refurbished and upgraded at Dubai International, and construction started on a new terminal at Abu Dhabi International. Airport expansion is also underway at King Abdulaziz International (Jeddah) and King Khalid International (Riyadh).

Other challenges remain: Large sections of airspace remain under military control, reducing the airspace available for commercial traffic; and the region's air traffic control (ATC) systems are not centralized, leaving operators to contend with a patchwork of rules, agencies, and processes. Regional authorities are working to address these needs, and recent discussions of ATC coordination between the Gulf Cooperation Council countries and their neighbors serve as a sign of progress.

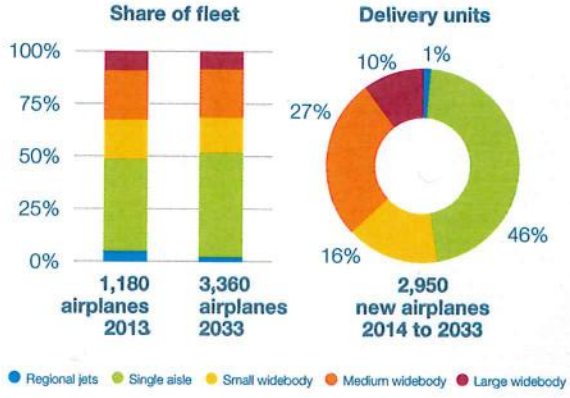
Middle East
Outpaces the World in international traffic growth

Source: IATA





Middle East
Market value: $640 billion



Middle East
Key indicators and new airplane markets

Growth measures (%)	
Economy (GDP)	3.8
Traffic (RPK)	6.4
Cargo (RTK)	5.9
Airplane fleet	5.4

Market size	
Deliveries	2,950
Market value	$640B
Average value	$220M

	New airplanes	Share by size (%)
Large widebody	300	10
Medium widebody	790	27
Small widebody	460	16
Single aisle	1,360	46
Regional jet	40	1
Total	**2,950**	

	2013 fleet	2033 fleet
Large widebody	100	270
Medium widebody	280	770
Small widebody	220	570
Single aisle	520	1,680
Regional jet	60	70
Total	**1,180**	**3,360**

Commonwealth of Independent States

Strong travel growth

The commercial aviation outlook for the Commonwealth of Independent States (CIS) foresees continued growth. The region's geographical size and diverse terrain make airline travel an attractive transportation option. Air travel will increase over the coming 20 years as personal incomes rise and air transport regulations are liberalized to make aviation services more available and affordable. The region's demand for new airplanes is increasing. Over the next 20 years, airlines in CIS will need 1,330 airplanes, valued at $150 billion.

The economies of the CIS are expected to continue to expand, with GDP growing 3.3 percent annually over the next 20 years. Russia's economy continues to be the region's largest, accounting for nearly 75 percent of the region's GDP in 2013. The economies of Ukraine and Kazakhstan follow that of Russia in size.

The Russian Transport Ministry's Federal Air Transport Agency reported that the number of passengers carried by Russian airlines rose to nearly 85 million in 2013, an increase of 14.2 percent compared with 2012.

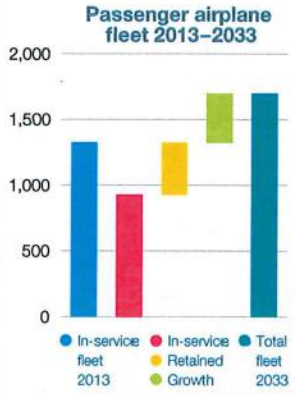
Developing fleet

International traffic is expected to grow at an annual rate of 4.6 percent, nearly doubling over the next 20 years, as market regulation liberalizes. Airlines will need 180 widebody airplanes to handle the increased traffic. The new airplanes will help the region's airlines increase their international footprint. Within the region, traffic is expected to grow 4.3 percent, creating a need for 990 single-aisle airplanes. Although the region's fleet continues to grow, 52 percent of new airplane deliveries will be to replace older airplanes as they retire from the fleet. New airplanes, such as the 737 MAX and the 787 Dreamliner, are more efficient than the airplanes they replace, so overall fleet efficiency will improve.

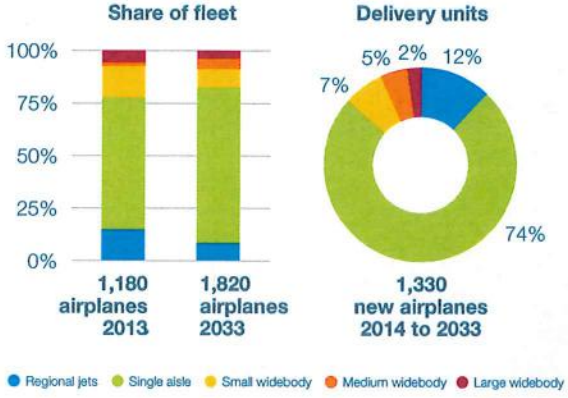
Shifting business models

The low-cost carrier (LCC) business model has been expanding throughout the globe, though with limited success in the CIS. This may be changing, as recent increases in the number of LCC flights from neighboring regions and Aeroflot's intention to launch a low-cost subsidiary could signal the market's readiness for airline business model innovation. Rail transportation is still very popular in the region, but LCCs operating with competitive airfares and faster travel time may capture traffic from the rails.

CIS
1,330 new passenger airplanes required



CIS
Market value: $150 billion



CIS
Key indicators and new airplane markets

Growth measures (%)	
Economy (GDP)	3.3
Traffic (RPK)	4.4
Cargo (RTK)	4.0
Airplane fleet	2.2

Market size	
Deliveries	1,330
Market value	$150B
Average value	$110M

	New airplanes	Share by size (%)
Large widebody	30	2
Medium widebody	60	5
Small widebody	90	7
Single aisle	990	74
Regional jet	160	12
Total	**1,330**	

	2013 fleet	2033 fleet
Large widebody	60	60
Medium widebody	20	90
Small widebody	180	160
Single aisle	740	1,350
Regional jet	180	160
Total	**1,180**	**1,820**

Economic growth prospects rival Asia's

Growth of Africa's economies has accelerated. Despite the global recession and political unrest in North Africa, gross domestic product has increased 4 percent annually over the past decade, compared with an average 2.2 percent rise during the 1990s. Rising demand for natural resources, particularly from emerging economies in Asia and the Middle East, contribute to this growth. Consequently, Africa conducts half its trade with developing economic regions.

Africa's acceleration is more than a natural resources story. Its economies are diversifying as telecommunications, banking, and retail flourish. An economy based on rising incomes, consumption, employment, and productivity is emerging, and these trends are forecast to continue.

Twenty-five African countries have attained middle-income status as defined by the World Bank. The emergence of a middle class equal in size to India's makes consumption a major driver of economic growth. Africa's labor force is forecast to grow by 122 million people by 2020, and a total workforce that will surpass that of China or India by 2035.

Strong economic prospects lead to robust demand for air travel

Traffic to, from, and within Africa is projected to grow about 6 percent per year for the next 20 years, driven by the economic outlook, increasing trade links, and the growing middle class.

Although air travel to and from Europe is Africa's largest market, stronger growth to and from emerging markets and within Africa indicatesmore blance in the future. Today, flows to Europe account for half of all Africa traffic. In 20 years, that share is projected to fall to one-third, owing to growth in emerging markets.

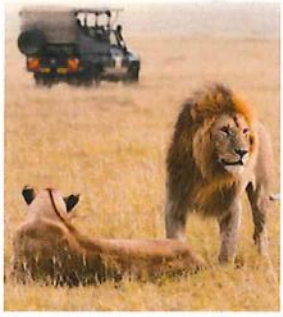
Growth and replacement drive delivery projections

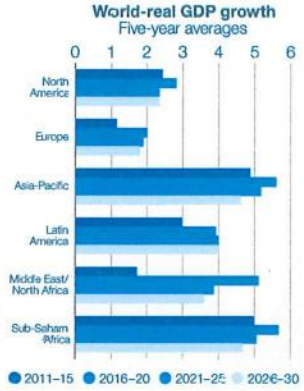
Africa is forecast to require about 1,100 new airplanes over the next 20 years, approximately two-thirds of which will expand the region's fleet. Replacing the aging fleet is also an important component of demand. Although the average in-service age of Africa's mainline fleet has declined by approximately 25 percent over the past decade, it remains higher than the world average.

Single-aisle airplanes will continue to be the largest segment of African airline deliveries. They can serve the majority of routes in Africa's top three markets, where their versatility and ability to provide higher service levels make them attractive. Widebody airplanes, purchased by airlines that fly high-density and long-range routes, will account for almost half of the total delivery value to African airlines.

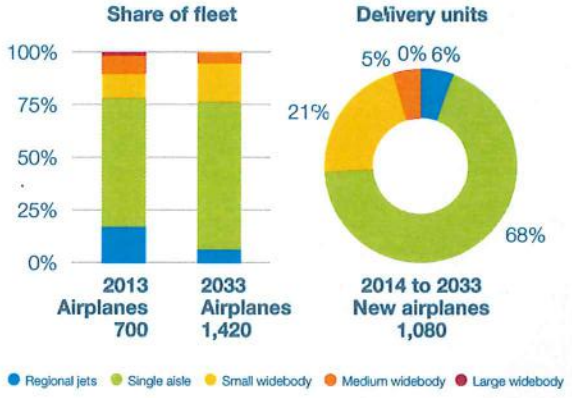
Africa
Economic growth prospects rival Asia's

Source:





Africa
Market value: $140 billion



Africa
Key indicators and new airplane markets

Growth measures (%)	
Economy (GDP)	4.7
Traffic (RPK)	5.9
Cargo (RTK)	6.1
Airplane fleet	3.6

Market size	
Deliveries	1,080
Market value	$140B
Average value	$130M

	New airplanes	Share by size (%)
Large widebody	–	–
Medium widebody	50	5
Small widebody	230	21
Single aisle	740	68
Regional jet	60	6
Total	**1,080**	

	2013 fleet	2033 fleet
Large widebody	10	-
Medium widebody	60	70
Small widebody	80	260
Single aisle	430	1,000
Regional jet	120	90
Total	**700**	**1,420**

Pilot and technician outlook

Pilot and Technician Outlook

The 2014 Boeing Pilot and Technician Outlook projects that 533,000 new commercial airline pilots and 584,000 new maintenance technicians will be needed to fly and maintain the world fleet over the next 20 years.

Meeting this exponential increase in demand will require innovative solutions—focused on new, digital technology—to match the learning requirements of a new generation. The growing diversity of aviation personnel will also require instructors to have cross-cultural and cross-generational skills in order to engage tomorrow's workforce. Training providers will be more focused on enabling airplane operators to gain optimal advantage of the advanced features of the latest generation of airplanes, such as the 787 Dreamliner and 737 MAX.

Asia Pacific demand for pilots remains greatest

Although Asia Pacific remains the region with the highest overall demand, the anticipated number of pilots and technicians required in the Middle East has increased significantly, reflecting expected fleet expansion plans by the region's airlines.

Airlines across the globe are expanding their fleets and flight schedules to meet surging aviation demand in emerging markets. The industry continues to consider how to address challenges and fill the future pilot pipeline.

Emerging markets that have relied heavily on recruitment of pilots from outside their home markets will increasingly need a strong local foundation for developing and training qualified pilots.

Over the next 20 years, the Asia Pacific region, with a requirement for 216,000 new pilots, will see the largest growth in pilot demand. Europe will require 94,000; North America, 88,000; the Middle East, 55,000; Latin America, 45,000; the Commonwealth of Independent States (CIS), 18,000; and Africa, 17,000.

The need for technicians will remain strong

As new-generation airplanes come to dominate the world fleet over the next 20 years, airplane reliability will improve, and maintenance check intervals will lengthen. Although this trend will moderate growth in the demand for technicians, the global requirement remains significant.

The combination of global fleet growth and an increasing trend to outsource maintenance, repair, and overhaul activities to third-party providers in emerging markets will drive the need for the number of qualified technicians to increase and the number of geographical sources of trained technicians to expand.

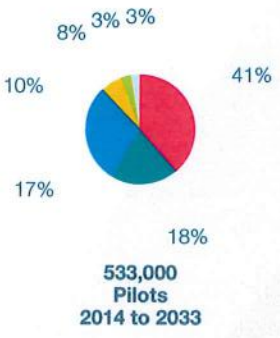
The need for maintenance personnel is greatest in the Asia Pacific region, which will require 224,000 new technical personnel. Airlines in Europe will require 102,000; North America, 109,000; the Middle East, 62,000; Latin America, 44,000; the CIS, 24,000; and Africa, 19,000.

Pilot and technician outlook
20-year demand for aviation personnel

Demand drives need for **a diverse and growing workforce**

Pilot and technician outlook
New pilots by region 2014–2033

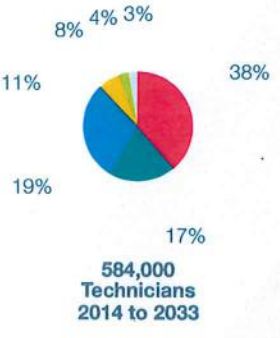
Region	Pilots
Asia Pacific	216,000
Europe	94,000
North America	88,000
Middle East	55,000
Latin America	45,000
CIS	18,000
Africa	17,000
Total	**533,000**



533,000 Pilots 2014 to 2033

Pilot and technician outlook
New technicians by region 2014–2033

Region	Technicians
Asia Pacific	224,000
Europe	102,000
North America	109,000
Middle East	62,000
Latin America	44,000
CIS	24,000
Africa	19,000
Total	**584,000**



584,000 Technicians 2014 to 2033

Airline passenger traffic
Growth by regional flow

Regions

RPKs in billions	2006	2007	2008	2009	2010	2011	2012	2013	2033	Annual growth 2013 to 2033 (%)
Africa– Africa	35.6	37.3	41.6	43.9	48.7	51.1	54.5	53.7	197.6	6.7
Africa–Europe	**121.9**	**125.3**	**125.6**	**128.2**	**135.5**	**134.1**	**140.4**	**140.4**	**368.6**	**4.9**
Africa–Middle East	20.9	23.1	24.9	32.9	36.4	39.4	48.6	50.8	206.0	7.3
Africa–North America	**4.3**	**4.9**	**6.3**	**8.8**	**11.3**	**11.4**	**12.6**	**12.2**	**40.1**	**6.1**
Africa–Southeast Asia	4.1	5.2	5.4	4.1	5.6	5.9	4.6	4.2	15.0	6.6
Central America–Central America	**28.2**	**29.7**	**32.3**	**29.8**	**31.3**	**32.2**	**33.8**	**36.5**	**88.5**	**4.5**
Central America–Europe	74.1	80.7	83.3	77.1	73.8	73.7	78.3	82.1	198.9	4.5
Central America–North America	**105.0**	**106.8**	**115.8**	**104.7**	**112.7**	**114.5**	**132.0**	**138.3**	**310.5**	**4.1**
Central America–South America	10.3	11.0	13.1	14.0	18.3	19.2	23.2	28.5	88.8	5.8
China–China	**189.8**	**223.1**	**236.5**	**287.4**	**335.4**	**380.1**	**411.3**	**460.8**	**1,669.7**	**6.6**
China–Europe	75.3	91.0	82.5	77.3	82.1	94.2	96.7	96.9	317.4	6.1
China–North America	**51.4**	**54.5**	**62.7**	**60.9**	**71.4**	**85.4**	**87.1**	**89.5**	**305.3**	**6.3**
China–Northeast Asia	42.4	49.3	48.4	43.2	51.8	51.5	60.9	60.7	162.4	5.0
China–Oceania	**19.3**	**19.4**	**21.4**	**22.8**	**27.4**	**31.4**	**34.1**	**35.0**	**125.3**	**6.6**
China–Southeast Asia	44.6	49.3	50.6	45.3	54.7	63.0	73.8	82.5	352.0	7.5
CIS Region–CIS Region	**77.3**	**80.8**	**88.9**	**76.9**	**87.6**	**103.1**	**107.1**	**118.3**	**273.7**	**4.3**
CIS Region–International	63.6	81.6	77.7	83.6	101.6	124.1	139.4	157.9	388.5	4.6
Europe–Europe	**593.3**	**634.2**	**660.5**	**624.9**	**640.2**	**659.5**	**676.6**	**714.0**	**1,411.4**	**3.5**
Europe–Middle East	99.2	106.6	115.2	131.2	143.8	153.3	178.0	196.8	561.6	5.4
Europe–North America	**403.4**	**420.6**	**432.4**	**405.4**	**418.6**	**430.2**	**432.9**	**441.8**	**817.9**	**3.1**
Europe–Northeast Asia	60.6	67.9	69.0	59.4	64.3	63.8	75.9	74.3	132.9	2.9
Europe–South America	**67.4**	**70.7**	**75.2**	**79.3**	**82.9**	**89.8**	**99.6**	**102.4**	**278.3**	**5.1**
Europe–South Asia	53.3	58.5	55.5	51.3	53.8	54.1	53.9	56.4	212.3	6.8
Europe–Southeast Asia	**95.9**	**96.8**	**101.5**	**95.9**	**97.1**	**100.4**	**106.6**	**105.3**	**266.7**	**4.8**
Middle East–Middle East	53.7	60.3	63.4	68.6	77.9	82.4	76.5	86.3	239.9	5.2
Middle East–North America	**20.6**	**23.4**	**29.5**	**41.6**	**45.7**	**50.3**	**57.1**	**63.2**	**214.6**	**6.3**
Middle East–South Asia	42.0	46.5	49.5	64.8	75.1	83.0	87.3	95.1	445.1	8.0
Middle East–Southeast Asia	**33.4**	**41.1**	**45.4**	**46.7**	**56.3**	**61.3**	**66.4**	**79.0**	**259.2**	**6.1**
North America–North America	977.4	1,022.4	974.1	915.1	946.3	976.3	984.7	998.4	1,565.8	2.3
North America–Northeast Asia	**140.7**	**143.7**	**139.4**	**120.2**	**128.4**	**135.4**	**149.0**	**150.4**	**211.4**	**1.7**
North America–Oceania	30.6	32.1	32.3	34.8	34.9	38.3	40.3	43.1	90.5	3.8
North America–South America	**50.7**	**52.1**	**52.7**	**56.9**	**60.9**	**66.7**	**72.0**	**79.2**	**238.6**	**5.7**
North America–Southeast Asia	9.4	11.3	9.3	10.3	10.3	11.3	10.7	9.8	34.0	6.4
Northeast Asia–Northeast Asia	**87.4**	**88.8**	**84.9**	**81.9**	**84.6**	**81.9**	**92.6**	**103.9**	**152.9**	**1.9**
Northeast Asia–Oceania	21.5	21.0	20.8	15.1	18.1	16.6	17.1	15.9	34.0	3.9
Northeast Asia–Southeast Asia	**80.1**	**86.3**	**87.7**	**74.3**	**79.6**	**92.3**	**104.9**	**113.3**	**256.8**	**4.2**
Oceania–Oceania	70.8	74.4	72.0	73.3	78.4	83.8	92.0	99.0	247.0	4.7
Oceania–Southeast Asia	**51.9**	**52.4**	**57.4**	**54.7**	**61.1**	**66.9**	**71.5**	**77.8**	**210.3**	**5.1**
South America–South America	74.2	83.1	81.6	86.9	115.8	134.4	141.9	147.4	633.4	7.6
South Asia–South Asia	**31.3**	**36.3**	**40.1**	**43.8**	**49.5**	**58.6**	**63.8**	**68.1**	**421.3**	**9.5**
Southeast Asia–South Asia	19.4	20.6	24.3	21.9	28.5	29.2	34.0	36.2	185.8	8.5
Southeast Asia–Southeast Asia	**78.8**	**93.4**	**93.2**	**96.0**	**113.1**	**130.7**	**145.1**	**166.6**	**734.7**	**7.7**
Rest of World	38.6	44.3	55.5	69.3	87.9	97.4	116.0	126.1	572.9	7.9
Grand Total	**4,253.6**	**4,561.9**	**4,639.2**	**4,564.2**	**4,938.7**	**5,262.2**	**5,585.0**	**5,898.0**	**15,537.6**	**5.0**

*Taiwan has been moved from Southeast Asia to Northeast Asia

Airplanes required

Passenger and freighter airplanes
Market value and demand by region

Demand and value by region

Region	$B	Airplanes
Asia Pacific	$2,020	13,460
Europe	$1,040	7,450
North America	$870	7,550
Latin America	$340	2,950
Middle East	$640	2,950
CIS	$150	1,330
Africa	$140	1,080
World	**$5,200**	**36,770**

Deliveries by airplane size and region

Region	Regional jets	Single aisle	Small widebody	Medium widebody	Large widebody	Total deliveries
Asia Pacific	350	9,540	1,940	1,420	210	13,460
Europe	120	5,870	810	590	60	7,450
North America	1,570	4,820	630	510	20	7,550
Latin America	190	2,360	360	40	-	2,950
Middle East	40	1,360	460	790	300	2,950
C.I.S.	160	990	90	60	30	1,330
Africa	60	740	230	50	-	1,080
World	**2,490**	**25,680**	**4,520**	**3,460**	**620**	**36,770**

Market value by airplane size and region*

Region	Regional jets	Single aisle	Small widebody	Medium widebody	Large widebody	Total deliveries
Asia Pacific	$10	$960	$490	$480	$80	$2,020
Europe	$10	$600	$220	$190	$20	$1,040
North America	$60	$490	$140	$170	$10	$870
Latin America	$10	$230	$90	$10	-	$340
Middle East	<$5	$130	$120	$270	$120	$640
CIS	$10	$80	$30	$20	$10	$150
Africa	<$5	$70	$50	$20	-	$140
World	**$100**	**$2,560**	**$1,140**	**$1,160**	**$240**	**$5,200**

*2013 $B catalog prices. Values above 10 have been rounded to nearest 10.

Passenger and freighter airplanes
In service and future fleet

Total airplanes in service

Size	2013	2033
Regional jet	2,620	2,640
Single aisle	13,580	29,500
Small widebody	2,390	5,570
Medium widebody	1,580	3,680
Large widebody	740	790
Total	**20,910**	**42,180**

Passenger airplanes in service

Size	2013	2033
Regional jet	2,570	2,600
Single aisle	13,040	28,440
Small widebody	1,810	4,760
Medium widebody	1,340	3,120
Large widebody	460	530
Total	**19,220**	**39,450**

Freighter airplanes in service

Size	2013	2033
Widebody	1,100	1,630
Standard	590	1,100
Total	**1,690**	**2,730**

Airplane demand

Size	$B	Airplanes
Regional jet	$100	2,490
Single aisle	$2,560	25,680
Small widebody	$1,140	4,520
Medium widebody	$1,160	3,460
Large widebody	$240	620
Grand total	**$5,200**	**36,770**

Passenger airplane demand

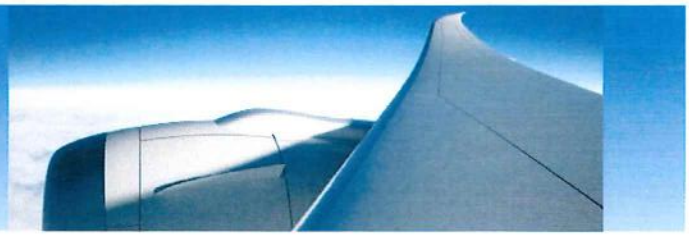
Size	$B	Airplanes
Regional jet	$100	2,490
Single aisle	$2,560	25,680
Small widebody	$1,090	4,270
Medium widebody	$1,010	2,990
Large widebody	$200	500
Grand total	**$4,960**	**35,930**

Freighter airplane demand

Size	$B	Airplanes
Large*	$190	590
Medium widebody	$50	250
Standard	-	0
Grand total	**$240**	**840**

*Large passenger and large freighter categories differ

Fleet development



Passenger and freighter airplanes
Market value and fleet development

Market by airplane size

Size	Market value 2013 ($B)	Market share value (%)	New airplane deliveries	Market share units (%)
Large*	$240	5	620	5
Medium	$1,160	22	3,460	22
Small	$1,140	22	4,520	22
Total twin aisle	**$2,540**	**49**	**8,600**	**49**
More than 175 seats	$730	14	6,380	14
90 to 175 seats	$1,830	35	19,300	35
Total single aisle	**$2,560**	**49**	**25,680**	**49**
Total regional jets	**$100**	**2**	**2,490**	**2**
Total fleet	**$5,200**	**100**	**36,770**	**100**

Passenger fleet development

Size	End of year 2013	Removed from service	Converted to freighter	New deliveries 2014 to 2033	End of year 2033
Large*	460	430		500	530
Medium	1,340	1,210		2,990	3,120
Small	1,810	1,320		4,270	4,760
Total Wide-body	**3,610**	**2,960**		**7,760**	**8,410**
More than 175 seats	1,720	1,270		6,380	6,830
90 to 175 seats	11,320	9,010		19,300	21,610
Total single aisle	**13,040**	**10,280**		**25,680**	**28,440**
Total regional jets	**2,570**	**2,460**		**2,490**	**2,600**
Total fleet	**19,220**	**15,700**	**1,330**	**35,930**	**39,450**

Freighter fleet development

Size	End of year 2013	Removed from service	Converted to freighter	New deliveries 2014 to 2033	End of year 2033
Widebody	1,100	680		840	1,630
Standard body	590	450		-	1,100
Total freighter fleet	**1,690**	**1,130**	**1,330**	**840**	**2,730**

Total fleet

Size	End of year 2013	Removed from service	Converted to freighter	New deliveries 2014 to 2033	End of year 2033
Passenger fleet	19,220	15,700	1,330	35,930	39,450
Freighter fleet	1,690	1,130	1,330	840	2,730
Total fleet	**20,910**	**16,830**	**1,330**	**36,770**	**42,180**

*Large passenger and Larger Freighter categories differ

Fleet by region

Fleet growth
by size and region

Fleet by airplane size

Size	Airplanes in service 2013	Fleet share 2013%	Airplanes in service 2033	Fleet share 2033%
Large*	740	4	790	2
Medium	1,580	8	3,680	9
Small	2,390	11	5,570	13
Total widebody	**4,710**	**23**	**10,040**	**24**
More than 175 seats	1,960	9	7,250	17
90 to 175 seats	11,620	56	22,250	53
Total single aisle	**13,580**	**65**	**29,500**	**70**
Total regional jets	**2,620**	**13**	**2,640**	**6**
Total fleet	**20,910**	**100**	**42,180**	**100**

Fleet by region in 2013

Region	Regional jets	Single aisle	Small widebody	Medium widebody	Large widebody	Total
Asia Pacific	130	3,820	710	520	290	5,470
North America	1,710	3,790	730	320	100	6,650
Europe	340	3,120	350	360	180	4,350
Latin America	80	1,160	120	20	-	1,380
Middle East	60	520	220	280	100	1,180
CIS	180	740	180	20	60	1,180
Africa	120	430	80	60	10	700
World	**2,620**	**13,580**	**2,390**	**1,580**	**740**	**20,910**

Fleet by region in 2033

Region	Regional jets	Single aisle	Small widebody	Medium widebody	Large widebody	Total
Asia Pacific	350	10,850	2,250	1,500	270	15,220
North America	1,610	5,950	920	560	80	9,120
Europe	150	5,830	980	640	110	7,710
Latin America	210	2,840	430	50	-	3,530
Middle East	70	1,680	570	770	270	3,360
CIS	160	1,350	160	90	60	1,820
Africa	90	1,000	260	70	-	1,420
World	**2,640**	**29,500**	**5,570**	**3,680**	**790**	**42,180**

Major traffic flows

Airline traffic flows
by region

Airline passenger growth rates 2013–2033

RPKs in percentages	Africa	Latin America	Middle East	Europe	North America	Asia Pacific
Asia Pacific	7.1	8.8	7.4	5.3	4.3	**6.4**
North America	6.1	4.7	6.3	3.1	**2.3**	
Europe	4.9	4.9	5.4	**3.5**		
Middle East	7.3	-	**5.2**			
Latin America	8.0	**6.9**				
Africa	**6.7**					

Airline passenger traffic in 2013

RPKs in billions	Africa	Latin America	Middle East	Europe	North America	Asia Pacific
Asia Pacific	19.8	2.3	244.9	332.9	303.3	**1,334.2**
North America	12.2	217.5	63.2	441.8	**998.4**	
Europe	140.4	184.4	196.8	**714.0**		
Middle East	50.8	-	**86.3**			
Latin America	3.0	**212.5**				
Africa	**53.7**					

Airline passenger traffic in 2033

RPKs in billions	Africa	Latin America	Middle East	Europe	North America	Asia Pacific
Asia Pacific	78.5	12.2	1,021.0	929.3	700.3	**4,616.6**
North America	40.1	549.0	214.6	817.9	**1,565.8**	
Europe	368.6	477.2	561.6	**1411.4**		
Middle East	206.0	-	**239.9**			
Latin America	14.0	**810.7**				
Africa	**197.6**					

Bold: Share within region.

Flow of airplanes

Airplane fleet
How the fleet develops as airplanes are added and removed

19,220
Passenger fleet in 2013

In service | Parked

Used

\+ **35,930** New airplanes

− **15,700** Removed airplanes

14,370 Permanently retired

1,330 Converted to freighter

39,450
Passenger fleet in 2033

1,690
Freighter fleet in 2013

In service | Parked

Used

\+ **840** New freighters

− **1,130** Removed freighters

1,130 Permanently retired

2,730
Freighter fleet in 2033

Traffic by region

Airline traffic flows
by region

Airline passenger growth rates 2013–2033

RPKs in percentages	Africa	Latin America	Middle East	Europe	North America	Asia Pacific
Asia Pacific	7.1	8.8	7.4	5.3	4.3	**6.4**
North America	6.1	4.7	6.3	3.1	**2.3**	
Europe	4.9	4.9	5.4	**3.5**		
Middle East	7.3	-	**5.2**			
Latin America	8.0	**6.9**				
Africa	**6.7**					

Airline passenger traffic in 2013

RPKs in billions	Africa	Latin America	Middle East	Europe	North America	Asia Pacific
Asia Pacific	19.8	2.3	244.9	332.9	303.3	**1,334.2**
North America	12.2	217.5	63.2	441.8	**998.4**	
Europe	140.4	184.4	196.8	**714.0**		
Middle East	50.8	-	**86.3**			
Latin America	3.0	**212.5**				
Africa	**53.7**					

Airline passenger traffic in 2033

RPKs in billions	Africa	Latin America	Middle East	Europe	North America	Asia Pacific
Asia Pacific	78.5	12.2	1,021.0	929.3	700.3	**4,616.6**
North America	40.1	549.0	214.6	817.9	**1,565.8**	
Europe	368.6	477.2	561.6	**1411.4**		
Middle East	206.0	-	**239.9**			
Latin America	14.0	**810.7**				
Africa	**197.6**					

Bold: Share within region.

Airplane categories

Passenger and freighter
Airplane market sector definitions

Single-aisle passenger airplanes

Regional jets	90 to 175 seats	More than 175 seats
Antonov An-148	Boeing 717, 727	Boeing 707, 757
AVIC ARJ-700	Boeing 737-100 through -500	**Boeing 737-900ER**
Avro RJ70, RJ85	**Boeing 737-600, -700, -800**	**Boeing 737 MAX 9**
BAe 146-100, -200	**Boeing 737 MAX 7, MAX 8**	**Airbus A321**
Bombardier CRJ	**Airbus A318, A319, A320**	**Airbus A321neo**
Dornier 328JET	**Airbus A319neo, A320neo**	**Tupolev TU-204, TU-214**
Embraer 170, 175	Boeing-MDC DC-9, MD-80, -90	
Embraer ERJ-135, -140, -145	**AVIC ARJ-900**	
Fokker 70, F28	BAe 146-300, Avro RJ100	
Mitsubishi MRJ	**Bombardier CRJ-1000**	
Sukhoi Superjet 100	**Bombardier CS100, CS300**	
Yakovlev Yak-40	**Embraer 190, 195**	
	COMAC C919	
	Fokker 100	
	UAC MS 21-200 -300	
	Ilyushin IL-62	
	Tupolev TU-154	
	Yakovlev Yak-42	

Widebody passenger airplanes

Small Two class: 230 to 340 seats Three class: 200 to 300 seats	Medium Two class: 340 to 450 seats Three class: 300 to 400 seats	Large* Three class: more than 400 seats
Boeing 767, 787	**Boeing 777, 777X**	**Boeing 747-8**
Boeing-MDC DC-10	Boeing-MDC MD-11	Boeing 747-100 through -400
Airbus A300, A310	**Airbus A340**	**Airbus A380**
Airbus A330-200, -300	**Airbus A350-1000**	
Airbus A350-800, -900	Ilyushin IL-86	
Lockheed L-1011	**Boeing 787-10**	
Ilyushin IL-96		

Freighter airplanes

Standard body Less than 45 tonnes	Medium widebody 40 to 80 tonnes	Large* More than 80 tonnes
BAe 146	Boeing 767	Boeing-MDC MD-11
Boeing-MDC DC-8, -9	Lockheed L-1011SF	Boeing 747-100 through -400
Boeing 737	Boeing-MDC DC-10	Boeing 777
Boeing 727	Boeing 787	Airbus A350
Tupolev TU-204	Airbus A300	Ilyushin IL-96T
Boeing 707	Ilyushin IL-76TD	Antonov An-124
Boeing-MDC MD-80		747-8F
Boeing 757-200		
Airbus A320, A321		

Bold: Airplanes in production or launched. Production and conversion (SF) models assumed for each type unless otherwise specified.
*Large passenger and large freighter categories differ.

Opinion and feedback

We value your opinion
Please provide your name, position, company, and address below, or attach your business card.

Feedback
What do you think?

Your perspective

- What will be the main factors to affect future air transport markets?
- What will be the likely impact of these factors?

Your feedback

- What do you think of web-only access to forecast information (with a PDF for you to print locally)?
- If you have used the interactive forecast database on our website, tell us what you think of it.
- What areas would you like to see covered in more detail in the Current Market Outlook?
- What additional data would you like us to make available?
- What did you find most valuable?
- Was there anything you disliked?

Send your comments to us
Our contact details are below.

Your comments
Any other questions or comments?

Website
www.boeing.com/cmo

Forecast database
www.boeing.com/cmo/data

Contact
Darren Hulst
Director
Product Forecasting

E-mail
BoeingCurrentMarketOutlook@Boeing.com

Fax
1.206.766.1022

Address
Boeing Commercial Airplanes
Market Analysis
P.O. Box 3707, MC 21-28
Seattle, WA 98124-2207

Boeing Commercial Airplanes
Market Analysis
P.O. Box 3707 MC 21-28
Seattle, WA 98124-2207
www.boeing.com/cmo

Printed in USA 261664 9/14