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FOREWORD

Picking your assets

Airfinance Journal's annual review of aircraft characteristics provides data to assist in investment choices.

To borrow a term from the world of personal finance advice, values can go up or down. For a long time aircraft have been seen as a sound investment, with demand for the more popular models outstripping supply as a result of seemingly inexorable growth in air traffic. Even major economic recessions seemed to apply only a temporary break to the production lines of manufacturers. But in recent years questions about economic lives and new aircraft production rates have worried many investors.

The questions remained unanswered in 2013, as the debate over how long new aircraft can expect to stay in revenue service rumbled on and manufacturers insisted their production rates were justified by market demand.

For those investors, particularly some lessors, that are concerned by the threat to current market values from new-technology aircraft, recent developments have perhaps brought little cheer. Embraer's launching of the second generation of its E-Jet family *(see Increasing competition in regional market, page 20)* and Boeing's announcement that the 777X will go ahead *(see Boeing and Airbus fight for widebody orders, page four)* will add to such concerns, but manufacturers are in the business of building better products.

In a world where environmental concerns are thought by many to be the biggest threat to growth in air transport, it is difficult to argue against the logic of developing aircraft with improved fuel burn. But if growth is restrained, the new types will replace the less-efficient current models, rather than meeting a need for additional capacity that many in the industry are relying on. In any case, with fuel accounting for about half of operating costs on long-haul flights, the case for airlines buying new-technology aircraft is increasingly compelling.

Airfinance Journal's latest findings suggest investors continue to back the best current-generation models, but the approaching entry into service of new-technology aircraft is starting to change opinions *(see Investors' and Operators' Poll 2013, page seven)*.

Despite becoming increasingly dominant in aircraft operating costs, fuel efficiency is not the only consideration for operators and investors. Maintenance remains a major expenditure, and unexpected costs can seriously impact investor returns. Engine choice will be a key factor in investment decisions regarding the 737 Max and A320neo, and an understanding of maintenance trends for these engines should be high up on any investor's list of priorities *(see New-generation engines, values and costs, page 14)*.

If the International Air Transport Association's figures are to be believed, the market for freighter aircraft is more fragile than its passenger counterpart. New freighters are arguably a niche market, and orders have been few and far between. Passenger-to-freighter conversions offer a lower capital cost solution to operators, but the balance between supply and demand presents a challenge to conversion facilities and investors alike (see Difficult markets for new and converted freighters, page 23).

Many aircraft types offer investment value, but not all models can be relied on to provide a good return over a lifetime. Picking winners and losers is not easy, but the data contained in these pages should provide some help.

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WIDEBODIES

Boeing and Airbus fight for widebody orders

Boeing's launch of the 777X programme at the 2013 Dubai Airshow triggered a new phase in the relentless battle between the US manufacturer and Airbus, its European rival. Air Investor looks at the merits of the manufacturers' competing aircraft families.

Boeing launched the widely anticipated 777X family at the Dubai Airshow in November marking the start of an intensive contest with Airbus's A350XWB family. The US manufacturer is offering two variants of the 777X.

The 777-9X offers seating for more than 400 passengers, depending on an airline's configuration choices. According to the manufacturer's data, the -9X will have a range of more than 8,200 nautical miles (15,185km). The second member of the family, the 777-8X, will seat 350 passengers and offer a range capability of more than 9,300 nautical miles (17,220km).

The competition between the new Boeing and Airbus widebody aircraft is likely to be as intense as the high-profile fight for market share in the single-aisle market, where the manufacturers claim superiority for the 737Max and the A320neo respectively.

A good indication of the key areas of the contest between the twin-aisle rivals is the content of Boeing's initial statements about the latest version of its successful 777 family. The US manufacturer trumpeted the "record-breaking" launch stating that it has agreements for 259 aircraft from four customers (Lufthansa with 34 aircraft, Etihad Airways with 25 Qatar Airways with 50 and Emirates with 150). The combined value of the agreements, according to Boeing, is more than $95 billion at list prices.

Despite this start, orders for the 777X are well behind the A350, which has 756 firm orders from 38 customers. The gap is perhaps unsurprising given that the A350 was launched in 2006 and will enter service some six years before Boeing's target of 2020 for the 777X. Whether Boeing can close the gap in sales will be the acid test.

Fuel efficiency and operating cost will be a crucial influence on airline and lessor purchasing decisions, but comparisons may not be straightforward. Ray Conner, Boeing Commercial Airplanes president and chief executive officer, is quoted as saying: "The airplane [the 777X] will be 12% more fuel efficient than any competing airplane."

The claim is difficult to square with recent Airbus presentations, which show

Boeing launched the 777X programme at the 2013 Dubai Airshow

the A350-1000 having a fuel burn per trip about 7% lower than the 777-8X and some 15% lower than the 777-9X.

A new General Electric engine model – the GE9X – will power the 777X. Boeing is developing an all-new composite wing that has a longer span than today's 777 models. The new models will have folding, raked wingtips and Boeing says the optimized span will result in greater efficiency, significant fuel savings and complete airport gate compatibility. However, Airbus suggests that, unlike the A350-1000, the 777-9X will not fit in the current 777's "airport box".

Cutting through the manufacturers' claims and counter claims is complex for the rival twin-aisle products, with even the establishment of equivalent seating layouts presenting a complex task. There is a further difficulty in that the respective families cover different seating ranges.

The 777-8X competes directly with the A350-1000, but the A350-900 is closer to the 787-10 than any of the 777X family. Boeing says the 777-9X does not have a direct competitor because it is significantly larger and than any of the A350 models.

Despite being smaller, Airbus says both the A350-900 and A350-1000 will have lower fuel burns per seat than the 777-9X. Given Conner's statement, it is clear that Boeing strongly disagrees with this analysis, which would give the Airbus aircraft a huge advantage.

In an interview with *Airfinance Journal*, Randy Tinseth, Boeing's vice-president

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Boeing and Airbus seem to agree that the market will need about $2.3 trillion-worth of twin-aisle aircraft over the next two decades.

marketing, confirms that the Boeing figure of a 12% fuel burn advantage refers to the company's view of the fuel per seat of the 777-9X compared with the A350-1000. Boeing states the fuel burn advantage will contribute to a 10% improvement in operating economics over the A350-1000.

Tinseth says that the 10% figure refers to cash operating costs and points out that, at its current price, fuel accounts for about half of these costs on typical long-haul routes. Boeing's figures therefore imply the 777X's fuel advantage will directly provide a 6% saving in cash costs. Tinseth adds that the remaining 4% will come from various factors, but principally from maintenance cost savings.

Much of the debate between the manufacturers focuses on whether the 10-abreast layout proposed by Boeing for the 777X economy cabin will find favour with airlines. The A350 was originally conceived with a fuselage based on the A330, but this was rejected by some prospective customers causing Airbus to redesign the aircraft as the A350 XWB (extra widebody).

Boeing has clearly not felt the need to alter the cross-section of the 777 and points to the launch orders as evidence of customer acceptance. Airbus's high-profile campaign on the acceptability of wide seats is evidence of the European manufacturer's determination to reap the rewards of redesigning the A350 cabin.

Tinseth agrees that it is difficult to make comparisons of seating capacity between competing widebody aircraft, but says that the best guideline to relative capacities is cabin floor area, and here he says the -9X has an 11% to 12% advantage over the A350-1000. This is a debate that is set to continue, and the outcome is likely to differ between airlines.

Another area of disagreement is the two manufacturers' views on the strengths of their own product line and the weaknesses of their competitor's family of twin-aisle aircraft. The two companies' marketing materials show opposing views that are difficult to reconcile.

Manufacturers tend to focus on the advantages of offering a family (or families) of aircraft, but not everyone in the industry attaches the same importance to this aspect of aircraft selection.

Andy Foster, senior lecturer, Centre for Air Transport Management, Cranfield University, suggests to *Airfinance Journal* that, although the family argument will be important for some airlines, many will have a specific mission in mind, and for them such arguments are irrelevant. He adds that some operators will purchase from both manufacturers, such as Lufthansa has already done.

Airline purchasing decisions and the resultant market share will define which of the manufacturers wins this latest battle between the two giants of the aircraft manufacturing world. However, some caution will still be required by observers and analysts when making judgments. Airbus claims to have won 59% market share in the twin-aisle market and Boeing claims 56%. Surprisingly, both are right, but the Boeing claim is based on a 10-year period and the Airbus figure relates to the past five years.

Taking a step back from the argument, is it possible that the claim and counter claim are an unnecessary distraction? Boeing reckons (and Airbus more or less agrees) that the market will need about $2.3 trillion-worth of twin-aisle aircraft over the next two decades. So, despite the obligatory heated arguments between them, there is probably room for both manufacturers' products to be successful. It may be that there will be no loser, but that may not ensure a spirit of goodwill.

AIRBUS AND ROLLS-ROYCE PUSH A340 REVIVAL

As well as competing in the twin-aisle market with its new-technology A350, Airbus is joining with Rolls-Royce to boost the market appeal of its A340-600 model, with a view to increasing demand for the aircraft in the secondary market.

Airbus acknowledges that the A340-600 burns 12% more fuel than the similarly sized Boeing 777-300ER, but it claims the four-engined aircraft can be competitive thanks to its lower ownership costs, which the company says are about $850,000 a month. There is also tacit acceptance that engine maintenance costs need to be addressed.

In this context Rolls-Royce says it will bring maintenance costs for an A340's four Trent 500s in line with those of a pair of General Electric GE90-115Bs, which power the 777-300ER.

As part of the sales drive, Airbus has undertaken to certificate a high-density seating configuration for the A340-600 by raising the exit limit from the current 440 seats to 475. Airbus is also offering a two-class layout that uses narrower economy seats to permit nine-abreast seating. This has 18 business-class seats and 457 economy seats.

Airbus says it is targeting high-density Boeing 747-400s operated by charter carriers. It claims that the A340-600 burns 21% less fuel per trip than the Boeing widebody. According to the European manufacturer, a 475-seat A340 has an overall monthly cost advantage over the 747-400 of $557,000.

Investors' and Operators' poll 2013

Operators and investors enjoyed an improved market in 2013.
Joanna Vickers analyses the industry's favourite aircraft, and reviews the growing impact of the new technology options on the current engine jets.

Over the past 12 months the market has improved for airlines and lessors. Access to liquidity has improved, and lease rates for many assets have risen above the rate of inflation. Despite the upturn, the industry is also becoming more inventive in how it makes money, with increasing numbers of younger aircraft being parted out to maximize profit.

The highest overall ranking aircraft is Boeing's 777-300ER widebody, closely followed by its 737-800 single-aisle jet. Airbus's A330-300 and A320 offerings are in second place in the twin-aisle and narrowbody categories, and are likely to have been compressed slightly as a result of the European manufacturer's new technology options. This follows one notable trend seen this year – a decline in ratings for both the 737- and A320-family current-engine technology assets, as the delivery dates for the new-engine options draw closer.

Profit in part-out

In 2013 the industry witnessed a number of aircraft part-outs relatively early, prompting some market insiders to question the validity of the traditional 25-year life cycle of aircraft.

Secondary lease rates on older, less popular, asset types are causing problems for lessors which bought the jets at a premium a few years ago, when Libor was about 5%. These aircraft are coming off their first leases, and entering a low interest market, resulting in disappointing lease rates.

The motivation for parting out relatively young aircraft is purely financial. If an asset is among the first of its generation to be broken down, the parts will command a premium.

"If there's no market established yet for the aircraft in the secondary market from a parts perspective, as soon as you put them in that market you're going to maximize value. As you get to 22 years, these aircraft start retiring in larger numbers as the value of the parts decreases," explains Abdol Moabery, GA Telesis's chief executive officer.

Some operators and investors are parting out A340-500s and -600s that are barely 10 years of age. The A340-500 in particular is a very niche aircraft, with fewer than about 50 produced, and has sunk to the bottom of the survey results for widebody jets.

"We are seeing some part-outs of relatively young aircraft. In the single-aisle space, a small number of 737 Next Generation aircraft have been parted out. The aftermarket for the smallest versions of these types – the 737-600 and A318 – is and has been especially weak, which has made them good part-out candidates because their prices have fallen dramatically in the used market. Indeed, we have bought such aircraft as young as eight years old, although, more recently they might be 14 or 15 years old," says David Treitel, managing director at Apollo Aviation Group.

When interest rates begin to creep upwards, the market is likely to see fewer very young aircraft parted out, as financing for new aircraft becomes more unattainable for second-tier airlines. These lower credit carriers will instead shift towards buying or leasing older models.

Narrowbodies adjust to new technology

One of the most important aspects to consider when investing in a multimillion-dollar asset is the user base. The biggest user bases globally are focused on the A320 and 737 narrowbodies – unsurprisingly, these are by far the most popular assets for leasing companies.

About 12 to 18 months ago the demand for A320s was compressed on the back of the bankruptcies of Mexicana and Kingfisher Airlines, which, combined with a hefty lessor order backlog for the narrowbodies, created an oversupply in the market.

However, this backlog has dissipated, and A320s are the order of the day for operators and investors. "We're out of A320s at the moment. We could move a few if we had them right now but they're all gone. I was in Barcelona last week and there were a bunch of people looking for A320s, and we just don't have them anymore,"

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INVESTORS' AND OPERATORS' POLL 2013

Narrowbodies

says Aengus Kelly, AerCap's chief executive officer.

Alongside the A320, the A321 is enjoying burgeoning popularity in the market. Demand from operators is high, and limited numbers of the aircraft in circulation means lease rates are shifting upwards.

"The A321 is the aircraft that's most in demand right now – there's not that many of them, and it doesn't really have a direct competitor," explains Kelly.

Boeing's out-of-production 757 is the A321's nearest competitor, and with the fleet rapidly ageing and dwindling in numbers, the manufacturer is losing out to its European rival in this seat-number range.

The 737 Max8 topped the results for the new-technology aircraft, with investors and operators particularly confident in the asset's remarketing potential. In fact, the results for all of the 737 Max variants were up compared to the previous year, whereas the A320neo family's results were slightly squeezed.

Boeing's 737-800 came out on top in all categories for the narrowbody sector, followed closely by the A320. For almost all the 737- and A320-family models the popularity dipped slightly – most likely because of the approaching introduction of the new engine types.

Lease rates enjoy upturn

A number of lessors have found the upturns in lease rates to be most acute for the Boeing narrowbody range, and consider improvements in the A320 rates to be slower-paced.

The A319 is one of the year's more unpopular assets for both airlines and lessors, as a result of its small size compared with its A320-family relatives, and an oversupply in the market. Boeing's comparably sized jet, the 737-700, has managed to avoid such strong downward pressure in rates because of the high percentage of the model making up Southwest Airlines' fleet, wit h much lower numbers moving around the leasing channels.

Lessors are also keener to tie in longer lease terms, given the higher rates they are able to secure. "Due to the global recession, in 2011-12 we saw a temporary move towards shorter lease terms amongst lessors – and yes we did a few six-year leases. We're past that now, and we're able to get better terms and better lease rates out of our new pipeline airplanes which are delivering today," says Awas chief commercial officer, Marlin Dailey.

Narrowbody league table

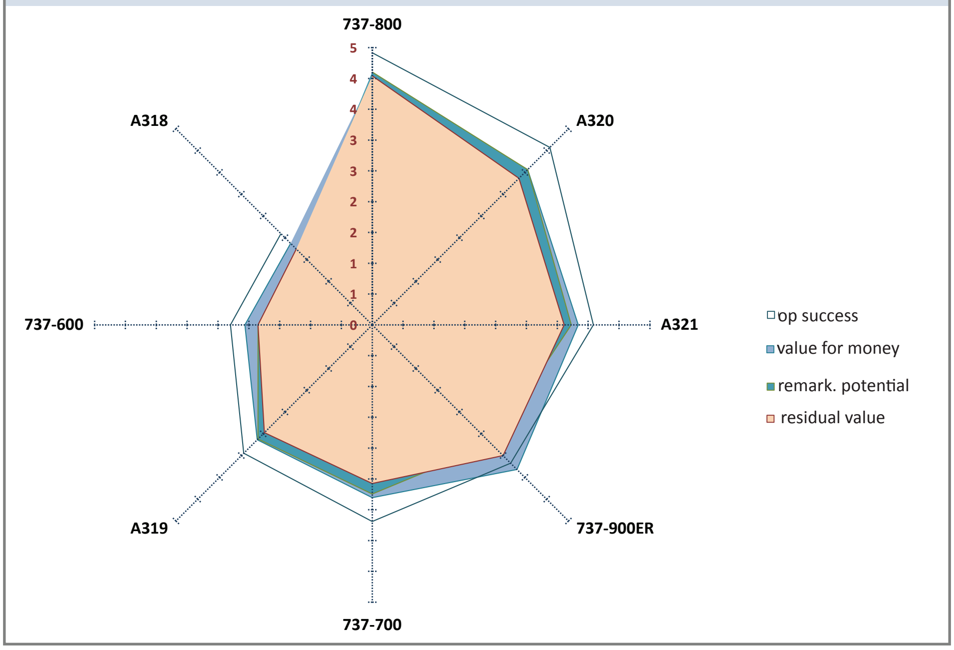
Model	Value for money	Remark. potential	Op success	Residual value	Overall	2012	DIF
In production							
737-800	4.02	4.10	4.42	4.04	**4.15**	4.72	-0.58
A320	3.56	3.56	4.07	3.36	**3.64**	3.65	-0.01
A321	3.34	3.23	3.58	3.11	**3.32**	3.51	-0.20
737-900ER	3.32	2.74	3.17	3.00	**3.06**	3.66	-0.60
737-700	2.80	2.74	3.19	2.57	**2.83**	3.18	-0.35
A319	2.64	2.62	2.95	2.47	**2.67**	2.86	-0.19
737-600	2.06	1.85	2.30	1.85	**2.02**	1.80	0.21
A318	1.87	1.69	2.09	1.74	**1.85**	1.64	0.21
Not in production							
737 Max8	3.94	4.19	-	-	**4.06**	3.92	0.15
A320neo	3.85	3.95	-	-	**3.9**	4.1	-0.2
A321neo	3.72	3.74	-	-	**3.73**	3.9	-0.17
737 Max9	3.63	3.72	-	-	**3.67**	3.25	0.42
737 Max7	3.09	3.26	-	-	**3.17**	3.1	0.07
A319neo	2.83	2.81	-	-	**2.82**	3	-0.18
CS300	2.43	2.3	-	-	**2.36**	3	-0.64
CS100	2.33	2.25	-	-	**2.29**	2.58	-0.3

Source: Airfinance Journal *research.*

“We currently see better risk/return trade-off on twin-aisle aircraft”

Hani Kuzbari, vice-president, Novus Aviation Capital

Narrowbodies: Popularity by aircraft type



Narrowbodies – size matters
The size of narrowbody jets is inextricably linked to their popularity. The larger models of the A320 and 737 family attained much higher results than the smallest variants, the 737-600 and the A318. The reason for the unpopularity of these assets is largely economic; the low number of seats makes them more comparable to regional jets, which are cheaper to buy and to operate.

The ubiquitous popularity of the A320 and 737-800s stems from their ideal seat numbers to suit passenger demand on routine short haul flights. The A321 and 737-900ER are more attractive to airlines seeking to fit capacity on busier short haul flights – generally between large cities or to tourist destinations.

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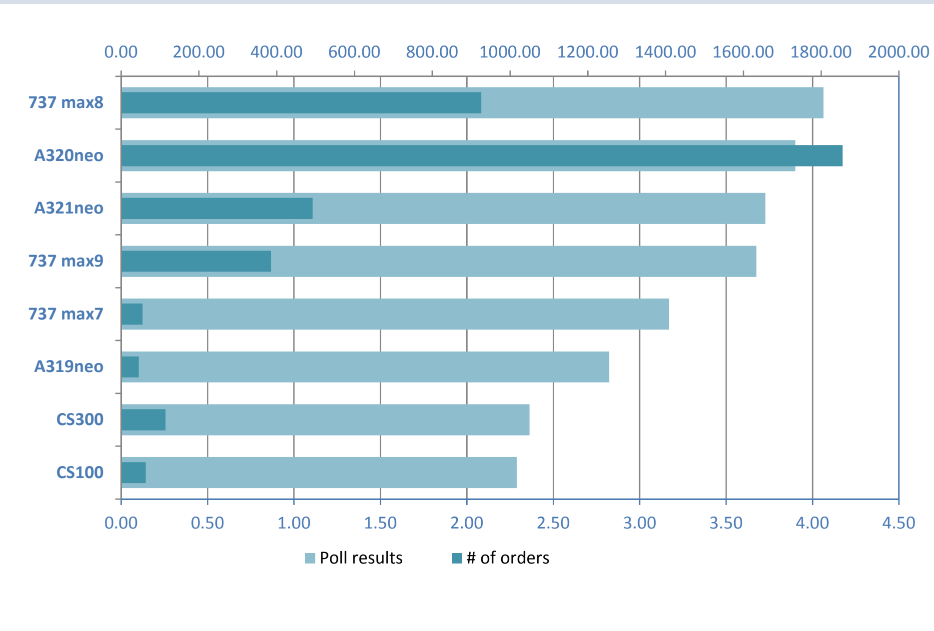
Narrowbodies (not in production)
Although orders for the A320 neo are still outpacing the Max by far, the popularity of the new 737 max has overtaken the neo this year. In fact, the popularity of the Neo has dipped slightly, relative to the number of orders it has secured, possibly suggesting a future slowdown in new commitments.

While the neo is still far ahead in terms of numbers of orders, Boeing’s Max does seem to be catching up, and will be further boosted by recent commitments for 200 of the jets out of China.

Aside from the 737max8 and A320 neo, levels in market confidence for other max and neo family aircraft, and Bombardier’s CSeries are significantly higher compared to the quantity of orders secured – perhaps indicating an approaching rise in commitments for these assets.

Narrowbodies: Popularity vs. orders



INVESTORS' AND OPERATORS' POLL 2013

Widebodies

Widebody league table

Model	Value for money	Remark. potential	Op success	Residual value	Overall	2012	DIF
In production							
777-300ER	4.09	4.06	4.53	4	**4.17**	4.57	-0.4
A330-300	3.58	3.38	3.81	3.33	**3.52**	3.89	-0.37
787-8	3.46	3.52	3.11	3.54	**3.41**	4.2	-0.79
777-200ER	3.51	3.17	3.55	3.26	**3.37**	3.45	-0.08
A330-200	3.29	3.12	3.76	2.92	**3.27**	3.33	-0.05
777-200LR	3.07	2.78	3.26	2.87	**2.99**	2.66	0.33
767-300ER	3.04	2.6	3.31	2.62	**2.89**	3.16	-0.26
A380	3.1	2.24	3.35	2.71	**2.85**	2.73	0.11
747-400	2.82	2.29	3.47	2.29	**2.72**	2.24	0.48
747-8	2.69	2.24	2.82	2.47	**2.56**	2.48	0.08
767-200ER	2.56	2.16	2.84	2.22	**2.44**	2.17	0.27
767-400ER	2.38	2	2.42	2.13	**2.23**	1.82	0.41
A340-600	2.2	1.8	2.14	1.86	**2**	1.91	0.09
A340-500	2.04	1.71	2.02	1.78	**1.89**	1.68	0.21
Not in production							
A350-900	3.85	3.83	-	-	**3.84**	3.19	0.64
787-9	3.7	3.83	-	-	**3.76**	4.65	-0.89
A350-1000	3.78	3.73	-	-	**3.75**	3.58	0.17
787-10	3.56	3.59	-	-	**3.57**	-	-
A350-800	3.29	3.29	-	-	**3.29**	3.19	0.1

Source: Airfinace Journal research.

Widebodies' popularity grows

The 777-300ER once again topped the tables for the widebody market, outstripping the competition by a sizable amount. The ubiquity of the asset among airlines across the globe makes it a tried-and-tested favourite of the investor community year after year.

Although narrowbodies, given the broad operator base, may often provide a more simple investment option for lessors, the potential return on widebody assets is attracting increasing numbers of firms.

"We currently see better risk/return trade-off on twin-aisle aircraft," says Novus Aviation Capital's executive vice-president, Hani Kuzbari. "But competition is being more intense on that segment of the market versus 18 to 24 months ago," he adds.

The A350-900 has enjoyed a boost in popularity since 2012, particularly compared with the 787-9, which saw an unsurprising slump in market confidence. Despite this, the 787 and A350 are the preferred options of many in the industry. Smaller than the A380, with a wider potential customer base, these aircraft combine new technology and fuel-saving options with impressive long-haul capacities.

Avolon also expects to increase the proportion of widebodies represented in its portfolio, according to its head of strategy, Dick Forsberg.

It has been a difficult year for the Dreamliner. In January the Federal Aviation Administration (FAA), the US aviation regulator, pulled the worldwide Boeing 787 fleet out of service after a number of battery-related problems.

While the aircraft have returned to the skies, Boeing will undoubtedly have to come to some sort of compensation agreement with the airlines affected. Despite these teething problems, the majority of the 787's investors and operators remain bullish on the aircraft's future.

"Frankly I think Airbus is lucky that Boeing is cutting their teeth on a lot of the technology issues and Airbus can learn from this before they release the A350 – they've already said they won't use the same batteries that Boeing was having problems with," says Moabery.

Despite market commentators' bullish attitude towards the long-term future of the Dreamliner, the survey results showed a significant dip in overall popularity of the asset compared with 2012. As a result, the asset slid to third place, overtak-

"The passenger wants the A380 – the question is how many airlines have routes that they know they can consistently fill that aircraft on?"

Aengur Kelly, CEO, AerCap

en by Airbus's ever-popular A330-300.

One size too big?

The A380 continues to struggle to secure widespread market support, and achieved a middling position in this year's poll, with overall popularity of just 2.85/5. Orders for the A380 have also fallen off this year, which is a big concern for Airbus.

In spite of overall market reticence, at this year's Paris Air Show Doric Lease Corp (DLC) committed to an order of 20 A380s, worth $8.1 billion at list prices. Doric and DLC, a new operating lease company, have been the only lessors to invest in the world's largest aircraft, after ILFC cancelled its A380 order in 2011.

"I was at a dinner in London with the CEO of a big bank – he had to go to the Far East the next day, and he was trying to change his flight to go on an A380. The passenger wants it – the question is how many airlines have routes that they know they can consistently fill that aircraft on?" asks Kelly. Most lessors see

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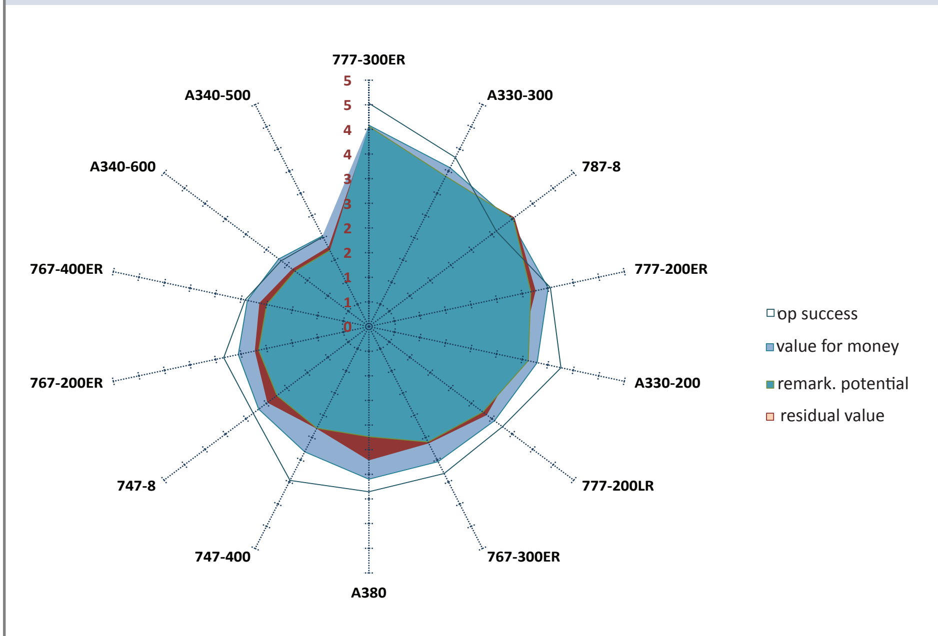
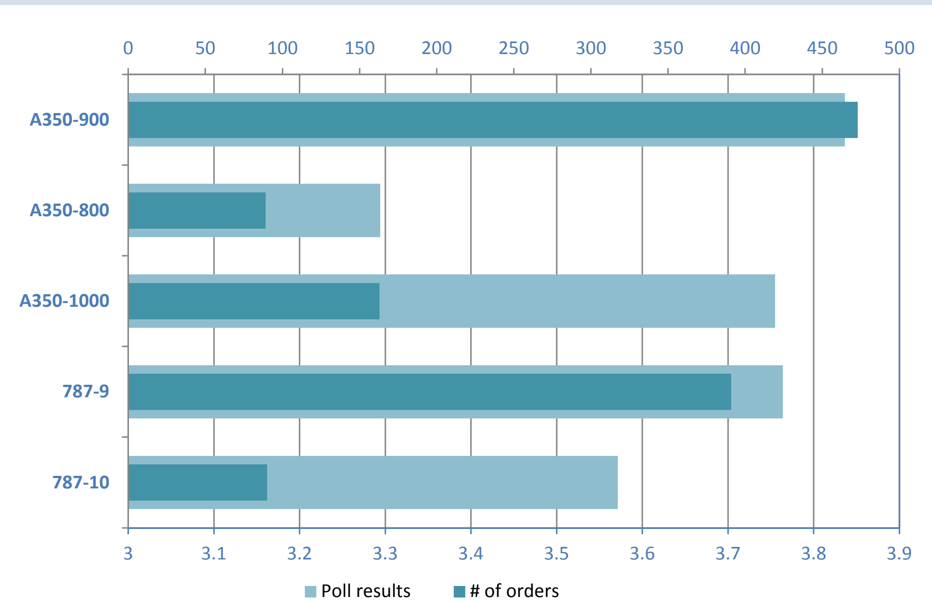
Widebodies: Popularity by aircraft type



Widebodies: Popularity vs. orders



Widebodies (not in production)

Airbus' A350-900 tops the poll for new technology widebody jets this year. Indeed, its notable market popularity significantly outstrips the other options, with the 787-9 trailing behind. Conversely, the A350-1000's popularity far exceeds a much smaller number of orders, suggesting that this asset may begin to ramp up orders where the -900 variant could start to lag.

Although Boeing's Dreamliner has had a problematic year, the industry continues to give the asset its vote of confidence. Both the new variants, the 787-9 and -10, secured impressive ratings for value for money and remarketing potential. The 787-10 was launched at this year's Paris Air Show in June, and has already attracted a noteworthy number of commitments.

INVESTORS' AND OPERATORS' POLL 2013

Regional aircraft

the financial exposure of an A380 as too risky, given the perceived difficulty in refitting and moving such a large asset to a secondary lessee.

Despite problems attracting new investors, Airbus's existing customers are more than happy. Indeed, Emirates recently stated that it would be keen to take a stretched version of the A380.

Regional jets take off

Regional jets continue to be a niche asset class, but, for the right investor and operator, they can offer unparalleled economic appeal and efficiency.

ILFC placed a hefty order for 50 Embraer E2 jets at the Paris Air Show this year. Henri Courpron, the US-based lessor's chief executive officer, said that the comparative lack of customers for Bombardier's CSeries helped ILFC decide between the two regional jets. Embraer expects to have more than 1,500 current-generation jets flying by the time the E2 options begin delivering, with more than 65 existing airline customers worldwide.

Although Embraer's twin-engined E190 and 195 topped this year's poll, turboprop technology remains particularly attractive in today's high-fuel-cost environment. ATR's offering – the ATR 72-600 and -500 turboprops – followed closely behind in second and third positions. Both ATR and Bombardier are vying to establish turboprop assembly lines in Russia – hoping to capitalize on the short-haul domestic routes across that vast country.

Russian lessor Ilyushin Finance has stated that it hopes to break into the Middle East and African market by leasing Bombardier jets, and has already ordered 32 CS300s, plus 10 purchase options.

The cycle continues

Aircraft are being traded every day. Some people may be losing money on them; others are making money. But as long as an asset is still flying, there will be a home for it. If a lessor cannot secure sufficient lease rates, it may be parted out early, but once interest rates begin to shift upwards, so too will lease rates and residual values.

The past 12 months have seen a gradual recovery in market values, even for older-vintage examples. This trend is likely to continue, and may accelerate as the cycle recovery gathers momentum.

The rapid growth of low-cost carriers, particularly in emerging markets, will stimulate high demand for the new-technology narrowbody options, as well as the larger models.

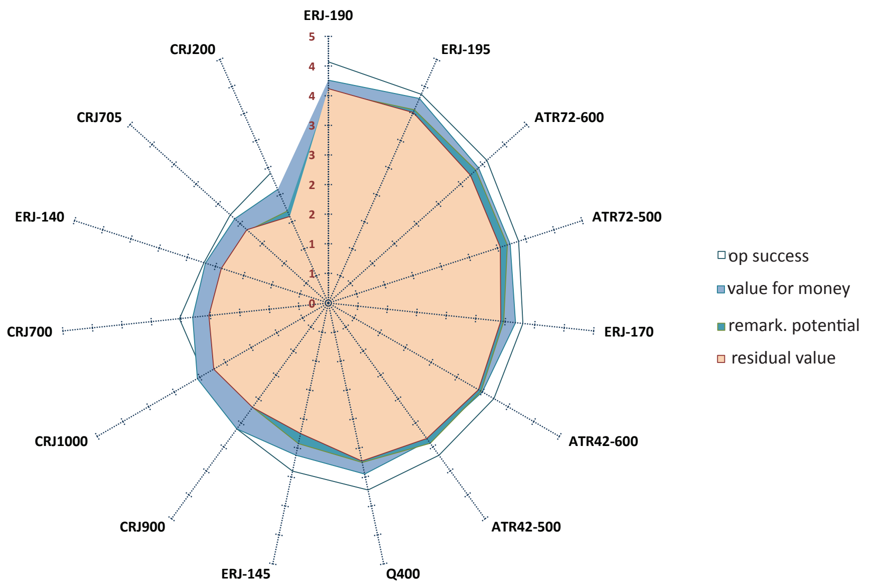
Regional jet league table

Model	Value for money	Remark. potential	Op success	Residual value	Overall	2012	DIF
In production							
E190	3.76	3.57	4.07	3.62	**3.76**	4	-0.24
E195	3.78	3.57	3.86	3.52	**3.68**	1.65	2.04
ATR72-600	3.41	3.35	3.6	3.23	**3.4**	4	-0.6
ATR72-500	3.23	3.18	3.38	3.05	**3.21**	3.5	-0.29
E170	3.18	2.98	3.3	2.93	**3.09**	3.5	-0.4
ATR42-600	3	2.97	3.23	2.93	**3.03**	3	0.03
ATR42-500	2.88	2.93	3.18	2.83	**2.95**	2.73	0.22
Q400	2.95	2.75	3.23	2.73	**2.91**	1.52	1.39
ERJ-145	2.63	2.43	2.9	2.25	**2.55**	3	-0.45
CRJ900	2.63	2.18	2.63	2.18	**2.4**	1.52	0.88
CRJ1000	2.55	2.1	2.43	2.23	**2.33**	1.65	0.68
CRJ700	2.3	1.93	2.53	2.03	**2.19**	2.25	-0.06
ERJ-140	2.18	1.82	2.21	1.9	**2.03**	1.8	0.23
CRJ705	2.13	1.83	2.23	1.85	**2.01**	2.61	-0.6
CRJ200					2.1 1.7	2.4	1.6
Not in production							
E195-E2	4.08	4.12	-	-	**4.1**	3.31	0.79
E190-E2	4.04	4.08	-	-	**4.06**	3.46	0.6
E175-E2	3.72	3.76	-	-	**3.74**	3.31	0.43

Source: Airfinace

"Turboprop technology remains particularly attractive in today's high fuel cost environment"

Regional jets: Popularity by aircraft type



A growing appetite for the newest, most fuel-efficient jets, will, inevitably, begin increasingly to impact on the existing generation of A320 and 737 families.

Although the older models are likely to weather the introduction of the Max and Neo with little-to-no impairment, current engine jets that are manufactured closer to the first delivery dates of the Max and Neo may begin to suffer from a compression in the lease rates they are able to secure, and the residual values may sink.

An aircraft can fly for a quarter of a century and beyond. The question for today's investors and operators is, given the purchase price of the asset, is it more profitable to continue leasing an older asset or to recover costs by parting out?

Overall, investor appetite remains fairly stable. New technology is increasingly impacting on older asset models, but the good news for lessors is that lease rates, especially for the A320, are rising. In addition, airlines are increasingly demanding longer lease terms – in keeping with the growing global demand for aviation.

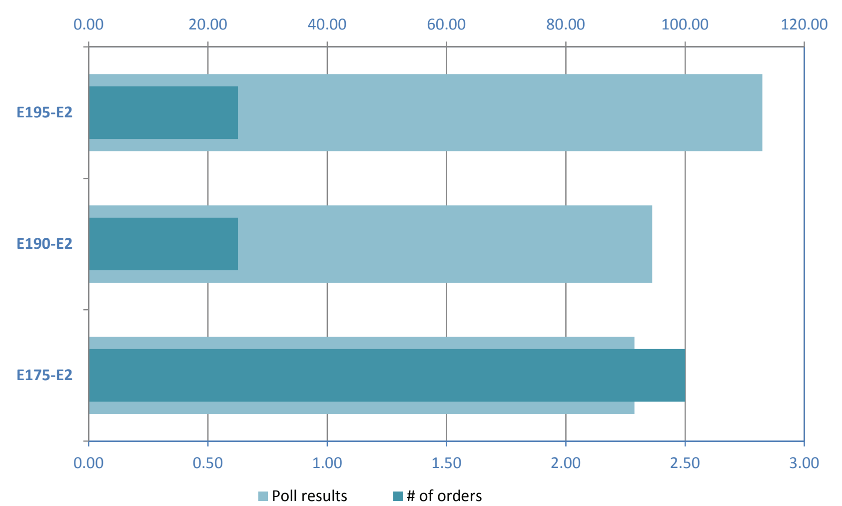
Regional jets (not in production)

Embraer's new second generation E-Jets secured relatively high levels of market confidence, The smallest option, the E175-E2, has secured the highest number of orders, with commitments for 100 from carrier SkyWest made at this year's Paris Air Show. SkyWest also ordered up to 200 current generation E175s earlier this year.

The E175-family has an advantage of sitting in a relatively underserved market sector - Mitsubishi's MRJ70 is the only other new technology aircraft this smaller size category

The E195-E2 will accommodate up to 132 seats, moving the jet closer size-wise to the A319ceo/A319neo and 737-700/737 Max7. ILFC has committed to take 25 of each of the E195-E2 and E190-E2 jets.

Regional jets: Popularity vs. orders



SPONSORED EDITORIAL

New generation engines values and costs

Lionel Maisonneuve, technical support services manager, TES Aviation Support, looks at the likely trends in values and maintenance costs of the engines that will power the next generation of single-aisle aircraft.

This year is set to see significant milestones for the new generation of engines powering narrowbody aircraft. CFM's Leap engine should start flight-testing during 2014 and Pratt & Whitney's (P&W) PW1000G geared turbofan is expected to enter into service. Both engines will power multiple aircraft types, including the Bombardier CSeries (PW1500G), Airbus A320neos (Leap 1A and PW1100G-JM), Boeing 737 Maxs (Leap 1B), Mitsubishi Regional Jets (PW1200G), the Comac C919 (Leap 1C), Irkut's MS-21 (PW1400G) and Embraer's E2 Jet family (PW1700G and PW1900G).

The two original equipment manufacturers (OEMs) – CFM and Pratt & Whitney – claim that their new products will bring significant improvements compared with the current generation of engines. Those improvements are expected to reduce fuel burn, NOx emissions and noise levels. It is interesting to note that from a fuel burn and NOx emission point of view, both OEMs are claiming comparable improvements.

However, things look a little different from a maintenance cost perspective. According to the latest information available, the Leap engine should have maintenance costs comparable to today's industry-leading CFM56 engines (ie, CFM56-5B and CFM56-7B), while the PW1000G is targeting lower maintenance costs than the V2500-A5 (up to 20% reduction).

To assess the expected maintenance costs of the new engines it is helpful to compare them with the current generation of engines and to look at the major technical improvements these engines will bring. The A320 current engine option (ceo) is powered by the CFM56-5B or the V2500-A5, while the 737 NG is exclusively powered by the CFM56-7B.

Starting with the fan

Both engines will have a lower number of fan blades (18) compared with current engine types. The PW1000G will feature bimetallic fan blades, while the Leap will introduce 3D woven carbon fibre composite blades. Thanks to the lighter fan blades on the Leap engine, CFM estimates a weight saving of 50% compared with the standard CFM56-7B parts. This also translates into additional weight savings on the fan disk and fan case (lighter containment structure). However, the manufacturing costs of such advanced fan blades are likely to be higher than traditional components, and the cost of ownership and the repairability needs to be evaluated. Both engines will feature a composite fan case.

The PW1000G uses a geared architecture allowing the fan to rotate at a lower speed than the low-pressure system while keeping the core rotating at high speed. By comparison the Leap engine uses a more conventional direct-drive configuration. The benefit of one configuration over the other is yet to be measured in real life operation.

The gearbox enables P&W to reduce the number of stages especially in the low-pressure turbine

	A320ceo	A320neo	A320ceo	A320neo	737 NG	737 Max
Engine	CFM56-5B	Leap 1A	V2500-A5	PW1100G-JM	CFM56-7B	Leap 1B
Thrust	21.6k-33k	24.5k-32.9k	23.5k-33k	24k-33k	19.5k-27.3k	23k-28k
Bypass ratio	5.4-6.0	about 11	4.5-4.9	about 12	5.1-5.5	about 9
Fan diameter (inches)	68.3	78.7	63.5	81.0	61.0	68.4
Fan blades	36	18	22	18	24	18
Reduction gearbox	-	-	-	1	-	–
LPC stages	4	3	4	3	3	3
HPC stages	9	10	10	8	9	10
HPT stages	1	2	2	2	1	2
LPT stages	4	7	5	3	4	5
Entry into service	1994	2016	1995	2015	1998	2017
Ordered	6,800 +	1,600 +	6,000 +	1,600 +	13,000 +	3,300 +
Delivered	5,978	-	5,040	-	9,955	-

> "Most of the revenue for the OEMs comes from the parts sold when engines undergo shop visits."

(LPT) section (three stages compared with seven for the Leap). According to P&W, the gearbox does not contain any life-limited parts and, providing the reliability achieves expected standards, there should not be significant maintenance costs relating to the gearbox.

Both engines will use a blisk (or integrally bladed rotor) configuration in the high-pressure compressor (HPC) – stages one to five for the Leap. Both engines have been designed to reduce debris ingestion into the core. The blisk architecture is a proven technology because it already features in the CF34, PW6000 and GEnx engines.

The combustion sections of both engines will utilize the latest technologies to minimize fuel burn and reduce emissions. Durability and repairability of these com bustors is yet to be proven.

Two for one

Both engines have a two-stage high-pressure turbine (HPT), which use the latest coating and cooling technologies. The two-stage configuration represents a change for CFM as a single-stage HPT distinguished the CFM56 from the V2500. No doubt this will have a significant impact on the shop visit costs because two sets of HPT blades will always be more expensive to repair or replace than one set in a typical time and material (T&M) engine shop visit. The Leap will also introduce HPT stage one shrouds made of ceramic matrix composite to improve efficiency.

The main difference in the LPT section is the number of stages in each engine type (PW1000G has only three stages, while the Leap has seven). Therefore, the number of airfoils will be significantly higher in the Leap. Based on the durability of the LPT section and the workscoping philosophy, this again could have a significant impact on the maintenance costs in a normal T&M shop visit.

This is a theoretical assessment and the commercial proposals offered to airlines will certainly ensure the operational costs and durability match those of the previous generation of engines. This is expected to be achieved through power-by-the-hour-type proposals.

The exact number of life-limited parts (LLPs) and their respective limits are unknown because the engines are yet to be certified. However, it is expected that original equipment manufacturers (OEMs) will provide guarantees to at least match the limits, in terms of LLP profile, of the previous technology engines such as the CFM56-5B, CFM56-7B and V2500-A5.

More shops required

Aside from the specific maintenance costs linked to the architecture of each engine, the shop visit costs will depend on the willingness of the OEMs to authorize third-party maintenance, repair and overhauls (MROs) and vendors to maintain and repair their products. Since a lot of new technology and exotic materials will be introduced in these engines, they will require highly specialized repairs usually controlled or performed by the OEMs. A wider base of independent maintenance repair and overhaul facilities and vendors allows greater competition, and thus helps to drive the maintenance costs down. Historically, CFM and P&W have not restricted the engine MRO market. There are many independent MROs, as well as independent piece parts repair vendors, capable of maintaining the CFM56 and P&W engines and components.

The size of the fleet can also play an important role in maintenance costs. It can be reasonably expected that the Leap and PW1000G fleets will eventually reach a similar size to the current CFM56-5B, CFM56-7B and V2500-A5 fleets. As a result, the OEM's shops, based on their current capacity, could not maintain such a high number of engines and the resultant shop visits (400-plus a year for the CFM56-5B and 700-plus for the CFM56-7B). This is a business decision that needs to be made by the OEMs on whether the fleet of engines will be maintained in-house or through joint ventures or third-party (independent) MROs.

Contract choice

Since these engines have not entered service and there is no in-service experience on which to base decisions, airline customers are mainly choosing power-by-the hour-type maintenance contracts to alleviate any technical and financial risk. Once these products mature, then T&M contracts can become more cost effective, provided there is a competitive market for repairs. This, of course, depends on the ability of the customer to manage properly the engine shop visits and thus control the costs.

Another aspect impacting the maintenance costs of such engines will be their time on wing. If they perform as expected or better then the cost per flight hour can be significantly reduced. However, if they face entry-into-service issues this could have considerable impact on the operating costs.

Customers that choose competitive power-by-the hour contracts will be initially protected against such technical, operational and financial risk; however, those contracts are only valid for a limited period and for a specific operator and type of operation.

Transition to another operator or type of operation means operational assumptions will be different and commercial terms of power-by-the-hour contracts will be different too.

From a lessor's point of view, the details and restrictions on such contracts can have an impact on the transitioning between operators. Great consideration must be given to items such as engine condition at the end of the contract and the possibility to transfer the contract and its maintenance and LLP reserves funds to another operator, which might have different monthly utilization, flight hour/cycle ratio, operating environment or thrust-rating requirements.

Another point to consider is the ability to supply used serviceable material into the engines once they have become mature products. Most of the revenue for the OEMs comes from the parts sold when engines undergo shop visits. By tying customers in with power-by-the-hour contracts and preventing independent MROs entering the market, the OEMs can maintain control of what material is fitted to the engines during shop visits and thus maintain a constant demand for new parts, which is a critical part of an engine OEM business model.

If independent MROs and piece-parts repair vendors have not been allowed to enter such a market, there will be no real open market for used serviceable material.

In turn this means there will be less trading activity because of a lack of confidence in the residual value of those engines. Only engines with enough green time (remaining life) will be valuable – for short-term lease, for example – and there will be little or no part-out trading activity. As a result, the residual value at the end of life of the engines will be greatly affected.

On the other hand, if independent MROs are allowed to maintain the engines, usually under T&M contracts, then the spare parts market will be much more active. Again, this will help drive shop visit costs down and will generate a more dynamic market for end-of-life assets.

At this stage it is still too early to forecast precisely the value trend for the new generation of engines or to forecast their maintenance costs in a traditional time and material approach. It is clear that the strategy chosen by the OEMs in terms of access to the shop visit market by independent MROs, and the ability to repair parts and supply used service material, at a later stage, will dictate the maintenance costs and value of the new generation of engines.

Engine market stabilizes after oversupply

Airfinance Journal's 2013 engine poll finds a market gradually balancing out after a period of overproduction. Insiders, however, remain cautious about difficult-to-finance mid-life engines, reports Yana Palagacheva.

The engine market saw an increased number of shop visits in 2013. Overall the market has remained healthy, with a growing demand for spares. Insiders note that a few programmes have bounced back after a slowdown, a result of overproduction from some of the engine manufacturers.

The CFM56-7B and -5B are generating more shop visits and an increased overhaul surge. Insiders state growing interest in the CF6-80 and slowly increasing activity for the VS2500-A5. Demand for the IAE engine, however, is still very soft and a number of -A5s have not been placed yet. The CFM56-3C is also suffering mainly because of increased delivery of new aircraft to replace the 737 classics.

Overall, however, the general feeling is that if well-managed, aircraft engines are providing good yields and attractive returns for investors.

The steadiness of the market can be seen in the 2013 poll. The CFM56-7B remains on top for investor appeal, remarketing potential and residual value. The CFM56-5B has maintained second place and its popularity is gradually growing – in 2013 it received six points out of seven on remarketing potential, compared with 5.6 the year before.

Despite the general stability of the market, difficult financing on mid-life engines and the uncertainty around the financing of next-generation aircraft are some of the issues causing headaches for investors.

Balancing the market

Financiers and engine lessors state there is enough spare engine demand but because of overproduction by some of the original equipment manufacturers (OEMs) the market has had a period of supply exceeding demand. Insiders say this is a consequence of several manufacturers increasing their engine supply to keep up with the rise in production of new aircraft.

The problem has been exacerbated for lessors by the longer-than-expected wing time of both CFM and IAE engines. This has delayed the expected shop visits that would have increased spare demand.

The problem is most visible for the VS2500-A5. The market for this engine is very soft, and there are still a number of spares that have not been placed. There is a high ratio of spare engines to installed engines – 12% for the -A5 compared with 7% for the -7B.

Most lessors still have a number of -A5s off-lease, but insiders say they have had some more activity in the past couple of months.

Separately, the -7B and -5B programmes have continued to improve. These types have had a growing number of shop visits and a bigger leasing demand on spares.

According to Dan Coulcher, managing director, Willis Mitsui & Co, the market is bouncing back, especially on the -7Bs and -5Bs.

"On both of those programmes the visits are increasing, the MROs [maintenance, repair and overhaul companies] are telling us they are increasing and the airlines are saying they are expecting even more shop visits [in 2014] – that is actually starting to happen," he says.

Lothar Ratei, partner, GSI Fonds, agrees, saying that oversupply on certain engine types is still on the table, but the market is gradually moving towards a more balanced position.

"It is a very slow process. We had the first signs at the end of last year, but then we had again very weak months in demand in the market where a lot of the competition was quite tight," says Ratei. "But now I see light at the end of the tunnel with regards to the lease demand; trading should also increase more [in 2014]."

Financing

Secondary trading of mid-life engines between eight and 15 years of age is still fairly difficult to finance without a guaranteed income stream. One reason is that current narrowbody programmes are nearing their last few years of in-production engines before the Neo and Max enter service. The last V2500s and CFM56s produced will face challenging residual values, and lessors state they will not pay list price for these engines. There is plenty of activity, however, in the trading of older technology engines (12 to 24 years old), which are financed from equity for short-term leasing and disassembly. The residual value of these would more or less equal their purchase price, hence minimizing

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“Now I see light at the end of the tunnel with regards to the lease demand; trading should also increase more [in 2014].”

Lothar Ratei, partner, GSI Funds.

the exposure.

Financing on new spare engines also does not tend to be a big issue because it is usually negotiated as part of the initial aircraft transaction.

Bill Cumberlidge, executive director, KV Aviation, explains that the pressure put on manufacturers to finance the spare engines on the initial aircraft purchase or lease makes not being able to secure financing on new engines almost impossible.

“The new engines – they take care of themselves, don’t worry about the new engines,” says Cumberlidge. “The manufacturer and the airline will always find a way for a new engine to be financed, whether it is through ECA [export credit agency] guarantees or other structures.”

He stresses that one of the biggest issues is making sure there is enough financing in the secondary market.

In terms of players, the market is still quite concentrated and has not had any new lessors entering in 2013. The Japanese banks, however, are more actively investing in the industry, and there is an expectation that they will soon begin to diversify. At the moment Japanese banks are getting involved in bond structures, but are still not providing much direct financing in the operating business.

Ratei says: “The new banks entering the market are looking for a certain quality of assets, especially with engines, which are much more difficult to manage than aircraft. But even though it is hard to get in the market, I would not say there is a problem with engine financing.”

Next generation

Financing orders on next-generation widebodies such as the Boeing 787 and Airbus A350, as well as the Neo and the Max, can also become an issue for the engine market. The huge number of orders on those aircraft may put the market in a volatile position.

There is a substantial backlog of new orders for aircraft such as the A350 and 787. The price for spare engines for those widebodies is about $32 million.

Such sums, and the large orders for widebodies, mean that often it is the engine manufacturers which have to financing these engines.

Engines are generally seen as a very liquid asset that maintains its residual value over time much better than aircraft. However, insiders fear airlines and leasing companies might struggle to secure the financing of engines for some of the next-generation aircraft, especially at an early stage in their economic life.

Cumberlidge says: “It is fine to say that the A350 and 787 will be very financeable, especially during their initial period of operation. But with the absence of the proverbial crystal ball we do not know what the industry will be like in 10 years’ time. But airlines and lessors are ordering aircraft and in some circumstances well into the late teens and in some circumstances for after 2020.”

He asks: “How will you finance the engine for such an aircraft that far out if you don’t know whether the airline that ordered it will be in the market in 10 years?”

Manufacturers’ maintenance monopoly

The engine market used to be managed 30% by the manufacturers, with the other 70% divided between independent overhaul facilities, engine lessors and engine traders. Now about 80% of the engines are managed by the manufacturer, and the number is expected to grow.

The growing influence of the so-called fleet-hour arrangements (FHAs) or the power-by-the-hour programmes is one of the biggest issues for engine lessors. Under FHAs the airlines are paying the manufacturer for maintenance. This poses a problem for the lessors as they lose control of their traditional maintenance reserves.

Airlines benefit from FHAs because they do not have to worry about maintenance as the manufacturer is doing it technically. The programmes offer the same insurance to the lessors. If a default or change of lessee occurs during the term, the lessors do not have to pay for the next engine.

For lessors, however, the disadvantages are much more than the advantages, because the FHA takes away their flexibility when deciding whether to overhaul, sell or part out an engine at the end of its lease.

According to Willis Mitsui & Co’s Coulcher, manufacturers should have closer discussions with lessors regarding FHAs, and focus on cash options and transferability.

Insiders noted a growing demand for spare engines in 2013.

“I don’t think the manufacturers appreciate that the lessors are the ones actually financing and purchasing the aircraft or engine, so the airlines want to make sure that their lessors are being supported as well because otherwise the airlines can’t buy the product,” says Coulcher, adding that half of the modern narrowbody fleet is aleady owned by leasing companies.

KV Aviation’s Cumberlidge points out that FHAs increase the cost of ownership of an engine because they do not give airlines and lessors the option of putting their engines into third-party maintenance and repair organizations, which usually works out cheaper than the manufacturer.

“In this regards the industry was always well balanced by the amount of third-party facilities that was out there – third party gives you an option, flexibility, price comparisons. It allows the smaller firms a benchmark service provider, which on new large fan engines is the manufacturer,” says Cumberlidge.

Fleet-hour arrangements and lack of financing in the secondary market are keeping insiders wary. The industry is also cautious about how it will finance next-generation aircraft engines. However, those seem to be blips in what has been a good year for the engine market.

ENGINE SURVEY

Aircraft Engine Values

INVESTOR APPEAL	
Engine Type	Score (out of 7)
CFM56-7B (737NG)	6.37
CFM56-5B (A320)	5.75
GE90 (777)	4.68
TRENT 700 (A330)	4.25
VS2500-A5 (A320)	4.12
PW4000 (747-400s, 767s, 777s)	3.87
CF6-80 (747-400s, 767s)	3.75
TRENT 800 (777)	3.42
GP7200 (A380)	3.14
TRENT 900 (A380)	2.71
CFM56-5A (A320)	2.37
PW2000 (757)	2.37
RB211-535 (757)	2.37
CFM56-3C (737CL)	2.25
CFM56-5C (A340)	2.25
VS2500-A1 (A320)	1.87
TRENT 556 (A340-500)	1.5
TRENT 553 (A340-500)	1.5
PW6000 (A318)	1.37
RB211-524 (767, 747-300, -400)	1.12
RB211-524 (767, 747-300, -400)	1.12
CFM56-2 (DC-8-70s)	1
CF6-50 (747-200, -300)	1
CF6-6 (DC10)	0.87
CF6-45 (747-100/S)	0.87
JT8D (727s)	0.87
JT9D (747s, 767-200)	0.87

REMARKETING POTENTIAL	
Engine Type	Score (out of 7)
CFM56-7B (737NG)	6.37
CFM56-5B (A320)	6
GE90 (777)	4.31
PW4000 (747-400s, 767s, 777s)	3.75
CF6-80 (747-400s, 767s)	3.62
TRENT 700 (A330)	3.62
VS2500-A5 (A320)	3.37
TRENT 800 (777)	3
PW2000 (757)	2.62
GP7200 (A380)	2.42
CFM56-3C (737CL)	2.37
RB211-535 (757)	2.37
CFM56-5C (A340)	2.12
CFM56-5A (A320)	2
TRENT 900 (A380)	2
VS2500-A1 (A320)	1.87
PW6000 (A318)	1.5
TRENT 556 (A340-500)	1.37
TRENT 553 (A340-500)	1.37
RB211-524 (767, 747-300, -400)	1.25
RB211-524 (767, 747-300, -400)	1.25
CFM56-2 (DC-8-70s)	1
CF6-50 (747-200, -300)	1
CF6-6 (DC10)	0.87
CF6-45 (747-100/S)	0.87
JT8D (727s)	0.87
JT9D (747s, 767-200)	0.87

RESIDUAL VALUE	
Engine Type	Score (out of 7)
CFM56-7B (737NG)	6.37
CFM56-5B (A320)	5.62
GE90 (777)	4.56
TRENT 700 (A330)	4.37
CF6-80 (747-400s, 767s)	3.62
VS2500-A5 (A320)	3.62
PW4000 (747-400s, 767s, 777s)	3.62
TRENT 800 (777)	3.28
GP7200 (A380)	2.71
TRENT 900 (A380)	2.57
PW2000 (757)	2.37
CFM56-5C (A340)	2.25
CFM56-5A (A320)	2
RB211-535 (757)	2
CFM56-3C (737CL)	1.87
PW6000 (A318)	1.87
VS2500-A1 (A320)	1.75
TRENT 556 (A340-500)	1.28
TRENT 553 (A340-500)	1.28
RB211-524 (767, 747-300, -400)	1.12
RB211-524 (767, 747-300, -400)	1.12
CFM56-2 (DC-8-70s)	1
CF6-50 (747-200, -300)	1
CF6-6 (DC10)	0.87
CF6-45 (747-100/S)	0.87
JT8D (727s)	0.87
JT9D (747s, 767-200)	0.87

REGIONAL AIRCRAFT

Increasing competition in regional market

Embraer's launching of the second generation of its E-Jet family and Bombardier's progress with its CSeries are the latest steps in the battle for regional aircraft orders.

The E195-E2 has been stretched by three seat rows

Embraer's launch of the second generation of its E-Jet family of commercial aircraft, the E-Jet E2, has shaken up the competition in the small single-aisle aircraft market. The family comprises three aircraft types: E175-E2, E190-E2 and E195-E2. The manufacturer expects the E190-E2 to enter service in the first half of 2018. The E195-E2 is to follow in 2019 and the E175-E2 in 2020. Embraer forecasts a market of 6,400 aircraft over the next 20 years in the size category of its new family.

As well as introducing a number of major technology advances, the Brazilian manufacturer has taken the opportunity of rationalizing the size range of the E-Jet family. The middle-of-the-range E190 is the only model to retain the same passenger capacity. The larger E195 has been stretched by three seat rows, increasing capacity by 12 passengers. The E175 has been stretched by a single seat row and is the smallest aircraft in the second-generation family, because the E170 does not figure in Embraer's plans.

The dropping of the smallest model in the current family is unsurprising given that many people in the industry have queried the wisdom of producing two aircraft (the E170 and E175) so close together in size. There is now a more uniform step (about 20%) in capacity between each of the E2 models. This is a more logical progression than in the current family, although the increment is still smaller in percentage terms than between models in the Boeing and Airbus families.

In a typical single-class layout the E175-E2 will seat up to 88 passengers, while the E190-E2 keeps the same size as the E190, of up to 106 seats. The E195-E2 will accommodate up to 132 seats. This increase moves the aircraft closer in size to the A319ceo/A319neo and 737-700/737 Max7, which have maximum capacities of 145 and 149 seats, respectively. This market segment is becoming increasingly crowded (see table).

E-Jet E2 family and competitors in development

Model	Embraer E175-E2	Mitsubishi MRJ90	Embraer E190-E2	Bombardier CS100	Embraer E195-E2	Airbus A319neo	Boeing 737-7 Max	Bombardier CS300
Maximum seats	88	92	106	125	132	145	149	150*
Typical seats	80	83	97	108	118	124	126	130
Target entry into service	2020	2015/2016	2018	2014	2019	2016 (A320)	2017 (737-8)	2014
List price ($m)	47	42**	54	67**	60	92	82	76**

*160-seat version available in very high-density configuration. ***Airfinance Journal* calculation based on press releases.
Source: manufacturers' presentations/*Airfinance Journal* research

The E2 family is less directly in competition with the major manufacturers than the Bombardier CSeries.

However, the E2 family is less directly in competition with the major manufacturers than the Bombardier CSeries. Embraer has previously stated its belief that the smaller E175 would be a major beneficiary from the restructuring of the US airline industry and, in particular, the diminishing impact of the pilot scope clauses that limit the number of regional aircraft that the major US carriers can operate. The retention of the aircraft in the second-generation family is therefore not surprising.

One analyst commented to *Airfinance Journal* that the availability of a smaller model in the family could be a key advantage over Bombardier's CSeries in attracting new airline customers in developing markets. The E175 also has the advantage of being in a relatively uncrowded market sector.

Mitsubishi's MRJ70 is the only other new-technology aircraft in the size category, but the manufacturer has not announced a firm date for its entry into service, preferring to concentrate on the larger MRJ90. The larger Japanese aircraft has a head start over the E190-E2, but its planned entry-into-service date has been slipping, and its customer base remains limited.

Market base

Embraer's market position is one of the strengths of its new-generation aircraft. The Brazilian manufacturer says there are more than 950 of the current E-Jet family in service, with a customer base of more than 65 airlines. Cumulative orders are in excess of 1,200 aircraft.

The E2 family has a substantial number of launch commitments. US airline Skywest has ordered 100 E175-E2s, with purchase rights for 100 more. US lessor International Lease Finance Corporation has signed a letter of intent (LoI) for 25 E190-E2s and 25 E195-E2s . The LoI also includes options for an additional 50 aircraft. In addition, the manufacturer says it has signed letters of intent for a total of 65 aircraft with five undisclosed airlines from Africa, Asia, Europe and Latin America.

Commenting on the new family, Embraer's chief commercial officer, John Slattery, says: "Our focus is on serving our customers' growing needs in the 70- to 130-seat category; both today with the E1 [current-generation family] and seamlessly into the future with the E2 [family]. We continue to add new airlines operating E-Jets, and increasingly you'll see airlines order both E1s and E2s together before entry into service of the E2 in the first semester of 2018. Cockpit commonality between the E1 and E2 is one of our keys to success."

Adam Pilarski, senior vice-president, Avitas, says: "Embraer were much more successful [in obtaining launch orders] than most knowledgeable industry observers had expected. The US launch customers, particularly, were a surprise."

New technology

In common with the Mitsubishi aircraft, some variants of the A320neo family and the CSeries range, the E2 family will be powered by versions of Pratt & Whitney's PurePower geared turbofan (GTF) engine, which will provide the majority of the fuel savings.

One industry source thinks Embraer's switch from General Electric to the Pratt & Whitney engine is significant and may indicate that the CFM Leap-X technology does not provide the same benefits as the GTF engine in the thrust class required for the

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BOMBARDIER'S CSERIES COMPLETES FIRST FLIGHT

The first flight of Bombardier's CSeries took place in 2013, marking a major milestone in the aircraft's development programme. The maiden flight started the flight-test programme that will lead up to certification and delivery of the CSeries to the first customer, which is scheduled for 2014. The occasion was also the first flight for Pratt & Whitney's new, geared turbofan PurePower engine as part of an aircraft certification programme.

At the time of the first flight, Bombardier said the CSeries backlog of 177 firm orders met the company's internal expectations, but its chief executive, Pierre Beaudoin, suggested completing the first flight milestone could spur orders from potential customers who are still undecided about buying the aircraft. By the end of 2013 there hd not been a surge of orders, with customers possibly waiting to see how the flight testing progresses. Bombardier is reportedly aiming to secure 300 firm orders from about 20 customers by the time the CS100 enters service.

The CSeries will be offered in two variants – the CS100 and CS300. The CS100 typically seats 110 passengers, while the CS300 is about 20 seats larger. In capacity terms, the CS100 sits between the Embraer E190 and E195. The CS300 is larger than the largest model in the second generation of the Brazilian manufacturer's regional jet family; however, the E195-E2 is likely to be a competitor in a number of sales campaigns.

The CS300 competes most directly with the 737-7 Max and the A319neo but, unlike the Boeing and Airbus aircraft, it is an all-new design rather than a re-engining of an existing airframe.

A total of five CSeries flight test aircraft, all of which are in various stages of assembly, will join the flight test programme.

In common with the Mitsubishi aircraft, some variants of the A320neo family and the CSeries range, the E2 family will be powered by versions of Pratt & Whitney's PurePower geared turbofan (GTF) engine

E-Jet family.

In any case, Embraer is keen to present the new family as more than just a re-engining, and there are significant technical changes to the airframe. The latest models boast a new more efficient high aspect-ratio wing with a raked wing-tip. Other technology changes include the use of latest-generation avionics and full fly-by-wire control systems. The aircraft also have a revamped interior.

Less fuel and maintenance

The new family will offer significant fuel savings over the previous generation of aircraft. The clearest indication of what Embraer is targeting can be seen in the E190-E2, which the manufacturer says will provide a saving of 16% in fuel for each seat [and by implication for each trip] over the same-sized E190. Savings are slightly lower in the smaller E175-E2, where a 16% saving is achieved for each seat, but this is in part thanks to the increase in aircraft size between the two generations.

The most dramatic improvement is in the E195-E2, where the combination of increased size and improved fuel efficiency provides a fuel saving of 23% for each seat over the previous-generation model. This saving is all the more impressive given that the current generation of E-Jets are already fuel-efficient aircraft on the short- to medium-haul routes for which they are optimized.

More controversially, the manufacturer claims that the new-generation aircraft will provide a 15% reduction in maintenance costs, which if realized would amount to a $1 million to $1.5 million saving for each aircraft over 10 years of operation. Maintenance costs are notoriously difficult to benchmark, but some industry figures are sceptical about the claim. One airline consultant told *Airfinance Journal* that it might be theoretically possible to achieve a 15% reduction on the airframe, but such savings would prove extremely challenging on the new-technology GTF engine, which some specialists believe is likely to prove more expensive to maintain because of the use of a fan gear. Purchasers may want to see some commercial guarantees on maintenance cost savings before giving the figures too much weight in their selection criteria.

Better economics

It is difficult to determine relative operating costs between the various new-technology aircraft. The claim and counter-claim by manufacturers makes for a confusing picture. Nonetheless, if Embraer gets close to its targets, it is clear that members of the E2 family will be formidable competitors.

FREIGHTERS

Difficult markets for new and converted freighters

A depressed airfreight market is making life difficult for manufacturers of purpose-built new freighters and conversions alike.

The underperformance of cargo versus passenger traffic has been evident in revenue trends for some time. In 2003 cargo accounted for just over 12% of airline industry revenues, according to International Civil Aviation Organization figures. This had fallen to just over 9% by 2012.

Recent news has been slightly more encouraging. In its latest report on the freight market, the International Air Transport Association (Iata) released figures showing a small improvement in air freight growth in October 2013. Compared to October 2012, global freight tonne kilometers (FTK) grew 4.0%, with growth in all regions except Africa. The gradual expansion continues a trend that began in the third quarter of 2013.

In its latest forecast Iata predicts international air freight volumes will grow 17% during 2013-2017.

Nonetheless, there is no doubt that the market is struggling to recover from recession, manifested particularly in the slow sales of new cargo aircraft *(see orders for new-build freighters in short supply,* Airfinance Journal, *October 2013, page 35)*. However, converted aircraft provide a lower capital cost option for freighter operators and offer owners and financiers an opportunity to extend the lives of assets that might otherwise be retired. In difficult times this should prove an attractive combination.

AEI plans to convert about eight MD-80SFs a year

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Airbus freighter requirement forecast 2013-2032

Freighter category (Airbus definition)	Payload (tonnes)	Example in-service aircraft	Demand for converted aircraft	Demand for new-build aircraft	Total demand
Small	10-30	727, 737	605	–	605
Medium	30-80	757, 767, A300	824	413	1,237
Large	80-plus	747, 777	430	458	888

Sample current market values for freighter conversion aircraft ($m)

Model/build year*	1985	1990	1995	2000	2005
747-400BDSF (IAI/Bedek)		26.7	31.8	40.4	53.8
747-400BCF (Boeing)		27.2	32.7	41.5	55
767-300BDSF (IAI/Bedek)		16.4	20.6	25.4	36.4
767-300BCF (Boeing)		16.7	20.9	25.6	36.3
767-200SF (IAI/Bedek)	8	8.6			
757-200SF (STAero)	7.1	9.5	12.4		
757-200PCF (Precision)	7.1	9.5	12.5	17.5	25
737-300F (Pemco)	4.5	5.5	6.7		
737-300SF (AEI)	4.9	5.9	7.1		
737-400F (Pemco)		5.5	7.1		
737-400SF (AEI)		6	7.7		
MD-80SF (AEI)	2.4	2.4			
A300F-600R (Eads)		10.8	14.2	18.7	24.7

Source: Morten Beyer & Agnew **Build years refer to original passenger aircraft.*

“Boeing models dominate the conversion market with 747s, 767s, 757s and 737s, as well as MD-80s, being offered by a variety of suppliers”

But the management of conversion programmes is challenging. Sourcing suitable passenger aircraft for modification can be as difficult as finding customers for the completed conversions. A trend to shorter economic lives for passenger aircraft, which some observers believe is inevitable, would increase the availability of good quality candidate aircraft for conversion. However, it will need owners and financiers to accept a reduction in book values of passenger aircraft before the full benefit is passed on to the conversion market.

As has been evident from the debate in the pages of Airfinance Journal, it is by no means clear that there is a consensus on the reduction of economic lives.

There is, however, a consensus among forecasters that there is significant demand for converted freight aircraft. Airbus’s latest Cargo Global Market (released on October 10) indicates that converted aircraft will continue to make up the bulk of the world’s cargo aircraft fleet. The manufacturer believes that 2,730 freighters will be required by the end of 2032, and estimates that close to 1,860 of these aircraft will be converted from passenger models.

The Airbus forecast suggests that, over the next two decades, 605 small freighters will be required, and all of these will be converted aircraft. In the medium-sized category Airbus predicts 1237 aircraft will be required, with more than two-thirds to be converted from passenger aircraft. For large freighters the split between new build and conversions is close to 50-50 with a total requirement of 888 aircraft.

Boeing models dominate the conversion market with 747s, 767s, 757s and 737s, as well as MD-80s, being offered by a variety of suppliers (see boxes). Boeing is directly involved in the market in the guise of its Boeing Converted Freighter (BCF) brand.

Despite Airbus’s forecast pointing to the importance of conversions, the availability of such aircraft based on the European manufacturer’s models is limited. The A300/A310 programmes of EFW (Eads’ maintenance, repair and overhaul and conversion arm) have been quiet and the A330-200P2F has yet to fill the gap.

The suspension in 2011 of the Airbus,

MARKET OUTLOOK – WIDEBODY FREIGHTER CONVERSIONS

David Tokoph of Morten Beyer and Agnew (MBA) gives the US appraisal company’s views on the leading twin-aisle conversion programmes.

747-400BCF (Boeing Converted Freighter)
The 747-400BCF is the passenger-to-freighter conversion of the 747-400 offered by Boeing under the BCF banner. To date 28 aircraft have been converted; however, demand for the conversion has slowed in recent months. The increased availability of factory freighters has caused softening for values of the type. Boeing’s recent licensing of the equivalent Bedek conversion is another factor that will contribute to soft values.

747-400BDSF (IAI/Bedek)
The 747-400BDSF is the conversion option offered by the Bedek division of Israel Aerospace Industries under a supplementary type certificate (STC). Although this conversion has a lower empty weight and therefore a higher payload than the BCF variant, it has recently encountered weight limitations, hampering the type’s marketability. The STC is being licensed by Boeing, which will make the aircraft more competitive. However, as for the BCF model, there is still likely to be a long-term decline in values.

767-300BCF (Boeing Converted Freighter)
The 767-300BCF is the conversion offered by Boeing of the 767-300ER. Although relatively few aircraft have been converted, values for the type are expected to stabilize as demand strengthens in line with the airfreight market. The aircraft has good mid-range freighter characteristics, and with the retirement of older freighters such as the DC-10 and A300, demand for the type will return, along with a stabilizing of lease rates and residual values.

767-300BDSF (IAI/Bedek)
The 767-300BDSF is the only non-Boeing passenger-to-freighter conversion option. It is offered by IAI/Bedek under an STC for the 767-300ER. Boeing recently licensed the conversion, allowing for greater marketability of the type. Less than 10 aircraft have been converted. However, like the Boeing option, a rebound in the airfreight market will create additional demand for the type. Values and lease rates should stabilize in the short to mid term.

767-200SF (IAI/Bedek)
The 767-200SF is offered by IAI/Bedek under the sole STC for the type. Bedek has converted more than 60 aircraft since the programme launched in 2001. Values for the type vary greatly because the conversion can be accomplished on both the extended range (ER) and non-ER variants of the Boeing model. The spread of values is also increased by the wide range of vintages of converted aircraft (from early 1983 to mid 1990s) and the availability of different engine types.
As the 767-300 Freighter variants play an increasing role in the market, values for the -200 will continue to soften similarly to the passenger variant values, with ER variants performing better.

A300F-600RF (Eads/Airbus/EFW)
The A300F-600R is both a factory built and converted freighter by Eads. The aircraft became a successful freighter adopted by the integrators, with FedEx and UPS operating more than 80% of the active fleet. With conversions coming to an end and with fewer than 10 operators of the type, older aircraft will have an increasingly difficult time finding their next operators, and values of newer aircraft will continue to fall, albeit slowly. With the freight integrators focused on replacing their older fleets, the type is protected from significant impairment. However, values are very dependent on the plans of the operators of large fleets.

> "The Airbus forecast suggests that, over the next two decades, 605 small freighters will be required, and all of these will be converted aircraft."

EFW and Russian joint venture for A320 freighter conversions has left the single-aisle market almost exclusively to Boeing (and McDonnell Douglas) aircraft. The reason cited for the closure was that an increase in demand for passenger A320s had caused a rise in residual values that made conversions uneconomic. However, some commentators believe that a contributory factor to the suspension was the difficulty of covering the high overheads of an original equipment manufacturer (OEM) on the relatively low cost of single-aisle conversions.

The absence of a BCF option for the 737 could be seen as supporting this view. Costs for single-aisle conversions by third-party specialists for Boeing single-aisle aircraft are in the region of $2 million to $3 million.

Capital costs are key

Utilization of freighters, particularly for narrowbody aircraft, is typically much lower than for the equivalent passenger aircraft, and hence keeping capital costs low is vital in allowing economically viable operations. The absence of new-build programmes by the OEMs in the narrowbody sector is a result of the high price they would need to charge.

For widebody aircraft the problem of low utilization is less pronounced in some markets, but nonetheless the advantages of converted aircraft are striking. Morten Beyer & Agnew value a 2005-converted 747-400 at about $55 million; Boeing's list price for a new 747-8F is more than $355 million. Even at high levels of utilization that is a huge amount of capital cost to claw back in operating efficiencies.

Third-party interest

The freighter conversion market has seen a number of third-party suppliers come and go but some of the current crop are doing good business. Aeronautical Engineers Inc (AEI), which offers 737, MD-80 and CRJ200-conversion programmes, has been very active this year. On October 21 the company delivered the second of four 737-400 conversions to Allied Air of Nigeria. This was AEI's 15th of an estimated 23 freighter deliveries for 2013.

Robert Convey, vice-president

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MARKET OUTLOOK – NARROWBODY FREIGHTER CONVERSIONS

Third-party companies have the single-aisle freighter conversion market to themselves. Morten Beyer & Agnew's David Tokoph reviews the various Boeing-licensed programmes on offer.

757-200PCF (Precision Conversions)

The 757-200PCF is offered by Precision Conversions of Greensboro, North Carolina, under a supplementary type certificate (STC). It is the only 757-conversion programme that accommodates 15 pallet positions. The aircraft has been well accepted with 34 aircraft delivered to lessors and airlines. This freighter variant has retained values well, and is expected to continue to do so because it offers a unique mid-range high-weight capability. The slow down in global airfreight has impacted the short- to mid-range cargo sector; however, there continues to be potential for growth of the sector in Asia and South America.

757-200SF (ST Aerospace Mobile)

The 757-200SF is a conversion of the Boeing narrowbody offered by ST Aerospace Mobile, a US subsidiary of Singapore Technologies Engineering. With more than 110 aircraft converted, the programme has been very successful with integrators such as FedEx, the largest operator of the type, and DHL. This has aided value retention for the few aircraft that are not operated by the larger carriers; however, any changes in fleet plans of these big operators have the potential to impact values negatively.

737-300SF/400SF (AEI)

The 737-300SF and-400SF are offered by Aeronautical Engineers Inc (AEI) under STCs. Demand for the types has continued to rise despite the global cargo slow down, partly because of the lower acquisition and ownership costs of smaller narrowbody freighters. Values for both variants are expected to remain stable for the foreseeable future, with the AEI -400 conversion holding value better than the rival conversions by Pemco. The introduction of a 737NG or A320 freighter would impact values of these current-generation freighters.

737-300F/400F (Pemco)

The 737-300F and -400F are conversions by Pemco World Air Services of Tampa, Florida. Of the just over 30 aircraft converted under this STC only four are the -400 variant. Because of this lack of popularity, values for the -400 variant are more volatile than the-300 model. The outlook for the smaller -300 is similar to that of the AEI-converted aircraft, and values will benefit from any increases in short-range air cargo traffic.

MD-80SF (AEI)

AEI gained an STC for the MD-80SF, which is a conversion of the passenger MD-82, in early 2013. Partly because of the narrower fuselage of the MD-80 family, the modification has a more limited capacity than its competitors. The programme has yet to be established as a valuable low-cost low-weight freighter alternative. However, with the increased availability and decline in values of MD-80 passenger variants, the cost of acquisition of suitable aircraft for conversion may make the type an attractive option for operators.

Morten Beyer & Agnew is an international aviation consulting firm based in Washington, specializing in the analysis of the commercial aviation industry.

"Utilization of freighters, particularly for narrowbody aircraft, is typically much lower than for the equivalent passenger aircraft."

sales and marketing, AEI, says that the company plans to increase production to between 35 and 38 conversions a year, of which about eight are planned to be MD-80SFs. Convey thinks that there might be 15 to 20 single-aisle aircraft delivered by other conversion companies, which would make the yearly total significantly higher than the rate implied by Airbus's forecast of 600 small freighter deliveries over the next 20 years.

Convey concedes the figure seems high, but he says: "This type of demand is what I am seeing from customers at the moment. It is difficult to say how long it will last and whether our competition will capture another 15 to 20 on top of what we are converting."

This uncertainty is characteristic of the freighter conversion market. However, with a potential requirement of more than 1,800 aircraft over the next 20 years, existing suppliers are likely to stick with it, and there may even be some new entrants.

FREIGHTER VALUES OUTLOOK

Istat appraiser Gueric Dechavanne, vice-president, commercial aviation services, Collateral Verifications, gives his views on the market outlooks for new-build freighters.

Boeing 747-8F

The continued softness in the air freight market has not helped demand for the type. Of the 67 orders placed, 40 have been delivered, leaving Boeing with only a few years of production remaining on backlog.

As the cargo market recovers, there should be additional orders for the type, mostly from major cargo operators which can fully utilize the capacity of this aircraft.

Similar to the Boeing 747-400F, Collateral Verifications does not foresee the 747-8F being built in large numbers. However, not unlike its predecessor, this aircraft will always be more capable than converted aircraft, making it more attractive to certain operators. This should ensure some long-term stability in its values because the operator base will most likely keep this aircraft in their fleet for the long term.

Boeing 777-200F

The Boeing 777-200F (777F) has shown some good signs of success since its introduction in 2009. Of the 132 aircraft orders, 77 have been delivered, with more orders to be expected from the major cargo operators as the market recovers.

Collateral Verifications has seen the 777 replacing some of the ageing Boeing 747-400F because its capacity is not much less than the 747, and the 777 can fly further more efficiently.

Collateral Verifications expects that some passenger aircraft will be converted to freighters but we feel the price of the aircraft is still too high, especially when including the cost of the conversion.

As more aircraft become available, this will allow more aircraft to be converted, which should broaden the operator base for the type and allow some operators to complement their existing fleet of factory-built freighters. Overall, we feel this aircraft should continue to do well, ensuring a good long-term future for the type.

Boeing 767-300F

The market for the Boeing 767-300F has remained stagnant, especially with the current condition of the air-freight market. With only a handful of operators flying this aircraft, we do not expect to see many more orders for the type in the short or long term.

As values of the passenger version of the 767-300ER continue to decline, we expect to see more aircraft being converted to freighters. This will take potential purchasers from the factory-built versions as the price of converted aircraft should be significantly lower.

Overall, we feel that the existing operator base will continue to fly the type for the long term, which should help to provide some stability in residual values as not many aircraft will become available to the secondary market.

Airbus A330-200F

Unfortunately for Airbus, we feel this aircraft was introduced at the wrong time. Even with its attractive economics and payload capability, the aircraft has garnered very few orders.

Over the past few years many of the original orders for the type have been converted to passenger versions because this market has been more active. With only 20 orders remaining, it will be interesting to see if any of those deliver or if most of them will be converted to A330-300s.

Overall, the future of the type does not look very promising but this could change when the cargo market recovers.

Market values and lease rates

Year of build	CMV ($ millions)	Lease rate ($'000s/month)
747-8F		
2011	148.2	1,100
2012	158.4	1,200
2013	188.3	1,400
777F		
2009	108.8	950
2010	116.5	1,050
2011	119.9	1,150
2012	131.1	1,250
2013	153.8	1,350
767-300F		
1995	28.5	350
2000	34.6	410
2005	42.33	490
2010	56.56	590
2013	75.43	650
A330-200F		
2010	77.2	700
2011	81.4	750
2012	82.4	800
2013	95.6	850

Source: Collateral Verifications

AIRCRAFT APPRAISALS

Views on values

The Aircraft
Air Investor has reviewed the values and lease rates of a representative selection of aircraft including models from each of the main manufacturers and covering a range of commercial aircraft sizes and types. Values and lease rates are taken from aircraft profiles published in *Airfinance Journal*.

The Appraisers
For the selection of aircraft, *Airfinance Journal's* regular panel of specialists provided independent views on values and lease rates. The panel comprises Istat appraisers and senior appraisers:

Gueric Dechavanne,
Vice-president – commercial aviation services, Collateral Verifications (CV)

Martin O'Hanrahan,
Director, asset valuation, Avitas

Mike Yeomans,
Aviation Analyst, IBA

Stuart Rubin,
Principal, ICF SH&E

David Tokoph,
Vice-president, valuations and technical analysis, MBA

The Assumptions
Market value is based on the Istat definition – ie, the most likely trading price that may be generated for an aircraft under the market circumstances that are perceived to exist at the time in question. Market value assumes that the aircraft is valued for its highest, best use, that the parties to the hypothetical sale transaction are willing, able, prudent and knowledgeable, and under no unusual pressure for a prompt sale, and that the transaction would be negotiated in an open and unrestricted market on an arm's-length basis, for cash or equivalent consideration, and given an adequate amount of time for effective exposure to prospective buyers.

Lease rates are for indicative purposes. Monthly rental values will vary according to factors such as term and lessee credit rating.

Airbus A380

The double-deck four-engined A380 is the world's largest commercial aircraft. The current model – the A380-800 – has the capacity to carry 525 passengers in a typical three-class configuration or up to 853 in a single-class.

After a number of delays in the development programme, the A380-800 entered commercial service in October 2007 with Singapore Airlines.

The A380 is available with two types of engine – the Rolls-Royce Trent 900 or the Engine Alliance GP7000. Noise reduction was an important requirement in the A380 design, and particularly affects engine design. The A380 uses similar cockpit layout, procedures and handling characteristics to other Airbus aircraft, which the manufacturer says reduces crew-training costs.

The aircraft uses advanced aluminium alloys for the wing and fuselage, along with the extensive application of composite materials in the centre wing box's primary structure, wing ribs and rear fuselage section.

Future developments
Airbus initially intended to offer a freighter version (A380F) and to develop a larger capacity model (A380-900). However, development of both variants is on hold.

Current market value ($m)

Build year	2007	2008	2009	2010	2011	2012	2013
Avitas view	119.3	–	143.3	–	172.2	–	208.1
CV view	138.2	148.9	158.8	177.8	196.3	205	229.5
MBA view	122.9	134.3	146.6	160.2	175.9	194.5	215

Indicative lease rates ($m/month)

Build year	2007	2008	2009	2010	2011	2012	2013
Avitas view	1.20-1.30		1.34-1.45		1.52-1.65		1.70-1.85
CV view	1.05	1.17	1.3	1.42	1.55	1.67	1.8
MBA view	1.05-1.25	1.15-1.35	1.25-1.45	1.30-1.50	1.40-1.60	1.50-1.70	1.60-1.80

Values and lease rates taken from Airfinance Journal June 2013

AIRCRAFT APPRAISALS

Boeing 777-200ER

Since its entry into service in June 1995 Boeing has expanded the 777 family to five passenger models and a freighter version. The Boeing 777-200ER was the first evolution in the 777 range. The ER variant increased the payload and range capabilities of the original 777-200 and increased its appeal to airline operators.

The 777-200ER has achieved a solid market penetration and, although the focus of the market has shifted to the larger 777-300ER, the -200ER still plays an important role in its operators' fleets. The first aircraft of the type entered service in 1997.

When the 777-200ER was first launched its primary competition was the four-engine Airbus A340-300 and the three-engine McDonnell Douglas MD-11. The 777-200ER has been far more successful than either of these aircraft.

Unlike the most recent models of the 777 family the 200ER is offered with variants from each of the main engine manufacturers. General Electric offers its GE90 series, Rolls-Royce offers the Trent 800 series and Pratt & Whitney offers the PW4000 series

Future developments

Boeing launched the widely anticipated 777X family at the Dubai Airshow in November 2013, with a target entry into service of 2020. A freighter conversion programme of the 777-200ER is being studied.

Current market value ($m)							
Build year	2000	2002	2004	2006	2008	2010	2012
ICF SH&E view	47.5	53.9	61.3	70.0	80.1	92.0	105.9
CV view	40.1	46.7	53.5	61.1	67.7	76.9	82.9
IBA view	48.3	54.8	61.5	68.4	75.9	89.1	106.0

Indicative lease rates ($'000s/month)							
Build year	2000	2002	2004	2006	2008	2010	2012
ICF SH&E view	450-580	510-640	575-705	630-760	700-820	760-870	815-935
CV view	575	625	675	725	775	825	875
IBA view	440-590	512-650	584-710	656-770	716-830	780-890	830-940

Values and lease rates taken from Airfinance Journal July/August 2013

Airbus A330-200

The two main passenger variants in the A330 family are the A330-300 and the A330-200. Airbus also offers the A330-200 Freighter version, and the family includes a corporate jet version (ACJ330) and a military tanker transport model (A330-300 MRTT). The order book for the entire A330 family exceeds 1,200 aircraft.

The A330-200, the second variant in the family, first entered service in 1998 as a smaller and longer-range alternative to the A330-300. It offers improved performance because of the weight reduction resulting from a shorter fuselage.

It has a 222-inch fuselage cross-section, which is shared with the other members of Airbus's A330/A340 family. Airbus points to a commonality in cockpit and cabin systems with the A320 family, which the manufacturer says is leading to operators of the single-aisle aircraft stepping up to the widebody for higher-capacity, longer-range services.

Future developments

An increased maximum takeoff weight of 242 metric tonnes was launched by Airbus in November 2012. The new 242-tonne A330-200 will fly 350 nautical miles (nm) further, according to the manufacturer's figures. This latest takeoff weight increase brings increased fuel efficiency, according to Airbus, thanks to wing aerodynamic refinements and enhancements to the engines.

Current market value ($m)							
Build year	2000	2002	2004	2006	2008	2010	2012
ICF SH&E view	36.7	41.0	45.8	51.1	56.8	65.2	83.6
CV view	39.7	46.5	51.7	56.8	62.6	69.5	75.3
IBA view	39.9	44.5	49.6	57.1	65.0	73.9	85.8

Indicative lease rates ($'000s/month)							
Build year	2000	2002	2004	2006	2008	2010	2012
ICF SH&E view	390-450	420-490	460-530	500-580	550-630	630-710	730-820
CV view	450	500	550	600	650	720	805
IBA view*	410-490	440-520	470-540	510-580	560-630	620-690	690-760

Values and lease rates taken from Airfinance Journal *May 2013*

AIRCRAFT APPRAISALS

Airbus A319

The A319, which entered service in 1996, was the third variant of Airbus's A320 family, following the larger A320 and the stretched A321. A fourth model came after in the form of the smaller A318.
There is a high degree of commonality across the family and, to some extent, with other members of the Airbus product line. The A319 is offered with engines from either CFM or International Aero Engines. The A319's main competition has come from the in-production 737-700 and out-of-production 737-300.

The A319 typically seats 125 passengers, and this size category is being targeted by a number of new entrants, including Bombardier's CSeries, the Comac C919, the Yak-242 (formerly known as the MC-21) and Embraer's E195-E2.
Airbus has continuously developed the A320 family with a series of improvements to engines, interiors and aerodynamics, with the latest development being sharklet wing-tip devices, which the manufacturer says give a 4% fuel saving. American Airlines received the first sharklet-equipped A319 in July. 2013.

Future developments
Airbus has launched new engine versions of the A320 family that will offer fuel savings of 15% over non-sharklet-equipped current models. The designation for the new generation of aircraft is "new engine option" (neo), leading to the adoption of the term "current engine option" (ceo) for in-production models. The first A320neo is due to enter service in late 2015, with the A319 to follow in 2016.

Current market value ($m)					
Build year	1996	2000	2004	2008	2012
ICF SH&E view	9.70	12.45	16.09	20.94	26.43
CV view	9.60	12.73	17.10	23.19	31.67
IBA view	10.22	13.63	17.42	22.66	31.65

Indicative lease rates ($'000s/month)					
Build year	1996	2000	2004	2008	2012
ICF SH&E view	95	115	155	195	235
CV view	90-110	115-140	150-175	190-220	230-260
IBA view	95-120	116-150	144-186	180-230	220-278

Values and lease rates taken from Airfinance Journal November/December 2013

Boeing 737-800

The 737-800 is the biggest selling of the successful next-generation (NG) 737 family. The other members are 737-600, -700 and -900ER models
The next-generation family has received more than 6,300 orders. The 737-700 was the first model to be developed with its first delivery in December 1997. The 737-800, followed, entering service in spring 1998. The aircraft has been continuously developed, notably with the addition of a blended winglets option.
In 2009 Boeing and CFM introduced the new CFM56-7BE engine enhancement programme to coincide with airframe improvements. Boeing says the combination reduces fuel consumption by 2%. The interior has also been upgraded on several occasions, with the latest incarnation being marketed by Boeing as the Sky Interior.

Future developments
Boeing has launched the re-engined 737Max family, powered by CFM International Leap-1B engines. Boeing says the Max family "will reduce fuel burn by an additional 13% over today's most fuel-efficient single-aisle airplanes". Other design updates, including Boeing's advanced technology winglet, will result in less drag and further optimize performance, according to the manufacturer.

Current market value ($m)							
Build year	2000	2002	2004	2006	2008	2010	2012
Avitas view	21.3	24.3	27.7	31.5	35.5	40.1	45.9
CV view	17.1	18.4	23.1	27.3	30.4	33.7	36.7
MBA view	20.2	22.9	26.1	29.6	33.6	38.1	44.2

Indicative lease rates ($'000s/month)							
Build year	2000	2002	2004	2006	2008	2010	2012
Avitas view	220-240	240-260	260-280	290-310	310-330	340-360	360-380
CV view	210	230	250	270	290	315	345
MBA view	190-220	210-235	230-250	240-270	260-290	290-325	320-350

Values and lease rates taken from Airfinance Journal *March 2013*

AIRCRAFT APPRAISALS

Bombardier CRJ900LR

The Bombardier CRJ900 is a stretched version of the CRJ700 regional jet, which is a stretch from the successful CRJ200. The CRJ200 was a development from Bombardier's Challenger business jet. Compared with the CRJ700, the CRJ900 has a more powerful engine – the GE CF34-8C5B1 – strengthened wing and main landing gear, increased baggage volume and two additional overwing emergency exits.

The CRJ900 typically has 86 seats in single-class configuration – in a high-density layout it can accommodate up to 90 passengers. The aircraft is available in standard, extended range (ER) and long-range (LR) versions, with maximum take-off weights of 80,500lbs, 82,500lbs and 84,500lbs, respectively.

An enhanced performance package incorporating slat optimization and a new winglet was incorporated into the production line from serial number 15060. Additional cabin interior improvements across all models were introduced in 2007 with the announcement of the CRJ NextGen family.

As part of this upgrade, a NextGen CRJ900 variant was introduced, which incorporated technological advances that had been developed for the larger CRJ1000. The improvements included better fuel efficiency and increased performance. Bombardier also produced the CRJ705 variant, which is the same size as the 900, but is certified with fewer seats to meet the pilot scope clause requirements of the Canadian regional market. The CRJ900 has extensive commonality with other members of the CRJ family.

Future Developments

Bombardier's focus on developing its CSeries airliner is likely to limit any major developments of the CRJ family.

Current market value ($m)

Build year	2002	2004	2006	2008	2010	2012
Avitas view	11.7	13.6	15.9	18.3	21.4	24.9
ICF SH&E view	–	–	14.9	17.2	19.9	23.1
MBA view	–	14.5	16.9	19.6	22.7	26.8

Indicative lease rates ($'000s/month)

Build year	2002	2004	2006	2008	2010	2012
Avitas view	105-115	120-130	135-145	150-160	175-185	200-210
ICF SH&E view	–	–	140-180	155-200	175-220	190-240
MBA view	–	130-160	150-180	170-200	180-210	200-240

Values and lease rates taken from Airfinance Journal September 2013

Embraer E190

Embraer's E190 is a stretch of the E170/175 models and is fitted with a new larger wing, larger horizontal stabilizer and a new engine, the General Electric CF34-10E. The aircraft competes with the smaller Bombardier CRJ1000, but is primarily aimed at the bottom end of the single-aisle market where the Airbus A318 and Boeing 737-600 have failed to attract significant orders.

The E190 benefits from being optimized as a "100-seater", and Embraer has fought against the aircraft being categorized as a regional jet. As with the E170/175 programmes, Embraer has produced two models that are very close in size, with the larger E195 having barely 10 more seats.

Future developments

The success of the E190 (and E195) has been in part because of the absence of an efficient direct competitor. However, Bombardier's new-technology CSeries is aimed at a similar market segment and the development of the A320neo and the 737Max erodes some of the E190's trip cost advantages. In this context Embraer has launched the next generation of its E-Jet family.

Current market value ($m)

Build year	2004	2006	2008	2010	2012
Avitas view	17.3	20.1	23.3	27.1	31.8
IBA view	19.6	21.5	23.8	27.1	32.8
MBA view	17.8	20.5	23.8	27.5	32.9

Indicative lease rates ($'000s/month)

Build year	2004	2006	2008	2010	2012
Avitas view	145-175	160-200	180-220	210-250	230-270
IBA view	180-220	191-230	204-250	222-270	241-290
MBA view	170-195	190-210	210-230	225-250	260-285

Values and lease rates taken from Airfinance Journal January/February 2013

AIRCRAFT APPRAISALS

Bombardier Q400

The Q400 (original designation Dash 8-400) is the only member of the Dash-8 family still in production. The family consists of four models. The original Series 100 entered service in 1984 and has a maximum capacity of 39 seats. The Series 200 has the same capacity but offers more powerful engines, the Series 300 is a stretched 50-seat version and the Series 400 is a further stretch originally seating a maximum of 78 passengers, which has subsequently been pushed to 80. More than 1,000 Dash 8s of all models have been built. Only the Series 400 is still in production

All models delivered after 1997 have cabin noise suppression, and Bombardier adopted the designation Q (Dash 8-Q400) to emphasize this development. The Dash 8 prefix has since been dropped from the company's marketing literature – the aircraft is now generally referred to simply as the Q400.

The current version, introduced in December 2009, is designated by the manufacturer as the Q400NextGen, and has an updated cabin and improved landing gear. The manufacturer says it also offers reduced fuel and maintenance costs compared with its immediate predecessor. The Q400 has a direct competitor in the ATR 72-500/-600, but the Bombardier aircraft is much faster than the ATRs, thanks to its more powerful engine. This, of course, comes at a cost in fuel and list price.

Future developments

Bombardier says it is considering launching a stretched version of the Q400, but the industry consensus is that its competitor, ATR, is closer to entering the 100-seat turboprop market. If ATR gets the go-ahead for a launch, Bombardier may have to respond, because the Q400's performance advantage is likely to be eroded by an upgraded ATR model.

Current market value ($m)							
Build year	2000	2002	2004	2006	2008	2010	2012
CV view	7.50	8.70	10.01	11.87	13.91	16.10	18.93
ICF SH&E view	8.05	9.38	10.91	12.66	14.68	16.99	19.65
IBA view	9.11	10.20	11.46	12.72	14.25	16.15	18.70

Indicative lease rates ($'000s/month)							
Build year	2000	2002	2004	2006	2008	2010	2012
CV view	105	115	127.5	142.5	157.5	172.5	187.5
ICF SH&E view	70-85	90-110	110-125	125-145	145-160	160-180	175-200
IBA view	70-84	80-100	93-116	107-131	125-150	145-170	165-190

Values and lease rates taken from Airfinance Journal April 2013

ATR72-500

The ATR 72 was developed from the ATR 42 to provide capacity for 70 plus passengers, by stretching the fuselage, increasing the wingspan and adding more powerful engines. The original ATR72-100 variant entered service in October 1989, but was soon superseded by the -200 model. The aircraft was developed with a series of upgrades to maximum take-off weight and engine power, culminating in the ATR72-212.

The ATR72-500 (certificated as the ATR72-212A) is a major development of the aircraft, which incorporates six-bladed propellers in place of the original four-bladed configuration. Other enhancements include higher maximum weights as well as flight deck and passenger cabin improvements.

The ATR72-500 has significantly better airfield and en-route performance than the -200, but notably it does not match the cruise speed of the smaller ATR42-500.

The low fuel-burn of the turboprop provides significant cost advantages over jet aircraft, particularly on shorter sectors. Passenger acceptance of turboprops has been an issue in some markets, but developments in cabin noise suppression have reduced the problem.

Future developments

The ATR72-600 model replaces the -500 and is the current production standard. It offers further performance improvements and includes a redesigned cabin. Industry speculation continues that ATR will launch a larger turboprop.

Current market value ($m)						
Build year	2000	2002	2004	2006	2008	2010
CV view	7.95	8.95	9.99	11.18	12.94	14.96
Avitas view	6.8	7.7	8.9	10.2	13.9	16.4
MBA view	6.63	7.76	9.08	10.78	12.78	15.15

Indicative lease rates ($'000s/month)						
Build year	2000	2002	2004	2006	2008	2010
CV view	110	120	130	140	150	160
Avitas view	70-80	85-95	95-105	110-120	120-130	135-145
MBA view	60-90	75-100	85-110	100-130	110-140	130-150

Values and lease rates taken from Airfinance Journal January/February 2014

AIRCRAFT DATA

The numbers

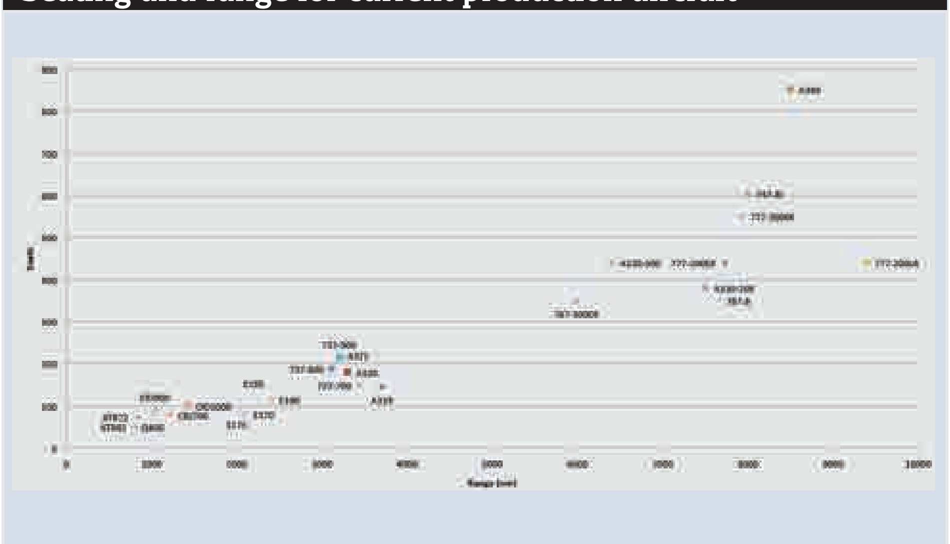
Aircraft data index

The following pages include key data for current production commercial aircraft. Aircraft that have not yet entered service are not included, because the information available has not been confirmed by in-service experience. Hence, for example, Airbus's A350 and Bombardier's CSeries are excluded. The information provided is based on a number of key assumptions as detailed in the following.

Technical characteristics

The maximum take-off weight (MTOW) shows the minimum and maximum options available for the type in question. There may be intermediate weights available. The operating empty weight (OEW) is based on the manufacturers' figures. Airline weights are likely to be higher than those quoted.

Seating and range for current production aircraft



Fuels and times

The figures shown for fuels and times are *Airfinance Journal's* estimates based on a variety of sources. They are intended to reflect 60% passenger load factors, international standard atmosphere (ISA) conditions en-route, zero winds and optimum flight levels.

Indicative maintenance costs

The maintenance figures are intended as a guide to the order of magnitude of reserves associated with the various aircraft types. The figures are intended to reflect mature costs with no account taken of warranty effects and other reductions associated with new aircraft.

The C-check and heavy-check reserves are based on typical check costs and intervals. No allowance is made for cabin refurbishment. The cost quoted for component overhaul excludes inventory support.

Engine maintenance cost estimates are based on figures quoted in the *Airfinance Journal* guide to financing and investing in engines 2013, page 29. Unless stated, the engine costs refer to the most common engine type for the aircraft model in question.

The information used to estimate the indicative maintenance reserves has been collected from a wide variety of sources. While *Airfinance Journal* has made every effort to normalize the data, direct comparisons between aircraft types may be misleading.

It should also be noted that maintenance costs of a particular type are highly dependent on the route structure, operating environment and maintenance philosophy of the airline with which the aircraft is in service. As such our estimates are difficult to reconcile with the numbers provided by manufacturers.

Seating/range

The numbers quoted for seating capacity are based on the manufacturers' selling standards. Large variations are possible, particularly for widebody aircraft. The ranges shown are for still-air conditions, optimum flight levels and are based on the typical seating figure and the operating empty weight quoted by the manufacturer. Ranges in airline operation are likely to be significantly less than the figures quoted.

A319

Seating/range		
Max seating	145	
Typical seating	124	(8+116)
Max range (Non ER version)	3,700	nm
Technical characteristics		
MTOW	64	tonnes / 76 tonnes
OEW	40	tonnes
MZFW	58	tonnes
Fuel capacity	23,860	litres / 29,840 litres
Engines	CFM56-7B/V2500	
Thrust	22,000	lbs (98kn)
Fuels and times		
Block fuel 200Nm	1,710	kg
Block fuel 500nm	3,140	kg
Block fuel 1000 Nm	5,620	kg
Block time 200Nm	54	minutes
Block time 500Nm	94	minutes
Block time 1000Nm	160	minutes
Fleet (including ACJs)		
Entry into service	1996	April
In service	1,390	
Operators (current and planned)	157	
In storage	23	
On order	139	(plus 27 A319neo)
Built peak year (2005)	142	
Built 2013	4	
Average age	8.9	years
Source AeroTransport Database December 2013		
Indicative Maintenance Reserves		
C-check reserve	$60-65	per flight hour
Higher checks reserve	$55-60	per flight hour
Engine overhaul	$95-100	per engine flight hour
Engine LLP	$120-125	per engine cycle
Landing gear refurbishment	$35-40	per cycle
Wheels brakes and tyres	$120-130	per cycle
APU	$75-80	per APU hour
Component overhaul	$210-220	per flight hour

A320-200

Seating/range		
Max seating	180	
Typical seating	150	(12+32)
Max range (Non ER version)	3,300	nm (6,1000 km) (with sharklets)
Technical characteristics		
MTOW	73.5	tonnes / 78 tonnes
OEW	42	tonnes
MZFW	61	tonnes / 62.5 tonnes
Fuel capacity	24,210	litres / 27,200 litres
Engines	CFM56-5B/V2500	
Thrust	25,000	lbs (120kn)
Fuels and times		
Block fuel 200Nm	1,850	kg
Block fuel 500nm	3,390	kg
Block fuel 1000 Nm	6,080	kg
Block time 200Nm	54	minutes
Block time 500Nm	94	minutes
Block time 1000Nm	160	minutes
Fleet		
Entry into service	1988	March
In service:	3,197	
Operators (current and planned)	276	
In storage	11	
On order	1,168	(plus 2,041 A320neo)
Built peak year (2013)	351	
Built 2013	351	
Average age	7.7	years
Source AeroTransport Database December 2013		
Indicative Maintenance Reserves		
C-check reserve	$60-65	per flight hour
Higher checks reserve	$55-60	per flight hour
Engine overhaul	$100-105	per engine flight hour
Engine LLP	$120-125	per engine cycle
Landing gear refurbishment	$35-40	per cycle
Wheels brakes and tyres	$120-130	per cycle
APU	$75-80	per APU hour
Component overhaul	$210-220	per flight hour

A321-200

Seating/range		
Max seating	220	
Typical seating	185	(16+169)
Maximum range (Non ER version)	3,200	nm (5,950 km) (with sharklets)
Technical characteristics		
MTOW	89	tonnes / 93.5 tonnes
OEW	48	tonnes
MZFW	71.5	tonnes/73.8 tonnes
Fuel capacity	23,860	litres / 29,840 litres
Engines	CFM56-5B/V2500	
Thrust	27,000	lbs - 33,000lbs (120-148kn)
Fuels and times		
Block fuel 200Nm	2,310	kg
Block fuel 500nm	4,230	kg
Block fuel 1000 Nm	7,590	kg
Block time 200Nm	54	minutes
Block time 500Nm	94	minutes
Block time 1000Nm	160	minutes
Fleet (including -100s)		
Entry into service	1996	April
In service:	84	
Operators (current and planned)	88	
In storage	20	
On order	590	(plus 570 A21neo)
Built peak year (2012)	92	
Built 2013	92	
Average age	7.3	years
Source AeroTransport Database December 2013		
Indicative Maintenance Reserves		
C-check reserve	$65-70	per flight hour
Higher checks reserve	$60-65	per flight hour
Engine overhaul	$115-120	per engine flight hour
Engine LLP	$120-125	per engine cycle
Landing gear refurbishment	$35-40	per cycle
Wheels brakes and tyres	$120-130	per cycle
APU	$75-80	per APU hour
Component overhaul	$210-220	per flight hour

A330-200

Seating/range		
Max seating	380	
Typical seating	253	(12+36+205)
Maximum range (Non ER version)	7,500	nm (13,900 km)
Technical characteristics		
MTOW	230	tonnes / 240 tonnes
OEW	121	tonnes
MZFW	168	tonnes/170 tonnes
Fuel capacity	139,090	litres
Engines	PW4000	/CF6-80E1/Trent 700
Thrust	68,000	lbs - 72,000lbs (303-316kn)
Fuels and times		
Block fuel 1,000 Nm	12,720	kg
Block fuel 2,000 Nm	23,710	kg
Block fuel 4,000 Nm	45,680	kg
Block time 1,000 Nm	184	minutes
Block time 2,000 Nm	299	minutes
Block time 4,000 Nm	529	minutes
Fleet (including freighter versions)		
Entry into service	1998	April
In service:	499	
Operators (current and planned)	92	
In storage	17	
On order	93	
Built peak year (2013)	60	
Built 2013	60	
Average age	6.8	years
Source AeroTransport Database December 2013		
Indicative Maintenance Reserves		
C-check reserve	$105-110	per flight hour
Higher checks reserve	$95-100	per flight hour
Engine overhaul (Trent)	$260-275	per engine flight hour
Engine LLP (Trent)	$240-245	per engine cycle
Landing gear refurbishment	$150-155	per cycle
Wheels brakes and tyres	$375-380	per cycle
APU	$105-110	per APU hour
Component overhaul	$420-425	per flight hour

A330-300

Seating/range		
Max seating	440	
Typical seating	295	(12+42+241)
Maximum range (Non ER version)	6,400	nm (11,900 km)
Technical characteristics		
MTOW	230	tonnes / 240 tonnes
OEW	121	tonnes
MZFW	173	tonnes/175 tonnes
Fuel capacity	97,530	litres
Engines	PW4000	/CF6-80E1/Trent 700
Thrust	68,000	lbs - 72,000lbs (303-316kn)
Fuels and times		
Block fuel 1,000 Nm	13,120	kg
Block fuel 2,000 Nm	24,460	kg
Block fuel 4,000 Nm	47,120	kg
Block time 1,000 Nm	184	minutes
Block time 2,000 Nm	299	minutes
Block time 4,000 Nm	529	minutes
Fleet		
Entry into service	1993	December
In service:	479	
Operators (current and planned)	56	
In storage	3	
On order	183	
Built peak year (2013)	68	
Built 2013	68	
Average age	6.8	years
Source AeroTransport Database December 2013		
Indicative Maintenance Reserves		
C-check reserve	$105-110	per flight hour
Higher checks reserve	$95-100	per flight hour
Engine overhaul (Trent)	$260-275	per engine flight hour
Engine LLP (Trent)	$240-245	per engine cycle
Landing gear refurbishment	$150-155	per cycle
Wheels brakes and tyres	$375-380	per cycle
APU	$105-110	per APU hour
Component overhaul	$420-425	per flight hour

A380

Seating/range		
Max seating	853	
Typical seating	525	three clas
Maximum range	8,500	nm (15,700 km)
Technical characteristics		
MTOW	560	tonnes
OEW	277	tonnes
MZFW	361	tonnes
Fuel capacity	320,000	litres
Engines	GP7200	/Trent 900
Thrust	70,000	lbs (311kN)
Fuels and times		
Block fuel 1,000 Nm	26,590	kg
Block fuel 2,000 Nm	50,580	kg
Block fuel 4,000 Nm	104,290	kg
Block time 1,000 Nm	146	minutes
Block time 2,000 Nm	265	minutes
Block time 4,000 Nm	501	minutes
Fleet		
Entry into service	2007	October
In service:	118	
Operators (current and planned)	21	
In storage	1	
On order	215	
Built peak year (2013)	33	
Built 2013	33	
Average age	2.5	years
Source AeroTransport Database December 2013		
Indicative Maintenance Reserves		
C-check reserve	$160-165	per flight hour
Higher checks reserve	$145-150	per flight hour
Engine overhaul	$190-195	per engine flight hour
Engine LLP	$195-200	per engine cycle
Landing gear refurbishment	$200-205	per cycle
Wheels brakes and tyres	$565-570	per cycle
APU	$155-160	per APU hour
Component overhaul	$575-580	per flight hour

ATR42-600

Seating/range		
Max seating	50	@30in
Typical seating	48	@30in
Maximum range	801	nm (1,480 km)
Technical characteristics		
MTOW	18.6	tonnes
OEW	11.5	tonnes
MZFW	16.7	tonnes
Fuel capacity	5,700	litres
Engines	PW127M	
Thrust	2,160	shp
Fuels and times		
Block fuel 100Nm	340	kg
Block fuel 200 Nm	560	kg
Block fuel 500 Nm	1,210	kg
Block time 100Nm	33	minutes
Block time 200Nm	55	minutes
Block time 500Nm	122	minutes
Fleet		
Entry into service	2012	1996 for -500
In service	7	plus 112 ATR42-500
Operators	46	
In storage	7	
On order	19	
Built peak year	28	
Built 2013	19	
Average age	1.1	year
Source AeroTransport Database December 2013		
Indicative Maintenance Reserves		
C-check reserve	$35-40	per flight hour
Higher checks reserve	$25-30	per flight hour
Engine overhaul	$95-100	per engine flight hour
Engine LLP	$25-30	per engine cycle
Landing gear refurbishment	$20-25	per cycle
Wheels brakes and tyres	$35-40	per cycle
Propeller	$15-20	per propeller hour
Component overhaul	$115-120	per flight hour

ATR72-600

Seating/range		
Max seating	74	@30in
Typical seating	70	@30 inch pitch
Maximum range	825	nm
Technical characteristics		
MTOW	22.8	tonnes/23 tonnes
OEW	14	tonnes
MZFW	20.8	tonnes/21 tonnes
Fuel capacity	6,370	litres
Engines	PW127M	
Thrust	2,475	shp
Fuels and times		
Block fuel 100Nm	370	kg
Block fuel 200 Nm	610	kg
Block fuel 500 Nm	1,310	kg
Block time 100Nm	36	minutes
Block time 200Nm	58	minutes
Block time 500Nm	125	minutes
Fleet		
Entry into service	2011	1998 for -500
In service	110	
Operators (ATR72-500)	46	
In storage (ATR72-500)	2	
On order	244	
Built peak year 2013	84	
Built 2013	84	
Average age (ATR72-500)	1	year
Source AeroTransport Database December 2013		
Indicative Maintenance Reserves		
C-check reserve	$35-40	per flight hour
Higher checks reserve	$25-30	per flight hour
Engine overhaul	$100-105	per engine flight hour
Engine LLP	$30-35	per engine cycle
Landing gear refurbishment	$20-25	per cycle
Wheels brakes and tyres	$35-40	per cycle
Propeller	$15-20	per propeller hour
Component overhaul	$125-130	per flight hour

Boeing 737-700

Seating/range		
Max seating	149	@30in
Typical seating	126	@34/32
Maximum range	3,440	nm (6,370 km) (with winglets)
Technical characteristics		
MTOW	70.1	tonnes (77.6 for ER version)
OEW	38	tonnes
MZFW	54.7	tonnes
Fuel capacity	26,020	litres / 40,580 litres
Engines	CFM56-7B	
Thrust	26,300	lbs (116 kn)
Fuels and times		
Block fuel 200Nm	1,810	kg
Block fuel 500nm	3,190	kg
Block fuel 1000 Nm	5,590	kg
Block time 200Nm	54	minutes
Block time 500Nm	94	minutes
Block time 1000Nm	160	minutes
Fleet		
Entry into service	1998	January
In service:	1,071	(includes 737-700C)
Operators (current and planned)	81	
In storage	16	
On order	160	
Built peak year (2014)	111	
Built 2013	15	
Average age	9.4	years
Source AeroTransport Database December 2013		

Indicative Maintenance Reserves		
C-check reserve	$65-70	per flight hour
Higher checks reserve	$50-55	per flight hour
Engine overhaul	$115-120	per engine flight hour
Engine LLP	$120-125	per engine cycle
Landing gear refurbishment	$45-50	per cycle
Wheels brakes and tyres	$70-75	per cycle
APU	$80-85	per APU hour
Component overhaul	$210-220	per flight hour

Boeing 737-800

Seating/range		
Max seating	189	@30in
Typical seating	162	@34/32
Maximum range	3,115	nm (5,767 km) (with winglets)
Technical characteristics		
MTOW	79	tonnes
OEW	41.1	tonnes
MZFW	61.7	tonnes / 62.7 tonnes
Fuel capacity	26,020	litres / 40,580 litres
Engines	CFM56-7B	
Thrust	27,300	lbs (121kn)
Fuels and times		
Block fuel 200Nm	2,000	kg
Block fuel 500nm	3,530	kg
Block fuel 1000 Nm	6,190	kg
Block time 200Nm	54	minutes
Block time 500Nm	94	minutes
Block time 1000Nm	160	minutes
Fleet		
Entry into service	1998	April
In service:	304	
Operators (current and planned)	147	
In storage	13	
On order	1.189	
Built peak year (2013)	413	
Built 2013	413	
Average age	6.1	years
Source AeroTransport Database December 2013		

Indicative Maintenance Reserves		
C-check reserve	$65-70	per flight hour
Higher checks reserve	$50-55	per flight hour
Engine overhaul	$115-120	per engine flight hour
Engine LLP	$120-125	per engine cycle
Landing gear refurbishment	$45-50	per cycle
Wheels brakes and tyres	$70-75	per cycle
APU	$80-85	per APU hour
Component overhaul	$210-220	per flight hour

Boeing 737-900ER

Seating/range		
Max seating	215	
Typical seating	180	
Maximum range	3,200	nm (5,920 km)
Technical characteristics		
MTOW	85.1	tonnes
OEW	42.5	tonnes
MZFW	67.8	tonnes
Fuel capacity	29,660	litres
Engines	CFM56-7B	
Thrust	27,300	lbs (121kn)
Fuels and times		
Block fuel 200Nm	2,080	kg
Block fuel 500nm	3,660	kg
Block fuel 1000 Nm	6,420	kg
Block time 200Nm	54	minutes
Block time 500Nm	95	minutes
Block time 1000Nm	160	minutes
Fleet		
Entry into service	2001	May (ER version)
In service:	261	
Operators (current and planned)	21	
In storage	0	
On order	329	
Built peak year (2013)	49	
Built 2013	49	
Average age	4.2	years
Source AeroTransport Database December 2013		
Indicative Maintenance Reserves		
C-check reserve	$70-75	per flight hour
Higher checks reserve	$50-55	per flight hour
Engine overhaul	$115-120	per engine flight hour
Engine LLP	$120-125	per engine cycle
Landing gear refurbishment	$45-50	per cycle
Wheels brakes and tyres	$70-75	per cycle
APU	$80-85	per APU hour
Component overhaul	$210-220	per flight hour

Boeing 747-8I

Seating/range		
Max seating	605	
Typical seating	467	three class
Maximum range	8,000	nm (14,815 km)
Technical characteristics		
MTOW	447.7	tonnes (987,000lbs)
OEW	218	tonnes
MZFW	295	tonnes
Fuel capacity	238,610	litres
Engines	GEnx-2B67	
Thrust	66,500	lbs
Fuels and times		
Block fuel 1000Nm	20,370	kg
Block fuel 2000Nm	38,760	kg
Block fuel 4000Nm	79,910	kg
Block time 1000Nm	146	minutes
Block time 2000Nm	265	minutes
Block time 4000Nm	501	minutes
Fleet		
Entry into service	2011	(2010 for freighter)
In service:	11	plus 26 freighters and 2 BBJ s
Operators (current and planned)	18	including freighters and BBJs
In storage	0	
On order	34	plus 28 freighters and 6 BBJ s
Built peak year (2012)	31	
Built 2013	30	
Average age	0.8	years
Source AeroTransport Database December 2013		
Indicative Maintenance Reserves (747-400 figures)		
C-check reserve	$155-160	per flight hour
Higher checks reserve	$115-120	per flight hour
Engine overhaul	$165-170	per engine flight hour
Engine LLP	$255-260	per engine cycle
Landing gear refurbishment	$160-165	per cycle
Wheels brakes and tyres	$750-755	per cycle
APU	$105-110	per APU hour
Component overhaul	$505-510	per flight hour

Boeing 767-300ER

Seating/range		
Max seating	350	
Typical seating	269	two class (218 three class)
Maximum range	5,990	nm (11,070 km)
Technical characteristics		
MTOW	186.9	tonnes (412,000lbs)
OEW	91	tonnes
MZFW	133	tonnes
Fuel capacity	90,770	litres
Engines	PW4000	/CF6-80C2
Thrust	63,300	lbs/62,100lbs
Fuels and times		
Block fuel 1,000 Nm	10,560	kg
Block fuel 2,000 Nm	19,760	kg
Block fuel 4,000 Nm	37,910	kg
Block time 1,000 Nm	184	minutes
Block time 2,000 Nm	301	minutes
Block time 4,000 Nm	536	minutes
Fleet		
Entry into service	1987	(1986 for original -300)
In service:	496	
Operators (current and planned)	79	
In storage	36	
On order	3	
Built peak year (1992)	53	
Built 2013	9	
Average age	16.0	years
Source AeroTransport Database December 2013		
Indicative Maintenance Reserves		
C-check reserve	$100-105	per flight hour
Higher checks reserve	$75-80	per flight hour
Engine overhaul	$165-170	per engine flight hour
Engine LLP	$255-260	per engine cycle
Landing gear refurbishment	$65-70	per cycle
Wheels brakes and tyres	$70-75	per cycle
APU	$109-110	per APU hour
Component overhaul	$250-260	per flight hour

Boeing 777-200ER

Seating/range		
Max seating	440	
Typical seating	400	two class (301 three class)
Maximum range	7,725	nm (14,305 km)
Technical characteristics		
MTOW	297.5	tonnes (656,000lbs)
OEW	137	tonnes
MZFW	191	tonnes
Fuel capacity	171,170	litres
Engines	PW4090	/Trent 895/GE90-94B
Thrust	90,000	lbs - 93,700lbs
Fuels and times		
Block fuel 1,000 Nm	14,140	kg
Block fuel 2,000 Nm	26,350	kg
Block fuel 4,000 Nm	50,780	kg
Block time 1,000 Nm	152	minutes
Block time 2,000 Nm	277	minutes
Block time 4,000 Nm	525	minutes
Fleet		
Entry into service	1996	for ER (1994 for original -200)
In service:	42	plus 86 non ER/LR models
Operators (current and planned)	38	
In storage	4	
On order	1	
Built peak year (1999)	63	
Built 2013	5	
Average age	12.2	years (ER version only)
Source AeroTransport Database December 2013		
Indicative Maintenance Reserves		
C-check reserve	$125-130	per flight hour
Higher checks reserve	$90-95	per flight hour
Engine overhaul (PW4090)	$305-310	per engine flight hour
Engine LLP	$520-525	per engine cycle
Landing gear refurbishment	$160-165	per cycle
Wheels brakes and tyres	$480-485	per cycle
APU	$105-110	per APU hour
Component overhaul	$410-415	per flight hour

Boeing 777-200LR

Seating/range		
Max seating	440	
Typical seating	301	three class
Maximum range	9,395	nm (17,395 km)
Technical characteristics		
MTOW	347.5	tonnes (766,000lbs)
OEW	137	tonnes
MZFW	191	tonnes
Fuel capacity	181,280	litres/202,570 litres
Engines	GE90-110B1	/GE90-115BL
Thrust	110,000	lbs - 115,300lbs (489 -512 kN)
Fuels and times		
Block fuel 1,000 Nm	14,140	kg
Block fuel 2,000 Nm	26,350	kg
Block fuel 4,000 Nm	50,780	kg
Block time 1,000 Nm	152	minutes
Block time 2,000 Nm	277	minutes
Block time 4,000 Nm	525	minutes
Fleet		
Entry into service	2005	
In service:	55	
Operators (current and planned)	13	
In storage	1	
On order	2	
Built peak year (2009)	16	
Built 2013	1	
Average age	4.6	years
Source AeroTransport Database December 2013		
Indicative Maintenance Reserves		
C-check reserve	$125-130	per flight hour
Higher checks reserve	$90-95	per flight hour
Engine overhaul	$290-295	per engine flight hour
Engine LLP	$450-455	per engine cycle
Landing gear refurbishment	$160-165	per cycle
Wheels brakes and tyres	$480-485	per cycle
APU	$105-110	per APU hour
Component overhaul	$410-415	per flight hour

Boeing 777-300ER

Seating/range		
Max seating	550	
Typical seating	365	three class
Maximum range	7,930	nm (14,685 km)
Technical characteristics		
MTOW	351.5	tonnes (775,000lbs)
OEW	168	tonnes
MZFW	238	tonnes
Fuel capacity	181,280	litres
Engines	GE90-115BL	
Thrust	115,300	lbs
Fuels and times		
Block fuel 1,000 Nm	15,610	kg
Block fuel 2,000 Nm	29,840	kg
Block fuel 4,000 Nm	60,900	kg
Block time 1,000 Nm	152	minutes
Block time 2,000 Nm	277	minutes
Block time 4,000 Nm	525	minutes
Fleet		
Entry into service	2003	for ER (1997 for original -300)
In service:	444	plus 60 non ER models
Operators (current and planned)	39	
In storage	1	
On order	269	
Built peak year (2013)	91	
Built 2013	91	
Average age	3.9	years
Source AeroTransport Database December 2013		
Indicative Maintenance Reserves		
C-check reserve	$125-130	per flight hour
Higher checks reserve	$90-95	per flight hour
Engine overhaul	$290-295	per engine flight hour
Engine LLP	$450-455	per engine cycle
Landing gear refurbishment	$160-165	per cycle
Wheels brakes and tyres	$480-485	per cycle
APU	$105-110	per APU hour
Component overhaul	$410-415	per flight hour

Boeing 787-8

Seating/range		
Max seating	350	
Typical seating	264	two class (242 three class)
Maximum range	7,650	nm to 8,200 nm (14,200 km to 15,200km)
Technical characteristics		
MTOW	227.9	tonnes (502,500lbs)
OEW	110	tonnes
MZFW	172	tonnes
Fuel capacity	126,920	litres
Engines	Genx	/Trent 1000
Thrust	64,000	lbs (280 kN)
Fuels and times		
Block fuel 1000Nm	10,176	kg
Block fuel 2000Nm	18,968	kg
Block fuel 4000Nm	36,544	kg
Block time 1000Nm	146	minutes
Block time 2000Nm	265	minutes
Block time 4000Nm	501	minutes
Fleet		
Entry into service	2011	October
In service:	105	
Operators (current and planned)	48	
In storage	0	
On order	884	all models
Built peak year (2013)	87	
Built 2013	87	
Average age	0.9	years
Source AeroTransport Database December 2013		

Indicative Maintenance Reserves	
C-check reserve	insufficient experience/data
Higher checks reserve	insufficient experience/data
Engine overhaul	insufficient experience/data
Engine LLP	insufficient experience/data
Landing gear refurbishment	insufficient experience/data
Wheels brakes and tyres	insufficient experience/data
APU	insufficient experience/data
Component overhaul	insufficient experience/data

BOMBADIER CRJ700

Seating/range		
Max seating	78	
Typical seating	70	at 31inch pirch
Maximum range	1,218	nm (2,256 km)
Technical characteristics		
MTOW	33	tonnes (72,750 lbs)
OEW	20.1	tonnes (44,245 lbs)
MZFW	28.3	tonnes (62,300 lbs)
Fuel capacity	10,990	litres
Engines	CF34-8C5B1	
Thrust	12,670	lbs (56 kn)
Fuels and times		
Block fuel 200 Nm	1,150	kg
Block fuel 500 Nm	1,950	kg
Block time 200 Nm	45	minutes
Block time 500 Nm	88	minutes
Fleet		
Entry into service	2001	
In service:	342	including 30 ER versions
Operators (current and planned)	20	
In storage	6	
On order	7	
Built peak year (2005)	68	
Built 2013	5	
Average age	8.6	years
Source AeroTransport Database December 2013		
Indicative Maintenance Reserves		
C-check reserve	$45-50	per flight hour
Higher checks reserve	$35-40	per flight hour
Engine overhaul	$70-75	per engine flight hour
Engine LLP	$100-105	per engine cycle
Landing gear refurbishment	$30-35	per cycle
Wheels brakes and tyres	$45-50	per cycle
APU	$55-60	per APU hour
Component overhaul	$150-160	per flight hour

BOMBADIER CRJ900

Seating/range		
Max seating	90	
Typical seating	88	at 31inch pirch
Maximum range	1,040	nm (1,940 km)
Technical characteristics		
MTOW	36.5	tonnes (80,500 lbs)
OEW	21.8	tonnes (48,160 lbs)
MZFW	31.8	tonnes (70,000 lbs)
Fuel capacity	10,990	litres
Engines	CF34-8C5	
Thrust	13,360	lbs (59kn)
Fuels and times		
Block fuel 200 Nm	1,240	kg
Block fuel 500 Nm	2,100	kg
Block time 200 Nm	45	minutes
Block time 500 Nm	88	minutes
Fleet		
Entry into service	2001	
In service:	256	including 54 ER & 71 LR versions
Operators (current and planned)	22	
In storage	24	
On order	70	
Built peak year (2008)	59	
Built 2013	1	
Average age	5.7	years
Source AeroTransport Database December 2013		
Indicative Maintenance Reserves		
C-check reserve	$50-55	per flight hour
Higher checks reserve	$35-40	per flight hour
Engine overhaul	$70-75	per engine flight hour
Engine LLP	$100-105	per engine cycle
Landing gear refurbishment	$30-35	per cycle
Wheels brakes and tyres	$50-55	per cycle
APU	$60-65	per APU hour
Component overhaul	$160-165	per flight hour

CRJ1000

Seating/range		
Max seating	100	
Typical seating	100	at 31inch pirch
Maximum range	1,425	nm (2,640 km)
Technical characteristics		
MTOW	40.8	tonnes (90,000 lbs)
OEW	23.2	tonnes (51,120 lbs)
MZFW	35.2	tonnes (77,500 lbs)
Fuel capacity	10,990	litres
Engines	CF34-8C5A1	
Thrust	13,360	lbs (59kn)
Fuels and times		
Block fuel 200 Nm	1,320	kg
Block fuel 500 Nm	2,200	kg
Block time 200 Nm	45	minutes
Block time 500 Nm	88	minutes
Fleet		
Entry into service	2011	
In service:	37	
Operators (current and planned)	4	
In storage	0	
On order	38	
Built peak year (2011)	15	
Built 2013	18	
Average age	1.9	years
Source AeroTransport Database December 2013		
Indicative Maintenance Reserves		
C-check reserve	$50-55	per flight hour
Higher checks reserve	$35-40	per flight hour
Engine overhaul	$70-75	per engine flight hour
Engine LLP	$100-105	per engine cycle
Landing gear refurbishment	$30-35	per cycle
Wheels brakes and tyres	$50-55	per cycle
APU	$60-65	per APU hour
Component overhaul	$160-165	per flight hour

Q400

Seating/range		
Max seating	80	
Typical seating	74	at 31inch pirch
Maximum range	1,010	nm (1,870 km)
Technical characteristics		
MTOW	29.5	tonnes (65,200 lbs)
OEW	17.8	tonnes (30,290 lbs)
MZFW	26.3	tonnes (58,000 lbs)
Fuel capacity	67,000	litres
Engines	PW150A	
Thrust	5,070	shp
Fuels and times		
Block fuel 100Nm	525	kg
Block fuel 200 Nm	855	kg
Block fuel 500 Nm	1,860	kg
Block time 100 Nm	35	minutes
Block time 200 Nm	55	minutes
Block time 500 Nm	108	minutes
Fleet		
Entry into service	1999	
In service:	416	
Operators (current and planned)	50	
In storage	29	
On order	64	
Built peak year (2012)	40	
Built 2013	42	
Average age	5.3	years
Source AeroTransport Database December 2013		
Indicative Maintenance Reserves		
C-check reserve	$45-50	per flight hour
Higher checks reserve	$34-35	per flight hour
Engine overhaul	$145-150	per engine flight hour
Engine LLP	$40-45	per engine cycle
Landing gear refurbishment	$30-35	per cycle
Wheels brakes and tyres	$45-50	per cycle
APU	$55-60	per APU hour
Propeller	$15-20	per propeller hour
Component overhaul	$145-150	per flight hour

E170

Seating/range		
Max seating	80	at 30/29 inch pitch
Typical seating	70	at 32inch pirch
Maximum range (AR version)	2,100	nm (3,890 km)
Technical characteristics		
MTOW	35.99	tonnes (79,340 lbs)
OEW	21	tonnes (46,385 lbs)
MZFW	30.14	tonnes (66,447 lbs)
Fuel capacity	11,670	litres
Engines	CF34-8E	
Thrust	13,800	lbs
Fuels and times		
Block fuel 200 Nm	1,120	kg
Block fuel 500 Nm	2,260	kg
Block time 200 Nm	44	minutes
Block time 500 Nm	79	minutes
Fleet data		
Entry into service	2004	
In service	184	
Operators (current and planned)	27	
In storage	6	
On order	15	
Built peak year (2008)	65	
Built 2013	17	
Average age	7.2	years
Source AeroTransport Database December 2013		
Indicative maintenance reserves		
C-check reserve	$45-50	per flight hour
Higher checks reserve	$35-40	per flight hour
Engine overhaul	$70-75	per engine flight hour
Engine LLP	$100-105	per engine cycle
Landing gear refurbishment	$30-35	per cycle
Wheels brakes and tyres	$50-55	per cycle
APU	$55-60	per APU hour
Component overhaul	$150-160	per flight hour

E175

Seating/range		
Max seating	88	at 30inch pitch
Typical seating	78	at 32inch pirch
Maximum range (AR version)	2,000	nm (3,706 km)
Technical characteristics		
MTOW	37.5	tonnes (79,340 lbs)
OEW	21.62	tonnes (47,664 lbs)
MZFW	31.7	tonnes (69,887 lbs)
Fuel capacity	11,670	litres
Engines	CF34-8E	
Thrust	13,800	lbs
Fuels and times		
Block fuel 200 Nm	1,180	kg
Block fuel 500 Nm	2,390	kg
Block time 200 Nm	45	minutes
Block time 500 Nm	81	minutes
Fleet		
Entry into service	2005	
In service	177	
Operators (current and planned)	22	
In storage	6	
On order	10	
Built peak year (2008)	56	(Combined 170&175)
Built 2013	22	(Combined 170&175)
Average age	4.6	years
Source AeroTransport Database December 2013		
Indicative maintenance reserves		
C-check reserve	$45-50	per flight hour
Higher checks reserve	$35-40	per flight hour
Engine overhaul	$70-75	per engine flight hour
Engine LLP	$100-105	per engine cycle
Landing gear refurbishment	$30-35	per cycle
Wheels brakes and tyres	$50-55	per cycle
APU	$55-60	per APU hour
Component overhaul	$150-160	per flight hour

E190

Seating/range		
Max seating	114	at 30inch pitch
Typical seating	98	at 32inch pirch
Maximum range (AR version)	2,400	nm (4,448 km)
Technical characteristics		
MTOW	47.8	tonnes (105,359 lbs)
OEW	27.72	tonnes (47,664 lbs)
MZFW	40.8	tonnes (89,949 lbs)
Fuel capacity	16,210	litres
Engines	CF34-10E	
Thrust	18,500	lbs
Fuels and times		
Block fuel 200 Nm	1,340	kg
Block fuel 500 Nm	2,710	kg
Block time 200 Nm	46	minutes
Block time 500 Nm	83	minutes
Fleet		
Entry into service	2005	
In service	613	
Operators (current and planned)	71	
In storage	16	
On order	183	
Built peak year (2011)	93	
Built 2013	86	
Average age	3.9	years
Source AeroTransport Database December 2013		
Indicative maintenance reserves		
C-check reserve	$45-50	per flight hour
Higher checks reserve	$35-40	per flight hour
Engine overhaul	$70-75	per engine flight hour
Engine LLP	$90-95	per engine cycle
Landing gear refurbishment	$35-40	per cycle
Wheels brakes and tyres	$55-60	per cycle
APU	$70-75	per APU hour
Component overhaul	$180-185	per flight hour

E195

Seating/range		
Max seating	122	at 30inch pitch
Typical seating	108	at 32inch pirch
Maximum range (AR version)	2,200	nm (4,077 km)
Technical characteristics		
MTOW	48.79	tonnes (105,359 lbs)
OEW	28.85	tonnes (63,603 lbs)
MZFW	42.5	tonnes (93,696 lbs)
Fuel capacity	16,210	litres
Engines	CF34-10E	
Thrust	18,500	lbs
Fuels and times		
Block fuel 200 Nm	1,420	kg
Block fuel 500 Nm	2,870	kg
Block time 200 Nm	47	minutes
Block time 500 Nm	85	minutes
Fleet		
Entry into service	2006	
In service	121	
Operators (current and planned)	67	
In storage	5	
On order	14	
Built peak year (2013)	23	
Built 2013	19	
Average age	3.3	years
Source AeroTransport Database December 2013		
Indicative maintenance reserves		
C-check reserve	$45-50	per flight hour
Higher checks reserve	$35-40	per flight hour
Engine overhaul	$70-75	per engine flight hour
Engine LLP	$90-95	per engine cycle
Landing gear refurbishment	$35-40	per cycle
Wheels brakes and tyres	$55-60	per cycle
APU	$70-75	per APU hour
Component overhaul	$180-185	per flight hour

NEW AIRCRAFT COSTS

NEW AIRCRAFT MARKET VALUES ($ MILLIONS)

Model	Avitas view	CV view	IBA view	ICF SH&E view
A319	39.6	37.0	34.3	36.0
A320	43.5	44.0	41.0	41.6
A321	53.8	51.2	48.0	50.2
A330-200	95.0	89.6	87.0	94.0
A330-300	105.3	101.2	100.0	101.5
A380	208.1	235.9	215.0	201.5
737-700	40.6	36.3	34.5	37.5
737-800	48.3	46.6	46.0	43.4
737-900ER	53.3	48.4	48.5	48.1
747-8I	171.0	162.8	170.0	167.4
767-300ER	77.8	53.8	61.5	67.7
777-200ER	132.5	104.1	115.0	120.0
777-200LR	154.7	150.5	141.0	144.1
777-300ER	165.9	171.4	165.0	162.1
787-8	115.3	116.1	113.0	117.2
CRJ700	24.6 (ER)	23.2	22.5	21.7
CRJ900	26.9 (ER)	25.3	25.0	25.0
CRJ1000	29.4 (ER)	27.1	27.5	28.3
E170 (LR)	27.9	27.4	27.0	27.0
E175 (LR)	28.8	28.7	29.2	29.2
E190 (AR)	31.9	33.1	32.5	31.9
E195 (AR)	35.0	35.3	34.5	34.7
Q400	21.3	20.6	21.0	20.5
ATR42-600	-	16.0	15.5	14.1
ATR72-600	19.0	19.6	20.0	19.9

NEW AIRCRAFT COSTS

NEW AIRCRAFT LEASE RATES ($000s)				
Model	Avitas view	CV view	IBA view	ICF SH&E view
A319	240-280	250	270	230-290
A320	295-345	330	320	270-330
A321	365-415	405	385	350-400
A330-200	775-875	795	850	700-820
A330-300	850-950 (HW)	885	900	770-880
A380	1,700-1,830	1850	1,700	1,400-1,600
737-700	265-305	250	300	240-300
737-800	340-400	365	360	310360
737-900ER	360-410	390	390	350-380
747-8I	1,235-1,365	1300	1,300	1,170-1,340
767-300ER	430-520	425	460	450-500
777-200ER	925-1,025	900	900	780-860
777-200LR	1,065-1,175	1250	1,150	1,080-1,120
777-300ER	1,035-1,145	1350	1,300	1,110-1,300
787-8	890-1,000	1050	1,100	900-950
CRJ700	185-215 (ER)	215	200	170-200
CRJ900	200-230 (ER)	240	220	180-210
CRJ1000	225-260 (ER)	250	250	220-250
E170 (LR)	205-240	230	230	200-230
E175 (LR)	215-255	240	250	210-240
E190 (AR)	240-280	295	280	240-270
E195 (AR)	275-315	310	300	250-300
Q400	180-210	195	190	160-180
ATR42-600	-	160	150	100-120
ATR72-600	175-205	190	190	140-160