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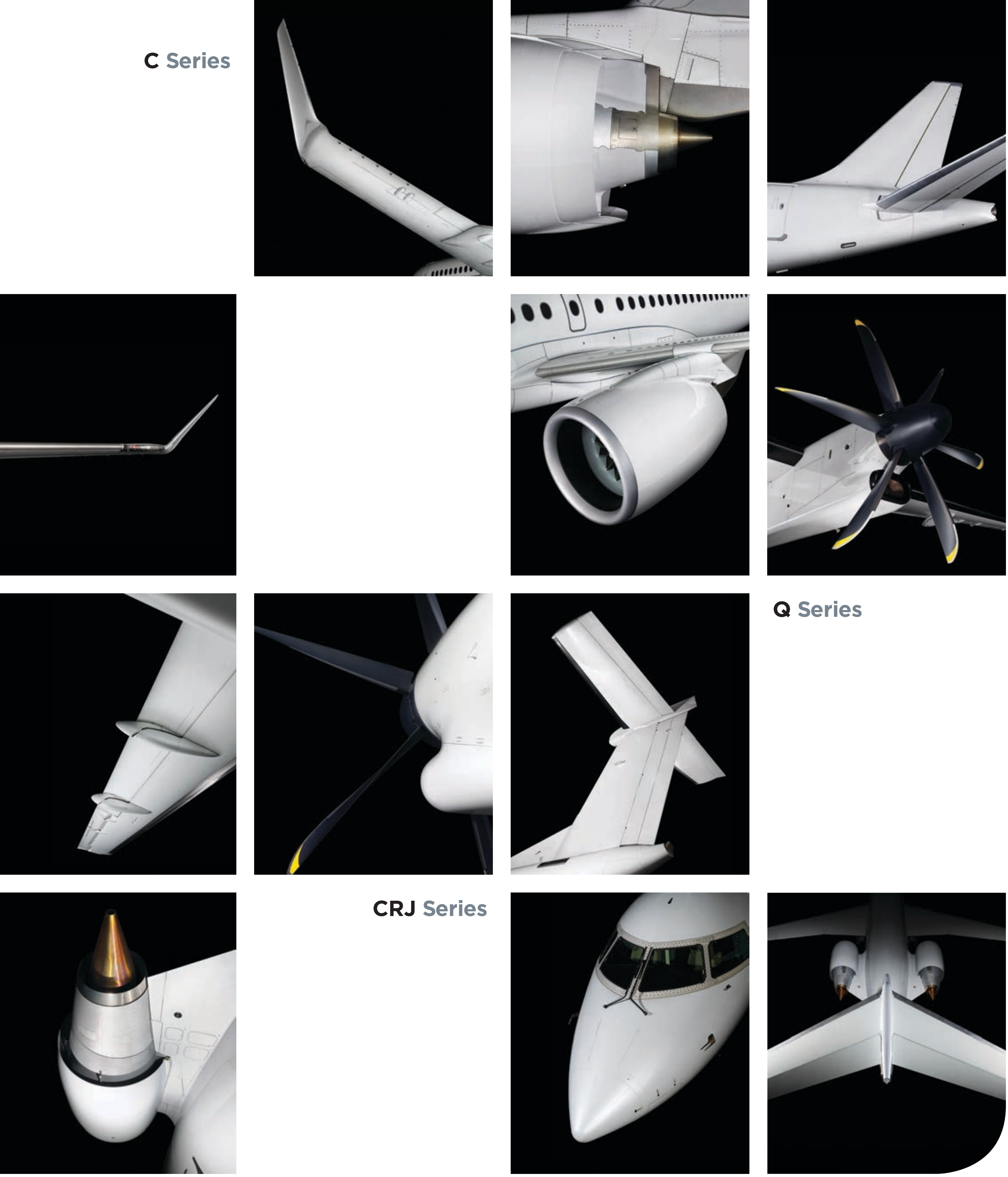
AIR INVESTOR 2016

Finding the right path for investors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CONTENTS

AIR INVESTOR 2016

OPERATORS' AND INVESTORS' POLL 2015

Narrowbodies stay on top

Airfinance Journal's annual landmark poll confirms investor confidence in future models.

The 737 Max8 nosed ahead of the A320neo

Manufacturers are often the target of criticism from the investment community, but the results from *Airfinance Journal*'s 2015 Investors' and Operators' Poll appear to be an endorsement of their development programmes.

The top three positions in the overall standings are occupied by aircraft models that had yet to enter service when the poll was carried out. All three models are narrowbodies or, as the manufacturers prefer to call them, single-aisle aircraft.

The entry into service of the A320neo, which came second in the poll, in January 2016 means the aircraft technically qualifies as a current-production model. However, as with the other new-generation aircraft yet to enter service, investors and operators are basing their judgments of the aircraft on the claims and promises of manufacturers.

Given the large order books for the new-generation single-aisle aircraft, support for these aircraft in our poll is perhaps unsurprising. The fact that the 737-8 Max nosed ahead of the A320neo to take first place might be seen as more surprising, given the Airbus model is ahead of its rival in terms of entry into service and accumulated orders.

There is much talk in the investment community that the new-technology models will undermine the values of current-generation single-aisle aircraft, but our poll suggests that significant confidence remains in the current models. Three current-generation types figure in the top 10 by overall ranking, aided by high scores in the operational success category. Of the four categories we asked respondents to consider, operational success is the only one that does not apply to both current production and future models.

Some respondents also commented that remarketing potential was difficult to assess for the new-generation models until fleet sizes had built up. To a lesser extent, this observation is valid for judgments on residual value.

NARROWBODY CURRENT

Aircraft Type	Residual value	Value for Money	Operational success	Remarketing Potential	Overall	2014 result	Change
737-800	4.33	4.08	4.90	4.58	4.48	4.52	-0.04
A320	3.92	4.00	4.90	4.50	4.33	4.03	0.30
A321	3.91	4.09	4.50	4.36	4.22	4.20	0.02
737-900ER	3.61	3.72	3.71	3.50	3.64	3.02	0.62
E195	3.06	3.17	3.21	2.83	3.07	3.3	-0.23
737-700	2.56	2.44	3.75	2.67	2.85	3.12	-0.27
CS300	2.64	3.07	n/a	2.58	2.77	2.81	-0.04
A319	2.50	2.56	3.11	2.60	2.69	2.58	0.11
CS100	2.64	2.79	n/a	2.58	2.67	2.74	-0.07

NARROWBODY FUTURE

Aircraft Type	Residual value	Value for Money	Operational success	Remarketing Potential	Overall	2014 result	Change
737 Max8	4.79	4.31	n/a	4.79	4.63	4.44	0.19
A320 neo	4.50	4.31	n/a	4.75	4.52	4.51	0.01
A321neo	4.64	4.50	n/a	4.42	4.52	4.47	0.05
737 Max9	3.79	3.79	n/a	4.08	3.88	3.91	-0.03
E190-E2	3.67	3.67	n/a	3.80	3.71	3.47	0.24
E195-E2	3.50	3.67	n/a	3.80	3.66	3.47	0.19
E175-E2	3.50	3.50	n/a	3.60	3.53	3.67	-0.14
737 Max7	3.17	3.17	n/a	3.17	3.17	2.84	0.33
A319 neo	2.70	2.90	n/a	2.70	2.77	2.82	-0.05
CS300	2.64	3.07	n/a	2.58	2.77	2.81	-0.04
CS100	2.64	2.79	n/a	2.58	2.67	2.74	-0.07

"The top three positions in the overall standings are occupied by aircraft models that had yet to enter service when the poll was carried out."

Perhaps the most straightforward category to judge is value-for-money, although a lack of transparency on discounting by the manufacturers complicates the issue. With a score of 4.50, the A321neo scores higher in terms of value for money than any other type, and new-technology models in general score well, perhaps suggesting that the premium that manufacturers are seeking for these models is not seen as excessive.

Engine choice

Some respondents have pointed out that rating certain aircraft types without reference to the choice of engine manufacturer is unhelpful because values can vary dramatically between the engine variants. There is clearly some merit in this argument, particularly when considering some of the more established widebodies.

However, given that the poll focuses on new production and in-development models, the issue is becoming less critical because fewer aircraft types are offered with a choice of engines from different manufacturers.

Among the more popular models only the A320 and 787 families offer a choice. The trend to single source engine suppliers is confirmed by the absence of an alternative powerplant on new widebody programmes such as the 777X and the A330neo. And, should an A380neo be launched, it seems unlikely that there would be more than one engine supplier.

Popular narrowbodies

As in previous years, popular narrowbodies have topped the poll across the board. Their scores in this year's survey also show that in-production aircraft remain popular, despite the imminent arrival of latest-technology variants.

Boeing's 737 family and Airbus's A320-family jets have remained attractive to investors because of their wide operator base and reliable performance. A wide and deep market for these aircraft means that investors feel comfortable with their remarketing potential – which is reflected by their strong scores.

The 2014 poll revealed investor belief in in-production aircraft had remained steady, despite the imminent arrival of new-engine variants. While some market figures voiced concerns about the residual value of the older aircraft, most respondents said that any substantial softening of in-production values, if it happens at all, would take a few years at least. This is because, for the first few years of service, the number of new-technology aircraft in the market would be dwarfed by the number of older aircraft.

THE TOP 20

Rank	Aircraft type	Overall score
1	737 Max 8	4.63
2	A320neo	4.52
3	A321neo	4.52
4	737-800	4.48
5	787-10	4.44
6	777-9X	4.42
7	A320	4.33
8	787-9	4.31
9	A321	4.22
10	A350-900	4.17
11	787-8	4.12
12	ATR 72-600	4.04
13	777-8X	3.94
14	737 Max 9	3.88
15	ATR 42-600	3.81
16	777-300ER	3.72
17	E190-E2	3.71
18	E195-E2	3.66
19	737-900ER	3.64
20	A350-1000	3.61

So, for the time being, investors have again shown confidence in in-production narrowbodies.

In our previous poll, for example, Airbus's A320-200 achieved an overall score of 4.03, while the A320neo was awarded 4.51. In this year's results, the types achieved 4.13 and 4.52, respectively, showing modest improvement for the in-production types.

The score for Boeing's most popular narrowbody, the 737-800, has gone down slightly from last year, but the model is still popular enough to take fourth place in the overall rankings. Last year, the 737-800 scored 4.52 and the Max 8 got 4.44. This year, the in-production model got 4.33, while the Max 8 got 4.63, topping the poll.

Some investors say the retention of high scores of in-production aircraft owes much to the low cost of fuel. The Max and the Neo appeal to airlines because of their fuel efficiency, but with Brent crude at $40 a barrel, this advantage becomes less significant. Older in-production aircraft, despite being less efficient, can be bought and leased for substantially less.

"Little effect on the values of the A320ceo and the 737NG is visible today, since the economics of the 737 Max and A320neo family are only really unlocked at higher fuel prices and/or when the market share of the new-generation aircraft grows more substantial," notes Simon Finn, senior vice-president, aviation research, DVB Bank SE.

Finn adds: "Values of both generations will continue to be affected by macro factors such as traffic, fuel prices and interest rates, but the residual value effect of new-generation aircraft should not become significant before the 2020s. A bigger risk is the threat of over production and the elevated levels of used aircraft transition that result from the growth of aircraft leasing activity."

The recent difficulties of Bombardier do not appear to have hit the popularity of the CSeries models as much as might have been expected. This may have been helped by the recent certification of the CS100, which was finally achieved at the end of 2015.

In the 2014 poll, both of Bombardier's single-aisle contenders had shown minor improvement to reach scores of 2.81 (CS300) and 2.74 (CS100). These have slipped only marginally to 2.77 and 2.67, respectively, in the current survey. However, the aircraft were already well down the ranking table and this remains the case.

One respondent confided to *Airfinance Journal* that it had scored all of Bombardier's aircraft, including the CSeries, poorly because of the uncertainty around the company.

Widebodies

Although there are specialists in widebody aircraft financing who extol the virtues of this market segment, it has been overshadowed by the single-aisle market. More limited customer bases and high transition/reconfiguration costs are often cited as drawbacks to financing larger commercial aircraft.

Our survey certainly shows a decline in confidence in current-technology aircraft in the sector. Last year, the 777-300ER, which at the height of its popularity topped our poll, had a respectable overall score of 4.07. In this survey, it scored 3.72, mirroring increasing concerns in the market that have been well documented (see 777-300ER – a remarketing challenge, *Airfinance Journal*, July/August 2015, page 27).

The smaller 777-200ER has also dropped in value this year. Scoring 2.78 overall, the aircraft has also scored poorly for remarketing potential. Respondents said that it is difficult to trade in the secondary market, partly because of the popularity of the larger -300ER variant.

"The 777-200ER is a great aircraft, but the remarketing of the aircraft has its challenges in the current market," says Abdol Moabery, president and chief executive officer, GA Telesis.

"The lack of an aftermarket trading environment, specifically related to the engines, has led

“The trend to single source engine suppliers is confirmed by the absence of an alternative powerplant on new widebody programmes such as the 777X and the A3330neo”

sellers to draw a blank when they approach the secondary aircraft traders and lessors. These secondary traders and lessors are the ones that provide liquidity to that market and in the current environment, the airline and top-tier lessor communities are hitting a brick wall when it comes to trading their 777-200ERs,” he adds.

Moabery says he expects 777-200ER values to continue to plummet.

“I anticipate greater problems ahead, especially as some of the larger 777-200ER fleets come to market. The engine OEMs [original equipment manufacturers] need to embrace the market that provides liquidity for their products,” he adds.

Boeing’s 787 models appear to be seen in a favourable light, perhaps reflecting that investors view them as new-technology models with the added advantage that the -8 and -9 variants are becoming well established in service. However, the in-development 787-10 scores better than both its in-service family members and, in sixth position, is the highest ranked widebody in the survey. The fact that the 787-10 is the largest model in the family may be a factor in its popularity as it scores well in the value-for-money criteria.

Respondents seem to think Boeing’s 777-9X is worth waiting for as it is the second highest-placed widebody despite having an entry-into-service target of 2020, several years behind any of the other aircraft considered in the poll.

Some respondents also drew attention to the A330-200 and -300, stating that values had begun to soften in the past year. This is supported by the results of the poll, which shows that the overall scores have dropped from 3.13 to 2.92 and from 3.80 to 3.37 for the -200 and -300 variants, respectively.

However, other investors brushed aside concerns about the value of these aircraft, insisting that they are still very strong performers. Under the operational success category, the scores remained steady or improved.

Regional aircraft

The term regional aircraft may be outmoded and is certainly disliked by the manufacturers of the latest generation of 100-seaters, but it is sill widely used by the industry. For our poll we have categorized aircraft that typically seat less than 100 passengers as regional aircraft. Therefore, both CSeries models are included in the main narrowbody category, but all other Bombardier aircraft are classified as regional aircraft.

For both generations of Embraer’s E-Jets, the line is drawn between the E190 and the E195, with the former included in the regional category together with the respective E170/175 models.

Although smaller aircraft have become more popular with financiers (see Small aircraft, big rewards, *Airfinance Journal*, November 2015, page 33), they continue to score relatively modestly compared to single-aisle aircraft. The highest placed regional aircraft is the ATR 72-600, in 12th place.

The A321neo joined the A320neo in the top three

A more detailed analysis, however, does show the aircraft in a good light. The larger ATR model has a respectable overall score of more than four, and has a better score for residual value retention than the current A320 model. Such a result for a turboprop would have been unthinkable a few years ago.

Embraer’s best-performing aircraft are its new-generation models, with the E190-E2 making it into the top 20 (as does the larger E195-E2). Embraer’s management of the transition to the new generation of aircraft appears to be having the desired effect of retaining confidence in the current E175 model. The E175 scores for both the current-generation and E2 models are marginally higher than in the previous poll and the two aircraft are together in the rankings.

The apparent disconnect between regional

WIDEBODY CURRENT

Aircraft Type	Residual value	Value for Money	Operational success	Remarketing Potential	Overall	2014 result	Change
787-9	4.28	4.17	4.50	4.28	4.31	4.37	-0.06
A350-900	4.25	4.06	4.00	4.38	4.17	3.88	0.29
787-8	4.00	3.88	4.36	4.25	4.12	3.51	0.61
777-300ER	3.41	3.65	4.50	3.32	3.72	4.07	-0.35
A330-300	3.08	3.08	4.05	3.25	3.37	3.80	-0.43
A330-200	2.54	2.86	3.73	2.54	2.92	3.13	-0.21
777-200ER	2.50	2.72	3.50	2.39	2.78	3.33	-0.55
A380	1.75	2.25	3.00	1.31	2.08	2.44	-0.36
747-8 pax	1.63	2.13	2.00	1.25	1.75	1.83	-0.08

WIDEBODY FUTURE

Aircraft Type	Residual value	Value for Money	Operational success	Remarketing Potential	Overall	2014 result	Change
787-10	4.33	4.50	n/a	4.50	4.44	n/a	n/a
777-9X	4.58	4.42	n/a	4.25	4.42	n/a	n/a
777-8X	4.00	3.83	n/a	4.00	3.94	n/a	n/a
A330-900 neo	3.44	3.31	n/a	3.50	3.42	3.78	-0.36
A330-800 neo	2.94	3.19	n/a	2.79	2.97	3.26	-0.29
A350-800	2.67	2.75	n/a	2.83	2.75	2.53	0.22

“Some investors say the retention of high scores of in-production aircraft owes much to the low cost of fuel.”

aircraft scores and increased investor appetite may be explained in the thinking of one respondent who commented: “We didn’t score regional aircraft that highly, but we quite like them as the pricing means you don’t have to bet the company on acquiring them.”

Introduction of SSJ

For the first time, this year’s poll has accepted submissions for the Sukhoi Superjet 100. The Russian-manufactured jet has traditionally been operated mostly by Russian carriers, although there are notable exceptions such as Mexican airline Interjet.

However, at the end of 2014 Belgian charter airline VLM Airlines became the first European carrier to agree to lease the aircraft. It signed a letter of intent with Ilyushin Finance Company in October 2014 for the 12-year lease of two aircraft. In October 2015, CityJet joined the list of European carriers that will operate the jet. It signed an agreement for 25 of the aircraft, and will begin taking delivery in the first quarter of 2016.

When asked about the aircraft from an investors’ standpoint, most respondents are cautious about its value. With an overall score of 1.94, the regional jet has scored lower in the overall category than the other assets in its seat range.

It has scored better in the value-for-money section, suggesting it can be bought for agreeable prices. This bodes well for Sukhoi as it seeks to expand its market share and widen its customer base.

Sukhoi still has work to do to take sales away from its regional rivals. In particular, the manufacturer must convince investors that the maintenance agreements in place are up to the job. It also needs to prove that the market is liquid enough to support trading.

However, the fact that the Superjet is the first Russian-built aircraft to be included in the *Airfinance Journal* poll could be seen as a breakthrough. Other non-western models such as the Irkut MC-21 and China’s Comac C919 are not as yet thought of as viable models for western financiers and as such were not included in our poll.

METHODOLOGY

The poll asked respondents to rate aircraft types from one to five in four categories (one is worst and five is best). The categories were: residual value, value for money, operational success and remarketing potential. Only current production and in-development models were included in the questionnaire. The operational success category was omitted for aircraft in development.

Overall ranking was calculated by a simple average of the relevant categories. Responses were completed on the understanding that they would remain anonymous..

Confidence in the E175 remains high

MRJ

We had not asked investors to look at the Mitsubishi Regional Jet for this poll because as a new aircraft from a new manufacturer there is relatively little experience on which to base a judgment.

The further delay to entry into service, announced at the end of 2015, adds to this view.

Some respondents did comment that they had an open mind about whether they would finance the aircraft, but the additional delay is unlikely to help its case.

REGIONAL CURRENT

Aircraft Type	Residual value	Value for Money	Operational success	Remarketing Potential	Overall	2014 result	Change
ATR72-600	4.17	3.83	4.00	4.17	4.04	3.99	0.05
ATR42-600	3.83	3.67	3.75	4.00	3.81	3.46	0.35
E175	3.31	3.44	3.42	3.56	3.43	3.37	0.06
E190	3.17	3.28	3.64	3.17	3.31	3.61	-0.30
Q400	3.25	3.08	3.63	3.25	3.30	3.36	-0.06
E195	3.06	3.17	3.21	2.83	3.07	3.3	-0.23
CRJ900	3.14	3.14	2.67	3.00	2.99	2.60	0.39
E170	2.93	2.79	3.10	2.79	2.90	2.77	0.13
CRJ1000	2.50	2.79	2.10	2.50	2.47	2.20	0.27
CRJ700	2.14	2.29	2.50	2.57	2.38	2.95	-0.58
SSJ-100	1.80	2.70	2.00	1.70	2.00	n/a	n/a
ERJ-145	1.75	1.75	1.75	1.64	1.72	1.77	-0.05
CRJ200	1.21	1.30	1.83	1.21	1.39	1.61	-0.22

REGIONAL FUTURE

Aircraft Type	Residual value	Value for Money	Operational success	Remarketing Potential	Overall	2014 result	Change
E190-E2	3.67	3.67	n/a	3.80	3.71	3.47	0.24
E175-E2	3.50	3.50	n/a	3.60	3.53	3.67	-0.14

SPONSORED EDITORIAL

Sunset and mature engines exit strategies

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Manager,
Strategic Knowledge
TES

The rate of aircraft retirements looks set to increase as deliveries of new-generation models gather pace. Lionel Maisonneuve, manager strategic knowledge, TES, looks at the impact on the economics of mature engines.

The imminent delivery of the first A320neo signals the beginning of a transition to a new engine/aircraft generation, with models such as the 737 Max, A350, 777X, 787 and A330neo set to follow in due course.

The arrival of these new models, the unprecedented number of aircraft retirements over the next 20 years and low oil prices are combining to place the economics of mature and sunset engines (engine types no longer in production and with in-service numbers decreasing) under the spotlight.

New growth

The commercial aviation industry has been a growing market for several consecutive decades and, despite temporary downturns because of external factors such as financial crises, oil price fluctuations, wars, terrorism and pandemics, the overall trend shows a regular and strong growth.

Based on the latest market forecasts, published by the two leading aircraft manufacturers, Airbus and Boeing, it is estimated that air traffic will grow at an average annual rate of 4.6% to 4.9% over the next 20 years.

To support this growth, between 32,600 and 38,050 new aircraft will be required by 2034. About 40% of these new aircraft will be direct replacements for existing aircraft that will be retired within the next 20 years, while the remaining 60% will support market growth. As a result, the worldwide fleet of aircraft in service is predicted to double over the next 20 years from 21,600 in 2014 to 43,560 in 2034. The vast majority of these new aircraft (70%) are expected to be single-aisle models.

Based on the projections from Airbus and Boeing, the number of aircraft retirements over the next 20 years is estimated to be over 16,000 units. If these projections are correct, retirement numbers will reach an unprecedented scale and will definitely have a negative impact on the residual value of aircraft currently in service.

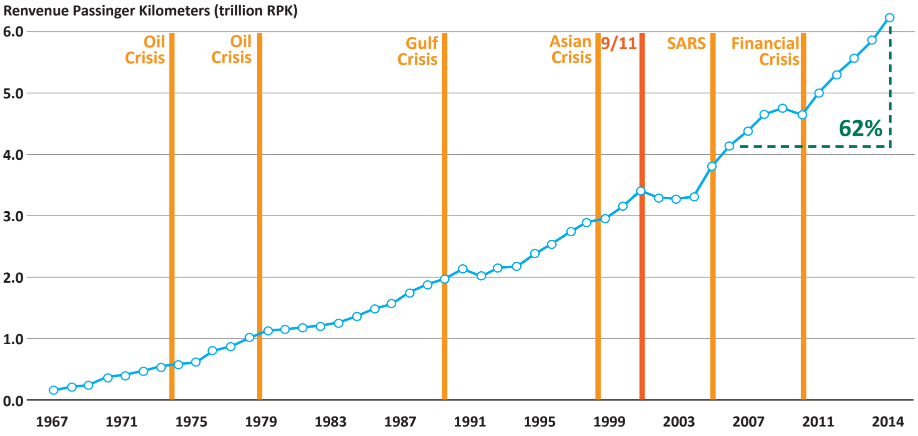
As an aircraft ages, most of the value resides in the engines, therefore engine owners and operators need to define exit strategies to extract the maximum value out of these assets.

Sunset engines include, but are not limited to, CF6-80C2, PW4000-94", CFM56-3, CFM56-5A1/5C, V2500-A1/D5, RB211-535E4 and PW2000 models.

Mature engines are engine types still in production but soon to be replaced by a new generation. In-service numbers are still growing but are about to reach their peak. These include CFM56-5B, CFM56-7B, V2500-A5, CF6-80E1, Trent 700 and PW4000-100" types.

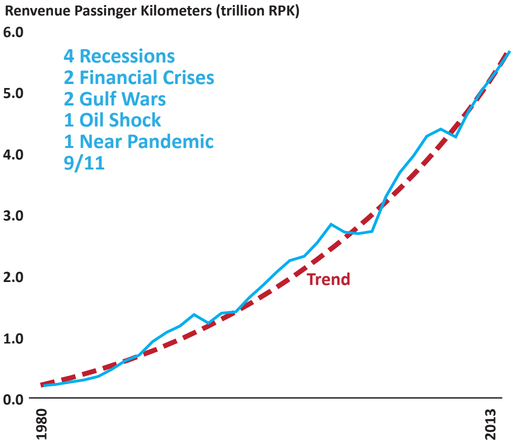
Despite several significant hardware upgrades under various technical/marketing designations (Tech Insertion, PIP, Evolution, SelectOne), the

World Annual Traffic (trillion RPK)



Source: Boeing Current Market Outlook 2014

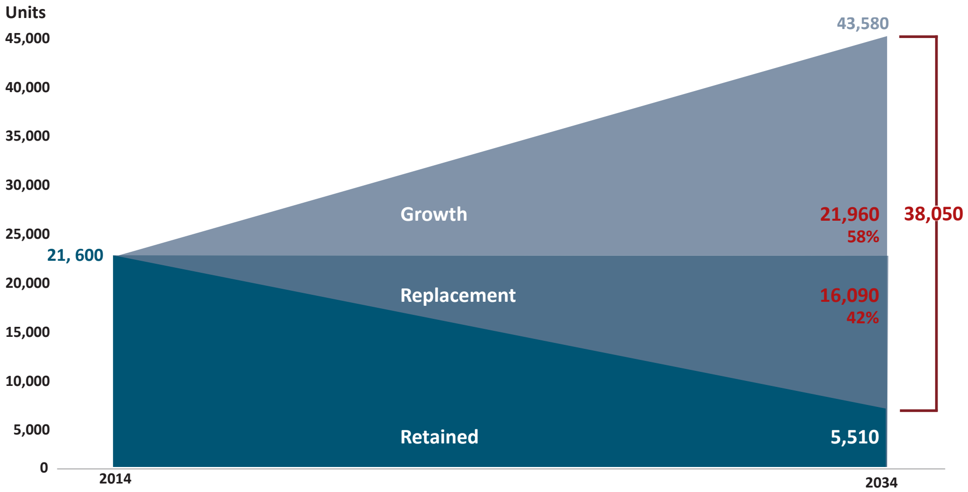
Traffic and Market Outlook



Source: Airbus Global Market Forecast 2015

"Based on the projections from Airbus and Boeing, the number of aircraft retirements over the next 20 years is estimated to be over 16,000 units. "

New Aircraft Demand



Source: Airbus Global Market Forecast 2015

CFM56-5B, -7B and V2500-A5 engine types are included in the mature category, because they entered service in the 1990s and their technology and design is therefore considered as mature, especially for the early versions. However, the hardware upgrades have meant there is very little commonality between the current and early versions.

Retirement and residual value

Many factors can influence the retirement rate of in-service aircraft and future residual values of sunset and mature engines. These include:

Demand: the ability of original equipment manufacturers (OEMs) to deliver the number of aircraft/engines on order will play a role in how values are impacted. There are more than 7,000 Airbus A320neo and Boeing 737 Max aircraft on order.
Delivery: entry-into-service issues for new products may have an impact on retirement rates. If the new products do not perform as expected, owners and operators may bae tempted to keep existing equipment in service a bit longer until these problems are solved.
Environmental and regulatory constraints: certain jurisdictions are placing restrictions/limitations on aircraft age to force their local carriers to operate newer aircraft. Although these intentions are good, it is clear that most accidents are linked to the way aircraft are maintained and operated rather than the age of the aircraft. If maintained correctly, a 25-year-old aircraft can be in a much better airworthy condition than a 10-year-old one.

Oil price variation: the OEMs' messaging about their new products is mainly centred on fuel efficiency, emissions and noise reduction. As much as this is a positive thing, especially with the increased focus on climate change, it does not mean the current generation of engines will stop flying any time soon.

As shown on the graph below, the cost benefit differential in fuel efficiency between the current and the new generation is currently undermined because of low oil price. Assuming a fuel price of $3.20 a gallon, a new-generation single-aisle aircraft flying 250 hours a month would have an annual fuel-cost advantage of $96,000 over a baseline single-aisle model. This advantage drops to $45,000 for a fuel price of $1.50/gallon.

Unless severe restrictions or financial penalties are placed on less fuel/noise-efficient aircraft, there is not always a justification to invest or operate a newer aircraft/engine type. The question is whether the potential savings generated by fuel efficiency offset the higher acquisition or leasing costs commanded by these new products.
Freighter conversion: the suitability of an aircraft types for passenger-to-freighter conversion can influence retirement decisions. Certain aircraft types are well suited for freighter conversion (737 Classic, 757, A321), which will help further extend the life of these products, thus keeping their residual value higher.
Third-party support: the willingness of (particularly engine) OEMs to let third-party independent maintenance, repair and overhaul (MRO) facilities maintain and repair new-generation products is an influencing factor. The OEM so tightly controls certain engine types that exit strategies for assets reaching their end-of-life are limited.

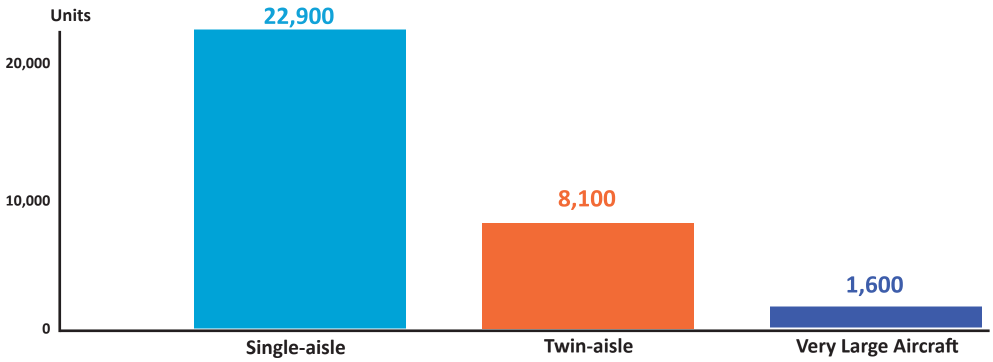
Exit strategies

Many industry players are developing and offering end-of-life solutions to try to maximize the residual life and value of these products. When it comes to exit strategies for mature and sunset products, there are several options available and the optimum method may differ from one engine type to another and from one operator/owner to another. There are a number of areas to consider:

Shop visits: many engine MROs offer so-called tailored workscopes with the aim of achieving cost-effective repairs. This is mainly achieved by building engines to an agreed build life and by maximizing the usage of USM (used serviceable material) to reduce material costs. However, this type of product can suffer from a lack of flexibility in the case of an owner/operator which wishes to extend the operation of its engines. In addition, engine shop visits are an expensive maintenance activity and their costs tend to be higher than budgeted because of unexpected findings (especially as engines get older).
Green time leasing: the aim is to generate additional revenue by leasing engines to utilize their remaining life. However, competition is strong on certain product types, leading to oversupply and therefore leasing rates can be lower than expected, resulting in reduced revenue. Logistical organization and transportation coupled with delivery/redelivery conditions can be time-consuming and resource-intensive.
Tear down: when engines finally reach a stage when it is not cost effective to send them for repair there is the option to tear them down with a view to repairing and selling some of their parts. However, this is not always the straightforward process that some people portray. Many factors impact the outcome of an engine teardown and owners have very little control over some factors, including:
Standard of paperwork: there are ever-increasing requirements for documentation life-limited parts trace and parts-manufacturer approval statements, for example). It will prove challenging to sell USM if paperwork is not compliant with the industry standard.

"Many factors can influence the retirement rate of in-service aircraft and future residual values of sunset and mature engines. "

20 Year New Deliveries of Passenger and Freighter Aircraft



	Single-aisle	Twin-aisle	Very Large Aircraft
% units	70%	25%	5%
% value	45%	43%	12%

Source: Airbus Global Market Forecast 2015

Hardware configuration: actual build-standard of specific engines can be problematic. For example, the set of high-pressure turbine blades is usually a key teardown value component for most engine types. However, some OEMs have placed restrictions on the ability to repair certain part numbers of blades because of technical issues. This has a significant impact on the overall revenue and profit that can be expected from an engine teardown.

Unexpected scrappage: damage to high-value components during teardown can jeopardize profitability.

Required investment: the ability to carry out engine teardowns and repair/overhaul parts requires significant investment and as such has an impact on the economics of exit strategies.

OEM/MRO programmes: the ability to provide parts to or via programmes offered by OEMs and/or MROs can reduce the requirement to sell parts on the open market.

Market volatility: market prices for USM tend to go down fairly rapidly, especially for slow-moving items. On certain engine types such as the CFM56-3, the average USM sales price is barely above the repair cost, hence creating challenges to generate any profit.

Timeframe: the time required to realize all the expected revenues and profits from a teardown can have an impact on the economics. It usually takes several years until all the key high-value components have been sold.

Engine exchange: there may be a possibility to exchange an engine with a better suited one in order to meet a chosen exit strategy. This option requires significant resources to carry out due diligence and the required inspection of records. This option is sensitive to variations in prices because of the supply and demand balance at the time of exchange.

Expert help

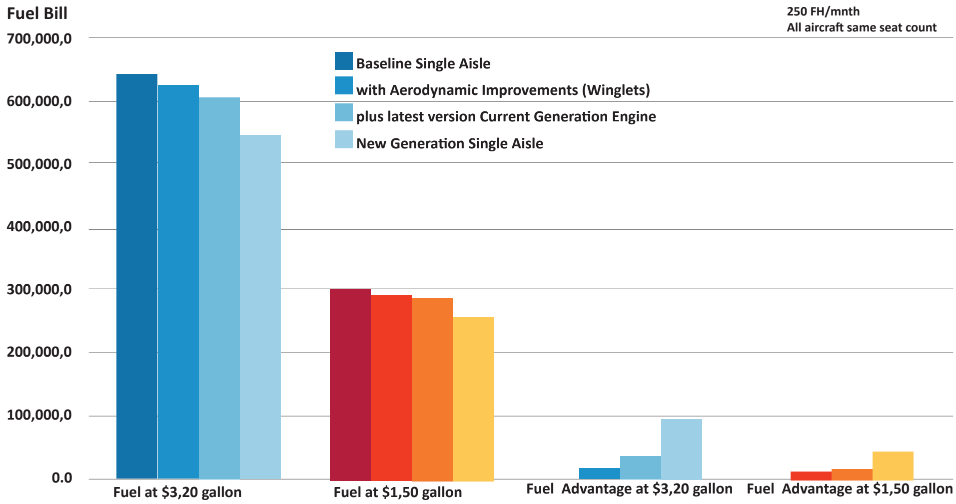
Engine specialists such as TES Aviation Group are able to use their expertise, contacts and networks to supply the best end-of-life solutions to owners and operators. These solutions can include any combination of the options discussed previously and allow owners/operators to have a clear understanding of the value that can be extracted from their fleet and the potential risks they face. Depending on their risk profile, they may elect to extract the residual value straight away and let the specialists carry the risks, or they may elect to keep some of these risks with a view to realizing higher residual values.

Some owners/operators may argue that they can manage their exit strategy themselves but this type of activity is not necessarily their core business and they do not always have the time, resource and knowledge to do it efficiently. When it comes to extracting residual value from end-of-life engines, mistakes can prove very costly and the line between success and failure is very thin.

Independent engine specialists, such as TES Aviation Group, with strong financial backing and proven track records, are better placed to perform this type of activity and to maximize the residual value of assets. Clearly, if a specialist takes on some or all of the risk, it is in their interest to succeed.

Therefore, the question owners/operators of mature and sunset engines should ask is: are we prepared to do deal with the exit strategy ourselves, in the hope of minimizing costs but with the risk of costly mistakes or would it be better to let an engine specialist do it for us, freeing up time to focus on our core business?

Low Fuel Reduces the Cost Advantage of the New Tech Aircraft



Source: DVB Analysis

NEW NARROWBODIES

Neo set to deliver on promises

The A320neo's entry into service is a striking milestone in the era of the new engine versions of Airbus and Boeing single-aisle aircraft.

In contrast to the fraught development phases of some recent aircraft programmes, such as the Boeing 787 and its own A380, Airbus looks as if it will deliver on the promised development timescale for its new engine option (Neo) single-aisle model.

The A320neo received joint European Aviation Safety Authority and Federal Aviation Authority type certification on November 24, paving the way for first delivery and entry into service before the end of 2015 The large degree of commonality with the existing A320 family appears to have helped avoid the pitfalls that some recent new aircraft programmes have suffered.

The new models, which will be equipped with either Pratt & Whitney PW110G geared turbofans or CFM International Leap-1A engines, will initially offer about 15% fuel savings over current models. Airbus says that this figure will improve with the additional developments it has planned.

Boeing's early reluctance to launch a re-engined model of its single-aisle family has meant its 737 Max programme lags its major rival, but the US manufacturer appears to be making good progress with its own development schedule. The company says the final assembly of the first 737 Max 8 began in September on a new production line at its Renton, Washington, facility. Boeing says it will roll out the first completed 737 Max by the end of 2015 and fly it in early 2016. Launch customer Southwest Airlines is scheduled to take delivery in the third quarter of 2017.

Boeing is talking in terms of a 14% increase in fuel efficiency improvement over its current-generation (NG) models, but this figure is not directly comparable to the Airbus claims.

Airbus and Boeing

The two major manufacturers have an unprecedented combined order backlog of close to 7,000 of the new engine variants. Reflecting this backlog and related demand, the combined output of Boeing and Airbus single-aisle aircraft is set to rise to well above 100 units a month as both manufacturers have plans to increase production rates.

The output of Airbus A320s and Boeing 737s stands at 42 a month each. Airbus plans to take production up to 50 a month by early 2017 and announced in October that it plans to boost production further to 60 a month in mid-2019.

Boeing plans to raise 737 production to 52 a month by 2017, but has intimated that it has the capacity to increase this further.

The backlog and production rates present a challenge for the manufacturers of competing products, such as Bombardier's CSeries, the Russian Irkut MC-21 and the Chinese Comac C919.

Bombardier looks to be facing the most difficulty of the new entrants. The Chinese and Russian manufacturers, particularly the former, may be able to count on large domestic markets to support their programmes. Embraer's offering in this market segment is part of a family and is likely to benefit from operators moving from the smaller regional aircraft in the range.

Bombardier CS100 and CS300

Bombardier's CSeries models, however, are aimed more directly at the Airbus and Boeing market. The all-new airframe and engine combination offers greater fuel efficiencies than its re-engined competitors. Bombardier says flight test results confirm the aircraft will offer a 20% fuel saving over current-generation aircraft and a 10% advantage compared to the new engine models of Boeing and Airbus.

As is always the case, these figures are difficult to reconcile with the claims of the other manufactures, but there is little doubt that the CSeries will be more fuel-efficient than its competitors.

However, the completely new design has contributed to difficulties in the development programme. The resulting delays have stretched Bombardier's resources and allowed the Boeing and Airbus aircraft to cement further their dominant position. In addition, the recent drop in fuel price has diminished the cost advantage of the Bombardier aircraft, at least in the short term.

Embraer E195-E2

Embraer seems to be much better placed than its long-standing rival. The re-engined E2 models of its successful E-Jet family have a platform to build on and are smaller than those offered by Boeing and Airbus, which have abandoned attempts to build efficient 100-seaters after failures with the Boeing 737-600 and A318, respectively.

The Brazilian company's offering in the mainstream single-aisle category is the E195-E2, which the manufacturer says will reduce the fuel-burn per

PRINCIPAL BOEING AND AIRBUS NEW ENGINE MODELS

Model	A319neo	737 Max 7	A320neo	737 Max 8	737 Max 9	A321neo
Maximum seats	145	149	180	189	220	220
Typical seats	124	126	150	162	180	185
Target entry into service	2017	2018	Q42015	2017	2018	2016
List price ($m)	97	90	106	110	117	124
Backlog*	35	60	3,112	2,085	421	1,022

*Source: AeroTransport Database

"The two major manufacturers have an unprecedented combined order backlog of close to 7,000 of the new engine variants."

NEW ENTRANT 100-200 SEATERS

Model	Bombardier CS100	Embraer E195-E2	Bombardier CS300	Irkut MC-21-200	Comac C919
Maximum seats	125	132	150	168	174
Typical seats	108	118	130	135	156
Target entry into service	2016	2019	2016	2017	2018
List price ($m)	67	60	76	72	50*
Backlog	92	90	177	175	437

*Based on Chinese press reports.

seat by 24% compared to the previous generation of E-Jet, although some of the saving is because of the increased capacity of the new version.

Comac C919

Comac, China's state-owned manufacturer, rolled out its C919 in November complete with CFM International Leap 1C engines. Despite this apparent success, the programme has suffered delays, and observers believe the first flight is unlikely to take place much before the middle of 2016.

The manufacturer will first pursue certification from the Chinese civil aviation authorities with a view to meeting a planned 2017 entry into service date. International certification with the US Federal Aviation Authority or European Aviation Safety Authority will be required subsequently, which probably makes 2018 the earliest possible date for operations outside of China.

Estimates on fuel efficiency are hard to come by, but, with the Leap engine, the aircraft is likely to get close to its western rivals. That, however, will be insufficient given that it will enter the market later. A low capital cost is likely to be the main attraction to non-Chinese operators.

Irkut MC-21

Irkut's MC-21 is the latest Russian offering with ambitions to break into non-domestic markets. Like its Chinese counterpart, the single-aisle aircraft is to be powered by the latest generation of western engines, but Irkut has opted for the Pratt & Whitney 1400G geared turbofan rather than a member of CFM's Leap family.

The manufacturer claims the aircraft will be 10% to 15% more fuel efficient than the equivalent Boeing and Airbus models. Work is also underway on an alternative Russian-built powerplant.

NEW REGIONALS

The division between regional aircraft and the main single-aisle market is becoming increasingly blurred. The Embraer E-Jet product line, in particular, straddles the two categories.

The major advantage for manufacturers in the 100-seat category and below is that there are no Airbus or Boeing products. Only two manufacturers, Embraer and Mitsubishi, have concrete development programmes for new or re-engined aircraft in the sub-100-seat category

Embraer E175-E2 and E190-E2

Embraer's E2 family will be powered by versions of Pratt & Whitney's PurePower geared turbofan engine. The new family will offer significant fuel savings over the previous generation of aircraft, according to the manufacturer.

The clearest indication of what Embraer is aiming for can be seen in the E190-E2, which is targeted to provide a saving of 16% in fuel per seat (and by implication per trip) over the same-sized E190. Savings are slightly lower in the smaller E175-E2, where a 16% saving is achieved per seat, but this is in part because of the increase in aircraft size between the two generations.

Mitsubishi MRJ90

The first flight, in November, of Mitsubishi's MRJ90 provided a welcome boost for a programme that had its share of problems and delays. The first flight was to have marked the start of an 18-month test campaign aimed at securing the targeted entry-into-service date of the second quarter of 2017.

However this boost proved short-lived. The manufacturer announced at the end of 2015 that there would be a further delay of approximately one year to the entry into service date.

Mitsubishi says the MRJ offers a 20% reduction in fuel burn over equivalent current-generation aircraft. This would theoretically give it an advantage over Embraer's E-Jet family, which might be expected, given the clean-sheet airframe design.

However, the Japanese newcomer can ill afford to slip behind its Brazilian rival, given the market strength of the E-Jet family. This latest delay is particularly damaging to Mitsubishi's hopes of capturing market share from Embraer.

Model	E175-E2	MRJ90	E190-E2
Maximum seats	88	92	106
Typical seats	80	83	97
Target entry into service	2020	2018	2018
List price ($m)	47	42	54
Backlog	150	223	80

NEW WIDEBODIES

No holding back for big two

Despite some worrying signals in the market for widebodies, both Airbus and Boeing are pressing ahead with new aircraft in the category.

Boeing and Airbus are unchallenged in the widebody market without the threat from new entrants that is a feature of the single-aisle segment. However, the widebody market presents its own difficulties, particularly where financing is concerned. Issues that are problematic for financiers include expensive reconfiguration costs and limited operator bases. For existing owners of widebody aircraft, the prospect of a spate of new-technology models coming to market is unlikely to be a cause for celebration.

But Airbus and Boeing are in the business of selling improved products, and the competition between them seems to be relentless, despite the effective duopoly they enjoy. Airbus is pushing ahead with manufacturing of the A330neo and Boeing's 777X programme has passed a major milestone in its design and development phase.

What distinguishes the new aircraft activity in the widebody sector from the single-aisle market is that the models being developed will be entering a market that is still absorbing relatively new designs. The first variants of the Airbus A350 and Boeing 787 have only recently entered into service, and further models such as the 787-10 and A350-800 are still in the development pipeline.

More Neos from Airbus

Airbus announced in early September it had begun manufacturing the first A330neo. The announcement referred to the first cutting of metal that aircraft manufacturers consider a significant landmark in the development and production of a new aircraft type. The A330neo will be built in two variants – the A330-800 and the A330-900.

Both the A330neo models are powered by latest-generation Rolls-Royce Trent 7000 engines, and incorporate aerodynamic improvements – including new sharklet wingtip devices.

Airbus says as a result of these upgrades, the A330neo delivers fuel savings of 14% per seat compared to in-production A330s. According to the manufacturer, the aircraft also offer a range increase of about 400 miles, additional payload capability and decreased maintenance costs.

Boeing's Generation X

Boeing has announced its 777X has reached "firm configuration", an important milestone in its design process. This comes after extensive studies with airlines and key suppliers to optimize the configuration of the new aircraft.

The firm configuration milestone marks the completion of configuration trade studies required to finalize the aircraft's capability and basic design. Wind tunnel test results, aerodynamic performance and structural loads are also evaluated to ensure design requirements are met.

The firm configuration means the 777X team can begin detailed design of parts, assemblies and other systems. As detailed designs are completed and released, production can begin.

The 777X family includes the 777-8 and the 777-9. Boeing claims both models offer significant range, payload and fuel burn advantages compared to Airbus's A350.

Boeing says the 777X will offer 12% lower fuel consumption and 10% lower operating costs than the competing A350s. The 777X programme has received orders and commitments from six customers. Production is set to begin in 2017.

A380NEO

While there is much activity in the twin-aisle market, the very large aircraft sector looks increasingly moribund. Airbus continues to forecast a significant demand in the category, suggesting that 1,550 such aircraft will be needed in the next 20 years.

Over the same period, Boeing foresees a much smaller market of 450 aircraft. Given the prediction, it looks unlikely that Boeing will develop the 747-8 further, but the signs from Airbus are more mixed. A re-engining has not been ruled out and it would possibly be done in conjunction with a small stretch of the airframe.

There appears to be a debate in Airbus as to the merits of such an investment and on its timing, but a new aircraft is unlikely to enter service before 2020.

NEW BOEING AND AIRBUS WIDEBODIES

Model	787-8	A330-800neo	A350-800	787-9	A330-900neo	A350-900	787-10	777-8X	A350-1000	777-9X
Typical seats	246	249	272	283	304	311	323	350	365	410
Typical range (nm)	7,650	7,900	8,300	8,200	6,800	8,100	7,000	9,300	8,000	8,200
(Target) entry into service	2011	2018	2016	2014	2017	2014	2018	(2020)	(2017)	(2020)
Number in service*	281	–	–	67	–	17	–	–	–	–
Orders backlog*	181	12	19	433	581	596	187	53	172	243
List price ($m)	225	250	270	265	285	305	306	371	352	400

*Source: AeroTransport Data Bank, December 2015

AIRCRAFT APPRAISALS

Views on values

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 Aircraft considered are:

737-400F, 747-400F, 777-300ER, A330-300, 737-700, A319, Sukhoi Superjet and Embraer 175

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 from a selection of consultancy companies:

Avitas
Martin O'Hanrahan, *director, asset valuation*

Collateral Verifications (CV)
Gueric Dechavanne, *vice-president, commercial aviation services*

IBA
Huda Syed, *senior aviation analyst*

ICF International -
Angus Mackay, *principal*
Stuart Rubin, *principal*

MBA
Lindsey Mohr, *manager valuations*
David Tokoph, *chief operating officer*

Oriel
Olga Razzhivina, *senior Istat appraiser*

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.

AIRCRAFT APPRAISALS

737-400 freighter conversion

The Boeing 737-400, together with the -300 and -500 models, is part of the family that has become known as the Classic generation of the 737.

The 737-400 passenger version was launched as a stretch of the original -300 model and is the largest member of the Classic range. The stretched model accommodates up to 168 passengers and first entered service in 1988.

The 737 Classic family was replaced by the next generation (NG) models, of which the 737-800 is the successor to the -400.

Current market value ($m)					
Build year	1990	1992	1994	1996	1998
CV view	6.90	7.53	8.06	8.65	9.44
Oriel view	7.05	7.25	7.45	7.75	8.15
MBA view	5.88	6.38	6.95	7.61	8.37

Assuming standard Istat criteria.

Indicative lease rates ($'000s/month)					
Build year	1990	1992	1994	1996	1998
CV view	110	120	130	140	150
Oriel view	130	130	130	135	145
MBA view	110-120	115-120	120-130	120-135	125-135

Values and lease rates taken from Airfinance Journal March 2015

There were no factory-built 737-400 freighters, but in 2006 Pemco Aviation Group delivered the first passenger-to-freighter conversion, which the company had carried out for Alaska Airlines.

Aeronautical Engineers Inc (AEI) and Israel Aerospace Industries (IAI) also offer conversions of the 737-400, under their respective supplemental type certificates (STCs). The AEI 737-400 conversion has significantly outsold the other models, having captured around half of the market to date. The IAI programme has not delivered an aircraft for some time.

Boeing 747-400F

The 747-400F is a Boeing factory-built freighter, equipped with a nose-loading door, which allows for oversized cargo.

The freighter model employs the updated systems and wing design of the 747-400 passenger version, but features the original short upper deck of the classic 747s. The shorter upper deck provides a major weight saving over passenger variants. The nose cargo door and superior payload/range capability of the factory 747-400F give it a significant operational advantage compared to converted passenger models.

Three manufacturers supply engines for the 747-400F. The choice of powerplant is between the General Electric CF6-80C2B1F, the Pratt & Whitney PW4056 or the Rolls-Royce RB211.

The 747-400ERF, which is the freight version of the 747–400ER passenger model, entered service in 2002. The developed model is similar to the 747-400F except for an increase in design weights. Thanks largely to these increased weights, the ERF variant offers about10 tonnes of extra payload or 525 nautical miles of additional range compared to the base 747-400F model.

The 747-400F is no longer in production, having been replaced by the 748-8

Current market value ($m)				
Build year	1994	1999	2004	2009
Avitas view	19.6	28.4	41.0	59.8
ICF view	20.1	29.0	41.6	59.6
MBA view	20.4	30.3	43.8	62.2

Assuming standard Istat criteria.

Indicative lease rates ($'000s/month)				
Build year	1994	1999	2004	2009
Avitas view	390-430	460-500	570-620	700-760
ICF view	300-350	400-450	500-550	600-650
MBA view	330-370	400-450	470-520	570-620

Values and lease rates taken from Airfinance Journal February 2015

Market background

The world cargo market has experienced significant decreases in volumes of traffic and yields since the global economic downturn of 2008. The downturn, along with an increase in widebody passenger lower-deck freight capacity and a slowdown in third-party US military cargo requirements, has meant a reduction in demand for dedicated widebody freighters, with a consequent impact on values.

Although growing more slowly than global economic activity, air cargo demand is starting to recover from the downturn. The primary drivers of this growth are improved business confidence and a rise in import volumes in advanced economies.

AIRCRAFT APPRAISALS

Boeing 777-300ER

The extended range (ER) version of the 777-300 entered service in 2003.

The 777-300ER continues to sell in both passenger and freighter. However, the launch of the -8X and -poses Boeing the problem of how to maintain sales of the current-generation 777s and keep the production line running as the entry into service of the more efficient aircraft models draws closer.

Boeing says it sees significant potential for freighters in this market segment. However, despite an upturn in cargo markets, many commentators believe the demand for dedicated freighters will remain depressed. As Airfinance Journal has previously reported, this is in part because of the increased competition from the belly freight capability of modern long-haul aircraft, such as the 777.

Boeing has previously stated it needs to sell between 40 and 60 current-generation aircraft a year to bridge the transition to 777X production. It met this target in 2014 with 63 sales and 2015 figures are at a similar level.

Future developments

Boeing has outlined a number of major improvements to the current-generation 777, including the -300ER, the-200LR and the freighter models.

Engine developments, as well as weight and aerodynamic improvements, which the manufacturer says will reduce trip fuel by 2%, will be phased into production by the third quarter of 2016. The overall structural weight of the aircraft will be reduced by 1,200lb (540kg). The reductions have been derived from production-line improvements being introduced as part of the move to an automated drilling and riveting process for the fuselage, which is intended to streamline production ahead of the start of assembly of the first 777-9X in 2017.

Boeing says it could make some of the improvements available as retrofits and adds that GE is considering an engine retrofit package.

Current market value ($m)

Build year	2005	2007	2009	2011	2013	2015
CV view	72.4	89.2	101.3	117.4	133.4	162.6
Oriel view	77.5	84.5	95.5	110.5	129.5	166.8

Assuming standard Istat criteria.

Indicative lease rates ($'000s/month)

Build year	2005	2007	2009	2011	2013	2015
CV view	0.78	0.85	0.95	1.05	1.15	1.25
Oriel view	0.90	1.00	1.10	1.20	1.33	1.48

Values and lease rates taken from Airfinance Journal *April 2015*

A330-300

The A330-300 is the largest member of Airbus's twinjet family and has a lot of commonality with the four-engined A340. Much of the technology, particularly on the flight deck, is derived from developments on the A320 family.

The first A330-300 variants entered service in 1992 but aircraft delivered from 1999 onwards have a higher standard maximum take-off weight (MTOW) of 230 tonnes (507,000lbs) and are normally identified as higher gross weight (HGW) versions. The A330 cross-section offers underfloor cargo holds that accept industry-standard LD3 containers.

Future developments

The latest variant of the Airbus A330-300, which has an increased MTOW of 242 metric tonnes, received certification from the European airworthiness authorities in Apri 2015l.

The increased weight, combined with various aerodynamic refinements and increased fuel capacity means that operators will benefit from an extended range of up to 500 nautical miles or be able to carry greater payload. Fuel consumption has been reduced by up to 2%, according to the manufacturer. However, the replacement of current-generation A330s by the A330-800 and -900 may have a significant impact on values.

Current market value ($m)

Build year	2002	2004	2006	2008	2010	2012	2014
MBA view	45.6	51.9	59.2	67.4	76.8	87.6	99.9
ICF view	40.5	47.9	56.0	65.0	74.9	85.9	97.9
IBA view	42.6	50.9	59.6	68.5	78.1	88.7	100.4

Assuming standard Istat criteria.

Indicative lease rates ($'000s/month)

Build year	2002	2004	2006	2008	2010	2012	2014
MBA view	495-530	535-575	585-625	635-675	685-730	745-785	810-850
ICF view	400-500	500-550	550-625	650-700	700-750	750-800	800-850
IBA view	350-465	410-530	480-595	550-670	615-740	685-815	755-885

Values and lease rates taken from Airfinance Journal May 2015

AIRCRAFT APPRAISALS

737-700

The 737-700 is part of the Boeing 737 Next Generation (NG) family, which also encompasses the -600, -800 and -900 models. The NG aircraft were a complete redesign of the so-called 737 Classic models and were equipped with more fuel-efficient General Electric/Snecma CFM56 engines. Unlike on the competing A320 family, no choice of engine manufacturer was offered.

Airframe changes from the Classic generation included a new wing design and a redesigned vertical stabilizer. The flight deck was upgraded with digital avionics, and passenger cabin improvements, similar to those on the Boeing 777, were included offering larger overhead bins than previous-generation 737s.

The 737-700 was the original member of the NG family, entering service in 1998. It was followed closely by the stretched -800 model. Boeing later introduced the 737-900, which was a further stretch.

Developments

The NG family has been constantly developed, including a significant upgrade to the engines in 2011, known as the performance improvement programme package.

Among the most recent improvements to the aircraft is the introduction of the Sky interior, which incorporates many features first seen on the 787.

Blended winglets are available as retrofits and are a standard option on current production aircraft. Overall fuel efficiency improvement with the winglets fitted is said to be up to 5%.

The NG family is to be superseded by Boeing's 737 Max family. The Max 7 is the replacement for the 737-700..

The Max 7 is scheduled to be the last of the family to enter service and has the fewest orders.

Current market value ($m)

Build year	2000	2003	2006	2009	2012	2015
Avitas view	12.5	15.7	19.7	24.1	30.0	39.2
CV view	11.4	13.2	16.3	18.7	22.6	36.1
Oriel view	10.5	13.3	16.5	20.3	24.8	36.5

Assuming standard Istat criteria.

Indicative lease rates ($'000s/month)

Build year	2000	2003	2006	2009	2012	2015
Avitas view	145-165	185-205	220-240	260-280	295-315	340-360
CV view	140	155	170	190	220	250
Oriel view	140	155	175	205	235	270

Values and lease rates taken from Airfinance Journal June 2015

Airbus A319

The A319, which entered service in 1996, was the third variant of Airbus's A320 family, after the original A320 and the stretched A321. A fourth model followed 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 powerplants 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.

Although higher capacity models are available, the A319 has typically seated 125 passengers, and this size category is being targeted by a number of new entrants, including Bombardier's CSeries, the Comac C919, the Irkut 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.

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, but the A319neo is not scheduled to enter service before mid 2017.

Current market value ($m)

Build year	2000	2003	2006	2009	2012	2015
Fintech view	7.6	10.9	15.7	20.9	26.4	33.3
MBA view	11.1	13.8	17.2	21.7	27.9	35.7
Oriel view	9.5	12.5	16.0	19.8	24.5	36.9

Assuming standard Istat criteria.

Indicative lease rates ($'000s/month)

Build year	2000	2003	2006	2009	2012	2015
Fintech view	96-106	109-119	125-135	158-168	206-216	239-249
MBA view	115-145	135-165	155-185	180-210	215-245	255-285
Oriel view	120	135	150	165	195	240

Values and lease rates taken from Airfinance Journal July/August 2015

AIRCRAFT APPRAISALS

Sukhoi Superjet100

The Sukhoi Superjet 100 (SSJ100) is a modern twin-engine 100-seater regional jet. The airline design was led by Sukhoi, a division of the Russian civil aerospace company, in cooperation with several foreign partners, which, at one stage, included Boeing.

The type received certification from the European Aviation Safety Agency in February 2012 and certification has followed in a number of other export markets.

The aircraft was designed to compete internationally with the larger Embraer and Bombardier models, such as the E190/195 and the CRJ900/1000. The Russian manufacturer claims substantially lower operating costs compared to these more established models.

The first SSJ100s delivered to Aeroflot did not meet the airline's requirements, and an upgraded version was launched and delivered to the national airline. Sukhoi took back 10 of the original Aeroflot aircraft, some of which have been placed with other airlines.

Future developments

The manufacturer is investing significant resources in new developments. A long-range variant – the SSJ100 LR – is nearing certification, and the company announced at the recent Moscow airshow that an upgraded more powerful version, designated B100, is being developed.

From 2017, new wingtips will be offered as an option for all SSJ100s. Sukhoi says the wingtips will deliver up to 4% in fuel savings and will also improve take-off and landing performance.

The original plan by the manufacturer was to produce 60-seat and 75-seat variants in addition to the nominal 100-seater. The smallest variants were postponed, and it is widely believed they will not be built. However, a stretched version seating up to 145 passengers is being studied.

Current market value ($m)

Build year	2011	2012	2013	2014	2015
CV view	14.9	15.7	16.6	17.5	25.2
IBA view	17.9	19.4	20.8	22.3	24.1
Oriel view	10.7	11.6	12.5	15.3	18.6

Assuming standard Istat criteria.

Indicative lease rates ($'000s/month)

Build year	2011	2012	2013	2014	2015
CV view	130	140	150	160	200
IBA view	140-165	150-180	160-195	170-210	180-225
Oriel view	–	–	–	–	–

Values and lease rates taken from Airfinance Journal *September/October 2015*

E175

The Embraer E175 is part of the Brazilian E-Jet family, which straddles the regional and single-aisle markets. The other members of the family are the similarly sized E170, as well as the larger E190 and E195 models. Close to 1,200 models from the family have been built and more than 1,150 aircraft remain in service.

All current models are powered by General Electric engines, and have significant commonality in aircraft systems and avionics. The fuselage cross-section is identical for all members of the family and accommodates four-abreast seating.

The E170 was the first version to be built and entered service in 2004. In response to market feedback, Embraer launched the E175, which has typically eight more seats. The first E175 was delivered in 2005 and has outsold its smaller stablemate, accounting for virtually the entire current order backlog.

The E175 is available in three major versions differentiated primarily by their maximum take-off weights and associated ranges. The models are designated as standard (STD), long-range (LR) and augmented range (AR) versions. The E170 and E175 compete with Bombardier's CRJ700 and CRJ900 models.

Future developments

Embraer has announced the launch of the second generation of the E-Jet family, which it identifies by the designation E2. The family comprises three models: E175-E2, E190-E2 and E195-E2. The E175 has been stretched by a single seat row and is the smallest aircraft in the second-generation family.

Embraer is targeting 2018 for entry into service of the E190-E2, but the E175-E2 is not scheduled to follow until 2020. The company has introduced a number of modifications and enhancements to improve the fuel efficiency on the current-generation E-Jet that will narrow the gap to the E2, with particular focus on the E175.

Current market value ($m)

Build year	2005	2007	2009	2011	2013	2015
Avitas view	13.1	15.6	18.5	21.6	25.1	29.5
CV view	14.2	15.5	16.7	18.8	22.3	29.1
MBA view	14.5	16.6	19.0	21.8	25.1	28.8

Assuming standard Istat criteria.

Indicative lease rates ($'000s/month)

Build year	2005	2007	2009	2011	2013	2015
Avitas view	130-150	140-170	170-190	180-210	200-230	230-270
CV view	140	160	180	200	220	240
MBA view	149-161	162-175	176-190	191-207	209-226	228-246

Values and lease rates taken from Airfinance Journal November 2015

AIRCRAFT DATA

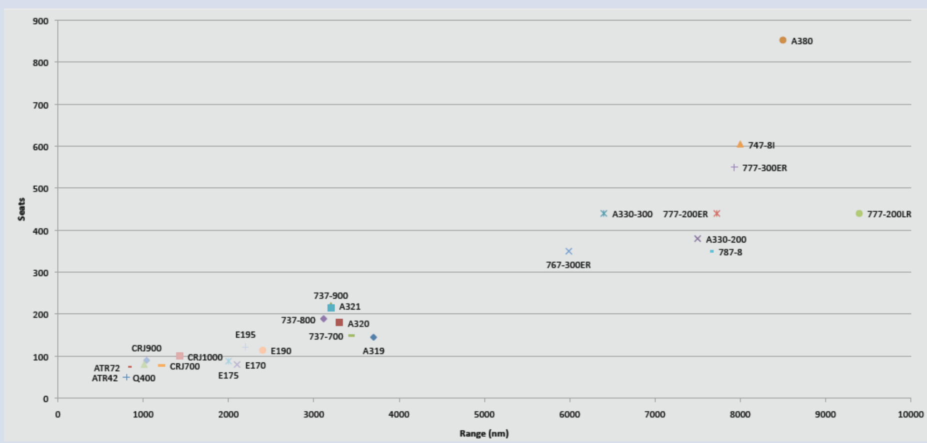
The numbers

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 2015, page 27. 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 two class	124	
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	1,397	
Operators (current and planned)	167	
In storage	34	
On order	79	(plus 35 A319neo)
Built peak year (2005)	142	
Estimated production 2015	30	
Average age	10.5	years
Source AeroTransport Database December 2015		
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	(195 Enhanced version)
Typical seating two class	150	
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:	3,721	
Operators (current and planned)	277	
In storage	101	
On order	646	(plus 3,112 A320neo)
Built peak year (2013)	352	
Estimated production 2015	348	
Average age	8.1	years
Source AeroTransport Database December 2015		
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	236	
Typical seating two class	185	
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:	1,140	
Operators (current and planned)	110	
In storage	23	
On order	559	(plus 1,022 A21neo)
Built peak year (2015)	201	
Estimated production 2015	201	
Average age	6.8	years
Source AeroTransport Database December 2015		
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	246	(two class)
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:	550	
Operators (current and planned)	106	
In storage	23	
On order	54	
Built peak year (2013)	51	
Estimated production 2015	44	
Average age	7.9	years
Source AeroTransport Database December 2015		
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	300	(two class)
Maximum range (Non ER version)	6,100	nm (11,300 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:	588	
Operators (current and planned)	67	
In storage	22	
On order	138	
Built peak year (2013)	68	
Estimated production 2015	8	
Average age	7.0	years
Source AeroTransport Database December 2015		
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

A350-900

Seating/range		
Max seating	475	
Typical seating	311	
Maximum range	8,100	nm (15,000 km)

Technical characteristics		
MTOW	268	tonnes
OEW	116	tonnes
MZFW	192	tonnes
Fuel capacity	138,000	litres
Engines	Trent XWB	/CF6-80E1/Trent 700
Thrust	84,000	lbf (374kn)

Fuels and times		
Block fuel 1,000 Nm	11,810	kg
Block fuel 2,000 Nm	22,010	kg
Block fuel 4,000 Nm	42,410	kg
Block time 1,000 Nm	179	minutes
Block time 2,000 Nm	291	minutes
Block time 4,000 Nm	512	minutes

Fleet		
Entry into service	2014	
In service:	16	
Operators (current and planned)	36	
In storage	none	
On order	582	
Built peak year (2015)	17	
Estimated production 2015	17	
Average age	0.8	

Source AeroTransport Database December 2015

Indicative Maintenance Reserves		
C-check reserve	$105-110	per flight hour
Higher checks reserve	$95-100	per flight hour
Engine overhaul	$260-265	per engine flight hour
Engine LLP	$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 class
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:	176	
Operators (current and planned)	15	
In storage	3	
On order	138	
Built peak year (2012)	30	
Estimated production 2015	38	
Average age	3.4	years

Source AeroTransport Database December 2015

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	22	
Operators	17	
In storage	3	
On order	42	
Built peak year (2014)	11	
Estimated production 2015	12	
Average age	1.8	year
Source AeroTransport Database December 2015		
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	250	
Operators	58	
In storage	8	
On order	278	
Built peak year 2014	108	
Estimated production 2015	96	
Average age (ATR72-500)	1.9	year
Source AeroTransport Database December 2015		
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:	1,086	(includes 737-700C)
Operators (current and planned)	92	
In storage	26	
On order	43	
Built peak year (2004)	111	
Estimated production 2015	12	
Average age	11.1	years
Source AeroTransport Database December 2015		
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:	3,769	
Operators (current and planned)	185	
In storage	60	
On order	922	
Built peak year (2014)	460	
Estimated production 2015	461	
Average age	6.6	years
Source AeroTransport Database December 2015		
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	
In service:	356	
Operators (current and planned)	21	
In storage	3	
On order	181	
Built peak year (2014)	70	
Estimated production 2015	73	
Average age	3.1	years
Source AeroTransport Database December 2015		
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:	32	plus 26 freighters and 6 BBJ s
Operators (current and planned)	20	including freighters and BBJs
In storage	2	
On order	6	plus 14 freighters and 2 BBJ s
Built peak year (2012)	25	
Estimated production 2015	25	
Average age	2.3	years
Source AeroTransport Database December 2015		
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:	435	
Operators (current and planned)	88	
In storage	86	
On order	1	
Built peak year (1992)	53	
Estimated production 2015	2	
Average age	17.6	years
Source AeroTransport Database December 2015		
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:	375	
Operators (current and planned)	41	
In storage	31	
On order	none	
Built peak year (1999)	63	
Estimated production 2015	none	
Average age	14.1	years (ER version only)
Source AeroTransport Database December 2014		
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:	56	
Operators (current and planned)	14	
In storage	3	
On order	none	
Built peak year (2009)	16	
Estimated production 2015	none	
Average age	5.4	years
Source AeroTransport Database December 2015		
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:	605	plus 60 non ER models
Operators (current and planned)	43	
In storage	1	
On order	171	
Built peak year (2013)	80	
Estimated production 2015	102	
Average age	4.6	years
Source AeroTransport Database December 2015		
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	
In service:	279	
Operators (current and planned)	53	
In storage	7	
On order	188	
Built peak year (2013)	103	
Estimated production 2015	81	
Average age	1.7	years
Source AeroTransport Database December 2015		
Indicative Maintenance Reserves		
C-check reserve	$110-115	per flight hour
Higher checks reserve	$80-85	per flight hour
Engine overhaul	$290-300	per engine cycle
Engine LLP	$300-305	per engine cycle
Landing gear refurbishment	$75-80	per cycle
Wheels, brakes and tyres	$100-105	per cycle
APU	$105-110	per APU hour
Component overhaul	$315-320	per flight hour

Boeing 787-9

Seating/range		
Max seating	408	
Typical seating	280	two class
Maximum range	8,300	nm (14,370 km)
Technical characteristics		
MTOW	252.7	tonnes (557,000lbs)
OEW	120	tonnes
MZFW	181	tonnes
Fuel capacity	138,700	litres
Engines	Genx	/Trent 1000
Thrust	71,000	lbs (320 kN)
Fuels and times		
Block fuel 1000Nm	10,480	kg
Block fuel 2000Nm	1,950	kg
Block fuel 4000Nm	37,630	kg
Block time 1000Nm	146	minutes
Block time 2000Nm	265	minutes
Block time 4000Nm	501	minutes
Fleet		
Entry into service	2014	
In service:	6	
Operators (current and planned)	39	
In storage	11	
On order	437	
Built peak year (2014)	10	
Estimated production 2015	62	
Average age	0.5	
Source AeroTransport Database December 2015		
Indicative Maintenance Reserves		
C-check reserve	$110-115	per flight hour
Higher checks reserve	$85-90	per flight hour
Engine overhaul	$305-310	per engine cycle
Engine LLP	$315-320	per engine cycle
Landing gear refurbishment	$75-80	per cycle
Wheels brakes and tyres	$100-105	per cycle
APU	$125-130	per APU hour
Component overhaul	$320-325	per flight hour

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:	340	
Operators (current and planned)	26	
In storage	8	
On order	2	
Built peak year (2005)	68	
Estimated production 2015	4	
Average age	10.3	years
Source AeroTransport Database December 2015		
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:	357	
Operators (current and planned)	23	
In storage	7	
On order	48	
Built peak year (2008)	59	
Estimated production 2015	44	
Average age	6.2	years
Source AeroTransport Database December 2015		
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	104	
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:	43	
Operators (current and planned)	4	
In storage	1	
On order	29	
Built peak year (2011)	15	
Estimated production 2015	19	
Average age	3.5	years
Source AeroTransport Database December 2015		
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:	468	
Operators (current and planned)	61	
In storage	22	
On order	70	
Built peak year (2007)	42	
Estimated production 2015	44	
Average age	6.5	years
Source AeroTransport Database December 2015		
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	185	
Operators (current and planned)	25	
In storage	8	
On order	4	
Built peak year (2004)	46	
Estimated production 2015	2	
Average age	9.0	years
Source AeroTransport Database December 2015		
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	319	
Operators (current and planned)	20	
In storage	2	
On order	175	Excluding E2 version
Built peak year (2008)	56	
Estimated production 2015	70	
Average age	4.2	years
Source AeroTransport Database December 2015		
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 32 inch 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	524	
Operators (current and planned)	76	
In storage	15	
On order	101	Excludes E2 models
Built peak year (2011)	95	
Estimated production 2015	3	
Average age	5.7	years
Source AeroTransport Database December 2015		
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	138	
Operators (current and planned)	17	
In storage	6	
On order	20	Excludes E2 models
Built peak year (2011)	24	
Estimated production 2015	4	
Average age	4.0	years
Source AeroTransport Database December 2015		
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

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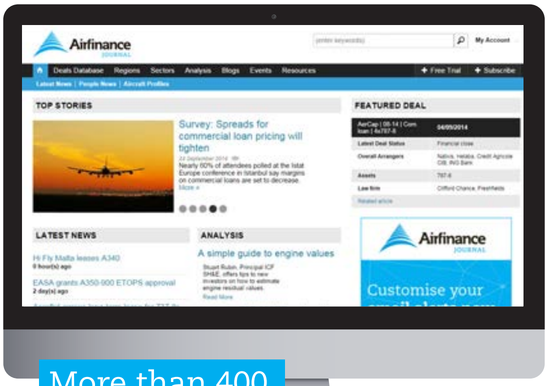

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Airfinance JOURNAL

NEW AIRCRAFT COSTS

NEW AIRCRAFT MARKET VALUES ($ MILLIONS)

Model	Avitas view	CV view	IBA view	ICF view	Oriel view	Average
Airbus						
A319	39.4	38.13	37.1	35.1	35.4	**37.0**
A320	44.6	45.3	44.5	43	43.4	**44.2**
A321	53.6	53.8	53.2	52	50.1	**52.6**
A330-200	95.5	90.0	94.7	90.5	90.8	**92.3**
A330-300	105.7	110.2	104.7	99.5	101.6	**104.4**
A350-900	139.6	150	144.9	138.5	149.4	**144.5**
A380	213.6	239.8	225.5	212.4	215.5	**221.4**
ATR						
ATR42-600	15.6	16.8	16.2	14.9	18.3	**16.4**
ATR72-600	20.2	20.5	21.3	20.3	19.8	**20.4**
Boeing						
737-700	39.4	36.5	37	36.1	34.6	**36.7**
737-800	48.3	47.5	47.8	46.3	47.5	**47.5**
737-900ER	50.6	48.6	50	49	49.1	**49.5**
747-8 (passenger)	175.6	149.8	165	175.5	154.2	**164.0**
777-300ER	166.9	160.0	165.0	167.5	156.1	**163.1**
787-8	119.3	117.8	118.9	116.0	119.0	**118.2**
787-9	137	141.4	134.8	131.0	136.7	**136.2**
Bombardier						
CRJ700	25.0	17.2	23.4	22.7	23.2	**22.3**
CRJ900	27.4	24.8	26.9	27.0	25.4	**26.3**
CRJ1000	29.8	25.1	28.4	28.7	28.4	**28.1**
Q400	23.1	20.6	21.9	21.9	21.4	**21.8**
Embraer						
E170	28.3	26.5	26.7	27.6	25.6	**26.9**
E175	29.3	29.7	29.3	29.1	27.6	**29.0**
E190 (AR)	33.7	34.1	32.9	31.5	33.2	**33.1**
E195 (AR)	35.9	35.7	34.7	35.1	34.0	**35.1**

NEW AIRCRAFT COSTS

LEASE RATES ($000S)

Model	Avitas view	CV view	IBA view	ICF view	Oriel view	Overall range
Airbus						
A319	290-340	280	250-310	230-280	240	230-340
A320	331-389	345	300-380	280-370	335	280-389
A321	400-460	410	380-435	360-400	405	360-460
A330-200	761-859	775	730-860	640-790	765	640-859
A330-300	846-954	900	790-920	690-850	900	900-1,242
A350-900	1,100-1,242	1,200	1,175-1,250	1,050-1,150	1,300	1,050-1,300
A380	1,872-2,028	1,900	1,175-2,000	1,650-1,750	1,800	1,175-2,028
ATR						
ATR42-600	143-167	150	135-150	120-150	165	135-167
ATR72-600	184-216	175	175-200	165-200	170	165-216
Boeing						
737-700	290-340	260	250-310	225-280	245	225-340
737-800	359-421	370	340-410	315-375	355	315-421
737-900ER	385-435	375	375-420	360-400	355	355-435
747-8 (passenger)	1,425-1,575	1,150	1,250-1,350	1,250-1,350	1,250	1,150-1,425
777-300ER	1,292-1,428	1,250	1,250-1,450	1,150-1,300	1,375	1,150-1,450
787-8	939-1,060	1,050	950-1,100	850-950	1,000	850-1,100
787-9	1,079-1,218	1,250	1,050-1,200	950-1,050	1,100	1,050-1,250
Bombardier						
CRJ700	186-214	200	175-210	160-180	200	175-214
CRJ900	205-235	230	200-240	190-230	225	190-240
CRJ1000	220-260	235	225-265	210-260	260	210-260
Q400	200-240	195	180-220	180-210	195	180-240
Embraer						
E170(AR)	210-250	240	195-225	180-210	235	180-250
E175(AR)	220-260	245	210-240	200-230	245	200-260
E190 (AR)	250-290	270	250-290	225-245	285	225-290
E195 (AR)	270-300	270	260-300	230-260	290	230-300