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A SPECIAL SUPPLEMENT

Guide to financing and investing in engines 2016

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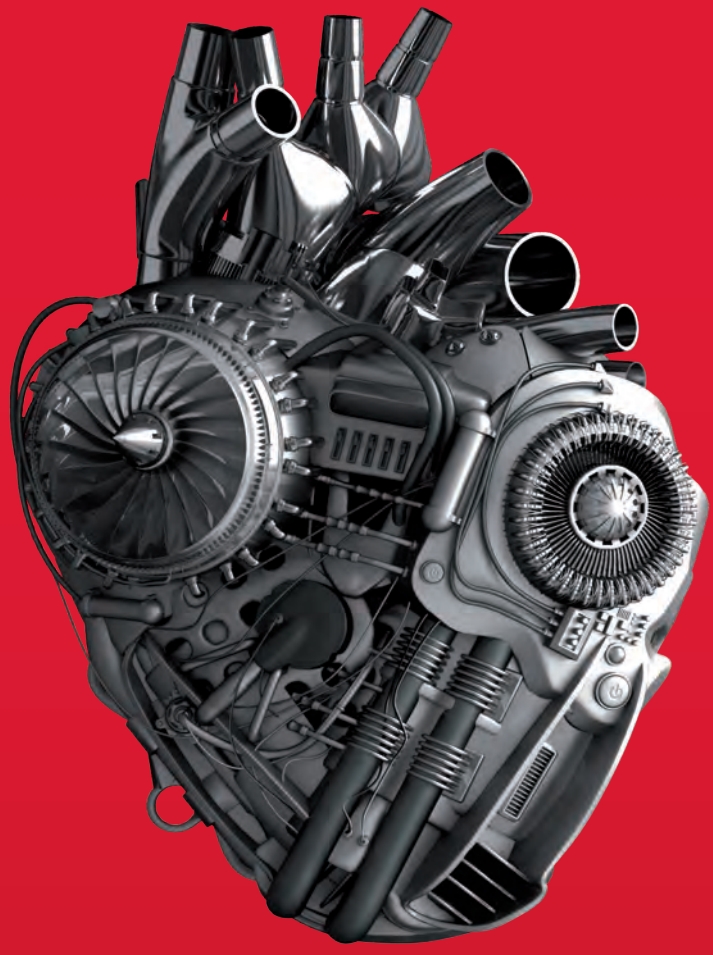

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EDITORIAL

A world of its own

New players in the engine financing market are finding they have entered a sophisticated space.

As with the commercial aircraft they power, the figures associated with future commercial aircraft engine deliveries are strikingly large. With forecasts indicating that about 35,000 new commercial aircraft will be delivered over the next 20 years, the requirement for new engines will exceed 70,000 to cover the installed fleet. The requirement for spare engines will add to this figure, but engine manufacturers are reluctant to quantify the requirement.

What the market will be worth is also difficult to assess, not least because of the discounts that manufacturers apply to list prices, with a view to gaining a platform for future maintenance, repair and overhaul (MRO) revenues.

Of course, as with all forecasts there is an element of uncertainty, and the forecasts for engine demand are subject to the same potential risks as those for the aircraft they power.

At the 36th Annual North America Airfinance Conference, several speakers pointed to the topical problem of a pilot shortage as a typical example of possible restraints on growth.

There are a number of key trends that will impact how the proceeds from the forecast market will be distributed.

Manufacturers are increasingly looking for ways to maintain and increase revenues in a world where engine reliability is increasing with a resultant drop in shop visits. The equation is very simple: if revenues are to be maintained, the cost of each shop visit needs to increase. Small wonder then that engine manufacturers are keen to control the overhaul market and are planning more original equipment manufacturer (OEM)-owned facilities and restricting licensing and joint ventures with independent MRO organizations.

A key trend in commercial aircraft that clearly impacts on the engine finance market is the move to an increasing proportion of the fleet being on operating lease. According to IBA, the trend to operating leases gives airlines more flexibility but it comes at a price. Return conditions for aircraft and engines become an increasingly contentious area and can result in large claims for compensation.

The issue of manufacturer approved parts (PMA) has long been a source of contention in engine maintenance circles and is a particularly sensitive issue in the case of leased engines, whether installed or for spares. OEMs do not like them because of their impact on revenues, but many in the industry believe their objections on technical grounds are unfounded. Whatever the technical merits of PMA parts and the cost/benefit arguments in their favour, lessors do not want them used on their engines for fear of a potential impact on residual values.

The issue of PMA parts is, however, declining in importance as the use of surplus materials becomes more prevalent. Industry analysis suggest that use of surplus parts for engine repairs is 10 times greater than the contribution from PMA parts.

The use of PMA parts is also being reduced by the increasing tendency for engines to be covered by manufacturer schemes. There are undoubted advantages to operators of such schemes in bringing predictability to maintenance and the transfer of risk to the manufacturer/scheme provided.

The downside is that the schemes can be expensive and there have been issues in transferring accumulated reserves when aircraft/engines are returned at the end of a lease. However, both engine manufacturers and lessors have been coming to terms with these issues, and solutions are available that ease the transfer of aircraft and engines to new operators/owners. The ability of new owners to buy-in to schemes is a key feature and requires a high degree of transparency, which still remains an issue in some cases.

There are differences between the markets for single-aisle and widebody powerplants. The markets for engines reflect the trends in the respective aircraft markets, with much greater liquidity for engines that power single-aisle aircraft than their widebody counterparts. The large costs associated with widebody powerplants means that very few independent MROs or airlines are willing to make the investment necessary to carry out the overhaul of these engines, resulting in a concentration of facilities under the ownership of the OEMs. The single-aisle market is following the same trend because of the rising cost and increasing reliability cited above.

Because of the market's complexities, engine leasing has been the preserve of specialist companies, but the arrival of several new financing institutions has made the landscape more competitive. The arrival of new players is welcome, but the engine financing market requires a high level of expertise and technical knowledge, probably even more so than its aircraft counterpart. Therein lies perhaps the key difference between engine and aircraft financing.

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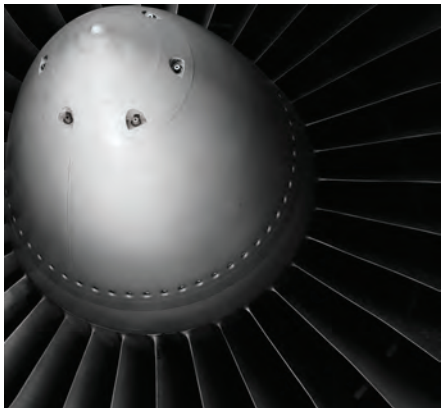

ENGINE SURVEY 2016 /06

A lease of life

A new model tops the *Airfinance Journal's* 2016 engine poll.

NEWS

Engine landmarks 2015/2016

JUNE 2015

Paris Airshow sees battle for new-generation engine orders

The 2015 Paris Airshow saw a rush of orders for new-technology engines. Among the deals, AerCap placed a $2.7 billion CFM order, Minsheng Financial Leasing confirmed it would take CFM Leap engines for its 737NG and 737 Max orders, leasing company Avolon decided on CFM-powered Neos, SMBC Aviation Capital opted for Pratt & Whitney PW 1100G geared turbofans (GTF) engines and China Aircraft Leasing selected GTF engines for its A320neo order.

JULY 2015

Comac receives Leap-1C

Commercial Aircraft Corporation of China (Comac) received the first CFM Leap-1C, the engine variant designed for the Chinese-built C919 single-aisle aircraft. The official entry-into-service date for the C919 is 2018, but there is increasing speculation that this target will not be met.

AUGUST 2015

Pratt & Whitney delivers GTF to Irkut

Pratt & Whitney announced at the Moscow Airshow that it had delivered the first PW1400G engine to Russia's Irkut Corporation. The PW1400G is the variant of Pratt & Whitney geared turbofan designed for Irkut's MC-21, a competitor to the Boeing and Airbus single-aisle aircraft, which its manufacturer is targeting for entry into service in 2017.

SEPTEMBER 2015

EIB confirms $427m Rolls-Royce loan

European Investment Bank (EIB) agreed to loan Rolls-Royce £280 million ($426 million) to support the development of the higher-thrust version of the Trent XWB engine.
Rolls-Royce is to use the seven-year loan to develop the Trent XWB-97, a 97,000lb-thrust engine that will power the A350-1000 when it enters into service in 2017.

OCTOBER 2015

First Leap-1Bs arrive at Boeing

CFM delivered the first two Leap-1B engines to Boeing for installation on a 737 Max prototype, paving the way for flight tests in early 2016.

GE Aviation rolls out 1,000th GEnx

GE Aviation assembled the 1,000th GEnx engine, five years after the first production engine was built

The company said the GEnx was the fastest-selling engine in GE's history.

NOVEMBER 2015

Pratt & Whitney engine for E2 jets begins flight testing

The PW1900G GTF engine for the Embraer E190-E2 and E195-E2 aircraft completed its first flight. The engine was installed on Pratt & Whitney's 747SP flying test bed.

Rolls-Royce prices $1.5bn notes

Rolls-Royce priced almost $1.5 billion-worth of notes, according to a company announcement.

It was the engine manufacturer's first issuance of Rule 144A/Regulation S notes

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TAESL partnership ends

Rolls-Royce and American Airlines announced plans to dissolve Texas Aero Engine Services (TAESL), a 50-50 joint venture between the two companies, based in Fort Worth, Texas.

TAESL was originally established in 1998 to work on Rolls-Royce aircraft engines operated by American Airlines. These included the Tay 620/650, RB211 and Trent 800.

MRJ flight-testing gets underway

The Mitsubishi Regional Jet (MRJ) made its first flight on November 11, taking off from Nagoya Airport in Japan. The MRJ is powered by the PW1200G variant of Pratt &Whitney's GTF engine.

FedEx Express selects GE Aviation engines for 767 Freighters

GE Aviation announced FedEx Express, a wholly owned subsidiary of FedEx Corp, selected GE's CF6-80C2 engines to power its recent order of 50 Boeing 767 Freighters. Deliveries for this order are scheduled to begin in 2018.

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NEWS

Engine landmarks 2015/2016

DECEMBER 2015

MRJ delayed by one year

Mitsubishi Aircraft Corporation and Mitsubishi Heavy Industries announced that the delivery of the first Mitsubishi Regional Jet (MRJ) would be delayed by one year.

The regional jet was originally scheduled to deliver in the second quarter of 2017.

Bombardier CSeries certificated

Transport Canada announced the aircraft certification for Bombardier's CSeries, marking a significant milestone for the company and for the engine supplier Pratt & Whitney.

GTF sales reach 7,000

Turkish Airlines signed a definitive agreement for Pratt & Whitney PW1100G engines to power its order of 92 A321neo aircraft. The deal is the largest engine order in 2015 for Pratt & Whitney and takes sales of the GTF engine family to about 7,000 orders, according to the manufacturer.

HNA Group signs $2.4bn engine deal

Chinese conglomerate HNA Group signed a $2.4 billion agreement for engines and services with Rolls-Royce.

The agreement was signed during the state visit by President Xi Jinping to the UK. The engines covered by the agreement will power 44 aircraft ordered with Airbus.

JANUARY 2016

Boeing 737 Max takes to skies

Boeing's 737 Max programme achieved a major milestone on January 29 when the Max 8 model took to the skies for the first time. CFM International Leap-1B engines powered the aircraft. The 737 Max family does not offer a choice between engine manufacturers, unlike the Airbus A320neo family.

It marked the start of an extensive flight-test programme before certification and delivery. First delivery of the 737 Max is planned for the third quarter of 2017.

FEBRUARY 2016

Embraer rolls out E190-E2

Embraer rolled out the first E-Jet E2 aircraft. The E190-E2 is the first member of Embraer's E-Jets E2 aircraft family and is powered by the PW1900G variant of Pratt & Whitney's GTF engine.

Aerolease commits to MRJ

Mitsubishi Aircraft Corporation announced the signing of a letter of intent for 10 MRJ90 aircraft with US lessor Aerolease. The aircraft are scheduled for delivery in 2018.

A321neo completes maiden flight

The first A321neo completed its maiden flight on February 9, from Hamburg. Leap-1A engines powered the aircraft.

The first flight of the A321neo was originally planned to be with a Pratt & Whitney geared turbofan engine, which had already flown on the A320neo.

Airbus maintained the change of powerplant for the first flight had no impact on plans for deliveries of the respective models, with the Pratt & Whitney-equipped A321neo still expected to reach customers at the end of 2016 and the CFM-equipped version in early 2017.

Rolls-Royce and GE launch new service agreements

Rolls-Royce launched a new engine maintenance service for its customers. The new product, called SelectCare, offers customers a certain number of engine overhauls at a fixed price, and also allows them to choose from a selection of other services.

GE Aviation, Services unveiled its new TrueChoice suite of engine maintenance offerings for the commercial aviation industry, emphasizing breadth and depth of capabilities and customization across the entire engine lifecycle.

MARCH 2016

Trent 1000 starts flight-testing

The Rolls-Royce Trent 1000 engine flight-testing programme got underway on March 23. The engine flew on Rolls-Royce's flying test bed aircraft, a Boeing 747, at Tucson, Arizona, USA.

The Trent 1000 will power all variants of the Boeing 787 family.

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KBRA CONTINUES TO LEAD THE AVIATION MARKET

ABS

AIM AVIATION FINANCE	SERIES 2015
APOLLO AVIATION SECURITIZATION	2014-1
ATLAS	SERIES 2014-1
CASTLELAKE AIRCRAFT SECURITIZATION	SERIES 2014-1 & 2015-1
DIAMOND HEAD AVIATION	2015 LIMITED
EAGLE 1	SERIES 2014-1
EMERALD AVIATION FINANCE	SERIES 2013-1
FAN ENGINE SECURITIZATION	SERIES 2013-1

CORPORATES

AIR LEASE CORPORATION
FLY LEASING
NEARLY 20 AIRLINE/LESSOR EETC & PRIVATE PLACEMENT TRANSACTIONS
FIVE PRIVATE AIRCRAFT LESSORS

KBRA's Aviation Team Awarded 2015 Rating Agency of the Year

Aviation ABS Rating Methodology | EETC & Secured Aircraft Debt Rating Methodolog
Overview of the Aircraft Leasing Industry | EETC Historical Recoveries & Current Outlook

ENGINE SURVEY 2016

A lease of life

There has been a resurgence of interest in older assets over the past year, prompted by a dramatic drop in the price of Brent crude. Joe Kavanagh and Geoff Hearn analyse the key trends from this year's results.

CFM's Leap-1B has made a dramatic debut in the *Airfinance Journal* engine poll by coming out on top. The 737 Max powerplant has the confidence of investors, who have awarded it the top score across all three categories: investor appeal, remarketing potential and residual value.

The GEnX, which powers Boeing's 787, is another success story. As the top widebody engine in this year's poll, it has increased its scores across all three categories compared to last year's results, and earned the praise of poll respondents.

Although the winning engine is one that is yet to enter service, the less obvious success story of this year's poll is the resurgence of interest in older asset types. Respondents say that the low cost of fuel is causing more airlines to extend leases on older assets, leading to better value retention for these engine types.

As in previous years, respondents have stressed how crucial engines are to the value of aircraft. A recently released chart from Avitas (see below) shows just how vital the engine becomes to an aircraft's value as it matures. It states that for a 2013-vintage 737-800, powered by a CFM56-7B, the engines will constitute almost all of the asset's value by 2029.

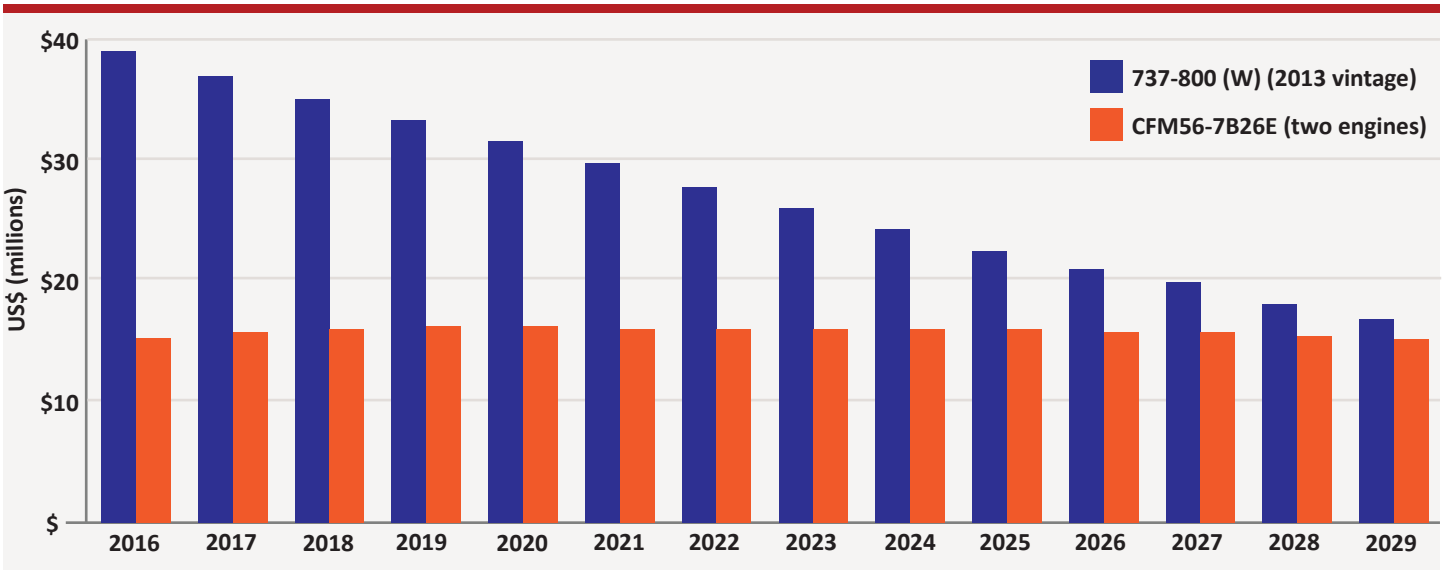
Another repeat theme is investor anxiety over original equipment manufacturer (OEM) control of the aftermarket. Financiers say the more an OEM controls this section of the market, the fewer buyers there are for spare engines and parts. The fewer buyers there are for an engine, the more unpredictable its residual value becomes, making it a more uncertain investment.

Respondents say that operators are choosing to extend the leases on older, less fuel-efficient aircraft more often. With fuel costs so low, airlines can afford to keep operating older aircraft. Although these aircraft require more maintenance, the low fuel spend makes them attractive assets to airlines.

Paolo Lironi, chief executive officer at SGI Aviation, notes a resurgence of interest in the CFM56-5C and -5A, which power the A340 and the A320ceo respectively. He also says that the various engines powering the 767 (the PW 4000, CF6, JT9D and RB211) have seen similar boosts of demand.

He notes: "We have definitely seen, since the second half of last year, airlines in one way

TOTAL ENGINE VALUE RELATIVE TO AIRCRAFT VALUE
FUTURE BASE VALUES 2016-2029 @ 1.0% INFLATION (AIRCRAFT) AND 2.5% INFLATION (ENGINES)



Source: Avitas

"Respondents say that operators are choosing to extend the leases on older, less fuel-efficient aircraft more often."

or another trying to extend leases, or in some cases even getting rid of the lease. In some cases, smart airlines and cash-rich airlines are actually choosing to buy the aircraft, rather than going through a costly redelivery with the lessor.

"The knock-on effects are various. First of all, there is increased interest in certain engine types. If two years ago people were wondering what was going to happen with end-of-life aircraft and engines, nowadays these sunset engines have been keeping their value."

The results of this year's poll support that view. The score for investor appeal for the CFM56-5C, for example, is 2.2. In last year's poll, the engine scored 1.4, perhaps because the price of fuel had not dropped to its current level as the responses were being collected.

MRO cycle

The maintenance, repair and overhaul (MRO) market is crucial to an engine's value.

Hooman Rezaei, president at International Aircraft Engine Association, notes that the value of an engine is largely determined by its place in the MRO cycle. For older engine models, the spares and parts market is more established, meaning residual values can be predicted with greater certainty.

When asked about the state of the market, respondents still mention the issue of OEM control. Many say that the residual values of certain engines are negatively affected by the fact that there are few buyers for those assets in the secondary market.

Kane Ray, senior aviation analyst and engine specialist at consultancy IBA, believes OEM actions in the aftermarket mean that the difference between the widebody and narrow-body engine markets is getting less pronounced.

He says: "There are typically fewer spare engines in the twin-aisle market, because of the high investment cost, but OEMs in all sectors are moving in the same direction in trying to sign operators up to inclusive maintenance packages. The airlines are attracted to these schemes in part because they want to keep the risks with the OEM."

A380 switch

Emirates' decision to switch engine providers on its ordered A380 has boosted the scores for the selected engine type.

In April 2015, the airline chose to switch manufacturer of the engines for the 50 A380s it ordered in 2013. The $9.2 billion deal saw the carrier switch from the GP7200 (provided by Engine Alliance) to the Trent 900 (made by Rolls-Royce). As a result, the Trent 900 has seen a boost in interest and has done better in this year's scores than in 2015.

However, when asked about these models, respondents still comment on the small installed base for this engine and the limited number of operators. With only 182 A380s in service, as of March, the market is nowhere near as liquid as that of other successful widebodies. As a result, A380 engines score lower for remarketing potential than investor appeal.

A LEAP FORWARD

This year's engine poll allowed respondents to score the CFM Leap-1B for the first time.

The engine has shot to the top of the leader board across all three categories, proving conclusively that the investment community has a high level of confidence in the model.

It has scored very highly – 6.8 out of seven – for investor appeal in particular, but has also topped the polls for remarketing potential and residual value. The engine will power the 737 Max when the aircraft enters into service in 2017. Crucially, the Leap is the only engine type for this aircraft. With more than 3,000 orders placed already for the aircraft family, there is already a wide base of operators.

When it comes to the A320neo, however, operators can choose between the Leap-1A and the PW1100G. This may go some way to explaining why these engines have been outperformed in the poll by the Leap-1B.

GENX WINS 787 VOTE

Another success story this year is the engines that power Boeing's 787.

The more successful of the two, according to the survey, is the GEnX, which has come third in two of the three categories. It is the best-performing widebody engine in this year's poll, with high scores in each section.

The other engine option, Rolls-Royce's Trent 1000, has also performed strongly. However, for remarketing potential and residual value the engine is further down in the table, indicating concern about the secondary market for the type.

As of March, Boeing had delivered almost 400 of the aircraft to its customers, and had a backlog of almost 750. Appraisers also rate the engine highly for its investment appeal.

In last year's *Airfinance Journal* Operators' and Investors' Poll, the 787-9 was the best-performing in-production widebody in the operational success category. The aircraft's popularity among operators is clearly having a knock-on effect on the market for its engines, which is particularly good news for GE.

ENGINE SURVEY 2016

INVESTOR APPEAL (OUT OF 7)	
CFM Leap-1B	6.8
CFM Leap-1A	6.3
GEnX (787)	5.8
CFM56-7B (737NG)	5.6
PW1100G (A320neo)	5.5
CFM56-5B (A320)	5.4
Trent 1000 (787)	5.3
CF34-8E (E-Jets)	5.1
Trent XWB	5.0
V2500-A5 (A320)	5.0
GE90 (777)	4.8
CF34-8C (CRJ)	4.7
CF34-10E (E190/195)	4.6
GP7200 (A380)	4.3
PW150A (Q400)	4.3
CF6-80 (747-400s, 767s)	4.2
Trent 700 (A330)	4.0
Trent 900 (A380)	3.8
PW127 (ATR)	3.6
CFM56-3C (737Classic)	3.3
RB211-535 (757)	2.8
PW4000 (747-400s, 767s, 777s)	2.7
PW2000 (757)	2.5
V2500-A1 (A320)	2.4
CFM56-5C (A340)	2.2
JT9D (747s, 767-200)	2.2
Trent 800 (777)	2.0
CFM56-5A (A320)	1.9
RB211-524 (767, 747-300, -400)	1.7
PW6000 (A318)	1.0
Trent 553 (A340-500)	1.0
Trent 556 (A340-600)	1.0

REMARKETING POTENTIAL (OUT OF 7)	
CFM Leap-1B	6.3
CFM Leap-1A	5.8
GEnX (787)	5.8
CFM56-7B (737NG)	5.6
CFM56-5B (A320)	5.1
CF34-8E (E-Jets)	5.0
PW1100G (A320neo)	5.0
Trent XWB	5.0
V2500-A5 (A320)	4.6
CF34-10E (E190/195)	4.6
CF34-8C (CRJ)	4.6
Trent 1000 (787)	4.5
CF6-80 (747-400s, 767s)	4.3
GE90 (777)	4.3
PW150A (Q400)	3.6
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PW2000 (757)	2.7
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V2500-A1 (A320)	2.2
CFM56-5C (A340)	2.0
Trent 800 (777)	2.0
CFM56-5A (A320)	1.9
RB211-535 (757)	1.8
JT9D (747s, 767-200)	1.2
RB211-524 (767, 747-300, -400)	1.2
Trent 553 (A340-500)	1.0
Trent 556 (A340-600)	1.0
PW6000 (A318)	0.8

RESIDUAL VALUE (OUT OF 7)	
CFM Leap-1B	5.8
CFM56-7B (737NG)	5.6
CFM Leap-1A	5.3
GEnX (787)	5.2
CFM56-5B (A320)	5.1
CF34-8E (E-Jets)	5.0
Trent XWB	5.0
V2500-A5 (A320)	4.6
CF34-10E (E190/195)	4.6
PW1100G (A320neo)	4.5
Trent1000 (787)	4.5
GE90 (777)	4.3
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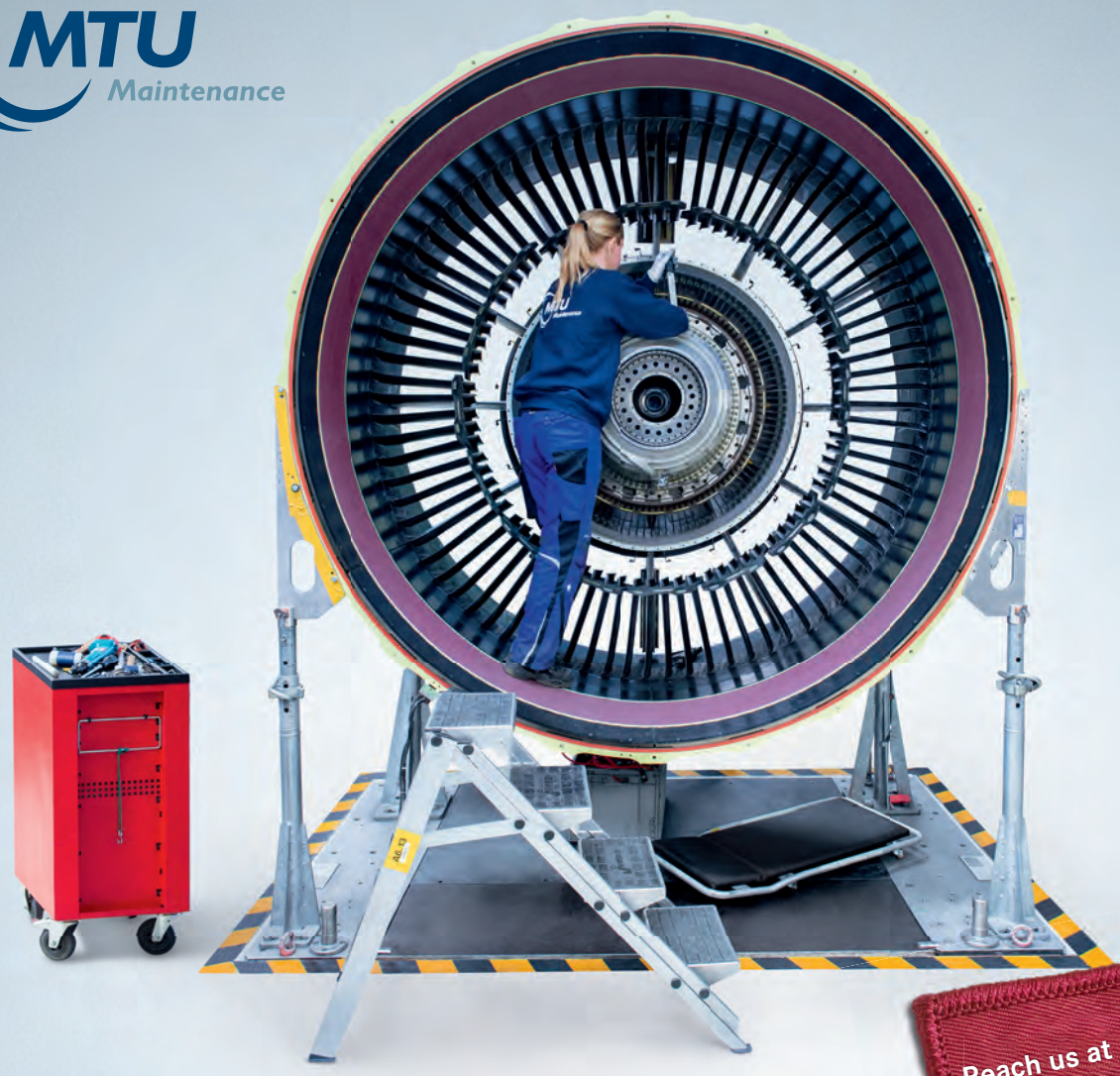
CFM56-5C (A340)	2.0
PW2000 (757)	2.0
Trent 800 (777)	2.0
RB211-535 (757)	1.8
CFM56-5A (A320)	1.7
JT9D (747s, 767-200)	1.2
RB211-524 (767, 747-300, -400)	1.2
PW6000 (A318)	1.0
Trent 553 (A340-500)	1.0
Trent 556 (A340-600)	1.0

MTU Maintenance



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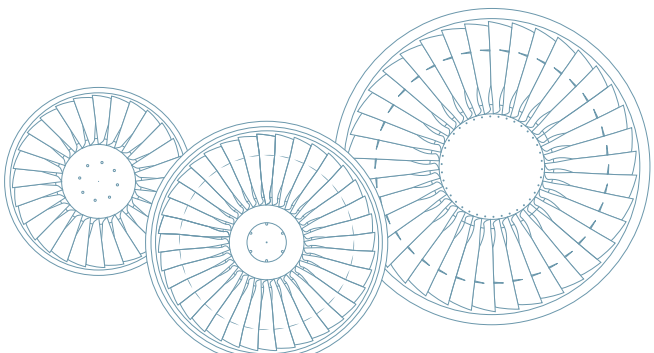

NEWS ANALYSIS

Tokyo Engine roundtable 2016 round-up

Michael Allen reflects on what made this year's *Airfinance Journal*/CFM Roundtable in Tokyo such a success.

On March 9, in conjunction with CFM, *Airfinance Journal* hosted its Financing and Investing in Aircraft Engines Roundtable 2016. The event was held at The Peninsula Hotel, Tokyo, where delegates were treated to presentations on trends in engine leasing and the Japanese airline market from industry specialists at DVB Bank, Mitsui and White & Case Tokyo, as well as CFM.

The manufacturer also offered participants the chance to examine hi-tech engine parts from its latest technology engines. The increasing prominence and importance to the aircraft finance community of engine leasing was evident from the high-quality debate and insightful questioning from delegates.

Akira Kaido, from Mitsui's aero-engine business department, spoke about the engine leasing market. He said the demand for leased engines was rising because of the increased use of leased aircraft, increased capital costs for modern engines, and operators' desire for more flexibility and more efficient use of working capital. Leased engines, he remarked, made up about 32% of the spare engine market and that figure was expected to grow to 40% by the end of 2030.

DVB Bank Tokyo's managing director Yoichi Hirotani gave a presentation on Japan's airline market. He analyzed how Japanese airlines had changed since the 1990s, looking at which were the key routes. Hirotani also examined the financial statements of heavyweights ANA and JAL, and spoke about how they compared.

One of the major issues for Japanese carriers is slot shortages at Haneda Airport, the airport closest to central Tokyo. Hirotani gave an outline of slot availability at Haneda and the other Tokyo airport, Narita, and explained how Haneda expansion could be good for the industry.

Finally, Hirotani noted the trend of Japanese companies pouring money into the aircraft leasing industry, such as SMFL and Sumitomo Corp's 2012 acquisition of RBS Aviation Capital, MUL's acquisition of Jackson Square Aviation in 2012 and Marubeni's equity stake in Aircastle, among others.

Masahiro Mita, a senior vice-president at DVB Bank Tokyo, gave his insights in a presentation entitled Perspectives on the Engine Market. He noted how the number of new aircraft in the market was increasing and that several new types of engine were coming into the market. He suggested, however, that because of technological improvements, the number of engine shop visits might not be increasing at the same rate relative to fleet size, as had been the case historically. However, he feared maintenance costs might increase because of a reduction in options for aftermarket support.

Jeffrey Dressler, an associate in White & Case's Tokyo office, provided legal explanations of engine type and thrust configuration, maintenance reserves, return conditions, engine pooling arrangements, warranty assignments and Cape Town considerations for engines.

Positive response from delegates

There was a consensus among participants that the exchange of ideas had provided useful insights into this increasingly important facet of the aircraft financing market. Both hardened veterans and newcomers to the industry were fulsome in their praise of the event.

One senior Japanese Bank executive said he had gained a better understanding of which engine types offered the best investment opportunities, particularly with regard to their part-out potential. He also appreciated the information given regarding potential legal problems in the context of repossession and defaults.

At the other end of the experience scale, one first-time attendee said he had been surprised at how much engine financing differed form its aircraft counterpart.

The conference was a great success and we are already planning for next year.

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SPONSORED EDITORIAL

Investing in older engines: opportunities and pitfalls

Olga Razzihivina, senior Istat appraiser, Oriel, provides an insight into how powerplants are valued.

Asset investment in aviation is commonly associated with aircraft. However, engines can provide a viable, if not more secure, alternative. Yet, investment in engines is often seen as the preserve of the more sophisticated financiers, already familiar with the aircraft world.

The reason for such perception probably lies in the fact that aircraft demand is relatively easily understood by non-specialists. You do not have to be an industry insider to appreciate that the air transport industry is driven by passenger and cargo demand. Engines, however, are only a part of the aircraft and are therefore seen as requiring far greater technical expertise.

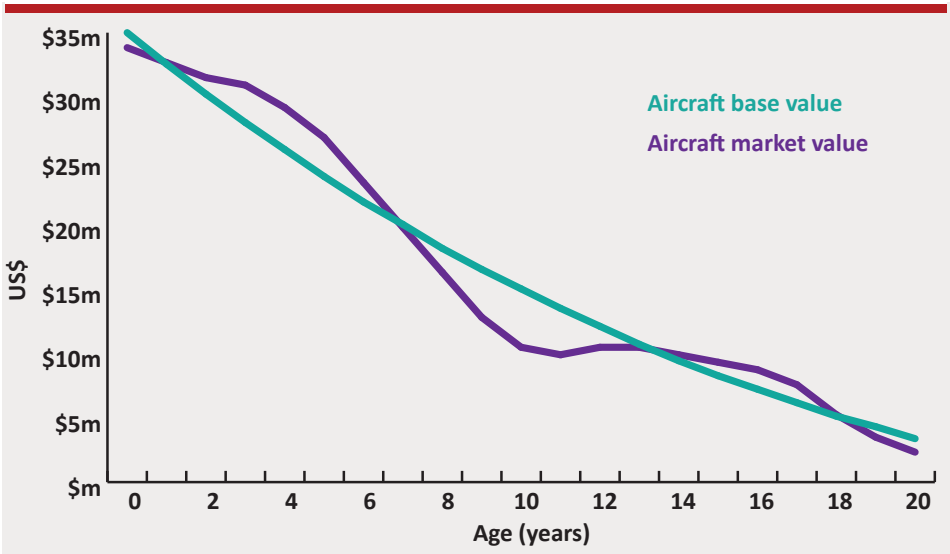
Yet, more and more investors are realizing the value of engines, either in their own right or as a part of older aircraft. The number of lessors specializing in the "end-of-life" solutions, relying heavily on the residual value of installed engines, is on the rise with some, such as Castlelake, even securitizing their portfolios.

The benefit of investing in engines can be easily seen in comparing value depreciation profiles of aircraft and engines. The chart below, and on the following page, show typical profiles for aircraft and engines.

The aircraft base value chart, which represents the long-term intrinsic value of the asset, starts its decline the moment the aircraft is delivered. The market value, which can be understood as the spot price, fluctuates around the Base Value in line with the aviation cycle.

It is accepted by investors that aircraft values can be volatile and subject to industry cycles. This volatility can be mitigated by investing in the popular aircraft types that are likely to remain in demand regardless of the economic situation.

TYPICAL AIRCRAFT VALUE TRENDS



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"Investors in mature and so-called sunset aircraft (ones close to retirement) are expecting to benefit from the relative stability of the engine values in the middle part of the production cycle."

Experienced investors play the cycle, buying assets at the nadir of the cycle and selling at the zenith. Risks still exist and increase when investors move from the most popular narrowbodies to more niche products, such as widebodies, in search of better margins.

Engine values do not require such close anticipation of the cycle and thus carry less risk. They are driven by the fact that even in the low ebb of the aircraft value cycle, airlines need engines to power their aircraft while minimizing investment in maintenance. This creates a more stable value environment without significant drops.

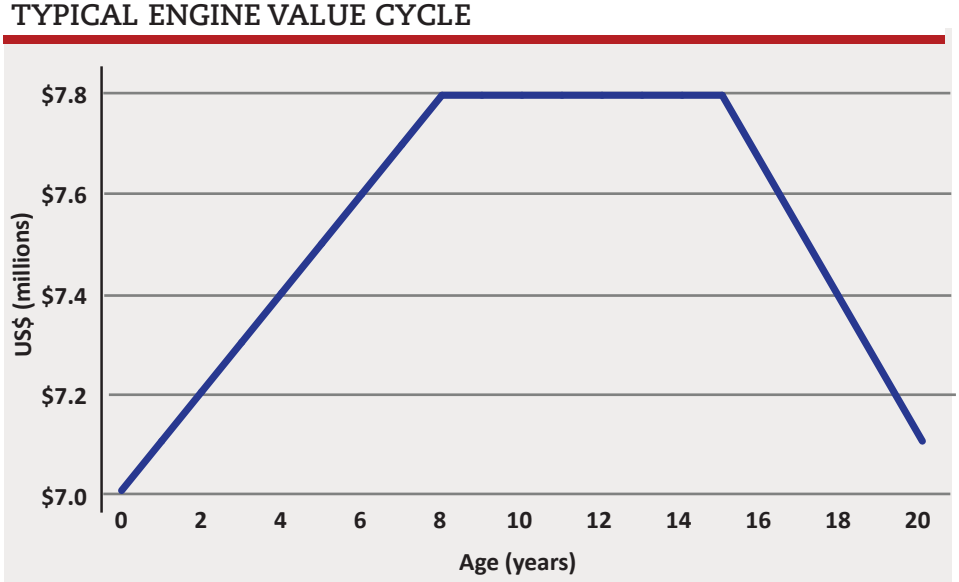
In the early part of the engine production cycle, its value grows, driven by annual increases in the prices of the engine life-limited parts (LLPs), which are high-value rotating parts. The trend is shown in the chart.

After an engine is out of production, its value enters a stable plateau phase when its platform aircraft is still flying with a large number of operators. Even if some aircraft are parted out during this period, their engines are used to support the remaining fleet. The decline in value only comes when the airframe platform is parted out en masse with the formerly installed engines entering the market in large numbers.

Investors in mature and so-called sunset aircraft (ones close to retirement) are expecting to benefit from the relative stability of the engine values in the middle part of the production cycle. Many of the older aircraft coming off lease require investment in maintenance before they can be redeployed. Lessors may have the necessary funds (collected as maintenance reserves and lease-end compensation) but investment in maintenance will not bring a dollar-for-dollar price increase. Re-leasing the aircraft can be a problem because only poor credit quality lessees might be interested.

In such circumstances, parting out the aircraft becomes a more attractive proposition, offering revenue in addition to collected maintenance reserves. While airframe parts constitute only a small portion of the end-of-life value, engines can offer several types of revenue: engines with green time (hours/cycles remaining to the next overhaul shop visit) can be rented out, after that they can be parted out for LLPs with remaining life, non-LLP parts, line-replaceable units and the quick engine change kit.

TYPICAL ENGINE VALUE CYCLE



Green time

The ability to monetize an engine's green time depends on several factors, including the size of the aircraft fleet, frequency of engine overhaul events, transit of aircraft to secondary operators, expending of green time of the spare engine pool and, above all, availability of the open market.

Operators' demand for green time is driven by the number of flying aircraft and the appetite of airlines to invest in engine maintenance. In the periods of low airline profitability (ie, the low ebb of the aviation cycle), airlines try to avoid any cash outlays, including engine overhauls, which cost millions of dollars. Operators opt for renting-in engines at relatively low monthly rates. During such periods, increased demand for spare engines coupled with the lack of maintenance investment consumes the green time of the overall engine population, driving up lease rates.

In the periods of high profitability, airlines increase their aircraft – and hence engine – utilization, reaching overhauls quicker. The elapsed time of an engine being unavailable while in overhaul can take up to several months when demand is high. Spare engines are needed during these periods to enable flying.

As aircraft leave the fleets of top-tier airlines they spread across a wider number of secondary operators, potentially increasing requirement for spare engines. While large operators can manage with a higher ratio of aircraft to spare engines, smaller operators may require a spare engine even for a small number of aircraft. Investors, however, need to be aware that airlines can enter pooling agreements, enabling them to own fewer engines.

All of these rental drivers are only at work if the engine type enjoys an open market. Limitations on use of engines from third parties imposed by engine original equipment manufacturers (OEMs) reduce leasing opportunities for spare engines and can even make it impossible for investors in the end-of-life aircraft.

The engine still has lots to offer in the part-out scenario once the green time is expended. This, however, has to be judged carefully. Timing the production cycle, ratio

"As aircraft leave the fleets of top-tier airlines they spread across a wider number of secondary operators, potentially increasing requirement for spare engines."

of remaining aircraft to available spare engines, parts manufacturer approval (PMA) parts, designated engineering representative (DER) repairs, quality of technical records and condition of the LLPs can all have an effect.

Disassembling an engine brings the best results in the, first, rising or, second, stable phases of the production cycle. Once the platform aircraft is being parted out en masse, the number of available spare engines increases dramatically, driving down prices and lease rates. Although opportunities may arise at the very end of the engine's life cycle when very few engines are in existence, these are sparse and require a long-term commitment.

PMA parts and DER repairs are approved by the Federal Aviation Administration and are used by US operators to reduce their maintenance costs. Other authorities, however, do not accept them and their presence in a disassembled engine is undesirable. The PMA parts have no resale value. Any high-value parts with DER repairs may have to be reworked or scrapped if the work is too costly.

Back to birth traceability is essential for the high-value engine parts. Arguably, well-maintained records are as important as the metal, if not more so.

Engine LLPs are potentially the most valuable element of the part out. To achieve the best results, their remaining lives have to hit the sweet spot. Parts with less than 25% of their life remaining usually will have zero value. Monetizing all of the remaining life on the long-lifed parts is unlikely because few operators would want to build an engine to such a high standard. Parts with 4,000 to 8,000 cycles remaining are typically in most demand.

Once again, all of these disposal avenues are only available in an open market. The opportunities for third parties reduce significantly if all or a majority of engine operators are restricted to using only new parts or used parts exclusively from the OEM.

New engine technologies

The main thing investors have to keep in mind is that the aircraft engine landscape is ever changing, in more ways than one. Some of the life-cycle-related or industry-driven fluctuations have been mentioned earlier. There are also future changes existing, which potential engine owners have to anticipate.

New engine technologies, such as geared turbofan, are being introduced to today's market. Any new engine entrant would be expected to have teething problems, as was the case, for example, of the V2500-A1 and PW4000. Even though engine manufacturers might provision for these eventualities, the severity of the problems and speed with which the OEMs are able to fix the issue can provide a short window of opportunity for engine lessors. In the longer term, investors have to assess how long it will take for the new engines to reach the wave of first overhauls. Lately, with the CFM56-5 and -7 engines, the timing of this overhaul wave has been misjudged by many because of engines' higher-than-expected reliability.

Advancement of the new manufacturing technology can also affect the engine aftermarket. New ceramics-based materials are expected to last the lifetime of the engine, thus making it unnecessary to replace them, and 3D printing promises a cheaper and quicker way to create spare parts, also potentially reducing demand for secondary material. Increasing use of exotic materials in engine parts is a positive trend because of their high cost.

Change in the type of enterprise involved in engine overhaul is another important factor. Smaller independent maintenance providers are disappearing, while the market is increasingly dominated by the engine OEMs. Rolls-Royce was the first engine manufacturer to introduce flight-hour agreement-type programmes for the airlines whereby maintenance is only provided by the OEM or its licensees. Other OEMs needed to respond and introduced similar programmes with different degrees of control. These flight-hour agreement programmes have advantages but they do limit engine and secondary material trading.

Having been the first to introduce the flight-hour agreement, Rolls-Royce is the first OEM to recognize its potential to affect the mature engine owners negatively. The proposed remedies are still evolving but they offer promise of monetizing engine values at the end of their life.

The effectiveness of the remedies is yet to be tested but they are important in demonstrating that engine OEMs recognize the importance of investors and non-airline owners.

Aircraft engines offer a potentially more stable investment than the aircraft they power, however, they do require more technical expertise and knowledge of factors specific to the engine market. For those investing in the end-of-life projects, timing is crucial in managing engine value through green time leasing and part-out.

The evolving engine landscape brings challenges as well as opportunities. Some of the challenges are OEM-related and thus outside investors' control. However, the role of investors is increasingly recognized, and solutions to accommodate their requirements are hopefully on the way.

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SPONSORED EDITORIAL

RRPF eyes emerging markets

Bobby Janagan, general manager, Rolls-Royce & Partners Finance (RRPF), talks to *Airfinance Journal* about how the company lessor is adapting to changes in the commercial aircraft engine business.

***Airfinance Journal:* Rolls-Royce & Partners Finance was established as a separate business in 1989, has GATX always had a share of the ownership?**
Bobby Janagan: No. When Rolls-Royce started this business, four shareholders were in the business. Rolls-Royce was the lead shareholder alongside three banks – NatWest, Chrysler Bank and Mitsubishi. However, the nature of the partnership changed after the recession triggered by the first Gulf War, so in 1994, Rolls-Royce bought out all other shareholders and it became a wholly owned business. In 1998, GATX came on board as a 50-50 shareholder. GATX and Rolls-Royce have equal rights on the board and equal say in the business, but it's a Rolls-Royce-branded business.

How much growth are you expecting in the engine leasing market in general and your business in particular? Where will the growth be coming from?
One of the macro trends we see is the growth opportunities in the emerging markets and the emergence of a large middle-class population because of rising income levels. The second trend is urbanization. For example, in India, there are mega-cities like Mumbai, Delhi, Hyderabad and Chennai. In mega-cities, the air traffic growth is in double digits because urban centres attract a wealthier population with aspirations to travel.

If you look at the UK, the rest of Europe as well as the USA, on a per capita basis, people travel by air at least twice a year. Whereas in China, people travel approximately once a year, and in India they travel only around 0.3 times a year, so there is huge potential for growth in front of us. If you read Airbus or Boeing's next 20-year forecasts, that's what they're both saying, projecting 35,000 aircraft to be delivered and the majority of them are for incremental capacity to the current flying fleet.

More engines will be needed to support the flying fleet. If you look at the near term – the next five years – Rolls-Royce has a huge order book, which provides opportunities for RRPF, particularly with Trent XWB on the A350, Trent 1000 on 787s and Trent 7000 on the A330neo. The final key trend is that the lessors' share of asset financing is reaching 40% to 50% of new deliveries. We haven't seen this

before. It is only recently that we have seen lessors' share of deliveries climbing above 30% and it is now heading towards 50%. This is good news for us as an engine lessor.

Are lessors' demands different to those of airlines when it comes to leasing engines?
At a very high level, you can put airlines into two groups. The first group of airlines refresh their fleet about every 15 years and the second group fly their fleet until it is uneconomic to operate anymore. Although lessors at a basic level provide funding to airlines, lessors also more importantly provide fleet flexibility solutions.

Let's take two household names, Emirates and British Airways. The former regularly refreshes their fleet every 15 years so they use operating leases to finance half their fleet because fleet flexibility and residual value exposure are important issues for them. The latter historically preferred to operate their fleet beyond 20 to 25 years and so they would be less concerned about residual-value exposure because the assets would be written down to an immaterial amount, hence only 25% of their fleet is on lease. However, in January this year, Willie Walsh [chief executive officer, IAG] said that IAG is aiming to increase the number of aircraft on operating lease to 40%.

"As a lessor, we invest over a longer period of time than most airlines. This investment period covers first-, second- and third-tier operators."

As a lessor, we invest over a longer period of time than most airlines. This investment period covers first-, second- and third-tier operators. We actively study fleet migration patterns and build such patterns into pricing and residual value forecasts.

Has the business of leasing spare engines changed a lot since the company was founded? What has changed in the last year?
There's been a big change. In the first 15 years, we acted as a finance provider, in the form of operating leases to second- and third-tier operators. In the last 10 years, instead of just providing the finance, we have been shifting towards being a provider of operational flexibility.

A good example is Emirates. If you go to any conference, you'll hear people from Emirates in panel discussions saying that they want to lease at least 50% and put the other half of their fleet on the balance sheet. Because they're growing at such a rapid pace, they need to have diversified sources of funding. Secondly, they see the flexibility that is associated with operating lease as something vital for them. It's very difficult for them to see what their fleet plans will look like 10 to 12 years ahead, but leasing will give them that flexibility to adjust the fleet and manage their prevailing needs in the future.

In terms of engine leasing, what do you see as the main differences between the single-aisle and widebody markets?
The single-aisle market has volume and quite a deep operator base compared to the widebody market. The operator base of widebody aircraft is typically smaller than the single-aisle fleet. As a result, independent lessors are more likely to be much more active in the single-aisle market. For example, instead of investing $30 million in one engine, they prefer to invest in three engines at $10 million each and lease the three engines to three different operators.

So from a credit and asset concentration risk perspective, narrowbody engine leasing can carry less risk than leasing widebody engines. For this reason, a higher proportion of widebody engines are financed by the OEM [original equipment manufacturer]-related entities, which are expected to provide support for their respective engine types. So with Rolls-Royce, it's RRPF and for GE, it is GE Engine Leasing.

Rolls-Royce engines lack presence in the single-aisle market. Is that something it is looking to change?
I can't speak to Rolls-Royce's plans for the single-aisle market. However, RRPF is the largest lessor of V2500s today, with around 100 engines. We cherish and value our customer relationships in this market. If our customers want us to lease GTF or Leap-X engines, we would look seriously at their request. We have a few G90 and CFM engines in our portfolio which are on lease with customers. We want to build long-term partnerships with customers, and incremental business helps maintain such relationships.

What is the likely impact on your business of the new-technology aircraft (Neos and Maxs particularly) that are coming onto the market?
I would say it's a positive impact. New-technology aircraft mean new engines that require financing. At the same time, the lower fuel price has stimulated passenger demand and both current- and next-generation aircraft are required to meet incremental capacity needs in the medium term. The lower fuel price has also narrowed the operating cost of current-generation technology and is deferring the retirement profile of these aircraft.

You obviously work a lot with lessors and airlines. Do you do much work with the MROs [maintenance, repair and overhauls]?
The majority of our leases are direct with airlines, but we do lease engines to MROs in order to support them in providing engines to customers during engine maintenance work. This is a bit like your garage providing a courtesy car.

It is customary under long-term operating leases that the airlines as lessee agree to maintain their engines. Airlines increasingly sub-contract their maintenance requirements to MROs.

However, on short-term leases, where the lease duration is less than 180 days, lessors often take maintenance risk. We work with MROs to repair our engines when they need work doing at the time of lease return.

Do you work closely with Rolls-Royce joint-venture maintenance facilities?
We are based in Rolls-Royce's head office in London, so we are clearly part of the family. As RRPF is a joint-venture company – we have an external shareholder – we work on an arm's-length basis, so pricing and any other commercial matters are decided independently.

As RRPF is a Rolls-Royce-managed business, it is a simpler process for us to work with other Rolls-Royce business units in the areas of engine repairs, access to engineering resource for expert opinions, as well as understanding and supporting their needs for carcass engines for serviceable used material [SUM]. You might have seen recent announcements from Rolls-Royce about its new TotalCare Flex and SelectCare offerings, which include the use of greater proportion of SUM to lower maintenance costs.

You have a portfolio of Rolls-Royce engines, can you say what percentage of your business each engine type accounts for?
Our portfolio, in percentage terms, roughly reflects size and shape of the in-service fleet. So we have a large number of V2500 engines to support the large number of A320 aircraft in service. Similarly, we have a reasonable number of Trent 700 engines, as the Trent 700 is the preferred engine choice for the A330 aircraft, which is a significant widebody fleet.

What are the main challenges engine lessors face in the near future?
We are excited by the prospect of growth in the emerging markets. However, the near-term challenge is, with the new-generation aircraft coming, that some of the current-generation aircraft are going to move to second- and third-tier operators, and some of these operators are in challenging jurisdictions.

How easy is it to repossess engines out of those jurisdictions? That is a challenge for all engine and aircraft lessors. For RRPF, this means that we will work to build closer relationships with customers in such jurisdictions so that we can minimize the risk of repossession.

SPONSORED EDITORIAL

Is your mother's pension invested in spare engines?

Ben Hughes, marketing and business development director, Rolls-Royce & Partners Finance, looks at why spare engines are an attractive asset.

Ten years ago, if you had told industry outsiders that British Airways would fly its new Rolls-Royce-powered 787 Dreamliner daily to Chengdu in Sichuan province of China they might not have believed you.

The population of Sichuan was 81 million in 2011, with an urban population of more than 10 million. Over the past decade, the province has economically prospered, as has China in general. Today, a significant number of people living in Chengdu want to travel.

Chengdu Airport, which reports that it is managing more than 37 million passengers a year, is the fourth busiest airport in China, as well as one of the top 30 busiest airports in the world. In the next 10 years, we will see many similar stories because of the increasing number of cities in the world with populations of more than five million and sufficient disposable income for air travel.

This increasing passenger traffic, particularly from the emerging markets, has created a sustained demand for new aircraft. Airbus and Boeing have managed to secure sizeable order books, and wide sources of finance will need to be found to pay for these aircraft.

It is not just the new aircraft that will require finance but also the spare engines that support them. Spare engines are vital to ensure that aircraft are kept constantly in operation during periods of engine maintenance. It is our estimate that over the next 20 years, $65 billion-worth of spare engines will be required to support the new aircraft.

Spare engines are an attractive investment in many ways. They have a predictable annuity stream when they are on lease and retain value longer than aircraft. This is because of the ease of moving engines between operators of aircraft, as well as the large quantity of parts that are replaced during each overhaul. New-technology engines are increasingly significant investments, with list prices for very large widebody engines exceeding $30 million. The demand for spare engine lease solutions is also growing as more airline customers opt for the flexibility of a lease verses the risks of ownership.

Four spare engine lease management companies (or lessors) opened their doors for business in the 1980s to take advantage of this opportunity. Two were linked to manufacturers (Shannon Engine Services and Rolls-Royce & Partners Finance) and two were independents (Engine Lease Finance Corporation and Willis Lease). These early pioneers are still significant players today, having survived and prospered through three economic shock delimited cycles (Gulf War, 1991; 9/11 attacks, 2001; financial crisis, 2008).

This now well-established market is also a very competitive space with an increasing number of better-financed lessors.

In the late 1990s, Gecas entered the market by acquiring Curtis Power, and more capital was made available to the existing players, with BTMU investing into ELFC, GATX investing into Rolls-Royce & Partners Finance and Willis Lease listing on the stock exchange. In the 2000s, Macquarie launched an engine lease management business; while large financial institutions such as RBS, DVB and

"There is clearly investor demand for engines. They have proven to hold longer value than aircraft."

Sumitomo linked up with existing players through managed portfolio arrangements to gain equity exposure to the market. In the 2010s, the Macquarie portfolio was acquired by ELFC, while RBS and DVB wound down their position in the market for different reasons.

More recently, new lease managers such as Team and Sumisho have entered the market, while used aircraft parts trading companies have increasingly made engine lease management their core business and, at the same time, banks have increasingly focused on providing spare engine finance solutions directly to airlines for spare engines. As a result, there are more lease managers today and ultimately more choices available to airlines seeking finance for spare engines than during any previous economic cycle.

However, it is typically the scale of capital market syndication and the depth of investor base that is used to measure the maturity of a financial market.

The regulatory framework is an important factor in this context. The Convention on International Interests in Mobile Equipment and the related Aircraft Protocol (the Cape Town Convention) signed in 2001 explicitly recognized the importance of spare engines by providing the ability to register investor ownership interests in the same way as aircraft. This ability to register ownership interests globally, combined with an expedited local legal process, means that lessors can increasingly be confident about their ability to recover assets when a lessee does not pay. These formal rights and international regulatory framework has in turn provided confidence to a broader base of investors, including those in the capital markets.

The first widely reported capital markets syndication of engines was completed by Continental Airlines in 1999. This spare engine debt deal was followed by other US airlines, as well as lease managers such as Willis Lease with its West structure in 2005.

In 2006, the first equity placement was achieved in the $362 million Blade syndication transaction by Gecas. It was based on 50 engines and represented 25% of the lease manager's portfolio. Gecas followed this in 2011 with a smaller transaction consisting of 30 engines. Separately, in the early 2000s, the German investment firm GSI Funds deployed retail investor equity through managed portfolio arrangements with existing lease managers such as ELFC and Willis Lease.

There is clearly investor demand for spare engines. The assets have been proven to hold value longer than aircraft. The lease managers have been tested over a number of economic cycles. There is increasing competition between managers to ensure market efficiency. There is an improved regulatory framework to protect investor interests. So why have we not seen further syndication?

Spare engines are a small segment of the total aviation finance market. Typically, only one spare engine is required for every 10 installed aircraft engines delivered. In 2016, about $127 billion of new aircraft will need financing, whereas only about $3 billion will be needed to finance the associated spare engines. The challenge therefore is scale.

One of Macquarie's reasons for leaving the spare engine lease management space in 2011 was that it was non-scalable. This implies that the business was struggling to grow in accordance with shareholder expectations. The limited number of assets available in the market and strong competition mean that any new entrant will need patience from their investors to compete in the market. Scale, or more specifically the number of engines under management, is important because it provides a broad base of relationships with airline customers. These relationships provide the network within which the managers can understand the market and successfully transition engines. The related revenue, especially on depreciated assets, makes it easier to pay overheads and dividends to shareholders.

It could be that there is a limit to the number of lease managers that can survive in the spare engine market. Only time will tell. For now, the frequency of future syndications of spare engines will be dependent on the established lease managers which hold the assets.

There is some initial evidence of a trend towards syndication enabled by the maturity of the spare engine finance market, but the market is not yet as advanced in tapping a deeper base of investors as the wider aircraft finance market. Spare engine lease financing has historically followed developments in the wider aircraft lease finance market and so it is interesting to reflect finally on recent aircraft finance structures that have secured wider sources of investment.

In 2010, Doric listed its first Nimrod deal on the Specialist Fund Market of the London Stock Exchange. Nimrod offered the opportunity to a wider base of investors to take an equity position in a specific aircraft lease deal. The objective of the fund was to obtain income returns and a capital return for its investors by acquiring, leasing and then selling a single A380 aircraft operated by Emirates. Nimrod Air One has since been followed by Nimrod Air Two and Three, with increasing numbers of aircraft.

In the post-financial crisis world, retail investor commentators, such as Patrick Hosking of The Times, have written positively about the Nimrod model, noting its simplicity and suggesting it is appropriate for institutional as well as sophisticated private investors.

Ten years ago, while it may have seemed slightly strange to an industry outsider that Chengdu would have daily connections to London Heathrow, it would have sounded even more bizarre to hear that their mother's pension could be invested in spare aircraft engines. However, an increasing number of people want to travel by air, and the new aircraft and spare engines needed to carry them all need to be financed. A deeper pool of institutional investors, especially pension and insurance companies, has the potential capacity to provide such finance.

It is increasingly likely that your mother's pension will be invested in aviation assets in the coming years, and now that spare engines have greater recognition as attractive investments, it would not be that surprising if spare engines are added to the same pension portfolio.

SPONSORED EDITORIAL

Maximizing the value of your assets with MTU

Last October, MTU Maintenance launched MTUPlus to help its customers extract the maximum value from their engine assets as they approach end-of-life. *Airfinance Journal* speaks to Martin Friis-Petersen, managing director of MTU Maintenance Lease Services, about the new service, the narrowbody and widebody engine leasing markets and where engine investment is coming from.

***Airfinance Journal:* Why did MTU choose to get into the value maximization market?**

Martin Friis-Petersen: As the largest independent provider for aero engine services, we have completed more than 16,000 shop visits and have 35 years of experience in the market. To stay competitive, we are always looking to optimize the costs of ownership and maximize earnings for aircraft engines on behalf of our customers.

Engine ownership is increasingly moving from the operator to the investor community. Investors have different goals for their assets – namely, first, ensure their liquidity, and secondly, make sure that they have a financially optimized exit strategy for those high-value assets.

At the same time, they must minimize their book value exposures while maximizing their competitiveness. As an MRO [maintenance, repair and overhaul] provider, we have been faced with more and more requests for sophisticated integrated solutions that can offer both a reduction in maintenance cost and optimization in asset value. MTU's newly launched service was created to address these two aspects as a one-stop solution.

We think that MTU is a company with a unique background that combines large-scale MRO operations and its own asset pool with in-depth experience in engine trading and exchange, engine leasing and used surplus material trading. We have and can provide integrated in-depth market insights. This enables us to identify cost-effective options and define new attractive product offerings for our customers – both engine operators and investors.

Why aren't airlines and lessors making the most of maximizing the life of their used engines? What kind of mistakes are they making?

I don't think it's a question of making mistakes. One needs sales channels, predefined exit strategies and an experienced partner to execute on the predefined strategy. Thanks to MTU's broad MRO customer base, MTU Maintenance Lease Services has the tools and capability of leveraging and releasing locked-up asset value in a manner that is perhaps not available to all operators, or to the investor community.

Many asset owners don't have the interdisciplinary know-how that MTU has and, consequently, they are not in a position to recognize what might be best done with their engines. They may be only seeing the challenge from one angle, either the value angle or the operational cost angle. The market is a very complex one, and it is likely that they do not know all its facets and interactions.

So, it's not about mistakes. I just think that at MTU we can create additional value by using our integrated know-how to help them define the optimum exit strategies for their assets.

What new features is MTU bringing with the new service? You have other companies, such as GA Telesis, with similar services that help get the most value out of assets. How do you intend to have the edge over your competitors?

I actually think asset management is an upcoming market trend and that it is somehow shaping the future of the aftermarket. There are a lot of new entrants and a lot of announcements of companies entering the engine asset management market.

There are also a lot of established players already, but all with different backgrounds. The key players remain the large engine MRO providers, as well as traditional parts traders that have over time become active in the MRO and/or leasing businesses as well. We believe we can position ourselves in the market place by providing a one-stop asset management service, which has its DNA

"Integrated solutions that combine classical MRO work, asset management and additional services is our strength."

largely in MRO but also has over 15 years of engine leasing experience.

Finding that best value proposition for an asset owner is a fine balance between many different options: continuing to fly its engine, lease it out or selling it to others as a green-time engine, or tearing it down to remarket the sum of its parts.

In any case, determining the right timing for each option is crucial to value maximization. We differentiate ourselves by spotting trends early, having a natural in-house material consumption as a route to market the used material and executing on joint customer projects.

How long have you been considering entering this space, and is there any reason why you did not come into it earlier?

MTU's decision was primarily customer-driven, but also the result of increasing opportunities based on growing aircraft and engine retirements – and we believe that this trend will go on.

When the next-generation aircraft – such as the A320neos and the 737 Maxs – enter into service in large numbers, there will be a wave of retirements of current-generation assets. At that point in time, some asset owners will be facing book value challenges and will need an effective thought through exit strategy for their assets. The right timing will be of upmost importance. That's where we come into the picture, and the earlier we're engaged in discussion, the better a scheme MTU can set up.

How do you determine which parts of the engine have the remaining remarketable life?

Integrated solutions that combine classical MRO work, asset management and additional services is our strength. As an MRO provider, we have conducted more than 16,000 shop visits, so we know exactly which parts are of value and which ones aren't.

As said, due to the fact that we have a very high natural consumption of used parts within our MRO network, we have a natural outlet for the material in the first instance. In addition, we can remarket the parts externally to our broad customer base.

Which engines have the biggest potential to make value from?

I think it's hard to pick one engine or aircraft type. That's why we have to continuously review the potential value of an asset – either as a lease or exchange engine, or for tear-down. The short-term leasing market is a pure supply-and-demand market, and if there's an increasing demand causing a shortage of lease engines, I am better keeping the asset in my lease pool and trying to maximize the value of lease rates. In this case, I would postpone the engine teardown.

Having a foothold in both the leasing and the material management markets is key: if I see that the trend in the lease rates are not going in the right direction, then I have an alternative exit strategy by either selling the engine, or tearing it down eventually, and then I can recover the value out of the individual piece parts.

There are times when an engine may be attractive in the beginning of the year, but towards the middle of the year it might have changed due to different market conditions. I think the value creation is achieved by a thorough analysis and then having the confidence to execute on the decided strategy. It's all about professionalizing the execution and limiting execution risk of the asset owner.

What plans do you have for the asset management business?

MTU Maintenance has shown in the past that it is turning into a provider of engine services – with engine MRO remaining our core product. This is a customer-driven process. We have been approached by more and more customers looking for one-stop-shop solutions. The asset management part, and also the MTUPlus Mature Engine Solutions product we launched two years ago, is all part of a logical evolution of our business model. Based on customer needs, we will continue to develop our services – and asset maximization is certainly part of this process. With more than 800 aircraft per year being retired in the years to come, that means you have 800-plus asset owners that need some support to maximize the values of their fleets at end-of-life.

What are the biggest challenges in trying to maximize the value of engines?

There are two main issues: first, current pricing for used aero engine assets is challenging. The issue is that the available funds for investing into such assets partly outweigh the availability of high-value assets, and this puts pressure on pricing. Second, you need to have a clearly defined route to market. That's where I see MTU being very well positioned, as we have our in-house consumption and in-house requirement, as well as our broad customer base.

In terms of engine leasing, where would you say the main differences lie between the narrowbody and widebody markets?

First of all, you need to deploy a large sum in one asset for widebody engines. Further, you have a higher remarketing risk if you buy assets such as the GE90-115. From a market position perspective, there is a much broader potential customer base for narrowbody engines, as the installed number of engines in the market is larger. This means it is a much more liquid asset – there is much less risk from an asset owner perspective if you are investing into highly liquid narrowbody engines such as the CFM56s and the V2500s.

If you look at the widebodies, you have a concentration of few large fleets – that means fewer operators and, of course, that limits your route to market. So you need to consider that when you invest.

Where is the new investment in engines coming from?

It's primarily Asia – Chinese and Japanese investors, in particular – financial institutions and trading houses. I think it's obvious that engines are an attractive liquid asset. The fundamentals of the market are very promising – with passenger air transportation at a growth rate exceeding 5% per annum.

Also, with growing aircraft age, you see that the value of the engine makes up the majority of the aircraft value. So, if you look at 20- to 25-year-old aircraft, about 70% to 80% of the overall value is tied up in the engine. That's because you have a different value proposition for the aircraft versus the engine: every time the engine goes through a shop visit, it is updated to current standards. That means you have a completely different value deterioration profile than for an aircraft.

LESSOR PROFILE: MITSUBISHI UFJ LEASE & FINANCE

MUL's big engine spend

Michael Allen speaks to MUL's Osamu Muramoto and Takashi Ota about the company's recent foray into engine leasing and portfolio diversification strategy.

Last November Japanese leasing company Mitsubishi UFJ Lease & Finance (MUL) acquired the largest independent engine lessor in the world, UK-based Engine Lease Finance Corporation (ELFC). This 100% equity purchase followed a relationship with ELFC dating back to 2006 when the two companies formed a joint venture.

This strategic acquisition also came after MUL's purchase of US-based aircraft lessor Jackson Square Aviation (JSA) in 2013. With these two subsidiaries now under its belt, MUL has sent a clear signal to the market that it is serious about aircraft and engine leasing.

Like many Japanese leasing companies, MUL also offers the lease of non-aviation-related assets, but aircraft and engines remain the "key pillars" of the business, Osamu Muramoto, MUL's executive officer and general manager, structured finance department, tells *Airfinance Journal* over coffee at Tokyo's Peninsula Hotel.

He is joined by his colleague Takashi Ota, deputy general manager, corporate and strategic planning department.

Muramoto was formerly a general manager in the company's aviation business department. When MUL bought JSA, he was assigned the position of general manager of the aviation business department, before joining the structured finance department in April 2014.

MUL's target is to acquire about 25 aircraft a year – mostly narrowbodies – through JSA, but he says that the engine leasing business is equally as important as the aircraft side.

"Nowadays, we are actually focusing on the engine side more," says Muramoto, noting that ELFC has about 260 engines under its portfolio. However, he stresses that equal priority is given to both businesses.

"The engine is the most critical and valuable part of an aircraft," he adds. "The aircraft body itself is always depreciating, but the engines are holding their value because of refurbishment and maintenance. That's why ELFC has been quite profitable for a long time."

ELFC's portfolio will be expanded by about 30 engines a year. Each year the company decides on a budget with which to expand its engine portfolio, but at the same time MUL wants to distribute some of the equity in its engine assets to investors, something for which Muramoto says there is "huge interest".

ELFC has previously set up special purpose vehicles (SPVs) for engines, to which investors can contribute money. The debt-equity ratio and percentage of equity varies depending on the condition of the negotiation, but ELFC typically retains a "small portion" of the equity, with the majority coming from third-party investors. Some investors like to invest at a full 100%, while others prefer, say, 80% or 51%.

MUL's place among lessors

Thanks to Japan's rapid economic growth in the post-Second World War period, many of the country's banks and large manufacturers were able to establish leasing subsidiaries. As a result, there are now about 250 leasing companies in Japan. These, says Muramoto, can be divided up into four categories: bank-related companies, trading-related companies, manufacturing-related companies and independent companies.

In this crowd of lessors vying for business, Muramoto strongly believes there are no other leasing companies like MUL which, if its JSA and ELFC subsidiaries are included, falls into both the bank-related company and independent company categories.

This means that the independent companies JSA and ELFC are able to tap into funding from bank-related company MUL.

Besides Orix, MUL is the only major Japanese leasing company to achieve an A rating from two US rating agencies. In December Moody's gave the company an A3 rating, while Standard & Poor's (S&P) gave it an A. Orix, by comparison, has lower ratings: Baa2 from Moody's and A- from S&P.

Osamu Muramoto, executive officer and general manager, structured finance department, MUL.

Indeed, the company has already tested its mettle on the US capital markets, issuing three US-dollar denominated bonds in just over a year. The first bond, for $300 million, was issued in February 2014, had a five-year term, a floating rate and was priced at USD Libor plus 92.5 basis points. The second, in July 2014, was for $500 million with a floating rate and priced at 77.5 basis points over Libor. The third, issued in March 2015, was valued at $500 million with a five-year term and an interest rate of 2.5%.

"Now, many Japanese companies are aggressively expanding their businesses, and to grow their overseas business they need dollars," says Ota. "We have a good advantage to procure the US dollar, because we periodically issue the US dollar bonds in the overseas market."

Muramoto adds that the US dollar is "very important" for MUL because all of its assets are denominated in US dollars for trading.

"The company has already tested its mettle on the US capital markets, issuing three US-dollar denominated bonds in just over a year."

Global assets

Along with aircraft and engines, MUL has been working to diversify its asset portfolio to focus on "global assets", meaning assets – such as aircraft – whose value remains the same across national jurisdictions.

In November 2014, the same month it acquired ELFC, MUL acquired all of the equity interests of Beacon Intermodal Leasing, a company that leases marine containers. It also entered into a business alliance with Greenbrier Leasing Company, a supplier of transportation equipment and services to the US railroad industry, in May 2014.

Although these assets are not "business-wise interlinked", the benefit is that when the assets are distributed to, say, large financial institutions in Tokyo or overseas investors, the mixture of the portfolio and diversification of the asset gives it some security in the market, according to Muramoto.

"If we could have some security in different assets that will reduce some volatility of cash flow," he says.

Potential acquisitions

Muramoto believes there are two different strategies for MUL's expansion: vertical and horizontal integration.

Vertical means that original equipment manufacturer engines and aircraft will be provided to airlines in the form of sale/leaseback transactions. At the end of the lease agreements, the middle-aged aircraft could be sold or leased and eventually torn down and parted out.

Horizontal integration involves looking around the world and identifying MUL's competitors and seeking strategic acquisitions along the lines of its previous equity purchases.

"We have a lot of competitors around the world, so if we could consolidate or acquire some asset from somebody, that would expand our business area horizontally," he says. "In the medium term, we might think about some kind of growth, like asset acquisition."

Muramoto will not comment on any specific plans to acquire competitors or their assets, saying that to make MUL's strategy so "bold and transparent to other parties" might put it at a disadvantage.

"In the future, it's quite natural for us to expand and grow the business horizontally and also vertically, so that's what we can say," he adds. "Under the present situation, that's our aspiration."

MARKET ANALYSIS

Regional power

The market for regional aircraft engines has similarities to its counterpart for larger engines, but it has some specific challenges and some advantages. Geoff Hearn reports.

Many of the trends in the large-aircraft engine market have their origins in the regional aircraft sector. Aircraft fleets of regional operators were historically small – so, in-house engine maintenance was not an economic option and power-by-the-hour schemes similar to those for corporate aircraft became the norm.

Small aircraft fleets also make investment in spare engines prohibitively expensive and, hence, engine manufacturers traditionally have offered access to shared engine pools for predetermined fees. In addition to being an economic solution for operators of small fleets, these manufacturer schemes offer the advantage of predictable costs. Take-up rates of such schemes by regional operators have always been high, typically at the levels that are being seen for new-technology engines on A320neos and 737 Maxs.

The assurance of predictable costs has become increasingly important to operators and has probably become the prime driver in the take-up of manufacturer schemes. The evidence for this is that regional operators in the US typically have very large fleets, but almost all the engines in their fleets are covered by such schemes. The regional airlines typically operate for the US majors under capacity purchase agreements at predetermined costs. All parties therefore welcome predictable and transparent maintenance rates, even if such schemes are perceived to be expensive.

Unsurprisingly, given this background, many similarities remain between the regional sector and the market for larger commercial aircraft engines. Strong links between leasing agreements and all-inclusive (power-by-the-hour) maintenance contracts, a strong (some say excessive) original equipment manufacturer presence and high (again, some say excessive) pricing are common themes raised by stakeholders in the regional market.

As in the larger aircraft sector, the influence of original equipment manufacturers (OEMs) is increasing. For modern engines, the ability of third parties to enter the engine overhaul market and the associated leasing market is hampered by high costs of entry linked to expensive test equipment. The control of spare part pricing by the OEMs is a major problem for potential competitors given that material costs account for typically 80% of an engine's overhaul cost.

GE's historic dominance

General Electric (GE) engines power the major share of the in-service sub-100-seat jet market. Apart from GE, only Rolls-Royce has any significant presence in the sector, with the AE3007 on the effectively out-of-production Embraer 145. The US manufacturer's engines power all of the Bombardier CRJ models, as well as the current generation of the Embraer E-Jets, giving it a particularly dominant position in the 70-to 90-seat regional jet category.

Embraer's selection of a version of Pratt & Whitney's PurePower geared turbofan (GTF) engine for the second generation of E-Jets will erode GE's dominance. However, with the E-Jet E2 family not set to enter into service before the middle of 2018, it will be some time before Pratt & Whitney has a significant share of the in-service market. Nonetheless, Embraer's decision is key and threatens GE's long-term position, particularly because a variant of the Pratt & Whitney engine will also power the Bombardier CSeries.

GE's share in the strong selling CFM Leap engine programmes for the 737 Max and A320neo families softens the impact, but Embraer's decision may indicate that the Leap engine is less easily adapted to the thrust requirements of the regional jet sector than the competing Pratt & Whitney GTF models.

"A key characteristic of the market for engines that power 70- to 90-seat regional jets is the engine commonality between the two main competing aircraft families."

ENGINE TYPES FOR REGIONAL JETS (SUB-100-SEATERS)

Aircraft	Engine manufacturer	Engine type
ERJ 145	Rolls-Royce (Allison)	AE3007
E170/E175	General Electric	CF34-8
E190	General Electric	CF34-10
E175-E2	Pratt & Whitney	PW1700G
E190-E2	Pratt & Whitney	PW1900G
CRJ200/440	General Electric	CF34-3
CRJ700	General Electric	CF34-8
CRJ900	General Electric	CF34-8
CRJ1000	General Electric	CF34-8

TURBOPROP ENGINE TYPES

Aircraft	Engine manufacturer	Engine type
ATR 42-600	Pratt & Whitney (Cananda)	PW127M (2,160 shp)
ATR 72-600	Pratt & Whitney (Canada)	PW127M (2,475 shp)
Bombardier Q400	Pratt & Whitney (Canada)	PW150A (5,070 shp)

The economies of scale that GE has enjoyed from its presence in the regional market help it provide a wide range of maintenance and leasing solutions similar to its offering in the larger aircraft market, which covers a full range of operational and financial services, including short-term rentals, guaranteed spare engine availability, engine exchanges, operating leases (including sale/leaseback) and structured, long-term finance options. CF34 leasing is handled via Gecas, GE's aircraft leasing arm.

An issue facing regional operators is that the costs associated with regional jet engines are comparable to pricing in the larger aircraft market, which drives up the operating cost per seat of regional jets. IBA puts the cost of a short-term lease for a CF34-8C/E in the region of $30,000 to $50,000 a month. This figure excludes the maintenance reserves for engine overhaul and life-limited parts (LLPs). IBA puts LLP costs at $2.7 million, and other market sources suggest that an overhaul costs about $1.5 million.

Based on aircraft leasing quotations seen by *Airfinance Journal*, the CF34 engines on the E-Jet family need a reserve of about $100 per engine flight-hour (depending on model, engine age, average flight time and operating environment) to cover overhaul, plus a reserve of between $80 to $90 for LLPs.

Secondary aircraft market

Chris Beer, managing director of regional aircraft specialists SkyWorld Aviation, says the policies of engine manufacturers are critical in facilitating regional aircraft deals in the secondary market.

He says flexibility is the key, and told *Airfinance Journal*: "A willingness by engine manufacturers to find economic solutions that are in keeping with the values and costs associated with regional aircraft can pay dividends in terms of keeping aircraft flying and generating revenues back to the manufacturer."

He says that the flexibility of Roll-Royce, in particular its willingness to use surplus life-limited parts for overhauls, and expand its TotalCare concept to specialist operators in secondary markets, has been and will continue to be a factor in keeping a substantial part of the Embraer 145 (ERJ 145) fleet in service.

He adds: "Having over 90% of ERJ engines covered by TotalCare is giving used ERJ 145s an advantage over CRJ 200s since new ERJ operators are not facing very expensive engine overhaul bills – they just pay an hourly rate." According to Airfinance Fleet Analyst, the Embraer 50-seater aircraft has a lower percentage of its fleet parked than the competing Bombardier CRJ200.

A key characteristic of the market for engines that power 70- to 90-seat regional jets is the engine commonality between the two main competing aircraft families. Bombardier's CRJ 700/900/1000 models use GE's CF34-8 family, as do Embraer's current-generation E170/175 variants. This means that engines parted out from one aircraft family can be easily transferred and used as spares and/or a source of surplus parts for members of the other family. This helps the E-Jet fleet considerably, because the CRJ 700s have been in service much longer and are therefore being retired sooner.

Third-party involvement

Although the original equipment manufacturers dominate the regional market, they do face competition, with the specialist engine leasing companies Willis Lease Finance and ELFC both offering CF34 and AE3007 engines. Willis also has PW100 family and PW150 turboprops in its portfolio.

OEMs have historically dominated the engine overhaul market in the regional sector and this is still largely the case, but there are signs that third-party providers are gaining market share. For example, MTU and, to a lesser extent, Standard Aero are increasingly competing for business that has previously been seen as the preserve of the OEMs.

The engine commonality across aircraft families has aided the competition because third-party providers are actively buying used CF34-8 life-limited parts and using them in engines fitted to E175s and CRJ 900s. Used CF34-8 LLPs have previously primarily come from scrapping older CRJ 700s, although some older E170s are starting to be scrapped.

The effect is to reduce engine operating costs in the highly competitive regional sector, particularly in the US. This market is particularly important because 60% to 65% of the E170/E175 and CRJ 900 fleets are operating in the US and Canada – and the percentage is growing.

There is more diversity in overhaul provision for turboprop engines, particularly for the PW100 family, which powers a relatively large and diverse fleet. A further advantage of the turboprop market for maintenance providers is the relatively low capital cost of engines, making acquisitions of spare engines more attractive and enabling providers to offer comprehensive maintenance and spares support.

ANALYSIS

EU probes the MRO market

The EU has been looking into the engine maintenance, repair and overhaul (MRO) market to determine whether it is competitive enough, after complaints from high-profile industry figures. Joe Kavanagh reports.

Some European original equipment manufacturers (OEMs) and airlines received an unusual request in October 2015. The EU Commission wrote to them asking for information about the maintenance, repair and overhaul (MRO) market for aircraft engines. The request was part of a probe into the industry's competitiveness, which was begun after high-profile figures had complained about rising costs.

In response to the request, the International Air Transport Association (Iata) has become a complainant in the investigation, which is being led by the European Union's directorate general for competition (DG-COMP). A complaint was filed by Iata at the end of March. The airline association said that it is making no claims for monetary damages, but Tony Tyler, Iata's director general and CEO, said: "This is an area of deep concern for our members. There are relatively few equipment vendors and our members are frustrated that there is little flexibility in negotiations for aftermarket services".

The MRO market is worth more than $62 billion, according to data from ICF International.

The MRO market is crucial to everyone in the airline industry, from operators to investors. Not only is maintenance one of every airline's largest costs, but the MRO market also affects engine values. By the time an aircraft reaches the end of its life, more than 60% of its value will be contained in its engines. This has enormous significance for aircraft remarketers, lessors and financiers – not just engine specialists.

In short, a healthy and competitive MRO market could not be more important for commercial aviation. So it is unsurprising that the EU's probe has caused a few ripples.

What is the EU doing?

Airfinance Journal understands that Rolls-Royce, CFM and a number of MROs and some airlines have been contacted by the EU Commission. Rumour has it the asset types it is investigating include the popular CFM56 engine variants, which power the 737 and A320 families of aircraft. This has puzzled some observers, who note that the MRO market for this engine is one of the most competitive, with a deep, liquid market and a wide range of independent MRO shops.

A commission spokesman did not comment on the probe when contacted by *Airfinance Journal*, but confirmed there will be a statement if the EU decides to launch a formal investigation.

Yumiko Takahashi, a solicitor with Fieldfisher who specializes in EU competition, says that if the EU launches a formal investigation, its scope could be wider than that of the initial probe. She adds that there is another potential outcome. Before the commission decides one way or another, the parties involved in a formal investigation can reach what is called a "commitment decision". In this instance, the companies under investigation can reach a private agreement with the EU, in which they promise to reform some of their practices.

At this point, however, there is no indication either way about whether the probe will progress any further.

Is there a problem?

"The bottom line is that, especially for engines in the widebody market, there is not a lot of choice for maintenance support," says David Stewart, vice-president of ICF International.

The issue comes down to the support packages with which most new engines are now sold. Under these deals, often termed "power-by-the-hour" arrangements, the engine operator pays a fixed rate for maintenance while the OEM agrees to cover the cost of engine overhauls as and when they are needed.

Maintenance agreements allow the manufacturers to recoup extensive development costs for new engines. In response to fierce competition, OEMs often sell engines at cost price or even below, which places even more importance on power-by-the-hour arrangements for OEMs.

Fixed-cost maintenance agreements are very widespread on certain engine types. For Rolls-Royce's Trent engines, for example, the manufacturer controls more than 90% of the engine maintenance.

"This is an area of deep concern for our members. There are relatively few equipment vendors and our members are frustrated that there is little flexibility in negotiations for aftermarket services"

Tony Tyler, director general and CEO, Iata

But engine investors have long been raising concerns about how residual values of some assets are affected by OEM behaviour. By locking down so much of the market for maintenance and repair, these arrangements can take business away from independent MRO providers, by making it difficult for them to compete.

This reduces the number of independent MRO shops, and because MRO shops have traditionally accounted for a large part of the demand for spare engines, the result is fewer buyers of spare engines and dampened or at least unpredictable residual values.

For several engine types, the residual value scores are noticeably lower than the corresponding scores for operational success. Investors seem to be worried that they cannot achieve the value they want from some end-of-life assets.

Paolo Lironi, chief executive officer, SGI Aviation, says that aftermarket dominance creates a monopoly, leading to uncertainty over residual values.

He says: "If we look at the aftermarket model right now, only Rolls shops are capable of repairing the Trent 700, which means that only Rolls is buying used parts for Trent engines. This means that leasing companies and airlines, whenever they need to sell or to part out an engine, can only talk to Rolls. You are in a complete monopoly situation at that time, which basically doesn't allow the operator or the airlines to put a price against the engine. We've been asked many times, 'What is the value of a Trent 700?' And the only answer we can give is: 'Ask Rolls-Royce'."

Most market players point to the same asset types when asked to name engines. They say the Trent family and GE90 variants are examples of engines where there is a lack of choice in the MRO market.

Olga Razzhivina, senior Istat appraiser with UK firm Oriel, says: "Most of the Trent engines are covered [by flight-hour agreements]. GE90-100s are pretty much in the same ball park."

There is clearly a lack of independent MRO coverage for certain engine types (see Engine shop availability table), with some types offering no independent option at all.

Market forces

Different market forces affect each engine variant. For some variants, there are fewer assets in circulation, which makes it harder for independent MROs to enter the market, particularly if the engines are relatively young or feature the very latest technology. So it is not always helpful to compare, for example, the MRO market for engines powering the 737 against that of the engine powering a much smaller number of widebodies.

Richard Goodhead, senior vice-president customer strategy and marketing, Rolls-Royce, says comparing data on the narrowbody market with that of the widebody market is not useful.

He says: "Quite a lot of the rhetoric and analysis that is out there tends to oversimplify what is actually a relatively complex situation. Not only is the widebody MRO landscape inherently complex itself, but also it is fundamentally different from the narrowbody MRO landscape. Often the two get either deliberately or unconsciously mixed.

"The more engines there are, the more attractive it is for parties other than the OEM to get involved. And secondly, it relates to the age of that fleet. Because the younger that fleet is, the more likely it is that the customer's requirements are for the risk transfer that the OEM offers."

The manufacturer also says it expects more independent MRO shops to enter the Trent family market in the future, as more and more engines reach retirement age.

Goodhead points to the RB211-535. Retirements of this engine, which began about the year 2000, prompted the beginning of MRO trading for the type. In 2013, Rolls-Royce and its joint ventures accounted for 62% of shop visits, with the remainder split between two independent MROs.

Goodhead adds: "For the first 18 years of service of that engine, only Rolls-Royce overhauled it. It then got to the point where not only were there enough aircraft in service that there was still a demand to keep the aircraft flying, but there was enough of a supply of aircraft coming down from shop visits. You started to see independents start to come in and compete against Rolls-Royce. We've now got a market where there are three very well established players on -535 overhaul.

"That's what we expect to happen, for example, to the Trent 700."

Rolls-Royce points to the steps it has taken to address market concerns about its MRO activity for the Trent engine. In October, for example, it announced that Delta Tech Ops is to become an independent MRO shop for the Trent XWB and Trent 7000. The manufacturer says that this will contribute to a more competitive network for these engine types. It also hinted that more announcements would follow.

EU deliberations

For the time being, investors still say they want to see a more competitive MRO network for certain asset types. OEMs seem to have taken the market's complaints seriously and are taking steps to address them. However, some sources are sceptical about how much difference these steps will make, at least in the short term.

In the meantime, the EU's competition team is gathering information about the aftermarket. Whether it decides to launch a formal investigation or not, its conclusions will only increase the debate.

This article is an update of the feature that appeared in the December 2015/January 2016 issue of Airfinance Journal.

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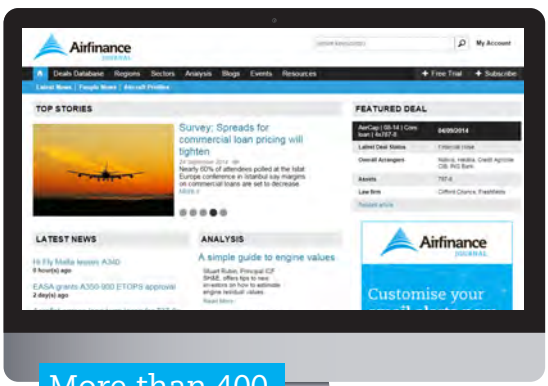

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AIRCRAFT ENGINE VALUES 2016

Criteria	Engine	Fair Market Value US$	Base Value ($m)	Monthly Rental	QEC cost range ($m)	LLP Cost (new) ($m)	MTBO	FH:FC
CFMI	CFM56-3C1 (23.5)	1.1	1.2	30-35	0.05	2.7	6,000	1.6
	CFM56-5B3/P	6.2	6.2	60-80	0.7-2.3	3.2	21,500	1.7
	CFM56-5B4/P	5.6	5.6	60-80	0.7-2.3	3.2	24,500	1.7
	CFM56-5B6/P	4.6	4.6	60-80	0.7-2.3	3.2	25,500	1.7
	CFM56-5B5/3	5.0	5.0	60-80	0.7-2.3	3.2	29,000	1.7
	CFM56-5B3/3 PIP	7.7	7.7	60-80	0.7-2.3	3.2	25,000	1.7
	CFM56-5B4/3 PIP	7.1	7.1	60-80	0.7-2.3	3.2	28,000	1.7
	CFM56-5B5/3 PIP	5.4	5.4	60-80	0.7-2.3	3.2	29,000	1.7
	CFM56-5B6/3 PIP	5.8	5.8	60-80	0.7-2.3	3.2	29,000	1.7
	CFM56-5C4/P	2.8	2.3	35-50	0.1-0.5	3.3	14,000	6.0
	CFM56-7B22	4.5	4.5	45-70	0.6-1.8	3.1	28,000	1.8
	CFM56-7B24	5.3	5.3	45-70	0.6-1.8	3.1	27,000	1.8
	CFM56-7B26/3	6.6	6.6	60-75	0.6-1.8	3.1	27,500	1.8
	CFM56-7B27/3	6.9	6.9	60-75	0.6-1.8	3.1	27,000	1.8
	CFM56-7B26E	7.4	7.4	60-75	0.6-1.8	3.1	27,500	1.8
GE	CF34-3B1	1.3	1.5	20-30	0.2-0.6	1.7	12,000	1.3
	CF34-8C5	2.8	3.0	30-45	0.4-0.8	2.6	11,000	1.3
	CF34-8E5	3.5	3.5	35-50	0.5-0.9	2.6	11,000	1.3
	CF34-10E6	5.3	5.3	55-70	1.0-1.8	2.1	16,000	1.3
	CF6-80C2B1F	2.2	2.6	30-50	0.3-1.6	6.8	20,000	7.0
	CF6-80C2B6F	2.8	3.4	40-60	0.3-1.6	6.8	20,000	6.0
	CF6-80E1A4B	9.6	9.6	90-125	0.3-2.5	9.9	22,000	5.0
	GE90-115BL	22.9	22.9	240-260	1.5-2.5	11.5	20,000	6.5
	GE90-115BL-P	20.5	20.5	220-250	1.5-2.5	8.2	20,000	6.5
	GEnx-1B74/75/P2G01 (PIP2)	17.6	17.6	240-280	2.0-4.2	7.6	27,000	6.0
	GEnx-1B74/75-P (PIP2)	14.8	14.8	210-250	2.0-4.2	7.6	27,000	6.0
IAE	V2524-A5	4.6	4.6	55-85	0.7-2.5	3.5	16,500	1.5
	V2527-A5	5.4	5.4	55-85	0.7-2.5	3.5	16,250	2.0
	V2533-A5	6.3	6.3	55-85	0.7-2.5	3.5	11,000	2.0
	V2524-A5 SelectOne	5.2	5.2	55-85	0.7-2.5	3.5	20,000	1.5
	V2527-A5 SelectOne	6.1	6.1	55-85	0.7-2.5	3.5	20,000	2.0
	V2533-A5 SelectOne	7.3	7.3	55-85	0.7-2.5	3.5	12,500	2.0
PW	JT8D-219	0.6	0.6	10-20	0.08	2.2	10,500	1.5
	PW2037	2.7	3.2	40-50	0.3-0.8	6	18,000	3.0
	PW4060	2.6	3.0	40-50	0.1-1.8	6.4	20,000	6.0
	PW4062	2.8	3.3	45-60	0.1-1.8	6.4	19,500	6.0
	PW4168A	6.7	7.1	70-95	0.3-3.2	8.1	17,500	6.0
	PW4090	9.9	9.9	110-160	1.0-2.5	13.4	17,000	7.0
Rolls-Royce	AE3007A1	1.1	1.6	15-30	0.1-0.3	1.8	6,700	1.1
	RB211-524H-T	2.3	3.2	20-30	0.1-0.7	5.4	24,250	8.0
	RB211-535E4	3.5	3.5	40-65	0.3-0.8	4.8	22,000	3.0
	Trent 772B-60 EP2	8.7	8.7	95-135	2.0	7.5	26,000	4.5
	Trent 970-84	14.0	14.0	120-170	0.6	8.5	25,250	9.0
	Trent 1000-J2	16.8	16.8	210-250	N/A	6.8	23,000	6.0
	BR715A1-30	2.7	3.0	30-50	0.3-0.7	1.8	12,350	1.6

Source: IBA

AIRCRAFT ENGINE OPTIONS

Model	Engine Type
717-200	BR715A1-30
	BR715C1-30
737-200A	JT8D-15
	JT8D-15A
	JT8D-17
	JT8D-17A
	JT8D-9A
737-300	CFM56-3B1
	CFM56-3B2
	CFM56-3C1
737-300QC	CFM56-3B1
	CFM56-3B2
	CFM56-3C1
737-300SF	CFM56-3B1
	CFM56-3B2
	CFM56-3C1
737-400	CFM56-3B1
	CFM56-3B2
	CFM56-3C1
737-400SF	CFM56-3B2
	CFM56-3C1
737-500	CFM56-3B1
	CFM56-3C1
737-600	CFM56-7B20
737-700	CFM56-7B20
	CFM56-7B20/3
	CFM56-7B22
	CFM56-7B22/3
	CFM56-7B22E
	CFM56-7B22E3
	CFM56-7B24
	CFM56-7B24E
	CFM56-7B26
	CFM56-7B26E
	CFM56-7B27
737-800	CFM56-7B22E
	CFM56-7B24
	CFM56-7B24/3
	CFM56-7B24E
	CFM56-7B26
	CFM56-7B26/3
	CFM56-7B26E
	CFM56-7B27
	CFM56-7B27/3
	CFM56-7B27/3B1
	CFM56-7B27/3B1F
	CFM56-7B27/B1
	CFM56-7B27E
737-900	CFM56-7B24
	CFM56-7B26
737-900ER	CFM56-7B26E
	CFM56-7B27
	CFM56-7B27/B1
	CFM56-7B27E
747-200F	CF6-50E2
	JT9D-7F
	JT9D-7Q
	JT9D-7R4G2
747-200M	JT9D-7F
747-300	CF6-50E2
	JT9D-7R4G2
	RB211-524C2

Model	Engine Type
747-400	CF6-80C2B1F
	CF6-80C2B5F
	PW4056
	RB211-524G
	RB211-524G/H2-T
	RB211-524G/H-T
	RB211-524H2
	RB211-524HT
747-400BCF	CF6-80C2B1F
	PW4056
	RB211-524H2
	RB211-524HT
747-400ER	CF6-80C2B5F
747-400ERF	CF6-80C2B1F
	CF6-80C2B5F
	PW4062
	PW4062A
747-400F	CF6-80C2B1F
	PW4056
	RB211-524G/H-T
	RB211-524H2
	RB211-524H2T-19
	RB211-524HT
747-400ISF	CF6-80C2B1F
	PW4056
747-400M	CF6-80C2B1F
747-8	GEnx-2B67
	GEnx-2B67B
747-8F	GENX-2B67
757-200	PW2037
	PW2040
	RB211-535C
	RB211-535E4
	RB211-535E4-B
757-200PCF	PW2037
	PW2040
	RB211-535E4
757-200PF	PW2040
	RB211-535E4
757-200SF	PW2037
	PW2037M
	PW2040
	RB211-535C
	RB211-535E4
	RB211-535E4-B
757-300	PW2040
	RB211-535E4-B
	RB211-535E4-C
767-200	CF6-80A
	JT9D-7R4D
767-200ER	CF6-80A2
	CF6-80C2
	CF6-80C2B2F
	CF6-80C2B4
	CF6-80C2B4F
	CF6-80C2B4FA
	CF6-80C2B6F
	JT9D-7R4D
	JT9D-7R4E
	JT9D-7R4E4
	PW4052
	PW4056

Model	Engine Type
767-200ERF	CF6-80A2
	CF6-80C2B2
767-200F	CF6-80A
	CF6-80A2
	CF6-80C2B2F
	JT9D-7R4D
767-300	CF6-80A2
	CF6-80C2B2
	CF6-80C2B2F
	CF6-80C2B4F
	JT9D-7R4D
	PW4056
	PW4060
767-300ER	CF6-80C2B2
	CF6-80C2B4
	CF6-80C2B6
	CF6-80C2B6F
	CF6-80C2B7
	CF6-80C2B7F
	PW4052
	PW4056
	PW4060
	PW4060-1/3
	PW4060-3
	PW4062
	PW4062-3
	RB211-524H
767-300ERF	CF6-80C2B2
	CF6-80C2B6
	CF6-80C2B6F
	CF6-80C2B7F
	PW4060
767-400ER	CF6-80C2B7F
	CF6-80C2B8F
	CF6-80C2B8FG01
777-200	GE90-90B
	PW4077
	PW4084
	TRENT 875-17
	TRENT 884
777-200ER	GE90-90B
	GE90-92B
	GE90-94B
	PW4074D
	PW4084D
	PW4090
	TRENT 884-17
	TRENT 892-17
	TRENT 892B
	TRENT 892B-17
	TRENT 895
	TRENT 895-17
777-200LR	GE90-110B1L
	GE90-115B
777-200LRF	GE90-110B1L
777-300	PW4090
	TRENT 892
	TRENT 892-17
	TRENT 892B
	TRENT 892B-17

Model	Engine Type
777-300ER	GE90-115B
	GE90-115B1
	GE90-115BG02
	GE90-115BL2
787-8	GENX-1B64
	GENX-1B67
	GENX-1B70
	TRENT 1000-A
787-9	GEnx-1B70
	TRENT 1000-J
A300-600F	PW4158
A300-600R	CF6-80C2A5
	CF6-80C2A5F
	PW4158
A300-600RF	CF6-80C2A5
	CF6-80C2A5F
	PW4158
A300B4-200	CF6-50C2
	CF6-50C2R
A300B4-200 Total	
A300B4-200F	CF6-50C2
A300B4-200F Total	
A310-300	CF6-80C2A2
	CF6-80C2A8
	PW4152
	PW4156A
A318-100	CFM56-5B8/3
	CFM56-5B8/P
	CFM56-5B9/3
	PW6124A
A319-100	CFM56-5A4
	CFM56-5A5
	CFM56-5B5/3
	CFM56-5B5/P
	CFM56-5B6/2
	CFM56-5B6/2P
	CFM56-5B6/3
	CFM56-5B6/P
	CFM56-5B7/3
	CFM56-5B7/P
	V2522-A5
	V2524-A5
	V2527-A5
	V2527M-A5
A320-200	CFM56-5A1
	CFM56-5A3
	CFM56-5B3/3
	CFM56-5B4
	CFM56-5B4/2
	CFM56-5B4/2P
	CFM56-5B4/3
	CFM56-5B4/P
	CFM56-5B6/3
	CFM56-5B6/P
	V2500-A1
	V2527-A5
	V2527E-A5

Model	Engine Type
A321-100	CFM56-5B1
	CFM56-5B1/2
	CFM56-5B1/2P
	CFM56-5B1/P
	CFM56-5B2
	CFM56-5B2/P
	V2530-A5
A321-200	CFM56-5B1/3
	CFM56-5B1/P
	CFM56-5B2/3
	CFM56-5B3/2P
	CFM56-5B3/3
	CFM56-5B3/3B1
	CFM56-5B3/3P
	CFM56-5B3/P
	V2530-A5
	V2533-A5
A330-200	CF6-80E1A3
	CF6-80E1A4
	CF6-80E1A4B
	PW4168A
	PW4168A-1D
	PW4170
	TRENT 772B-60
	TRENT 772C-60
A330-200F	PW4168A
	TRENT 772B-60
A330-300 HW	CF6-80E1A3
	CF6-80E1A4
	CF6-80E1A4B
	PW4168A
	PW4168A-1D
	PW4170
	TRENT 772-60
	TRENT 772B-60
	TRENT 772C-60
A330-300 LW	CF6-80E1A2
	PW4168
	TRENT 768-60
	TRENT 772-60
A340-200	CFM56-5C2
	CFM56-5C3/F
	CFM56-5C4
A340-300	CFM56-5C2
	CFM56-5C2/F
	CFM56-5C3/F
	CFM56-5C4
	CFM56-5C4/P
A340-500	TRENT 553-61
	TRENT 553A2-61
	TRENT 556-61
	TRENT 556A2-61
A340-600	TRENT 556-61
	TRENT 556A2-61
A350-900	TRENT XWB-84
A380-800	GP7270
	GP7270E
	TRENT 970-84
	TRENT 972-84

Source: Avitas