

As legacy engine fleets are replaced with new-generation types, and the engine manufacturers gain more control of the aftermarket, independent engine lessors are adding to their services. Many of these additional services are engineering and technical support functions.

# Developments in the engine leasing market

Over the next 12 months several new engine types will enter service. These will have had to evolve together with new airframes. Fuel efficiency, noise reduction and lower emissions are the aviation industry's main requirements.

Engines are also assets, however, to be moved by airlines off their balance sheets to increase liquidity and convert them into cash and eliminate residual risk. Investors dominate the engine leasing, taking advantage of the potential greater returns on the engine's residual value compared to the airframe it powers.

With 30,000 commercial jets expected to be in service by 2022, and 40,000 by 2032, the market for available engines needed to support this fleet is theoretically growing. But how is the market balance changing between the original equipment manufacturers

(OEMs), maintenance repair and overhaul (MRO) providers, and the independent engine lessors? What effect is it having on the engine values?

With the CFM International LEAP series due into service, the Rolls-Royce (RR) Trent 1000 and General Electric's (GE) GENx family increasing, and the Pratt and Whitney (PW) PW1000G engines entering service, just to name a few, it is clear that legacy engine types are likely to take second place to new generation types.

Engine lessors cannot always judge how well airlines are performing by their aircraft and engine orders. Falls in the global financial markets, and volatile fuel prices mean there is a risk that many new aircraft orders, for which the engine leasing market is preparing, could be put on hold while the ageing fleet keeps flying.

## Current trends

With the backlog in new aircraft deliveries at a record high and fuel prices 40% lower than a year ago, older engine types are getting a lot of attention from the market, but this does not necessarily mean that the market values and lease rates of the older engine types, like the CFM56-3, CFM56-5A, or CF6-80C2s, have firmed up.

Worldwide, aircraft retirements are flooding the market with spares, while a large number of end-of-life engines, with 'green time' remaining, are being marketed at reduced rates and values, with minimal need for maintenance reserves. To add to this, time-expired engines are increasingly being parted out. The overall value of each engine type is affected by different factors.

The engine leasing and aftermarket continues to evolve, however, as lessors provide new and additional infrastructure to support airlines' fleet engine requirements. These are products such as engine health monitoring (EHM), technical records management, and engine shop visit management. This is becoming an established way for airlines to save money, because they need less internal infrastructure to support such roles. An advantage to outsourcing engine support like this is that it feeds the technical capabilities of the engine leasing and management market. This means, however, that airline operators are losing

*With engine OEMs gaining more control of the aftermarket activities for new-generation engines, independent engine lessors are widening and developing their services for legacy engines to include technical support products.*



knowledge of, and skills in, engine types.

In relation to the current trend in sought-after engine types, Kane Ray from the International Bureau of Aviation Group (IBA Group) notes that: “The single-aisle market remains the same; CFM56-5B, -7Bs and V2500-A5 are probably the most sought after engines. They are also in demand for the engine teardown market. In the twin-aisle market, we have seen some GE90-115s being moved out of lessors’ portfolios, and we have also seen some lessors taking on the GENx-1B engine.”

### Predicted trends

With two-thirds of new aircraft over the next 10 years predicted to be single-aisle, the LEAP and PW1000G engines are set to dominate. It is predicted that they will account for 40% of all engines by 2018, with the CFM56 falling to a still significant 21% from 28% today. In addition to Boeing’s and Airbus’s single-aisle aircraft, the Bombardier CSeries, Embraer’s second generation E-Jets, and the Mitsubishi Regional Jet, example, are entering this market. These are all powered by the PW1000G.

Today, OEMs are trying to dominate the new engine leasing market and control asset values by dictating the parts

and components installed, and the repairs carried out, on their engines. This means that only parts from OEM-approved companies, and repairs at approved facilities, will be accepted. This is based on improved reliability and confidence in airworthiness, but for financiers it also preserves asset value by maintaining the integrity of the engine. Deviation from approved sources will affect warranty and contract terms. This may increase reserves, but will drive maintenance away from the independent MROs.

Technology is setting the trend as well. New engine types will have fewer shop visits, due to the longer on-wing scheduled timeframe, reducing the demand for engine shop visits. OEMs will want to capture this limited market to the best of their ability.

### Over-supply

Generally, older engines are at greater risk of becoming obsolete. “There is currently an oversupply of CFM56-3, CFM56-5A (A320), CFM56-5C (A340-200/-300), CF6-50/-80 series (except -80E1 models), and the RB211 535,” says Nigel Heath, director of Slipstream Business Solutions Limited. “This is in part due to the retirement of the aircraft they power. Compounding the problem

of over-supply, is the larger operators’ and lessors’ strategy of implementing fleet retirements for a period to reduce the average fleet age by up to half. This adds numerous engines into the network, if the airframes remain stored or awaiting sale elsewhere. As a base formula, if a fleet is bigger than five, then up to two spare engines may be required, in addition to the 10 installed engines,” adds Heath.

Airlines can capitalise on this over-supply if the situation is right by keeping their fleet in service for longer than planned to exploit the availability and low price of replacement parts and engines. The over-supply of engines then results in lower achievable returns per month, due to competition, which in turn drives the book value down. “The key for the industry is to predict when the cycle is about to start, and when to move the product on,” says Allan Jones, chief strategy officer at TES Aviation Group.

### New types

New engines are at risk of reliability issues, and unpredicted unscheduled maintenance and modification needs over the first few years when ‘settling in’. This is especially the case with new technology being released, like the PW1000G.

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over the next two years will have the lessors' strategic planners hard at work. "Single-aisle deliveries remain at peak levels," continues Ray. "There have been some slowdowns in A330 production, likely leading into A330neo production, and something similar may happen with the 777-300ER, although the 777X is still a longer way off. Another possibility is that orders for current generation aircraft could be switched to next generation types."

Lessors need to budget for spare engines to support the new aircraft types. "Generally speaking, spare engine counts usually fall to 6-15% of the installed fleet," adds Ray. The rate is lower for single-aisle and higher for twin-aisle aircraft, but there can be exceptions to this rule. OEMs can get it wrong, shortages can occur, or over-production can impact market values."

Jones adds that there is another point to note on the new aircraft arriving. "Of the products being released into service, only the 787 and A320neo offer operators a choice of two engine types. The 777-300ER and 777X, A350, A330neo, 737MAX, Bombardier CSeries, Embraer E-Jet E2, Comac C919, and MRJ all only have one engine option. Since there is no competition on these types, the engine OEMs can set the price

and have more leverage on the aftermarket."

### End-of-life market

The number of companies offering 'end-of-life' solutions for aircraft engines over recent years has risen. The remaining operational life on an engine, referred to as 'green time', is being managed in new ways. Although green time leasing does not require further investment to repair the engines, it results in greater depreciation of their value. At the end of OEM total care packages, operators want more flexibility not to maintain their engines to 'as-new' condition. If OEMs' total care contracts remain inflexible, then it will have a negative impact on the value and re-marketability of their engines.

"OEMs, such as RR, are buying off the older engines from operators to provide zero residual risk on the value of their engine, and then leasing the engines back to them under a Total Care support arrangement," explains Heath. "The OEM guarantees the operator access to spare engine availability, and recycles engines and modules through its approved shops to control the aftermarket."

Like the OEMs, the independent

market is also using this business model to buy engines with some life remaining. This time will be used up on short-term leases or an aircraft-on-the-ground (AOG) basis as required. At the end of an engine's life limited parts (LLP) threshold, the engine is parted out for its usable material and components, releasing any residual value left in the asset, instead of being overhauled. This relatively new market is driving the returns of some engine types down. "Five years ago a CF6-80C2 lease would have achieved \$80,000-90,000 per month, plus \$200 per engine flight hour (EFH) and \$250 per engine flight cycle (EFC) for maintenance reserves," explains Jones. "Green time engines of the same type are now on offer for \$60,000-75,000 per month, and with no maintenance reserves."

### Engine part-outs

"Some OEMs, like RR, keep expired engines in house or within the RR network to fulfil parts inventories and support RR overhaul facilities, so figures can be hard to come by. But the main buyers for engine part-out purchases are still teardown entities," says Ray. "Some have close relationships with MROs to tear down the engines in exchange for the



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## IBA GROUP GUIDE: ENGINE HALF-LIFE (10-YEAR) VALUES OVER THE PAST 10 YEARS

Engine variant example	2004	2006	2008	2010	2012	2014	2014 0% maint life 0% LLP life	2014 100% maint life 100% LLP life
PW4168A	\$6,830,000	\$7,500,000	\$8,147,000	\$7,544,000	\$7,000,000	\$7,480,000	\$1,410,000	\$13,550,000
PW4056	\$5,100,000	\$5,050,000	\$5,573,000	\$4,681,200	\$4,100,000	\$3,900,000	\$600,000	\$7,200,000
Trent 772B	\$6,440,000	\$6,744,000	\$8,350,000	\$8,578,000	\$8,600,000	\$8,600,000	\$2,230,000	\$14,970,000
RB211-524H-T	\$4,750,000	\$5,350,000	\$5,959,000	\$5,720,000	\$3,310,000	\$2,675,000	\$680,000	\$4,680,000
CF6-80E1A3	\$7,500,000	\$8,700,000	\$9,800,000	\$9,780,000	\$9,850,000	\$10,180,000	\$4,360,000	\$16,000,000
CF6-80C2B1F	\$4,182,000	\$4,675,000	\$5,248,000	\$4,426,000	\$4,600,000	\$3,900,000	\$600,000	\$7,200,000

Note: Values listed supplied by IBA Group for maintained engines (not green time engines)

best material. Others will tear down the engines to place parts into an airline from existing contracts (common in North America). Nowadays, a power-by-the-hour (PBH) spare component pool is the driver behind decisions. Some examples of companies involved in this are Apollo Aviation, GA Telesis, and AeroTurbine.

“General Electric is deep into used serviceable material (USM), and it sees it as a core business,” continues Ray. “Pratt & Whitney also began to buy up engines to help remove material from the market, in the hope that it could again improve its own throughput. Rolls-Royce is a closed book here generally speaking, although there are some avenues with RB211-535 engines. RR also has competitively priced mature engine shop visit workscopes for the RB211-535. Operators, however, are looking for a predictable or stable operation during maturity, and I believe non-OEMs offer a no-strings solution to this. To some extent, OEMs are already trying to combat this.”

The current value for an engine, whose green time has been used, and will be parted out, still very much depends on its remaining LLP lives, and remaining on-wing time before a shop visit is due. The value will then be assessed on the general condition of the engine in terms of usable stock that could be taken from it. There has to be a demand for the usable material in the market, however, and this is declining in some areas. Maintenance records condition is also a critical consideration prior to engine tear-down or acquisition, since USM buyers have ever increasing requirements (most of them are purely used for commercial negotiation reasons) for parts trace, in particular with regard to LLPs.

Jones describes the difference between the CF6-80C2 and the CF56-5B and -7B. “The CF6-80C2 was released in the mid-1980s and is still in production, unchanged, so the older part-out engine material is valuable to maintain the current fleet of more than 2,500 active engines. With operators like Fedex

placing large orders for the 767-300F powered by the 80C2, there is going to be a demand for these parts for many years. In comparison the CFM56-5B has had five different versions since its introduction in 1994. This creates far less interchangeable material that can be recycled into present-day production engines.” It is very much a supply versus demand direct link to market value.

## Companies

Many lessors are diversifying and developing new services to supply the market, even though engine leasing may still be considered the core business. The word appearing in many of the leasing and support packages is ‘flexible’, as competition in the market is affecting the returns and testing companies’ business models.

The largest engine lessors in the market are still OEMs. Rolls-Royce Partners Finance (RRPF) and GE Engine leasing, for example, each have portfolios of about 400 engines.

ELFC (300 engines) and Willis Lease (200) are two of the bigger independent lessors, while a dedicated subsidiary like Aeroturbine, owned by Amsterdam-based aircraft lessor AerCap Holdings, has an estimated 100 engines.

Other independents, like TES Aviation Group, are developing engine asset management services for industry investors, owners and operators, by offering integrated management solutions, and engineering and on-wing services.

## Market values & lease rates

OEMs need to service those markets that the independents will not touch. An independent lessor will be less likely to buy, for example, Trent engines for the A350, since the operator base is limited. The Trent XWB will also be hard, if not impossible, for an independent lessor to acquire.

As an engine’s asset value is maintained, or rejuvenated, over its life due to the replenishment of its LLP components, it will not depreciate as much, in terms of absolute value, as an airframe. “The value is driven by market conditions, OEM list prices for new engines, components, cost of shop visits (caused by inflation), but most of all the maintenance condition of the engine,” says Ray. IBA forecasts engine values with an escalation/de-escalation schedule. The figures can be accessed through annual guides, such as IBA Group’s Engine Values Book.

Some current engines still in production today will have their market value challenged by new types. On top of this, OEM control of aftermarket through end-of-life part-out activity will put the residual values under pressure. “OEM maintenance agreements are having a big effect on engine residual values,” says Heath. “They add value through OEM warranty, resulting in preserving market share.”

One of the challenges affecting the aircraft and leasing business is that lessors need to appear to be profitable, in order to attract further investment and funding. “The leasing market almost does not work, since depreciation is not what it should be,” says Jones. “This creates a situation where the residual book value is often much higher than the achievable market value for end-of-life assets. This is due to what has been described as lessors’ irrational behaviour, resulting in billions being taken in impairments by some of the major aircraft and engine lessors.”

To give an example of engines holding their value if being maintained as new, half-life values over the past 10 years are summarised (*see table, this page*). Also listed is the guide value of the engine with 0% maintenance life and 0% LLP life remaining, along with the value of an engine with a full life market value of 100% maintenance life and 100% LLP life. These figures have been supplied as a guide by IBA Group.

While the value of the airframe depreciates as soon as it is delivered into service, engines can still increase in value. This is driven by list price escalation and/or general availability of the type. Although maintenance condition affects both the airframe and engine, the date of manufacture has little effect on the engine, because crucial LLPs are replaceable. Where an aircraft over 25 years of age can drop to under a fraction of its initial value, the engine value after maintenance visits can remain constant, even overtaking the price of the aircraft it powers.

Limited choice of engine options and performance on-wing can also affect the airframe's value. Unforeseen global environmental and manmade disasters have their own impact on the markets. The industry is recovering well after the last global financial low. But an engine cannot exist without the airframe. "While engines will outlast an aircraft, they are only as good as the aircraft they power," says Ray. "Of course there are trends, such as engine component trading, that make money from engines."

### Lease contracts

More competition in the leasing market has led to growing variations to the standard leasing agreements from

those over the past years. A more diverse market is producing a wide range of engine leasing and operational support contracts to match the varying needs of customers. A sub-section of the aviation industry is now favouring the airlines, as the lessors fight for their business.

The current contract or contract term proving the most profitable is more difficult to outline. Operator history, region of operation, seat capacity variants, and overall financial stability will affect what contract is best suited for the individual deal. The contract must match the product. "A lessor may need to inflate the maintenance reserves in a contract to offset the potential risk of a period of non-payment," says Heath. "The dominance of OEM flight hour agreements (FHA) is generating additional demand for spare engines to create the engine pools necessary to guarantee engine availability. It is possible for non-OEM lessors to access the spare engine requirements of airlines subject to FHAs, but at a price."

The FHA is a hot topic in the industry, and has had a big impact on the engine leasing market. Long-standing fixed-price or time-and-material contracts have made way for the FHA. These are paid at a fixed rate per hour of operation to cover the support services, along with the use of the engine and access to spare

engines. RR was a front runner in developing this kind of package to focus on the aftermarket service offerings. This allows airlines to minimise disruption to its operations, allowing them to focus on their core business with relatively predictable expenses.

FHAs include maintenance reserves, and usually state both upper and lower utilisation limits. New engines will have little scheduled maintenance for the first few years, apart from servicing and minor inspections, so these agreements focus heavily on unscheduled maintenance support, including parts support and AOG services.

Packages like RR Total Care transfer both time on-wing and shop visit costs back to the OEM, with engine reliability being the driver and reward for the airline. This also increases the asset value and desirability of a new lease, and aligns the interests of the lessors with those of the airlines.

"The FHA creates another level of competition with maintenance providers, but also disagreement in some cases," says Ray. "This is particularly for engines that have little control from the OEMs. MRO rates and OEM rates can differ, and while lessors might set a reserve price for return conditions, airlines might disagree with them because they are aware of something more achievable."



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Upfront with an OEM, it is good policy because the rate can be set in year X, but the rate will increase with inflation year-on-year.”

The FHA may be popular for new engine types, but for older ones it appears anything will go. Leasing trends and contracts are being driven by the changing use of the product and number of people now involved.

## Market concerns

The new engines entering the market are designed for lower maintenance costs, and the OEMs will need to protect what work there is for themselves to a degree. So a concern among the independent market is that the OEMs will award only limited licences to independent MROs, which creates a wall between the parties. For engines that have been ordered in large numbers, such as the CFM LEAP, it is unlikely that the OEM will have the internal infrastructure to support and own the maintenance network needed, so it will appoint ‘OEM-approved’ service centres.

On top of this, any third-party MROs will have to be competitive and efficient to provide affordable shop visits. Independent MROs will need to invest more money into these new types from tooling, manuals and training, for infrastructure and repair schemes, on what is essentially a reduced maintenance scheduled engine, and with more module assemblies set for quick turnarounds.

There is also concern that the increasing number of players in the market will force companies to lease their engines below market rates. Normally a lease rental equal to 0.7-1.0% per month of the current engine value is desirable, so lower rates will drive engine values down, and leave future returns less than forecasted. This has been described as irrational behaviour by some lessors, and is often used in maintenance risk situations. This is leaving the contracts, with maintenance reserves and care packages with incorporated back-up and reliability services, in a market they are struggling to compete.

## Summary

Installed or stored engines are estimated at nearly 50,000 worldwide. While in the past airlines have had to balance the cost of holding spares against the risk of not having an engine when needed, the engine leasing market is awash with OEM lessors and subsidiaries, and independent lessors that have moved into the engine leasing world stage. There is so much out there for airline operators, that holding their own stock is less compelling.

This is not set to last for the new

engine types, however, because the current trend in the OEMs’ service agreements is to sign up the engine at point of sale. This will make it challenging for independent organisations to tender for this business, and will even restrict engine part-out options by contracted time restraints being set. The choice available to the airlines will then eventually reduce.

China, the Middle East and India

appear to be the most opportunistic markets for engine lessors. There is plenty of activity and diversity outside OEM aftermarket boundaries. How quickly the OEMs come to control more than 50% of the market will be something to watch. [AC](#)

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