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Financial intelligence for commercial aviation

A SPECIAL SUPPLEMENT

Guide to financing and investing in engines 2013

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www.airfinancejournal.com

Editor
Dickon Harris
+44 (0)20 7779 8853
dharris@euromoneyplc.com

Senior reporter
Jamie Bullen
+44(0)20 7779 8242
jbullen@euromoneyplc.com

Reporters
Yana Palagacheva
+44 (0)20 7779 8029
ypalagacheva@euromoneyplc.com

Joanna Vickers
+44 (0)20 7779 8072
jvickers@euromoneyplc.com

Technical editor
Geoff Hearn

Group sub editor
Peter Styles Wilson

Production editor
Clare Wood

Publisher
Graham Sherwood
+44 (0)20 7779 8857
gsherwood@euromoneyplc.com

Advertising Executive
Ben Sharpington
+44 (0)20 7779 8231
bsharpington@euromoneyplc.com

Subscriptions account manager
Sarita Bains
+44 (0)20 7779 8015
sbains@euromoneyplc.com

Deals database manager
Alfonso Olivas
+44 (0)20 7778 8225
aolivas@euromoneyplc.com

Business group manager
Sean Brierley
+44 (0)20 7779 8207
sbrierley@euromoneyplc.com

Divisional director
Roger Davies

SUBSCRIPTIONS / CONFERENCES HOTLINE
+44 (0)20 7779 8999 / +1 212 224 3570
hotline@euromoneyplc.com

CUSTOMER SERVICES
+44 (0)20 7779 8610
Nestor House, Playhouse Yard, London, EC4V 5EX

Executive chairman: Richard Ensor
Directors: Sir Patrick Sergeant, The Viscount Rothermere, Neil Osborn, Dan Cohen, John Botts, Colin Jones, Diane Alfano, Christopher Fordham (managing director), Jaime Gonzalez, Jane Wilkinson, Martin Morgan, David Pritchard, Bashar Al-Rehany
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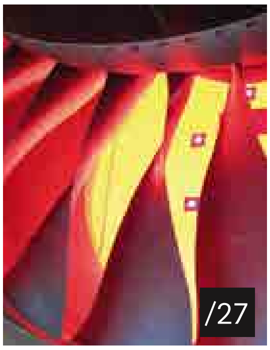


EDITORIAL

PML inches closer to practice

Dickon Harris examines the latest development of CFM's portable maintenance programme for lessors.

Last month Gecas finally signed an agreement to participate in CFM International's Portable Maintenance for Lessors (PML) programme.

CFM's product is a lessor-friendly fixed flight-hour maintenance agreement available for the CFM56-5B and the CFM56-7B engines. Unlike other standard flight-hour agreements, the programme exists as a contract directly between the lessors and CFM. The benefits, which include full shop visit coverage, as well as non-performance restoration shop visits, are then passed on to the lessees.

Under PML the lessors are free to negotiate an independent rate with their lessees for maintenance reserves; a transaction in which CFM does not need necessarily get involved. A lessee is still paying for the maintenance event but it is fully covered within the maintenance reserve funds it has with its lessor.

"The appeal for lessors is simple," states one interested lessor. "What you can get is an assignment of the flight-hour agreement with cash available. If you work with GE, or IAE, or Rolls-Royce on their flight-hour agreement you get an assignment of the benefits – ie, a shop visit at the same rate or an ability to take credit, but you never get the cash."

Allowing lessors to hold the reserves offers them additional security. CFM also argues that it encourages greater portability because it means there is little payment reconciliation required if engines drop in and out of the programme because the lessor retains most of the maintenance reserve payments.

Delays to the programme

Translating PML into reality has been slower than anticipated. The biggest hurdle has been introducing a pricing matrix with which lessors are comfortable.

"You have to anticipate a different bunch of thrust classes, engine configurations, operating environments and flight legs, so it is a big pricing matrix discussion," explains Brian Ovington from CFM's services group.

"Structuring and building out the pricing to align with the lessor's reserve rates, versus our traditional products with airlines, has taken some time," he adds. CFM designed a product that allowed lessors to switch operators fairly easily, which CFM states is a benefit under the programme because the second operator knows it has access to previous maintenance reserves.

However, one of the tough challenges CFM has had to face has been to accommodate the need for lessors to sell the assets themselves. Lessors needed a truly portable agreement that would travel with the operator even if the aircraft changed owners.

A second issue has concerned spare engine lessors.

Last year CFM signed a memorandum of understanding with ELFC regarding the PML programme. Insiders state that the short-term nature and frequency of different leases associated with spare engine lessors is difficult to reconcile under the PML programme.

The main sticking point is the transition from one operating environment to another. "If you put an engine into India, which has the highest hourly reserve rates in the world, and then you take it back after six months from India and lease it to Iceland, which has one of the lowest reserve rates in the world, you have to charge the India rate for the rest of the life of engine until its next shop visit," says a lessor.

Under the PML programme the harsher initial environment is now the benchmark for all future reserves until a comprehensive shop visit. Spare engine leases are as short as 30 or 90 days, while airframe lessors generally have leases of at least five years, which normally accounts for the first shop visit, which minimizes the problem. The nature of the PML programme means that lessors are obviously restricted to CFM shops, which have fixed rates, minimizing the competitive advantage for spare engine lessors to quote to their clients. Spare engine lessors intimate that given these restrictions the PML product is difficult in reality for just a handful of engines but would work better for a larger amount of engines under a longer-term lease with an airline client.

Now available for airlines

It might be six months later than expected but the good news is that CFM has its first master agreement in place with Gecas. The benefit of a contract with a lessor is that the lessor can offer smaller airlines the benefits of fixed maintenance costs. CFM states the initial talks with lessees have gone well because they can see the benefits of a product that should help provide assured maintenance costs within reserve rates and the reduced need for lease return shop visits.

The portability of the product needs to be tested but through Gecas the programme is now available to airlines. Airfinance Journal understands that CFM is in advanced talks with SMBC on signing another master frame work agreement. It appears that the product is much closer to being a real option for airlines.

DICKON HARRIS,
Editor, *Airfinance Journal*

NEWS

Engine News 2013

JANUARY

P&W to power new E-jets

Brazilian manufacturer Embraer selects Pratt & Whitney's PW1700G and PW1900G to power its second generation of E-jets.

The target entry-into-service date of the new aircraft is 2018.

Air Lease chooses Trent XWB

Air Lease Corporation signs an order for Trent XWB engines to power 25 A350XWB aircraft. The engine order is worth a total of $1.1 billion at list prices.

FEBRUARY

CFM reports record Leap production

CFM International announces it has firm orders and commitments for more than 1,100 Leap engines. The company said it produced nearly 1,420 CFM56 engines in 2012, compared with just more than 1,300 in 2011 and 1,250 engines in 2010.

The company plans to build 1,700 engines a year by 2019 as it moves from the CFM56 to Leap engine production.

Transport Canada certifies PW1500G

Pratt & Whitney (PW) achieves Transport Canada type certification of its first PurePower geared turbofan engine – the PW1500G. The manufacturer has conducted more than 4,000 hours of trials since the initial engine began testing in September 2010. The PW1500G engine test programme included 340 hours of flight-testing on PW's experimental 747 flight test aircraft.

Trent XWB receives certification

The European Aviation Safety Agency certifies the Rolls-Royce Trent XWB engine.

The certification covers Trent XWB engines that will power A350-800 and A350-900 aircraft. A higher thrust version of the engine is under development for the A350-1000.

The first flight of the A350-900 is expected in the second half of 2013. The aircraft is scheduled to enter service in 2014.

MARCH

Ryanair order boosts CFM56 backlog

Ireland-based low-cost carrier Ryanair's commitment to purchase 175 CFM56-7BE-powered Boeing 737-800 aircraft takes the CFM56 backlog to more than 5,450 engines, or about four years of production at current rates.

Willis and SAS close sale/leaseback for 19 engines

Scandinavian Airlines (SAS) signs a sale/leaseback agreement for 19 jet engines with Engine lessor Willis Lease Finance.

The purchase/leaseback transaction is valued at about $120 million.

According to Charles Willis, Willis Lease chief executive officer and chairman, the transaction is "one of the largest and most complex engine sale and leaseback transactions ever done."

APRIL

Willis Lease Finance wins engine award

Willis Lease Finance Corporation took the Airfinance Journal Engine Deal of the Year award for its $390 million asset-backed securitization structured by Crédit Agriciole Corporate and Investment Banking. The lessor also reported it had made a loss of $3.8 million for 2012.

Rolls-Royce secures $1.6bn Trent order from IAG

Rolls-Royce wins a $1.6 billion order, at list prices, from International Airlines Group (IAG) for Trent XWB engines to power 18 A350-1000 aircraft. The order includes long-term TotalCare® service support.

MAY

CFM freezes Leap-1B design

Engine manufacturer CFM freezes the design of the Leap-1B powerplant for the Boeing 737 Max. According to the manufacturer, the design freeze is on schedule, as were the design freezes of the Leap-1A and Leap-1C that power the Airbus A320neo and the Comac C919, respectively.

GE Aviation announces strong CF34 sales

GE Aviation announces it has received firm orders for more than 200 CF34 engines from customers since December 2012.

GE has delivered more than 5,700 CF34 engines since it entered service in 1992.

NEWS

Engine News 2013

GA Telesis acquires engine MRO provider

GA Telesis acquires part of Finnair Engine Services, a maintenance, repair and overhaul (MRO) provider. The deal comprises the sale of assets and transfer of 80 service professionals to GA Telesis Engine Services (Gates).

Gates has also entered into a long-term lease agreement for all of the engine maintenance and test cell facilities from Finnair.

JUNE

Boeing Selects GE as Engine Partner for 777X

Boeing's development study on improvements to the 777, known as 777X, will include General Electric (GE) as the engine partner on the twin-aisle aircraft, which is expected to enter service near the end of the decade.

GE Aviation's engine study, called GE9X, for the next-generation 777 aircraft has been underway for several years. The study is focused on an engine in the 100,000lb-thrust class and will offer a 10% fuel burn improvement over today's GE90 engines.

CIT orders Trent engines

CIT Group orders Rolls-Royce Trent engines to power 23 Airbus aircraft. The order includes Trent XWB engines for 10 A350XWB aircraft and Trent 700 engines for 13 A330 aircraft.

Singapore Airlines chooses Rolls-Royce for 787s

Rolls-Royce is selected by Singapore Airlines Group to supply Trent 1000 engines for the airline's 50 Boeing 787 Dreamliner aircraft. The announcement, which includes long-term TotalCare® service support, is worth $4 billion at current list prices.

PurePower engine for A320neo begins flight test

The Pratt & Whitney PurePower PW1100G-JM engine completed its first flight, launching the engine family's flight test programme. The engine flew on Pratt & Whitney's Boeing 747SP flying test bed at the company's Mirabel Aerospace Centre, Quebec, Canada.

CFM logs $15bn in new orders at Paris Air Show

CFM announces orders for 660 new engines (468 Leap and 192 CFM56) during the four trade days at the Paris Air Show in LeBourget. In addition, the company says it signed service agreements, which brought the value of deals announced to $15 billion at list prices.

Rolls-Royce announces $5bn of orders at LeBourget

Rolls-Royce increases its order book at the Paris Air Show, announcing new orders and agreements worth almost $5 billion. The company confirms the building of test engine for the latest development of Trent engine, the Trent 1000-Ten, will begin later this year.

Gecas and CFM finalize lessor PML

Gecas signs up for CFM's Portable Maintenance for Lessors (PML) Programme, a flight-hour-based maintenance agreement designed to address the issues that arise when aircraft are transferred between lessees.

Embraer launches E-Jet E2 family

Embraer announces the formal launch of its new-generation E-Jet (E-Jet E2) family, securing another aircraft application for Pratt & Whitney's PurePower geared turbofan engine.

JULY

Oman Air selects Trent 700

Flag carrier Oman Air places order for Rolls-Royce Trent 700 engines to power three A330-300s on order with Airbus.

Lufthansa Technik establishes support team in Montreal

Lufthansa Technik announces its support team based in Montreal, Canada, is to offer CFM56-5A/5B engine on-wing/on-site services, including module and blade replacement.

ENGINE NEWS

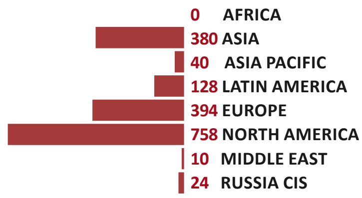
Engine orders at the Paris Airshow

1734 ENGINE ORDERS

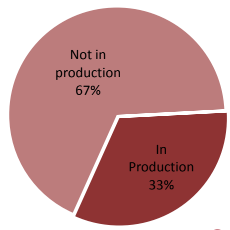
MANUFACTURERS

Manufacturer	Orders	Share	In production	Not in production
PRATT & WHITNEY	850 ORDERS	Share: 49.1%	32	818
CFM	372 ORDERS	Share: 21.4%	138	234
IAE	176 ORDERS	Share: 10.1%	176	0
ROLLS-ROYCE	168 ORDERS	Share: 9.6%	90	78 (34.8%)
GENERAL ELECTRIC	168 ORDERS	Share: 9.6%	168	0

ORDERS BY REGION



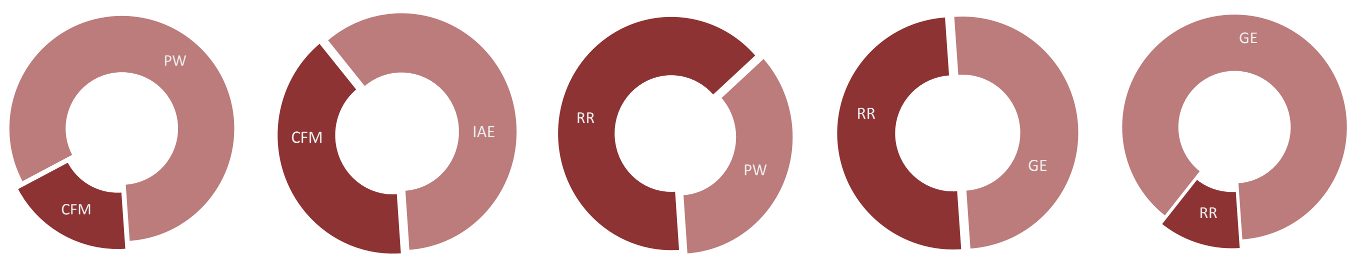
PROGRAMME STATUS



IN PRODUCTION 604 (34.8%)

NOT IN PRODUCTION 1130 (65.2%)

ENGINE COMPETITION



A320 neo	A320	A330	B777	B787
358 PW ORDERS	118 CFM ORDERS	58 RR ORDERS	16 GE ORDERS	120 GE ORDERS
94 CFM ORDERS	176 IAE ORDERS	32 PW ORDERS	16 RR ORDERS	16 PW ORDERS

Q&A: BOBBY JANAGAN

Waiting for demand

Bobby Janagan, General Manager, Rolls-Royce & Partners Finance (RRPF), tells *Airfinance Journal* about the state of play in the engine leasing market, and what trends are likely to be seen in the coming years.

***Airfinance Journal:* Where is the demand for engines over the next few years going to come from?**

Bobby Janagan: In the near term demand is going to be flat for new spare engines. This is because the majority of new aircraft deliveries are going to existing operators which have sufficient spare engines. Secondly, from a lessor point of view, the price of the engines will need to reflect that the engines are from the tail end of production programmes, and I don't see that reduction in price happening just yet.

Saying that, the flat demand will probably pick-up from 2016 onwards as we begin to see A350s, the 737 Max and A320neo start to arrive. Are we likely to see more leasing of engines?

Airlines are increasingly focused on their core business, which means that they are outsourcing a significant proportion of maintenance and asset management functions, as well as leasing a larger proportion of their fleet. This has resulted in long-term maintenance contracts with OEMs [original equipment manufacturers] and MROs [maintenance, repair and overhaul] and spare engines being sourced via operating lease.

Airlines are taking engines on lease for three key reasons: the high price tag of engines, the difficulty of sourcing finance and the fact that airlines are focusing more on their core business. So in summary, I expect more spare engines to be leased going forward than in the past.

What is driving the change towards more spare engines being leased?

In the past airlines either benefited from implicit state guarantees or reduced competition due to protective bilateral regulations. They were therefore able to source attractively priced finance with relative ease, and the actual engines were operated by the same operator on a long-term basis, perhaps 20-plus years.

Governments worldwide liberalized the airline industry and infused competition into the sector. Intense competition has pushed airlines to focus on their core business and outsource non-core activities. One aspect of competition is the push to renew fleets more frequently to attract customers with fresh product offerings, and therefore asset value risk becomes more of a problem.

Owning and trading spare engines is a non-core activity for many airlines and they see the benefits of leasing. Leasing is a simple and attractive solution for many as it provides a source of finance, operational flexibility and eliminates asset value risk.

Bobby Janagan, General Manager, Rolls-Royce & Partners Finance.

The current trend is a mixed ownership model – own some and lease some. I expect that in the future around 50% of spare engines will be owned and 50% will be leased – particularly on the new deliveries.

So spare engine leasing will follow the same trends we are seeing from the airframe lessors?

Lessors now finance a significant proportion of new aircraft deliveries, particularly on the narrow-body models. A large number of new players have entered the market, which has created a highly competitive aircraft leasing market.

Aircraft lessors and parts traders are moving into the engine leasing market by diversifying from their core business. The high level of competition seen in the aircraft leasing market over the last few years is likely to be seen very soon in the engine leasing market, and this will erode the margins significantly, unless the service offering is differentiated significantly.

But the engine market is smaller than the airframe market, so how many lessors can play the market?

> "For the last 20 years four lessors have been active in the market. However, going forward the market is likely to see many more lessors."

Typically, engine manufacturers recommend an 8% to 12% spare engine cover ratio depending on how the fleet is operated.

If a large airline orders 50 aircraft, it would probably require 10-plus lessors or banks to finance these deliveries. However, on the spare engine side, the fleet would only require eight to 10 engines. Depending on the airline's creditworthiness, one or two lessors can easily support all the spare engines, as the sums involved are relatively small.

Given annual spare engine deliveries are in the region of $3 billion, the market needs to attract sufficient capital to fund the deliveries, but a rapid flow of liquidity can erode profitability and make it unattractive for a sustained flow of capital.

What types of new players are entering?
Investors generally now understand engines as an asset class. The background of the new entrants varies but they include parts traders, Japanese banks or trading houses, German KG funds, as well as private equity.

Why are engine OEMs so involved in engine leasing?
Independent lessors will be selective how they invest. They typically prefer, from a risk point of view, highly liquid engine types operated by a diverse range of airlines. So they would prefer CFM56 and V2500 now and LeapX and GTF in the future.

But as a Rolls-Royce-affiliated lessor we need to support all Rolls-Royce engine types, including niche types such as the Trent 900 that powers the A380. Rolls-Royce's customers naturally expect such support, and we are here to help them.

Leasing rates on engines: soft or high?
There is a supply and demand imbalance in the market for certain narrowbody engine types, primarily V2500, CFM56-5B and -7B, which is causing softness in lease rates. There is no imbalance in the widebody market at the moment – hence rates are balanced to reflect the cost of ownership of the engine type.

Engine manufacturers and market players have recognized the imbalance and are now working towards reducing the imbalance either by reducing production of new engines or breaking high time engines for parts.

On the back of an improving global economy, aircraft utilization is increasing. With increased aircraft utilization and reduced capacity, V2500 and CFM56 lease rates are recovering.

Is there an advantage to sourcing spare parts from an independent?
At a certain stage in an engine's life cycle it makes sense to refurbish the engine at a lower cost by using serviceable used parts. Both OEM and independents can supply serviceable used parts. Serviceable used parts are cheaper but on-wing life can be shorter compared to using new parts.

Rolls-Royce parts are said to be hard to get from independents. Is that a specific strategy?
The Rolls-Royce-powered fleet is comparatively small when compared to CFM56, CF6 or PW4000 fleets. A larger fleet would provide plenty of opportunities and attract a greater number of independent parts traders.

For example, there are 500 Rolls-Royce-powered 757s flying in-service compared to 1,200-plus CFM56-3-powered aircraft – both engine types entered service in 1984. As a result, about half-a-dozen parts traders sell 535E4 material, whereas two dozen parts traders are selling CFM56-3 material.

Why does Rolls-Royce focus on the widebody market so much?
I can only talk about RRPF, which is a spare engine lessor and not a manufacturer, but talking as an industry observer it is clear that an engine manufacturer will invest in building an engine for a specific airframe project based on the merits of the business case. Rolls-Royce and Pratt & Whitney are planning a new joint venture to develop engines for future mid-size aircraft.

Where will we see the demand for spare engines come from?
The projection for the next 20 years is 32,000 aircraft will be delivered. To support these aircraft about 5,200 spare engines are required and the value of annual deliveries is about $3 billion. I believe at least 50% of these engines will be on operating lease.

How about India though?
India should be a big market but it is disappointing to see how the government has treated leasing companies during recent aircraft repossessions. This experience is likely to put a lid on growth as lessors decide to invest elsewhere or apply jurisdiction premiums.

Although India has ratified the Cape Town Convention, the reality on the ground during recent repossessions did not match the spirit of the convention.

What financing trends do we see in the spare engine market?
On the positive side, airlines are not keen on acquiring the spare engines as it is not a core business and, as a result, I believe at least 50% of new deliveries will be financed via operating lease. However, on the negative side, a number of new entrants are entering the market and eroding yields. Ultimately, the industry needs to produce attractive returns to keep investors interested, especially given the $3 billion-worth of new deliveries to be financed each year.

What kind of financing structures do we see in the spare engine market?
Unlike aircraft financing, spare engine financing tends to be simpler. Typical financing structures used by airlines are bank debt, ECA [export credit agency] debt and operating leases.

The new engines are set to be more reliable than ever. Will this affect the spares market?
Yes. Engines are getting more reliable and staying on-wing longer. Built-in sensors in the new engine types can give more accurate operational data to improve reliability. This means that the aircraft fleet can be managed with fewer spare engines.

For a spare engine lessor, reliability is a problem; greater reliability means less demand for spare engines.

However, people's propensity to travel is increasing globally on the back of rising economic prosperity. As more people travel, airlines need more aircraft, and aircraft utilization will increase. As a result, more spare engines will be required to support the enlarged fleet.

So, although the spare engine cover ratio is reducing due to improving engine reliability, the overall pie is getting bigger thanks to a larger aircraft fleet and rising economic prosperity.

So the spare engine leasing market will still be played by a comparatively small number of players?
For the last 20 years four lessors have been active in the market. However, going forward the market is likely to see many more lessors.

SPONSORED EDITORIAL

IAE celebrates 30-year track record

The V2500 is the preferred choice for the Airbus A321. Jon Beatty, IAE's president and chief executive officer, examines the firm's engine programme and its recent innovations.

John Beatty
President and CEO
IAE

As International Aero Engines AG (IAE) celebrates 30 years, it counts close to 200 airlines and leasing companies across the globe among its loyal customers, and looks back on a successful aerospace programme that resulted in the V2500 – a cleaner, quieter and more fuel-efficient engine.

IAE is a multinational aero engine consortium whose shareholders are comprised of Pratt & Whitney (NYSE: UTX), Pratt & Whitney Aero Engines International GmbH, Japanese Aero Engines Corporation and MTU Aero Engines.

IAE is a successful civil aerospace programme with more than 5,500 engines delivered and firm deliveries through 2017. V2500 engines in total have accumulated more than 115 million flying hours and are available across three platforms: the Airbus A320 family, the Boeing MD-90 and the Embraer KC-390 – the engine's first military application.

"We believe the product has excellent potential," says IAE president Jon Beatty. "The V2500's world-class reliability has made it the preferred engine for our customers. It is also the most technologically advanced engine for the A320 family based on a track record of continuous improvement from the initial A1 standard through the latest SelectOne™ upgrade.

"We have reached this leading position because of our customers' trust in us and in the V2500 – a trust we have earned through years of world-class reliability," adds Beatty. "Our success has been fostered by the continuous support and commitment we receive from our customers. IAE spends a lot of time working with customers to see what they want. Any time you invest in the product you want to make sure it is addressing customers' needs and providing value. We are currently working with airlines to determine what product enhancements they would like to see in our next upgrade."

The current-build standard SelectOne™ entered service in 2008. It delivers class-leading fuel burn performance, along with a corresponding reduction in CO_2 emissions. It improves time on wing by up to 20%, and demonstrates compliance with all applicable CAEP emissions standards. The SelectTwo™ engine upgrade will be available in 2014 and will provide an additional, incremental fuel-burn benefit.

The V today

The V2500 has become the preferred engine for A321 operators worldwide with more than 60% of the A321s in service with V2500 engines and nearly 80% of the production backlog.

"As Airbus continues to increase the production rate of A321s, IAE will continue to do well in narrowbody sales," says Beatty. "In addition to providing a superior fuel burn advantage over the competition, the V2500 offers improved time on wing and the lowest noise and emissions."

IAE is on course to build more than 500 engines in 2013. IAE set a new production milestone in 2012 by building 470 engines – the highest number of annual engine production in the programme's history.

"The V2500 has become the preferred engine for A321 operators worldwide with more than 60% of the A321s in service with V2500 engines and nearly 80% of the production backlog."

IAE's production will continue to ramp up, and ultimately the consortium expects total engines delivered to top out at about 8,000 units. The ramp up in production over the past few years means a relatively young fleet in service. The average age of the V2500-A5 fleet is almost seven years; so about 50% of the fleet has not yet had a shop visit.

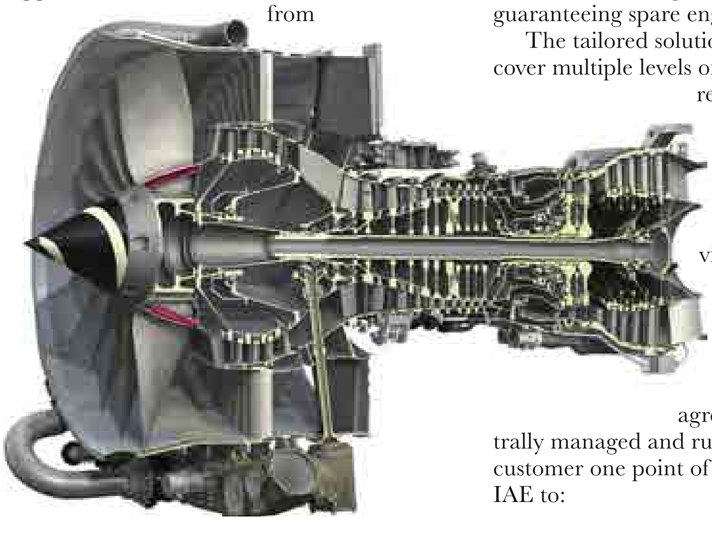
To help care for the growing number of V2500s in operation, the company recently launched its comprehensive aftermarket portfolio V-Services℠.

V-Services℠: customized solutions

"There is a vast difference among our customers, which include legacy airline customers, low-cost carriers, lessors and government agencies," says Beatty. "When it comes to aftermarket needs, no one size fits all."

IAE's popular Fleet Hour Agreements (FHA) and Fixed Price Maintenance solutions allow for proactive engine maintenance management through continuous engine health monitoring, optimized shop visit planning and predictable maintenance cost – maximizing fleet availability and minimizing cost.

To address various operator needs, V-Services℠ offers customized services such as Lessor Direct Maintenance Options that address lessors' needs and requirements and support the seamless movement of aircraft from airline to airline. V-Secure℠ is another option that provides lessors with additional maintenance reserve security and increased protection in the event of customer defaults. IAE has more than 40 V-Secure℠ agreements with more than 13 leasing companies.



"Engines in different fleets need to be managed according to their specific operating parameters," says Beatty. "Fleets also change over time as they age and fragment. This requires creative solutions and more refined operational efficiency. The V2500's global fleet presence and our easy access to global maintenance data and engine performance puts IAE as the OEM [original equipment manufacturer] in the best position to understand the engine behaviour under a variety of operating conditions across the globe. By continually monitoring the V2500 fleet, anticipating trends and providing support early in the relationship, V-Services℠ can provide customized support that allows operators to better plan their fleet requirements with respect to engine maintenance."

Other options available through V-Services℠ include IAE's Spare Engine Solutions, which IAE recently expanded in response to customers' operational and financial needs. This service provides customers with the opportunity to reduce their total engine-related investment, reduce residual value risk and provide flexibility for the transition to next-generation aircraft, while guaranteeing spare engine availability.

The tailored solutions of V-Services℠ cover multiple levels of work from defined restoration work scopes on engine to full under cowl FHA support for both engine and nacelle. In addition, IAE provides support through V-Services℠ when customers bring used aircraft into their fleet.

All V-Services℠ agreements are centrally managed and run by IAE, giving the customer one point of contact. This enables IAE to:

- leverage IAE's fleet knowledge;
- identify trends and issues that may affect engines in the future;
- proactively manage engines in operation; and
- apply the power of IAE's OEM network to provide predictable maintenance costs, optimized engine performance and reliability.

Customer value

Overall, V-Services℠ gives V2500 operators the best value, prevents unnecessary maintenance, helps customers manage their fleet and lowers total cost.

Additional benefits to the customer include:

- predictable maintenance cost;
- optimized engine performance including reliability and fuel burn;
- improved marketability; and
- increased residual value.

Nearly 60% of the installed V2500 fleet and more than 80% of future deliveries are backed by a V-Services℠ agreement. At the heart of IAE's product support and aftermarket services is 145-field support personnel located in close to 70 field offices around the world. IAE's goal is for more customers to experience these benefits by increasing the percentage of the fleet under service contracts.

"Customers have commented on the fantastic support they receive and the focused on-site support that provides them with immediate technical, operational and fleet solutions," says Beatty.

Over the past 30 years IAE has accomplished virtually every goal it set for itself. Today it is entering a new and exciting era, with IAE and its party companies positioned to best serve all A320 customers by allowing more flexible offerings to the narrowbody segment.

As for the future, Beatty says: "IAE will evolve as it has in the past to meet customer and business needs and will continue to do so throughout the collaboration agreement lasting at least until 2045.

"We believe there are opportunities for a unified and coordinated approach to sell V2500 and PW1100G-JM engines. IAE's shareholders are currently discussing these opportunities. The intent is to make any coordinated approach beneficial for customers."

ENGINE DEAL OF THE YEAR

Willis Lease Finance Corporation

In September Willis Lease Finance Corporation (WLFC) closed the largest aviation asset-backed securitization (ABS) since 2008.

The company completed a sale of $390 million-worth of senior secured notes through Willis Engine Securitization Trust II (West II). The ABS represents more than a half of WLFC's consolidated total outstanding debt.

The notes were secured by a portfolio of 79 aircraft engines acquired from WLFC at a loan to value of about 70%. Crédit Agricole Corporate and Investment Banking was the sole structuring agent and a joint bookrunner along with Goldman Sachs.

The coupon rate on the securitization trust is 5.5%. The average life is 7.3 years with a final maturity of 25 years.

West II is a wholly owned statutory trust, meaning that the assets and debt will remain on the company's balance sheet. Another highlight of West II is that it eliminates certain administrative costs for servicing and other third-party expenses.

"This transaction allows us to lock in today's low interest rates for 10 years, provides significant capital for growth and share repurchases, as well as gives us better access to cash-flow operations going forward," says Charles Willis, chief executive officer and chairman, WLFC.

The net proceeds of the notes, together with borrowings under WLFC's existing revolving credit facility, will be used to repay notes previously issued by Willis Engine Securitization Trust. The ABS also provides significant liquidity and capital for the lessor for future engine acquisitions, common and preferred stock share repurchases and for large-scale sale/leaseback transactions.

Brad Forsyth, chief financial officer, WLFC, said at the time the deal was announced: "The West II structure will provide significant liquidity for us, now and in the future. As part of the repayment of the existing West notes, we will book a pre-tax charge of approximately $15 million in the third quarter, representing unamortized debt issuance costs, note discount and swap termination costs related to the existing West floating rate that will be extinguished."

Willis Lease Finance Corporation is the first aviation lessor to tap the asset-backed securitization market during the credit crisis. It previously completed engine ABS securitizations in 2005, 2007 and 2008.

SPONSORED EDITORIAL

Capacity, capacity, capacity

Bobby Janagan, General Manager, Rolls-Royce & Partners Finance.

In the economic downturn that came after the September 11 2001 terrorist attacks, airlines worldwide posted large losses because of the significant drop in demand. The economic downturn that followed the 2008 financial crisis was much more severe, but airlines did not incur losses to the same magnitude. How did the airlines perform better second time around?

The answer is capacity management. Since 2008 airlines have managed their capacity in a more disciplined way and focused on yield instead of load factors. They have managed that capacity either by parking or returning aircraft to the lessors.

In the past 25 years two major drivers have propelled growth in the aviation industry. First, significant passenger and freight demand has been achieved on the back of general economic growth, particularly from the emerging markets. Second, governments worldwide have liberalized the airline industry by privatizing state-owned airlines, as well as relaxing ownership and bilateral rules. The result has been lots of new airlines and a lot more competition in the industry.

The competition is not just for customers, but also for investment. Shareholders have pressed the airlines to focus on efficient use of capital to generate better returns. An important source of capital has increasingly been the operating lease. Leasing aircraft, engines and other assets not only provides capital but also mitigates residual value exposure.

In the background, aircraft manufacturers increased production levels to meet expected demand. While it is normal to see new aircraft replacing economically unviable old aircraft, it is unusual from an historical market perspective to see new aircraft displacing popular mid-life-generation aircraft, such as A320 and 737 types. There have been numerous examples of this happening in recent years. The owners of such used aircraft are finding it difficult to refinance their aircraft and are also obtaining lower lease rentals as they compete with new aircraft. The new aircraft are being offered at highly competitive lease rates – in part because of historically low interest rates, which are set to continue as governments struggle with anaemic economic growth and opt for loose monetary policy. The new aircraft also come with reduced maintenance burden and an aesthetically pleasing new cabin. Used aircraft are unable to compete effectively against new aircraft in this context.

The problem is compounded by a recent trend of new aircraft being offered to much less-creditworthy airlines, new start-ups and carriers based in difficult jurisdictions that were the homes for mid-life aircraft in the past.

The convergence of excess supply of new aircraft, reduced importance of lessee credit for new aircraft placement, financiers' preference for newer aircraft and softening lease rates for used aircraft is leading lessors to consider parting out aircraft earlier than historically has been the case. In the past two years a number of A319s and 737-700s have been parted out. Although the number of aircraft parted out has so far been relatively small, it may not stay that way for long.

There are a number of well-funded new entrants in the used parts trading market. These new players could aggressively grow their market because of the difficulty of placing used aircraft, the potential arbitrage of catalogue price of new parts versus market price and ease of finding investment thanks to the relatively quick pay-back time of their business model (the average pay-back time is less than three years).

It is in this context that we review the spare engine market. Before the financial crisis in 2008 both CFM and IAE were predicting a wave of shop visits that would require the support of a greater number of spare engines. Both engine manufacturers increased the supply of spare engines but lower aircraft utilization due to reduced economic activity and higher-than-expected engine reliability created an excess supply in the market. In addition, in the age of the internet, airlines are better able to source spare engines at short notice and less inclined to take the recommended spare engine ratio cover on long-term lease. Airlines are increasingly relying on the spot market for their spare engine cover.

Spare engines lessors need to exercise more discipline in order to thrive.

The additional spare engines delivered to support the shop visit wave and engines from parted out aircraft have created an over-supply imbalance in the market. Spare engine lessors are suffering a capacity conundrum similar to the airlines during the last downturn. Spare engine lessors are increasingly carrying incremental costs such as maintenance, storage and legal fees as more and more leases are short term in nature. It is market practice that such costs are for the account of the lessee if it was a long-term lease.

About 32,000 aircraft of various different types will be delivered in the next 20 years. The associated spare engine market will be about 5,200 engines, with a catalogue price of $65 billion (2013 price levels). We believe that at least 50% of these future spare engines will be delivered via operating lease. The spare engine lease market will need to attract significant capital to support these future deliveries. In order to meet our investors' expectations of returns, we need to focus more on yield and be more disciplined in our capacity management. We need to learn from our customers.

ENGINE SURVEY 2013

Engine market stabilizes after oversupply

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

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

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

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

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

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

Balancing the market

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

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

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

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

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

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

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

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

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

Financing

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

> “Now I see light at the end of the tunnel with regards to the lease demand; trading should also increase more next year.”
>
> **Lothar Ratei, partner, GSI Funds.**

equal their purchase price, hence minimizing the exposure.

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

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

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

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

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

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

Next generation

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

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

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

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

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

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

Manufacturers’ maintenance monopoly

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

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

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

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

Insiders note a growing demand for spare engines in 2013.

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

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

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

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

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

ENGINE SURVEY

Aircraft Engine Values

INVESTOR APPEAL		REMARKETING POTENTIAL		RESIDUAL VALUE	
Engine Type	Score (out of 7)	Engine Type	Score (out of 7)	Engine Type	Score (out of 7)
CFM56-7B (737NG)	6.37	CFM56-7B (737NG)	6.37	CFM56-7B (737NG)	6.37
CFM56-5B (A320)	5.75	CFM56-5B (A320)	6	CFM56-5B (A320)	5.62
GE90 (777)	4.68	GE90 (777)	4.31	GE90 (777)	4.56
TRENT 700 (A330)	4.25	PW4000 (747-400s, 767s,	3.75	TRENT 700 (A330)	4.37
VS2500-A5 (A320)	4.12	CF6-80 (747-400s, 767s)	3.62	CF6-80 (747-400s, 767s)	3.62
PW4000 (747-400s, 767s,	3.87	TRENT 700 (A330)	3.62	VS2500-A5 (A320)	3.62
CF6-80 (747-400s, 767s)	3.75	VS2500-A5 (A320)	3.37	PW4000 (747-400s, 767s,	3.62
TRENT 800 (777)	3.42	TRENT 800 (777)	3	TRENT 800 (777)	3.28
GP7200 (A380)	3.14	PW2000 (757)	2.62	GP7200 (A380)	2.71
TRENT 900 (A380)	2.71	GP7200 (A380)	2.42	TRENT 900 (A380)	2.57
CFM56-5A (A320)	2.37	CFM56-3C (737CL)	2.37	PW2000 (757)	2.37
PW2000 (757)	2.37	RB211-535 (757)	2.37	CFM56-5C (A340)	2.25
RB211-535 (757)	2.37	CFM56-5C (A340)	2.12	CFM56-5A (A320)	2
CFM56-3C (737CL)	2.25	CFM56-5A (A320)	2	RB211-535 (757)	2
CFM56-5C (A340)	2.25	TRENT 900 (A380)	2	CFM56-3C (737CL)	1.87
VS2500-A1 (A320)	1.87	VS2500-A1 (A320)	1.87	PW6000 (A318)	1.87
TRENT 556 (A340-500)	1.5	PW6000 (A318)	1.5	VS2500-A1 (A320)	1.75
TRENT 553 (A340-500)	1.5	TRENT 556 (A340-500)	1.37	TRENT 556 (A340-500)	1.28
PW6000 (A318)	1.37	TRENT 553 (A340-500)	1.37	TRENT 553 (A340-500)	1.28
RB211-524 (767, 747-300,	1.12	RB211-524 (767, 747-300,	1.25	RB211-524 (767, 747-300,	1.12
RB211-524 (767, 747-300,	1.12	RB211-524 (767, 747-300,	1.25	RB211-524 (767, 747-300,	1.12
CFM56-2 (DC-8-70s)	1	CFM56-2 (DC-8-70s)	1	CFM56-2 (DC-8-70s)	1
CF6-50 (747-200, -300)	1	CF6-50 (747-200, -300)	1	CF6-50 (747-200, -300)	1
CF6-6 (DC10)	0.87	CF6-6 (DC10)	0.87	CF6-6 (DC10)	0.87
CF6-45 (747-100/S)	0.87	CF6-45 (747-100/S)	0.87	CF6-45 (747-100/S)	0.87
JT8D (727s)	0.87	JT8D (727s)	0.87	JT8D (727s)	0.87
JT9D (747s, 767-200)	0.87	JT9D (747s, 767-200)	0.87	JT9D (747s, 767-200)	0.87

SPONSORED EDITORIAL

CFM's leap into the future

Jamie Jewell
Director, Strategic Communications
CFM International

When CFM executives talk about the LEAP program, it's with the distinct air of confidence that comes from treading on familiar ground. While the combinations of technologies represented in LEAP are new to the CFM line, development, testing and planning for entry into service is familiar territory, with CFM having been through 21 entries into service and six major engine certifications on the CFM56 family over the last 30 years. So far, component and rig testing is validating that the company has made the right choices.

In 2012, CFM claimed that it would be approximate $3.5 million NPV better than the competition. In 2013, with another year of LEAP testing completed and the in-service experience of the GEnx, which shares many of the same technologies, the company now says it will have a $4 million NPV advantage.

We believe the LEAP will go into revenue service on the A320neo with 1 percent better fuel burn than competition, based on testing to date," Chaker Chahrour, executive vice president of CFM International.

"We also believe that our unique technologies, such as the debris rejection system, will mean that the engine will retain that advantage over time. Over that life of the product, that adds up to another 1 percent advantage," said Chahrour. The story is even better on the A321neo because the airplane has longer flight legs and we have better cruise SFC (specific fuel consumption. So, in the case of the A321neo, one plus one equals three."

The value of that 3 percent advantage is worth approximately $2 million U.S. per aircraft new present value (NPV). In addition, the engines longer time on wing will translate to two fewer shop visits over the life of the engine, equating an additional $2 million U.S. NPV.

Lower line maintenance costs for the fan case-mounted accessories make up the rest of the calculated advantage. "The line replaceable units do not see the temperatures" of the core-mounted accessories on the geared turbofan, he argues.

Legacy of technology

LEAP engines incorporate revolutionary technologies never before seen in the single-aisle aircraft segment. The new engine combines advanced aerodynamic design techniques, lighter, more durable materials, and leading-edge environmental technologies, making it a major breakthrough in engine technology.

The 15 percent better engine fuel efficiency compared to today's best CFM56 engine, at current fuel prices, translates to as much as $1.6 million in fuel cost savings alone for customers per airplane, per year. LEAP technology will also achieve double-digit improvements in CO2 emissions and noise levels, all while providing the industry's best reliability and lowest maintenance costs.

One of the most aggressive technologies going into the engine is an all-new wide-chord composite fan, a first for CFM. For LEAP, the fan will have just 18 blades, half the number on the CFM56-5C, and 25 percent fewer than the CFM56-7B.

The composite fan and containment case pay off in terms of weight savings. The LEAP engine will be 1,000 pounds lighter per ship set than if the fan and case were made of metal. And because of GE's experience with wide-chord composites on the GE90 and GEnx, they are confident about durability as well: to date, there have been no ADs on the GE90 fan blades, and in the course of some 35 million flight hours in more than 18 years, only a few blades have been taken out of service.

The engine core draws heavily on GE's expertise developed for the GE90 and GEnx programmes, with compressor, combustor and coatings technology all being pulled forward into LEAP to improve performance while maintaining reliability.

CFM has completed testing on three builds of an advanced core, logging more than 550 hours of testing and validating CFM's performance and operability predictions. The company is also installed LEAP hardware, scaled to size, in four builds of a GEnx engines to gain even more test data prior to the first full engine test in the autumn of 2013.

CFM's LEAP engine is on track for the first full engine test in late 2013 and certification in 2014.

Twin Annular Pre-Mixing Swirler (TAPS) fuel nozzles, first developed as part of CFM Project TECH56 in the late 1990s and now in commercial service on the GEnx, premix air and fuel and enable the engine to run at lower peak temperatures with longer residence time, key factors in reducing NOx emissions. TAPS also makes for a more compact combustion chamber, and eliminates the need for dilution holes, reducing stress on the chamber and diminishing cracking of the combustion chamber liner.

Because of the precise control of fuel and air and the solid, double wall liner, exit temperature variation is reduced, improving durability of the high pressure turbine components, which are in the most brutal temperature environment in an engine and are major drivers of maintenance and overhaul costs.

The LEAP high-pressure turbine (HPT) is the first commercial introduction of ceramic matrix composites (CMCs) in the stage 1 HPT shroud. This material has been in development for more than 30 years. At one-third the weight of a comparable metal part, CMCs couple the thermal capability of ceramics with the durability that the matrix design provides. Using the very light material with outstanding thermal capability allow CFM to use less cooling air, which will provide fuel efficiency

MRO

Balance of power favours manufacturers

Geoff Hearn looks at the market for engine maintenance, repair and overhaul, and finds significant differences with its airframe counterpart.

Engine original equipment manufacturers (OEMs) are much more directly involved in the after-sales and maintenance, repair and overhaul (MRO) markets than their airframe counterparts. A look at the revenue streams that are generated by engine maintenance gives an indication as to why this might be the case.

Industry forecasts suggest that the civil aviation MRO market is worth about $56 billion annually, with engine maintenance expenditures representing about 40% of the total. The forecasts vary in predicted growth rates but there is a consensus that it will be about 3.5% a year over the next 10 years, with engine overhaul predicted to maintain its share of the total expenditure.

Despite this apparently healthy trend, there is arguably overcapacity on the supply side of engine MRO services, and some observers believe there will be more consolidation. This apparent contradiction is explained by the different maintenance characteristics of new technology engines compared with their predecessors.

The development of engine maintenance is evolving rapidly as the technology becomes more complex. This complexity has increased the requirement for overhaul shops to invest heavily in tooling and test equipment, while improved engine reliability has led to increased on-wing times, resulting in fewer shop visits. The result is a decreased number of overhauls but the average cost of each overhaul has substantially increased. The reduced number of overhauls has led to fewer overhaul shops and the virtual disappearance of independent providers of overhaul services for the latest technology engines.

Additionally, the price of fuel is lowering the average age of the commercial aircraft fleet as older less fuel-efficient aircraft are retired early. Many of these aircraft are equipped with low-time engines. This has created a supply of surplus engines and parts, making it cheaper to buy spare engines than to overhaul existing ones.

Nonetheless, the size of the engine market helps explain why OEMs are prepared to sell their engines at virtually cost price (or less in the view of some commentators). The key difference between engine and airframe maintenance is that the cost of engine overhaul is dominated by the cost of parts, whereas airframe maintenance is labour intensive. This means that engine manufacturers can effectively control the pricing of overhaul, particularly if parts manufacturer approval spares do not gain industry acceptance.

There is an increasing uptake of engine manufacturers' maintenance per flight-hour schemes, because operators and owners are attracted to such packages as they offer a predictable cost level. This is particularly important on new-technology engines, where quantifying maintenance costs is still difficult because of a lack of in-service experience. Manufacturers are more able to predict, and to some extent control, maintenance costs and are therefore in the strongest position to offer all-inclusive packages.

The CFM56 and LeapX engines indicate the trend. Sources suggest that of the 17,000 engines that have entered service, between 30% and 35% are covered by power-by-the hour schemes, whereas 100% of the LeapX engines sold by CFM are covered by the manufacturer's scheme. This poses the question as to what future there is for third-party providers other than partnerships with the OEMs.

The increasingly strong position of the OEMs also poses the question as to who is best placed to negotiate and purchase the power-by-the-hour deals. Large airlines remain well placed to negotiate reasonable terms provided such negotiation takes place when new aircraft/engines are ordered. But smaller operators are in an increasingly weak position, particularly if their fleet is comprised largely of leased aircraft. The obvious solution is for the lessors to negotiate with the engine manufacturers for lifetime coverage of engines, although there are difficulties with this approach when allocating costs to lessees.

CFM's Portable Maintenance for Lessors programme is the engine manufacturer's attempt to address the issue. The product enables lessors and operators to equalize engine maintenance costs throughout the life of an aircraft. Under the terms of the agreement, CFM provides engine maintenance, repair and overhaul services for leased aircraft at a fixed rate per flight hour with the ability to

"A sign that there is a continuing market for older technology engines was provided by GA Telesis' acquisition of Finnair Engine Services"

accommodate a change either in the operator, owner or both. Aircraft lessors SMBC Aviation Capital and Gecas have both signed up to the agreement, as has engine lessor ELFC.

From a maintenance perspective, there is a clear divide between new technology engines (such as GEnx and the PW GTF and LeapX) and older technology engines (such as PW4000s and CF6s and CFM56s).

On older engines third parties have a good knowledge base on costs because there is lots of experience in the market, but on new technology engines the maintenance costs are much more difficult to gauge because of the complexity of the technology and the lack of experience in the market.

A sign that there is a continuing market for older technology engines was provided by GA Telesis' acquisition of Finnair Engine Services. The deal is comprised of the sale of assets and transfer of personnel to GA Telesis Engine Services (Gates). Gates has simultaneously entered into a long-term lease for all of the engine maintenance and test cell facilities from Finnair.

The facility will provide comprehensive repair and overhaul services for the General Electric CF6-80C2 and CFM International CFM56-5B/C jet engine models, as well as repair and modification services for Pratt & Whitney PW2000 engines. Collectively, these engine models constitute the greatest number of single- and twin-aisle jet engines in commercial airline operation. Gates has the capacity to overhaul up to 200 engines a year.

Regional market

The introduction of engine leasing for commercial aircraft can be traced to the regional aircraft market, and many similarities with the equivalent market for larger commercial aircraft remain. 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 industry insiders.

As in the larger aircraft market the OEMs' influence 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 dominance

General Electric (GE) has the major share of the sub-100-seat jet market. Apart from GE, only Rolls-Royce has any significant presence in the regional jet market, 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 dominant position in the sub-100-seat market.

Embraer's selection of a version of Pratt & Whitney's PurePower geared turbofan engine for the second generation of E-Jets may eventually result in a more balanced market in the sector. 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.

The economies of scale that GE enjoys 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)

Regional jet engine types

Aircraft	Engine manufacturer	Engine family
ERJ-145	Rolls-Royce (Allison)	AE3007
E170/E175	General Electric	CF34-8
E190/E195*	General Electric	CF34-10
CRJ200/440	General Electric	CF34-3
CRJ700	General Electric	CF34-8
CRJ900	General Electric	CF34-8
CRJ1000	General Electric	CF34-8

*E190/195 are included for reference but have capacity in excess of 100-seats.

The cost of engine overhaul is dominated by the cost of parts

and structured, long-term finance options. CF34 leasing is handled via General Electric Capital Aviation Services.

The costs associated with GE's regional jet engines are comparable to pricing in the larger aircraft market. The UK consultancy, IBA, says a CF34-8E52 costs about $35,0000 to $40,000 a month on a short-term lease. This figure excludes the maintenance reserves for engine overhaul and life-limited parts (LLPs). IBA puts LLP costs at $2.09 million and the price of an overhaul at between $800,000 and $1.2 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.

Third-party involvement

Although the OEMs 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.

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.

SPONSORED EDITORIAL

Better the devil you know

Steven Taylor, senior vice-president, sales and marketing, at TES Aviation, discusses how creating a transparent and accurate forecast of engine costs can help airline treasury departments be as cost-effective as possible.

Steven Taylor
Senior Vice- President
Sales and Marketing
TES Aviation

"Better the devil you know than the devil you don't." This familiar phrase, coined, it is believed, by Rev Taverner in 1539 Ireland, is used often when it is better to deal with something bad that we know, rather than something bad we don't know. In my view, this applies directly to engine maintenance costs, which are always a bitter pill to swallow for any chief financial officer of an airline, and contribute to a large percentage of operating costs.

The prevalent lack of detailed engine maintenance cost forecasting, derived not from ill intent but inexperience with historical costs or lack of data, sees a large number of airlines under budgeting for future engine maintenance events. This unknown exposure can have significant cash-flow consequences for airlines already operating and competing in a very lean environment.

For an airline with a rapidly expanding fleet, understanding how best to manage a maintenance, repair and overhaul (MRO) or engine maintenance programme is of grave importance given the associated cost exposure linked with the risk of getting it wrong. In the world of predelivery payment financing, risk distribution for debt/equity and participation in senior/secured/post-delivery asset finance, all of which are synonymous with aircraft acquisitions for fleet expansion, the headline cost to purchase/finance is one of a number of important elements of the financial equation to determine viability.

Attracting outside investment or allocating internal cash for such acquisitions is just the beginning; understanding what additional direct costs result from the added aircraft (of which have a direct bearing on bottom-line results) is where the real fun begins. You will be surprised how suddenly jumping from a $20 million engine maintenance budget to a $90 million engine maintenance budget will grab the attention of the chief executive officer and chief financial officer.

The chief financial officer of an airline, in an endless task of managing multiple budgets, does not want to see how much each nut and bolt costs. But the cost of each nut and bolt will roll up to have an overall impact on the chief financial officer's engine maintenance budget. The details need to be present, and it needs to be accurate, but the financial management and executive team need numbers in their totality for analytical brainstorming that powers resultant plans.

Since TES' conception more than 17 years ago it has been, and continues to be, the company's driving objective to lower the overall operating costs of airlines relative to engine exposure. TES knew back then that it needed a robust tool to manage all off-wing engine management activities, in order truly to understand (as best it could) the future engine maintenance cost exposure for any given airline customer. With this motivation, TES spent significant time and resources to develop EFPAC (Engine Fleet Planning and Costing). EFPAC is a TES-designed software platform that enables every minute detail of an engine's makeup and history to be input for use in an infinite number of scenario-modelling projects.

Flexibility

Something that TES understands to be increasingly important for its airline partners is flexibility. Given the competitive and complex environment of airline operations, to have an instantaneous future view of predicted engine maintenance costs resulting from changes to variable factors (lease return dates and conditions, UER's engine management programme, early retirements or fleet extensions) is something that can provide a competitive edge for our airline partners in what they do best – flying.

So there is definitive value in using EFPAC, as will be echoed by all current users of the tool and can be supported by multiple case study examples of cost reduction. However, to increase the percentage accuracy of predictive maintenance costs, TES has some additional contributors that no other independent engine asset management company and very few airlines have – useable supporting data.

Over its 17 years of supporting global airlines and lessors, with engines operating in all environments and being repaired across a large cross section of MROs, TES has built a valuable knowledge pool of resultant scrap rate and maintenance cost data to the advantage of each of our airline and lessor partners. TES analyses the data on a current term basis to update a master cost

"The beauty of TES Aviation's forecasts is that it allows airlines to make multiple what-if scenarios for management analysis within moments."

template that sits behind the EFPAC system for each engine type operated by its airline and lessor partners.

Based on the OEM-recommended and TES-suggested engine management programme (modular level workscopes and life-limited parts – LLP – build goals, etc), TES can assign predicted costs to a modular and component level in conjunction with the master template. Time-on-wing data is also utilized to provide accurate soft time/performance removal predictions, than when overlaid with hard time removal requirements (LLP/AD) it provides a future forecast for engine removals.

When multiple removals are forecast within the same monthly time frame, manual optimization can be implemented (stagger programme) to increase operating efficiency and reduce spare engine coverage requirements. The beauty of both forecasts set in a masterplan is to have the ability to perform multiple what-if scenarios for management analysis. An airline can ask: "What if we were to extend the lease for the quantity six 767-300 aircraft with quantity 12 CF6-80C2 engines leased from three different lessors for an additional 12 months – what impact would that have on my lease return qualification for each lessor, exposure to additional maintenance work required [shop visits] and overall engine maintenance budget for the financial year?"

Within a moment accurate reports can be produced to detail the expected position of each proposed change without affecting the master removal and cost forecast plan.

TES has previously interacted with a large UK low-cost airline which expressed an interest in the EFPAC software for optimization of its engine-removal programme. With a large preliminary forecast of shop visit removals over the pending years, the airline desired to have a simple one-click optimization tool that factored all the variables in a background calculation to produce the optimized removal plan for minimal overall engine maintenance cost exposure. It wished for an alternative to the current option of utilizing experienced TES powerplant consultants familiar with using the tool and maximizing the use of TES data for fleet optimization. I am confident that given the multimillion dollar amounts at jeopardy the results of the desired one-click optimization would require review and validation from said airline management, and as Dan Rather, the American journalist, once put it: "To err is human but to really foul up requires a computer."

We must use computers and the software on them as the tool they are intended to be, as an aid and support to the experienced end-user. To put all and singular trust in them without thorough validation would leave you vulnerable. Therefore, it has to be considered whether it is more effective to invest precious resource in producing the optimization, or validating it after the one-click software optimization.

For operators of new-generation aircraft and engines, the philosophy is somewhat different. A large percentage of new engines sold are done so with supporting OEM maintenance cost per hour (MPCH) programmes, whereby the engine management and maintenance services are provided by the OEM in exchange for a dollar payment for each operating flight hour and cycle of the engine. Even though the perception of such a support programme "can be all" is covered, I believe there is still an importance in overseeing the MCPH programme to ensure any exclusions are managed to limit exposure, engine asset value is safeguarded when the engines leave the MCPH programme and shop visits do not fall outside the MCPH term when they do not need to be, resulting in a direct cost to the airline.

MROs

TES has witnessed a gradual change in the market with attitudes between the MRO and airlines/lessors. Historically, there was an inherent mistrust placed on the MRO by the airline. The same level of mistrust may still reside between car owners and car repair garages. I have often had a vehicle repaired and left the repair garage with an unpalatable bill with associated basic summary of work completed. How I have often wished I could have had someone oversee the entire process to ensure I am paying for the work that a) needed to be done and b) was performed. Instead, I leave wishing that cars were designed to facilitate duct tape as the fix to all problems.

With this said, I also appreciate that once I find a repair station that makes me feel completely confident in its services, a garage that is completely transparent, explaining the efforts it has made to reduce the costs by sourcing alternative parts or exploring alternative solutions, showing me the box of parts for all replaced parts, explaining the invoice in detail and willing to reduce that bill where it can when the costs are greater than I anticipated – then it gains my trust, and with it my loyalty.

TES is seeing this transfer into the aircraft engine MRO market also. We are seeing an increased drive from MROs to gain that trust and loyalty of the airlines to secure partnerships rather than fixed-term contracts campaigns. The MROs are having to adapt to an increasingly competitive MRO environment, where airlines are signing fewer exclusive contracts in lieu of several GTAs to ensure flexibility and competitiveness, so the MROs are creating support services surrounding the traditional repair-only model and working at an integrated level within the airline teams to ensure they retain airlines' trust, loyalty and custom.

As an airline, even in the event of securing a very competitive MRO contract and forming a partnership relationship, there still remains a requirement to direct and manage all maintenance activities undertaken at the MRO by virtue of the complex nature of the repair process and sheer number of people and processes involved. I recommend that although the MROs may offer to take more control of the process, in what I will assume to be an honest solicitation to help lower the engine maintenance costs (in their efforts to retain your custom), the control resides with you, the airline. They are after all your engines, and if not your engines, then your money was used to repair them in honouring your lease agreements.

Whether a dedicated internal team or outsourced support, there must be focus from the airline on managing the MRO to have it deliver what you, the airline, wants it to deliver – an engine repaired for as cost effective as possible matching your exact operational requirements.

In summary, engine maintenance costs for current engine fleets will continue to be a challenge to manage for any airline, and especially those looking to expand their fleet. As new-generation engines come on line, with promises of longer time on wing, we are yet to see whether the associated higher cost of repair will result in an overall net reduction in engine maintenance costs. One thing is for certain, there will always be a need to have the right tools and the right data to support intelligent decision-making in an ever-changing world of engine maintenance cost management.

To contact the author of this article with any questions or feedback please visit the TES LinkedIn page 'TES Aviation Group' or the TES Twitter page @tesaviation.

ENGINE VALUES 2013

OEM schemes and the impact of residual values

Stuart Hatcher, head of valuations and risk, IBA Group, asks how the increased number of OEM power-by-the-hour agreements will affect the residual value of new-technology engines.

Stuart Hatcher
Head of Valuations and Risk
IBA Group

As I write this article the Paris Air Show is mid swing and judging by the wave of orders it would seem that business is largely back to normal – well for the latest technology at least.

Embraer launched its new E2 platform and in doing so, Pratt & Whitney (P&W) added another two variants to its growing PW1000G family. Boeing launched the 787-10, and for yet another year orders were dominated by the lessors. However, when you look at some of the order splits there were a few anomalies that have not been seen before or for some years at least.

Pratt & Whitney secured more than double the orders of CFM International, regional jets beat widebody orders to second place and Embraer managed to take second spot behind Airbus. It is not surprising that little emphasis was placed on the existing technology from both CFMI and International Aero Engines (IAE) because the number of available delivery slots is already probably in minus territory as manufacturers continue to manage over-orders.

It also was not surprising to hear a single P&W/IAE voice now that Rolls-Royce has sold its share in the consortium. It should provide comfort to those who have long-term interests in the V2500 family of engines because IAE will almost certainly adapt to look after the PW1100G-JM and continue to develop new ways to capture much of the V2500 aftermarket too.

With so much focused on new technology, the greatest concerns within the engine leasing market will be on how long-term residuals and rentals will be affected by the launch of new technology and the continual evolution of the original equipment manufacturer (OEM) business models to include more power-by-the-hour agreements (PBTH). These agreements are not new and have been around in some form for many years, but since Rolls-Royce launched TotalCare™ at the beginning of the last boom cycle, others have redeveloped their approach to capture more of the aftermarket. It is no secret that engine OEMs rely heavily on aftermarket support because fitted engines continue to be heavily discounted at the point of sale. But after Rolls-Royce successfully managed to capture most of its own aftermarket (after having proved the concept for corporate jets), others naturally mobilized to do something similar for the narrowbody engine market.

This battleground is not just about capturing shop visit contracts, but more a longer-term protectionism strategy that puts a stop to the whole parts manufacturer approval (PMA)/designated engineering representative (DER) debate. But in doing so, aircraft lessors lose out on being able to hold on to reserves, engine lessors receive greater competition for spare engine provision and maintenance, repair and overhaul companies (MROs) have been dragged into a price war or forced to incorporate leasing as part of their business to draw in overhaul contracts.

In the case of the current in-production widebody engine market, most independent engine lessors have relatively little involvement when compared with the OEM-lessors because the capital cost and potential risk exposure is not always reflected in the lease rate dynamics.

OEM-lessors will be able to secure engines at a much lower cost, compete more aggressively on lease rates and are often more able to package in cheaper maintenance rates as well. As CFMI and IAE increase their PBTH market share in the narrowbody sector and MROs offer cheap engine leasing to win shop visit business, the non-OEM engine leasing market is justifiably concerned. While OEMs may point out they control more than 50% of the PBTH for narrowbody engines, it is important to note that most of these contracts will simply be for fixed-price shop visits rather than spare engine support, but the level of full OEM support does continue to grow as more new engines are delivered.

At the extreme level, the Rolls-Royce model whereby the shops, parts and leased engines are almost totally controlled by the OEM also causes concern among the investors in aircraft. A critical step in the value profile of an aircraft is the buoyancy of engine residual values over time. This is maintained by the all-important fleet dispersal process whereby 100 aircraft with one operator can end up being 100 aircraft across 10 operators all requiring spare engine coverage, followed by eventual part-out. Assuming that engines continue to lose reliability with age, the demand for spare engines should increase so long

It is critical that investors perform the necessary due diligence on each and every engine and not just the basic engine family because each variant and thrust class will have its own investment profile.

as a significant amount of spare engine coverage is provided by the independent engine lessors. If, however, the part-out market is squeezed by the OEMs such that the market for engine parts in general diminishes, then the residual value profile for aircraft will be under pressure too.

On the positive side, this extreme scenario does not seem likely to apply to the current generation of CFMI, IAE, P&W and General Electric engines, because too many independent shops and airlines handle overhauls and parts, but the emergence of totally new designs will make the OEMs reflect on how best to protect their aftermarket interests.

Even with the growth of these new programmes it is likely that OEMs will be unable to capture anything close to 100% of the narrowbody fully inclusive PBTH market because the level of infrastructure required would be immense, on top of the fact that airlines will still prefer to control their own maintenance needs. It is more likely that the OEMs will continue to gather market share for narrowbody engines and spare part provision, and monitor the activities of the independent MROs and lessors to restrict the activities of the part-out companies and PMA manufacturers.

As for the direct impact of new technology with respect to the residual values of the existing fleet, there is a long way to go yet. Even though the A320neo is essentially the same airframe with a different engine choice, if the new engines cannot be retrofitted to the older variants, then this can be considered to be a totally new aircraft from the perspective of an engine investor.

Although not quite in the same league, the new engine option (Neo) is more akin to the market differences encountered between the A1/5A1 and the replacement A5/5B technology in the early 1990s. With the exception of the Northwest CFM56-5A deliveries 10 years after the introduction of the 5B, most new deliveries from 1993 incorporated the A5/5B technology – about 20 years ago. Despite this, residuals and lease rates remained relatively intact for more than 15 years, with up and down swings during periods of demand/supply fluctuations, eventually reaching the depressed position they are in now.

What kept this demand up was partially because of the fact these engines were less reliable and therefore remained in high demand from lessees, plus the A320 has continued to remain in production. With the emergence of the Neo, the basic A320 footprint remains intact, meaning that operators can theoretically operate mixed fleets, but as far as measuring the impact on residual values of existing technology, the timing and magnitude of the fleet dispersal process, the expected degradation of mature engines leading to higher shop visit frequency, and the extent to which upgrades are incorporated, will all dictate the future market.

By the very nature that the engines cannot be retrofitted means the effect on residuals is indirect, unlike the effect we see for thrust variations and upgrade programmes. While most aircraft lessors and banks would have preferred that CFMI and P&W/IAE had simply produced another stepwise and retrofittable engine upgrade, from the perspective of engine residuals, a standard upgrade can often cause considerable value pressure on the older variants. This is particularly worrying for engine lessors, as many major upgrades will not be incorporated because the capital cost is usually very high and only economical at the point of overhaul. Given that many leased engines exhibit a considerably lower utilization, the time to overhaul may be in excess of double that time encountered for an engine owned and fully utilized by an operator.

Similar to those engines held by lessors that are fitted with lower thrust plugs, the market has moved to a place where high thrust, low fuel burn and low maintenance cost are essential. Upgrades tend to address these key points, leaving the pre-upgraded engines to suffer from depressed lease rates and values.

With more money moving into the engine leasing space, it is therefore critical that investors perform the necessary due diligence on each and every engine and not just the basic engine family because each variant and thrust class will have its own investment profile.

On a positive note, the existing 5B/7B and A5 technology will continue to perform well way past the introduction of the A320neo and 737 Max. While the demand for new technology spare engines may not occur for another eight or more years, the reliability of existing technology will continue to fall and improve the fortunes of the lessors because leasing demand is expected to rise. We can deduce this from the fact that despite the age of the existing technology, most of these engines have yet to undergo their first major shop visit. Even engines such as the CFM56-3C1 are in demand again because the number of good high thrust variants have reduced.

Engines' residual values are a hot topic.

Another factor in the supply/demand balance is to what level are current-generation engines being parted-out? Over the past few years the 5B/7B and A5 engines have been highly sought after – especially the lower thrust variants, but there is only so far you can go until the parts market is saturated to the point where it no longer makes economic sense to do so.

Of course, this balance is also linked to the number of shop visits performed, but as most engines are staying on-wing for such long periods and blade technology has evolved, it makes sense to use the latest new parts from the OEM. The exception to this is where a high thrust engine or one that has been operated in harsh conditions has been driven off wing earlier and the owner must consider the life remaining on the low-pressure modules.

In conclusion, there is still a long way to go before we see the long-term effects of the incoming technology on the engine leasing market. We have seen time and time again how demand can rise and fall even 15 to 20 years after an engine has stopped production. Also, because most current-production engines have yet to have their first major shop visits, it highlights just how far these programmes have to go before even reaching maturity.

As always, caution is advised when assessing the current and forecast residual profile for engines because they are not all the same. Pricing may be tightening but not for every member of the family.

AIRCRAFT ENGINE OPTIONS 2013

Engine	Base Value ($m)	Fair market Value ($m)	Monthly rental ($'000s)	QEC cost range ($m)	LLP cost (new) ($m)	Overhaul (ex LLP) ($m)	MTBO (hours)	FH:FC
CFM International								
CFM56-3C1 (23.5k)	1.95	1.65	20-37	0.65-0.20	2.33	1.35	7,000	1.4
CFM56-5B3/P	6.80	6.40	60-80	0.90-2.00	2.59	2.30	14,000	1.8
CFM56-5B4/3	6.70	6.70	60-75	1.10-2.40	2.59	2.30	19,000	1.8
CFM56-5B5/P	5.00	4.80	40-60	0.90-2.00	2.59	2.30	18,000	1.8
CFM56-5B6/3	5.48	5.48	50-70	1.10-2.40	2.59	2.30	20,000	1.8
CFM56-5C4/P	5.18	4.62	43-55	0.80-1.50	2.73	2.25	15,000	6.0
CFM56-7B20/3	4.73	4.70	40-60	0.75-1.50	2.52	2.30	22,000	1.8
CFM56-7B22	4.90	4.80	40-60	0.50-1.20	2.52	2.30	19,000	1.8
CFM56-7B24	5.70	5.60	45-70	0.50-1.20	2.52	2.30	17,000	1.8
CFM56-7B26/3	6.75	6.70	64-83	0.75-1.50	2.52	2.30	18,000	1.8
CFM56-7B27/3	7.05	7.00	65-85	0.75-1.50	2.52	2.30	17,000	1.8
General Electric								
CF34-3B1	1.75	1.30	20-30	0.185-0.80	1.40	0.80	11,500	1.3
CF34-8C5	3.21	3.21	35-43	0.50-0.90	1.40	0.80	11,000	1.3
CF34-10E6	4.96	4.96	53-78	0.80-1.60	1.85	1.25	13,500	1.3
CF6-80C2B6F	5.24	4.90	50-65	0.30-0.80	5.55	2.60	15,000	6.0
CF6-80E1A3	10.10	10.10	90-125	1.20-2.50	7.99	3.00	15,000	5.0
GE90-115BL	22.95	22.95	190-280	0.70-2.10	9.57	6.00	21,000	6.5
International Aero Engines								
V2522-A5	4.30	4.20	40-60	1.00-2.50	2.82	2.20	21,000	2.0
V2524-A5	4.80	4.70	45-70	1.00-2.50	2.82	2.20	19,500	2.0
V2527-A5	5.75	5.41	50-80	1.00-2.50	2.82	2.20	16,400	2.0
V2533-A5	6.90	6.39	60-85	1.00-2.50	2.82	2.20	11,500	2.0
Pratt &Whitney								
JT8D-219	0.60	0.60	8-20	0.08	1.60	1.00	8,750	1.5
PW2037	4.40	3.50	35-55	0.38-1.00	4.95	3.50	17,000	3.0
PW4060	5.00	4.40	50-70	0.30-1.80	5.33	2.50	17,500	6.0
PW4158	5.25	4.30	40-60	0.30-1.80	5.33	2.50	10,500	1.8
PW4168A	7.70	7.00	80-110	1.40-3.20	6.67	5.00	17,000	6.0
PW4090	10.40	10.40	115-160	1.00-2.50	10.95	6.00	19,000	7.0
Rolls-Royce								
AE3007A1	2.40	1.50	20-30	0.085-0.30	1.63	1.00	8,450	1.3
RB211-524H-T	4.55	3.03	20-40	0.12-0.90	4.91	4.80	22,000	8.0
RB211-535E4	4.00	3.20	30-50	0.42-0.90	4.03	4.50	18,000	2.4
Tay 620-15	1.05	1.00	20-30	0.15-0.28	0.91	1.70	11,000	1.1
Trent 772B	8.60	8.60	95-135	2.00	6.40	6.00	18,000	4.0
Trent 892B	13.65	13.65	120-150	N/A	7.96	7.20	20,600	5.6
BR715A1-30	3.25	2.50	30-50	0.30-0.90	1.82	1.35	10,400	1.6

Source: IBA Group

PILARSKI SAYS...

What is the exact meaning of a ‘sexy engine’?

Adam Pilarski, senior vice-president at Avitas, examines what makes an engine truly attractive.

I caused a stir more than two years ago when I accused, in a public forum, the new CFM engine of not being perceived as sexy as the new Pratt & Whitney geared turbofan engine. The head of CFM, a close personal friend, demanded to know how exactly to measure the degree of sexiness of an engine. When talking of engines I meant of course something a little different than the standard realm of sexiness. Pratt & Whitney managed very successfully to project the image of a game changer via its new engine architecture incorporating gears that allow the speed of the fan to be slower and the speed of the low-pressure turbine to be fast.

Traditional architecture runs both at the same speed and the gear-induced separation enhances engine performance. To non-engineers like me that was sexy: something new, that makes sense, was different and more efficient. Yes, I knew that geared engines existed for a long time but the new application of this technology to bigger engines looked like a breakthrough that will benefit us all.

At the time of my proclamation Pratt & Whitney had virtually the whole market to itself, capturing almost the whole new engine option (Neo) market. CFM looked like its counter was quite feeble: we will use better materials and technology. That is non-sexy. To non-technical people like me it sounded as if Pratt & Whitney had the new, sexy way of doing engines while CFM said they would work harder and better.

Since then the realities in the market have changed. Pratt & Whitney has an exclusive contract with Bombardier’s CSeries, as well as contracts in place with the MRJ and MC-21. The original equipment manufacturer also recently won the new Embraer E-Jet E2 and a share in the Airbus Neo market, while CFM has an exclusive deal with the Boeing Max and Comac 919, and a share of the Airbus Neo market.

Since the Paris Air Show in June the picture has been updated. Across its three platforms the CFM Leap engine has now won about 2,485 firm aircraft orders, of which the Max accounts for just more than 1,430. Pratt & Whitney’s PurePower has about 1,320 across its five platforms.

In the head-to-head competition for the Airbus Neo, the market is split 50.9% versus 49.1% in Pratt & Whitney’s favour for the firmly ordered aircraft count, with about 775 aircraft (of the almost 2,250 firmly ordered) still awaiting an engine selection. My belief is that people who buy engines know what they are doing. The fact that the market is split means each of the competing engines has some advantages over their rivals and that there are trade-offs between the various characteristics of these engines.

I was recently invited to observe first hand some of the technical features of producing the Leap engine and I must admit that a lot of the stuff I saw is quite sexy, again in a different sense than most of us think. Those who know me are familiar with my aircraft model collection. I do have a very nice PurePower model in my office (thank you Pratt & Whitney).

On my trip I received a small Leap model, made out of cobalt chromium. The turbine can be rotated; a small trap door can be opened and displays the inside with its moving parts. The most amazing thing, though, is that this model has been produced by additive manufacturing. I saw the 3D printer in action. It goes layer by layer – 2,000 layers per inch. The machine does not get tired and does not need breaks, though I got bored after a few minutes of watching. The whole model with its moving parts was produced over a few hours as one entity – not parts that were put together.

GE/CFM will use such technology to produce some of the more complicated parts, such as the fuel nozzle, which with standard technology would require 15 different parts but with additive manufacturing will be produced out of only four different parts. This technology will allow the production of quite complex forms in one swoop.

Another thing that amazed me was seeing how the new carbon fibre composites are put together. I have seen other manufacturers produce composites by having new materials put together, infused and baked. But Snecma (or CFM) went a step further by acquiring a textile factory and weaving the strands of revolutionary new materials in a 3D fashion. I looked at the raw material, then the woven product and could not believe that finally it becomes a real fan blade, looking like a real fan blade but being much stronger and lighter.

What are the implications of all this for a financial person like me? One, all this new technology is very impressive and, yes, sexy, and explains to me the high cost of engines. Two, the competing manufacturers achieved efficiency in different ways. Pratt & Whitney went with a conventional engine with an updated gearbox. CFM selected traditional architecture with new materials and manufacturing technology. So, sexiness abounds in the engine competition but true love will only emerge when we see which engine delivers better results in terms of total cost and performance.

AIRCRAFT ENGINE OPTIONS

IBA ENGINE VALUES 2012

Engine	Fair market value ($m)	Base value ($m)	Monthly rental ($000)	QEC cost range ($000)	LLP cost (new) ($m)	Overhaul (ex LLP) ($m)	MTBO ($m)	FH:FC (hours)
CFM International								
CFM56-3C1 (23.5k)	1.75	2.00	25-45	0.12-0.25	2.19	1.00-1.50	7,000	1.4
CFM56-5B3/P	6.60	6.80	60-85	1.40-2.35	2.43	2.00-2.50	13,000	1.7
CFM56-5B4/3	6.50	6.50	60-75	1.40-2.35	2.43	2.00-2.50	19,000	1.7
CFM56-5B6/P	4.85	5.05	40-70	1.40-2.35	2.43	2.00-2.50	19,500	1.7
CFM56-5B5/3	4.90	4.90	40-40	1.40-2.35	2.43	2.00-2.50	21,000	1.7
CFM56-5C4/P	4.20	5.40	40-60	0.75-2.00	2.56	2.00-2.50	15,000	6.0
CFM56-7B20	4.40	4.40	40-60	0.80-1.60	2.43	2.00-2.50	22,000	1.8
CFM56-7B22	4.90	4.90	40-60	0.80-1.60	2.43	2.00-2.50	18,000	1.8
CFM56-7B24	5.70	5.70	50-70	0.80-1.60	2.43	2.00-2.50	17,000	1.8
CFM56-7B26/3	6.70	6.70	60-80	0.80-1.60	2.43	2.00-2.50	17,000	1.8
CFM56-7B27/3	7.00	7.00	60-85	0.80-1.60	2.43	2.00-2.50	16,000	1.8
General Electric								
CF34-3B1	1.30	1.80	20-30	0.45-0.60	1.34	0.80-1.20	12,000	1.3
CF34-8E5	3.20	3.20	35-45	0.45-0.80	2.09	0.80-1.20	11,000	1.3
CF34-10E6	4.80	4.80	55-70	0.70-1.05	1.87	1.20-1.80	16,000	1.3
CF6-80C2B6F	5.20	5.40	50-65	0.40-1.60	5.17	2.50-3.00	15,000	6.0
CF6-80E1A3	9.85	9.85	110-130	1.40-2.60	7.41	3.00-3.50	18,000	6.0
GE90-115BL	21.80	21.80	200-260	0.90-2.10	9.04	5.50-6.50	18,960	7.9
International Aero Engines								
V2522-A5	4.30	4.30	45-65	1.25-3.00	2.65	2.20-2.50	21,000	2.0
V2524-A5	4.80	4.80	48-65	1.25-3.00	2.65	2.20-2.50	19,500	2.0
V2527-A5	5.50	5.50	58-70	1.25-3.00	2.65	2.20-2.50	16,400	2.0
V2533-A5	6.70	6.70	60-77	1.25-3.00	2.65	2.20-2.50	11,500	2.0
Pratt & Whitney								
JT8D-217C	0.60	0.60	18-25	0.05-0.12	1.60	0.80-1.00	9,500	1.5
PW2037	3.85	3.85	45-65	0.80-2.00	4.72	2.60-3.00	18,000	2.9
PW4060	4.40	5.50	50-65	0.50-1.50	5.05	3.00-4.00	18,000	6.0
PW4158	4.00	4.60	40-60	0.50-1.50	5.05	3.00-4.00	10,000	2.0
PW4168A	7.00	7.50	80-110	1.40-3.30	6.29	4.00-5.00	17,000	6.0
PW4090	10.20	10.20	115-160	1.30-2.50	10.50	5.50-7.00	18,000	7.0
Rolls-Royce								
AE3007-A1	1.40	2.50	20-30	0.30-6.50	1.58	1.00-1.40	8,450	1.3
RB211-524H-T	3.30	4.73	50-70	0.60-1.10	4.75	4.00-5.00	22,000	8.0
RB211-535E4	3.80	4.40	40-60	0.50-1.05	3.97	3.50-4.50	19,000	2.4
Tay 650-15	1.40	1.50	18-30	0.15-0.25	0.88	1.10-1.80	11,000	1.1
Trent 772B-60	8.90	8.90	100-135	1.60-2.00	6.06	5.50-6.50	21,000	5.0
Trent 895	14.20	14.20	125-170	n/a	7.47	6.00-7.00	19,000	7.0
BR715A1-30	2.50	3.38	30-45	0.35-0.90	1.73	1.30-1.80	10,400	1.6

Source: IBA Group