



There is a cautious approach against taking an engine off-wing too early.
Photo: IFS

Keith Mwanalushi provides a detailed analysis of engine maintenance trends in addition to strategic profiling of key players in the market, comprehensively analysing their core competencies.

The global aircraft engine MRO market is expected to grow at a CAGR of around 7% during 2016-2021, according to recent market research. The key factors driving the growth are participation of engine OEMs in the MRO industry, growing demand from emerging market, and growth in aircraft fleet and engines.

Engine costs make up 40-45% of total aircraft maintenance expenditure, and reducing that cost is always a prime focus for aircraft operators.

Pratt & Whitney for instance offers a variety of options for operators to reduce aircraft maintenance costs, two of which are fleet management programmes and material solutions.

"Fleet management programmes provide predictable maintenance costs, optimised engine performance and increased residual value," states Joe Sylvestro, VP Aftermarket Operations at Pratt & Whitney. "Engines maintained under fleet management programmes provide predictable, rate per engine flight hour maintenance costs, up to 20% longer time on-wing and 50% fewer unscheduled engine removals as well as higher residual value."

Also, the use of surplus material, including serviceable LLPs, has become a major force in recent years across the industry in reducing engine maintenance cost. Sylvestro observes that operators are demanding more services and support to efficiently manage their engine

fleets across the entire product lifecycle. "As the OEM, we are well-positioned to address their needs at each phase. For mature fleets, it is necessary to drive cost of ownership to a minimum to compete with the economics of new aircraft, so flexibility and tailored maintenance solutions are critical. Customers are now able to weigh a variety of service options as they evaluate fleet plans."

Leo Koppers, SVP MRO programmes at MTU Maintenance is aware that cost is indeed a big concern when it comes to MRO and MTU is striving to provide cost-effective services. "For customers with younger engines, the focus is on longer-term and cost-effective operations with increased on-wing times as a way of reducing costs.



Sylvestro says fleet management programmes provide predictable maintenance costs.
Photo: P&W

He explains that this can be achieved through services such as optimised fleet management – to ensure the optimal and most cost-effective removal time – customised workscoping, alternative repairs and engine trend monitoring.

When it comes to mature engines, this becomes even more pertinent, as older engines need regular maintenance and more replacement parts – driving up the costs. “But as the costs go up, so too does the range of alternatives, for and beyond maintenance,” Koppers points out.

MTU Maintenance has a mature engines programme for exactly such cases. The programme focuses on reducing costs for operators of ageing engines through cost-effective MRO alternatives (smart repairs, used parts, customised builds etc.) and alternatives to MRO (instant power solutions such as engine lease, sale and exchange).

“This diversity is aided by the amount of surplus material and engines becoming available on the market through retirements, which can be used to reduce MRO costs or substitute shop visits. This range of options can be considered the MTU “toolbox”. As each customer has specific operational and fleet planning needs, we look at each case individually and pick out the tools that make the most sense respective to the customer’s needs.”

Additionally, MTU Maintenance offers on-site and on-wing services and engine trend monitoring, which Koppers says can help plan and schedule maintenance and extend on-wing times. “We also provide spare engine and leasing support as well as 24/7 AOG support, which help minimise downtime.”

Pratt & Whitney has also developed innovative service offerings such as a mature engine portfolio which includes engine maintenance and asset management solutions that reduce costs while maintaining residual value with OEM standard parts and repairs. Targeted worksopes for specific time horizons and for meeting lease return conditions, material packages containing a combination of new and serviceable material, high used serviceable part fill rates and innovative LLP solutions with serviceable LLPs and buyback programmes drive down maintenance costs for mature engines.



Bradley says Magnetic MRO is looking to develop its engine line maintenance unit.

“The most effective strategy is planning the engine shop visit programme, calculating the optimum time for the shop visit to minimise down time during peak operational periods and based on when and if the engine has to be returned with the airframe to the lessor for redelivery,” Bradley mentions.

AJW Aviation say airlines should look at purchasing more used, surplus material in advance of their ESV to allow for potential repair and



Martson says its important to have a long and medium term engine maintenance plan. Photo: Aero Norway

overhaul lead times. “Proactivity rather than reactivity,” stresses Sam Rice, Director of Engines, AJW.

Rice is of the opinion that airlines and/or lessors with smaller power-plant teams should also look to take advantage of engine shop visit management schemes such as the service that AJW provides, which offers total support solutions for shop visits.

Relating to cost, Cliff Topham SVP, Sales and Business Development at Werner Aero says there are many strategies that can be adopted. He suggests overall better planning as the most consistent way – “Planned removals and a planned shop visit that can be converted to PBH agreements for example. To reduce the risk of premature removal and lower maintenance cost by operation to greatest de-rate will pay benefits,” he states.

It’s fair to say though that over the past twenty years, airlines have done a very good job at rationalising their cost structures at all levels, including engine maintenance costs.

Brian Neff CEO at CTS Engines recalls twenty years ago, there being no such thing as a “green time” engine lease, whereby an airline operated a half-life leased engine at a reduced price until it reached its life limit and torn down. “Another example would be with respect to the supply of spare parts in support of an airline’s engine overhaul requirements. Today it is very common for airlines to be involved in the supply of spare engine parts during an overhaul, at a reduced cost to the airline. This was not the case 20 years ago.”

Andrew Walmsley, President at Volo Aero also observes that the past couple of years has seen airlines burning green time off engine assets as a cheaper alternative to overhauling engines. “Whilst this works for lower utilisation airlines it’s not a long term fix, and we can see an upturn in shop visits as these assets have become scarce.”

As in independent MRO Volo Aero is more aligned to the classic mature aircraft and engine fleets.



Brian Neff Chief Executive Officer at CTS Engines



The CFM56 line should see considerable support.
Photo: Boeing

"We see the usage of serviceable material sourced from the secondary (non-new OEM supplied material) as an effective strategy not just for scrap replacement but also as a replacement for expensive repairs," Walmsley indicates.

It is crucial for airlines, OEMs and MROs to find solutions in engine maintenance procedures to keep AOG situations to a minimum.

There are several different scenarios that can cause AOGs and as Glenford Marston, General Manager for Aero Norway notes most operators will know where they are most vulnerable for to issues such as bearing failures, oil leaks, and over-heating.

As a CFM56 series engine MRO specialist, Aero Norway recommends some extra work due to the CIs/Hrs of the engine to expose areas that would not necessarily be exposed in a general inspection to prevent AOGs. "However even though it is possible to offer preventative measures on any of the aforementioned scenarios and reduce potential AOGs while the engine is in the shop for maintenance, customers may not want to pay the extra costs associated with visiting some of these areas," Marston highlights.

As engine and information technology has improved over the past decades, OEMs and MROs have been collaborating to move from reactive to predictive maintenance strategies. "Several decades ago, when an engine would not start, the maintenance team would go

through a standard trouble shooting tree with not much information," recalls Basil Papayoti, President and Director at GA Telesis Engine Services (GATES).

"As we started digitising our engine controls and we have more specific information at our finger tips, we have been able to quickly isolate and address engine issues to either avoid or limit AOG instances or time." Further, Papayoti emphasises that technology today allows the industry to monitor the engines in real time or have algorithms watch specific data full time during engine operation.

"This engine monitoring has enabled us to move from reactive maintenance to predictive which results in scheduling engine LRU or specific on-wing maintenance and not go AOG which disrupts the airline schedule. The maintenance event may also include scheduling an engine change in a timely manner with logistics that do not allow the airline to go AOG, especially at an out station. Besides us working with the OEM and airlines when it comes to specific findings during our shop visits which in turn builds our overall knowledge of avoiding AOGs, we have a GO (GATES On-wing) team that travels the world doing reactive to proactive maintenance that either reduces AOGs and or AOG times."

Through data analytics, Pratt & Whitney can create customised, intelligent workscopes, provide early warning detection focused on preventative maintenance and improve visibility into the overall health of the fleet.

The company's eFAST data ecosystem, is able to capture thousands of engine and aircraft data parameters throughout the full flight cycle instead of snapshots at take-off and cruise, "this allows us to better monitor engine performance, minimise disruptions and predict future maintenance visit," Sylvestro reports. eFAST is the exclusive data system on Bombardier C Series aircraft.

CTS has a fleet of spare engines that support AOG requirements. Neff believes this is a "must-have" for any top-tier MRO. In addition CTS offers emergency field support to its blue-chip customers in cases where they have an immediate need.

Figures from Pratt & Whitney shows that PurePower® Geared Turbo-fan™ (GTF) engine incorporates 40% more sensors than the V2500, and can generate approximately four million data points per engine per flight, enabling significant improvements in addressing unplanned maintenance.

"Our data analytics platform, ADEM (Advanced Diagnostics and Engine Monitoring), employs a suite of web-enabled software tools to provide expert analysis of real-time health data for more than 7,000 engines in service. ADEM capability has been enhanced to support analysis of this additional data enabling us to better identify any adverse events affecting performance," Sylvestro adds.

When it comes to engine maintenance concepts and procedures an issue that often arises are the circumstances in which to consider taking the engine off-wing for performance restoration work and what the implications are for airlines.



Basil Papayoti, President and Director, GA Telesis

"The health, with regards to an engine is basically down to the measure of its performance and most customers use Engine Gas Temperature (EGT) to measure that, the more margin you have the cooler the engine needs to be to produce the required take-off thrust, says Marston.

He explains that this means the more EGT margin operators have, the better chance there is to utilise the full value of their Life Limited Parts (LLPs) and enjoy a better yield from their aircraft/engine asset when they are repaired. "Aero Norway strives to maintain its reputation for delivering 15% higher EGT margins than the industry standard," he says.

Koppers also points to the EGT margin as a significant factor in performance restoration visits. He stipulates that these visits are part of complex decision making. "This is something we like to plan through a partnership approach between our airline customers and us as the engine services provider."

On the one hand, Koppers warns against taking an engine off-wing too early, especially if it means replacing LLPs during the visit even though they have remaining LLP life. "This can cause unnecessary costs."

On the other hand, it's also crucial not to keep an engine on-wing longer than is ideal, as this could lead to greater damage that could have been avoided, Koppers says. "It is about finding that optimal balance – a decision that is aided by tools such as ETM, fleet management programmes and the expertise MTU Maintenance has gained from over 35 years of MRO experience."

Bradley from Magnetic MRO weighs in: "The three main cases to take an engine off-wing for performance restoration include LLP reaching its life limitation, a low EGT margin recorded on the engine and in extremely odd cases, if you do not receive any signal from sensors. The airlines have options to exchange their engine, lease an engine for 60 days whilst the restoration is carried out, or time the restoration during the base maintenance visit."

Mr Papayoti also says this comes down to factors that would vary from how much margin one needs to the next engine removal action, to what can be done to push out the performance restoration.

"Several operators today are able to maintain engines on-wing until a LLP needs to be replaced. This is desirable as long as one has a sound overall LLP replacement strategy that optimises off-wing times and shop time.

"There are many strategies that operators utilise to avoid engine performance restorations which include derating engines before they go EGT critical, utilising de-rated take-off thrust programmes and engine wash and hot section on wing programmes. When an operator has exhausted all on-wing remedies, then it's time to plan for the performance restoration. Implications for the airline are cost and time for the repair, removal and installation of a spare or lease motor along with all the logistics that come with engine changes," Papayoti describes.



Rice - Proactivity rather than reactivity.
Photo: AJW

Topham from Werner Aero advises that unless covered by a PBH agreement the most efficient use of an engine is to continue with the engine on-wing as long as possible unless removal is driven by unserviceability or operational performance.

Looking ahead and in terms of engine MRO strategy, the folks at AJW Aviation see Asia and LATAM as markets with huge potential, even though these regions are more OEM focussed at present. "We expect to see more opportunities when these markets mature," says Rice. The main focus at AJW is on CFM56-5B / 7B and V2500-A5 engines as they will continue to be a large demand for many years. "We are also preparing for new engine types including the CFM LEAP and P&W GTF and have already started the process of procuring LRUs for these new engine types, in order to be able to offer component PBH programmes to support our customers."

GA Telesis will continue to update its portfolio of products which include the CF6-80C2, CFM56-5B and 5C along with the newest product line of the 7B. In the medium term Papayoti confirms the company will continue to develop engine cost saving strategies for customers using existing engineering and new technologies available and in the long-term evaluate new engine product lines to launch.

At Magnetic MRO they are looking to develop the engine line maintenance unit. "We have recently acquired and extended our capability for CFM56-5 and CFM56-7 engines.

"Our medium term focus is on the current mature engines (CFM56-7, CFM56-5 and V2500), with long term focus dependent on the support we will obtain from the OEMs in order to acquire repair licenses on the future engine types," says Bradley.

In April, Pratt & Whitney launched 'EngineWise', a new commercial engine service brand platform to better represent what the company offers, and how it's evolving to improve the predictability, reliability and health of aircraft fleets. The focus over the medium and long term is to grow this new initiative.

The overall goal at MTU is to create customised approaches that meet the needs of its customers individually – "for us this is a continuous process and part of who we are now and will be in the future," states Koppers.

Over at CTS Engines Neff expects to more than double throughput over the next 12-18 months as the result of recently announced programme wins, "mostly at the expense of MTU Aero Engines, our largest independent competitor. And we expect this trend to continue."

He says the biggest challenges are to manage this growth in a way that not only supports these new customers, but also keeps existing customers happy. "We are confident that we will be successful, and are excited about the future."



Cliff Topham, SVP, Sales & Business Development at Werner Aero