

MRO

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Mature Engines

The question is to repair
or replace it?

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Aircraft availability remains
the key challenge



Engine Maintenance at Aero Norway
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Mature Engines – Replace or Repair?

Effective strategies are necessary to maximize operational cost efficiency

By David Dundas

Mature aircraft engines necessitate a distinct approach compared to new-generation engines. While modern engine types are typically restored to serviceability during overhauls through the incorporation of new replacement parts and the repair of unserviceable components, the scenario is markedly different for mature engines.

When an aircraft type is increasingly retired, it marks the commencement of a new phase of life for all valuable components, including the engines. While engines with sufficient remaining life on their life-limited parts are preserved intact as spare engines, those with limited remaining life are in most cases dismantled into their individual components, which are then reintroduced to the market as replacement parts. As the availability of mature engines and used serviceable material (USM) increases, the importance of utilising used replacement parts during overhauls or even considering the complete replacement of an engine with a suitable used one becomes more significant.

To get a better understanding of the situation, we approached a number of key players in the industry sector to obtain a clearer insight into the challenges faced. To begin with, clearly there are multiple factors which have to be taken into consideration when deciding whether or not to repair an engine. We asked what the primary factors were.

According to David Blackburn, Senior Vice President Asset Leasing & Trading at StandardAero, availability of engine MRO induction slots can be crucial. "Availability of engine MRO induction slots is a key factor when considering the strategy to repair or replace an aircraft engine. In the case of the CFM56 turbofan, many overhaul and hospital engine shops are currently at full capacity, and an induction slot may therefore not be available for three or four months, possibly longer. This puts an airline or operator in a difficult situation, especially when a lift is needed to support the steady growth that airlines have been experiencing as the economy continues to improve and expand.

"Repair capacity at component

overhaul and repair shops can also be a significant factor when deciding to repair or replace an aircraft engine. Delays in the supply chain and/or excessive turn-times in material repair and overhaul processes can dramatically affect an engine's lead-time and recertification schedule. Availability of desired and/or needed serviceable whole engine assets at financially acceptable price levels can drive the necessity for engine repair vs. engine replacement. The market inventory of well-traced, strong-performing serviceable time-continued engines is currently limited for many engine types. This fact,



David Blackburn, Senior Vice President
Asset Leasing & Trading, StandardAero

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*David Blackburn, Senior Vice President Asset Leasing & Trading,
StandardAero*



Spare engines storage.

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combined with limited availability of USM at acceptable and/or reasonable market pricing to support the growing engine MRO market, is impacting efficient and cost-effective engine builds (and, hence,

engine availability) for aircraft operators worldwide.”

John McKirdy, the Chief Commercial Officer at Kellstrom Aerospace Group, looks more to the owner’s operating model. “Engine repair or replacement decisions are often influenced by the operating model that the owner is considering. If the purpose of the owner’s portfolio is to generate leasing revenue and for their operating strategy, the time and or cost of completing a repair themselves, versus selling and deploying that cash into an additional ready-to-fly asset, is of great importance to that owner. Others along that same value chain but in a different operating model then perhaps a lessor may be more

suitably able to repair that asset due to either an existing supply of material and a well-functioning engineering department that can effectively manage the shop visit. Sources of serviceable assets such as a pool of modules and or serviceable spare materials at a cost basis that is cost effective can provide additional advantages. Ultimately, the same asset can follow a different path based on the mission and needs of the owner given the mindset and purpose for that owner.”

Bruce Ansell, Technical Manager Engine Division, APOC Aviation focuses on probably the most critical element. “At APOC, we are currently seeing that spare engine availability is a key driver in this decision,



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after that it is cost and time. Generally, if an engine can be repaired within a suitable timeframe and budget then it will be. But both of these criteria are now being stretched due to shop visit availability and the material costs involved."

Aero Norway's Global Business Development and Marketing Manager, Jeremy Colin, believes there are four principal factors: type and severity of damage, economic considerations, remaining useful life (LLPs) and whether the asset is owned or leased. "Regarding findings, if the damage is extensive or vital components are impacted, certain repair tasks / scope of work may be prohibitively expensive. Consequently, it is essential to factor in the overall budget for a potential shop visit. The challenge lies in potential findings post-induction. Thus, the pre-induction phase and inspection are vital for assessing the prospective total invoice. Certainly, a substantial portion of the engine's residual value is tied to the Life

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Limited Parts (LLPs) and parts with soft life (HPT Blades). These elements significantly contribute to the overall financial assessment and are crucial factors in determining the engine's total value."

At Werner Aero, Cliff Topham, Senior Vice President Sales and Business Development points out that the overall condition of available engines certainly has to be factored in, stating that: "the cost of the repair or overhaul of the existing engine may include labor costs, replacement parts, and any additional materials or services required during the repair process. The time taken for repair or overhaul is crucial and the availability of parts can be a critical factor, especially in industries where downtime is costly. The availability of serviceable engines in the marketplace is also influenced by other circumstances such as demand, supply, and the overall condition of the available engines.

Wasim Akhtar, Director of Engines, AJW Group is keen to point out that the life left

remaining in an engine is key to making an informed decision, commenting that: "Different engines have distinct life phases, ranging from the production and take-off phase for new products to the settled phase for engines cruising smoothly with resolved issues. For example, the sunset engines like the 737 classics CFM56-3, PW2000, and RB211-524 are in a mature stage of their lifecycle. Older engines may face increased maintenance requirements, and their financial viability depends on factors such as market demand, financing, leasing options, and the availability of used serviceable material (USM). Investing millions in repairs may not be justified if there is limited life remaining. Assessing which phase of life an engine is in becomes crucial for making informed decisions on whether to repair or replace. Compliance with regulatory requirements plays a significant role while lease contracts with airlines are also determining factors, as they often specify acceptable life-remaining conditions upon the engine's return."

We then decided to look at the significance of the availability of used serviceable material (USM) and wondered how this affected respondents when it came to overhauling mature engines.

John McKirdy is quite clear on the matter. "In the current landscape, the availability of used serviceable material plays a pivotal role in the decision-making process when overhauling mature engines. Beyond considerations like the availability of maintenance slots, where the confidence in the selected repair and overhaul facility regarding the expected downtime and workscope creep management, revenue generation potential of that repaired asset would be the effective key objective related to the total cost of making that asset serviceable. The pivotal decision



Jeremy Colin, Global Business Development and Marketing Manager, Aero Norway

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arises between reinvesting in the overhaul, including time, or opting to sell the asset outright or dismantle it for the sale of used materials. In this context, the reparability of the engine's material during maintenance significantly influences the demand for used materials, either elevating or diminishing the cost of the maintenance effect. A high yield from repairs on high-value material increases the likelihood of the engine completing its maintenance cycle, as the demand for used material decreases, making the maintenance event economically viable.”

Wasim Akhtar is convinced that USM is critical to the whole point of overhauling mature engines, commenting that: “You must have USM available as replacement using new parts is highly costly and is not economically viable for an operator. Without steady access to USM, engine repairs don't make sense, so this is critical in the overhaul decision making process. By tapping into the engineering knowledge and experience of our Engine and Major Assets Teams, AJW proactively sources and has USM parts on



Wasim Akhtar, Director of Engines, AJW Group © AJW Group

hand for the overhaul of its engines.

“Operators are holding on to their mature engines for extended periods or utilising aging fleets to meet additional capacity needs. Consequently, there is a reduced inventory of engines available for parting out, causing a substantial increase in the demand for USM for mature engines. The prolonged operation of these aging fleets necessitates maintenance checks, presenting a demand for overhauling mature engines that may not have been as prevalent in the past. Compounding these challenges are persistent supply chain issues and shortages of skilled labour post-COVID, exacerbating the demand for used material.”

Christen Grant, Marketing and Business Development Manager at EirTrade sees the availability of spare parts through engine disassembly critical from a cost-saving perspective. “Due to the increased availability of spare parts through engine disassembly, USM offers significant cost savings versus new material offered by OEMs. For MROs, access to USM can shorten lead times for the overhaul of engines thus avoiding supply chain delays in getting new material from OEMs. In the case of CFM56-3 engines, and similar mature engine types, there is currently a shortage of material as freight and PAX operators continue to extend the usable life of these reliable engines. However, due to their age and the gradually declining numbers being operated, new material can be very difficult to acquire. Through the disassembly of these engine types by specialists like



Christen Grant, Marketing and Business Development Manager, EirTrade

EirTrade Aviation, operators can extend the life of more engines and keep their fleet flying while they wait for newer aircraft types in production.”

Interestingly, Bruce Ansell points to a shift in the remaining life of engine parts as having a big say. “More and more engines are being built to maximise the remaining life. A few years ago LLP components with less than 7,000 cycles weren't being considered, whereas at APOC we have seen requests this year for parts with as little as 3,000 cycles remaining. The demand for USM is driving lessors and operators to consider strategic changes to their operations and business plans to ensure that these mature engines remain available, albeit for a much-reduced period of operation.”

The focus of Jeremy Colin is very much on the CFM56 engine. “Utilising used serviceable material (USM) is crucial when conducting overhauls on mature CFM56 engines. In the context of ageing CFM56 engines, where certain components may become scarce or expensive, USM plays

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Wasim Akhtar, Director of Engines, AJW Group

a pivotal role. It provides a cost-effective alternative by integrating previously used but still serviceable parts. Efficient project cost management involves strategic planning for overhauling mature engines with USM. The complexity arises from various configurations, multiple part numbers, and the necessary remaining cycles, making it challenging to identify the right parts for the supply chain. Additionally, comprehensive documentation linked to the USM is now more critical than ever. Certain global regions are frequently rejected by lessors to prevent devaluation of the engine's potential."

David Blackburn makes it clear that savings can be as high as 40% when using OSM as opposed to new parts. "The availability of used serviceable material has an enormous impact when estimating the cost to overhaul and recertify an aircraft engine. Considering that engine material typically accounts for 60% to 80% of a mature engine shop visit cost, properly purchasing and/or allocated qualified overhauled and/or serviceable material to support engine repairs and overhauls can save an engine owner anywhere between 15% to 40% when compared to using new parts." Chris Topham puts it all very succinctly: "The availability of USM is critical particularly if replacing LLPs at an LLP expiry visit."

We then focused on identifying the factors which determine the purchase price of a mature, unserviceable engine.

APOC Aviation's Bruce Ansell feels the answer lies in whether the engine is fit for a rebuild or part-out. "If it is to be rebuilt then a cost/value calculation is required for the additional period of operation, before looking at the part-out value. If it is going directly for part-out then each engine component will have a value assigned to it; historical component yields are also essential criteria as some parts are always going to be declared BER (beyond economical repair). Thirdly is the cost of repair. These factors are all included, and a comparison is made to OEM list prices for new, and also current market pricing for USM."

StandardAero's David Blackburn considers a thorough "unserviceable engine analysis" to avoid costly mistakes. "This



CFM56-5B engine

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analysis must involve a full commercial, technical and physical review of the engine by experienced and knowledgeable personnel. All historical digital and physical records must be reviewed from the time of new engine manufacture to the time of last engine removal. Operational data, ownership documents, commercial statements and technical records must be authentic and reviewed for accuracy and completeness. Accurate part number configuration and installation must be confirmed, since PN obsolescence and/or PN revisions can change engine valuations by hundreds of thousands of dollars.

"Life-limited parts with marketable (i.e. valuable) cycles remaining must be fully traced back to birth to ensure future acceptance and marketability. Cycles since

new and cycles remaining on hard- and soft-cycle life-limited components, coupled with physical borescope inspections to potentially reveal internal FOD, BOMD or excessive component degradation (especially on critical parts that include fan blades, HPC vanes & blades, combustion chambers, HPT nozzles & blades, and LPT nozzles & blades, etc.) can significantly alter engine purchase values and remarkability."

Kellstrom Aerospace Group's John McKirdy is also focused on effective analyses. "When gauging the feasibility of repairing and reintroducing the unserviceable engine to generate additional revenues, the potential buyer must carefully assess the anticipated cost of the maintenance event plus the asset acquisition cost. This evaluation is crucial in relation to

the potential to generate sufficient revenue, either through leasing the asset until the end of its green time plus teardown value (residual value) or through an outright sale after refurbishment.

“Alternatively, if the decision is to proceed directly to tear down, a similar analysis is essential, focusing on the expected yields of what can be categorized as sellable material. In the current market with asset valuations at an all-time high, possessing a profound understanding of probable yields becomes a decisive factor for the buyer. Accurate analysis and an appropriate purchase price can lead to a successful financial outcome in a teardown scenario. Conversely, if the analysis is flawed and the purchase price is inflated, the risk of a negative financial impact looms large in today’s market.”

At AJW Group, Wasim Akhtar is focused on the remaining life of Category A USM. “The decision to purchase, or not purchase, is highly dependent on how much life remains in the Category A material of the engine in addition to the demand for this material. Supply and demand dynamics play a pivotal role, with prices surging during periods of high demand and limited supply, while they may decline when demand is low, and supply is abundant. The intrinsic value of the engine/engine system contributes to higher prices due to their complexity and crucial role in aircraft operation. Market conditions, economic fluctuations, and external factors like fuel prices further influence pricing.”

Jeremy Colin at Aero Norway recognizes that various market participants employ diverse methods to assess the value of mature engines. “Parts companies tend to evaluate most engine components, anticipating a return on investment through long-term returns on teardown, including Tier 1, Tier 2, and Tier 3 parts. On the other

hand, operators and maintenance, repair, and overhaul (MRO) shops adopt a shorter-term perspective, considering the overall engine value with a focus on critical parts such as Life Limited Parts (LLPs), airfoils (HPT Blades, Fan Blades), QEC, and accessories.”

Werner Aero’s Cliff Topham concludes: “Determining the purchase price of an unserviceable mature engine involves considering various elements related to the condition, market demand, and potential for refurbishment. Cyclic life left on LLPs is one example or if there is a low-cost hospital visit available to restore serviceability without expending money on a major shop visit, extending its operational lifespan.”

Finally, we wanted to look at the channels and sources used to acquire serviceable mature engines.

Wasim Akhtar feels that having the right contacts is what matters most. “We have spent the past nine decades building relationships and collaborating with industry partners, customers, and lessors. These well-established relationships are what allows us to procure and supply components and parts delivering the service excellence for which we are known. Our agility and rapid service delivery are what makes us an industry partner of choice,” while David Blackburn is of the same opinion. “Airlines, lessors, investors, traders, and engine MRO facilities are all entities that may possess at any time a serviceable and/or unserviceable engine asset which could be made available for sale, lease, or trade. Facilitating continuous dialogue with old and new contacts while building and enhancing supplier and customer relationships within the engine marketplace are vital to success in the aviation business.”

Jeremy Colin once again focuses on the CFM56 engine and advises that Aero Norway obtains mature engines

from multiple sources, including: “Online platforms (bidding): Engaging in online platforms where engines are listed, and transactions may involve a bidding process. Directly from customers based on Fleet Management Programmes: Airlines and operators may directly offer engines for sale based on their fleet management programmes. From lessors (lease return, for example): Engines returned at the end of a lease agreement may be available for purchase from leasing companies. Engine trading companies: Specialised companies involved in buying, selling, and trading engines often serve as intermediaries in the acquisition process, and networking: Building connections through networking and participation in industry events can provide opportunities to discover available engines.”

Like many others, for Bruce Ansell it is mainly about contacts. “It is a small industry where everybody has contacts, or contacts of contacts, and engines may be offered to the market in the form of RFQ’s from aircraft lessors. The bigger lessors are usually keen to start moving out of the mature engine market and free up funding for the new technology becoming available. It is also fairly common for aircraft teardown companies to advise that they are inducting an aircraft and serviceable engines will be available.”



Cliff Topham, Senior Vice President Sales and Business Development, Werner Aero

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