



There is growing trend to install new LLPs into popular engines.
Photo: Magnetic MRO

Engine materials

Material's management is the most critical aspect when it comes to providing cost-efficient MRO services for engines, **Keith Mwanalushi** delves into the solutions.

Materials can make up a considerable percentage of shop visit costs, depending on engine type and age. There are several factors that are key to being able to manage material costs for engines. For younger engines, this can be combatted with alternative repairs to save costs and intelligent work scoping says Ruediger Heinrich - De Stefano, Director Asset Management, MTU Maintenance.

Whereas for mature engines, De Stefano observes that when MRO costs increase due to the need for heavier shop visits, used serviceable materials are increasingly used. "Luckily, the mature engine market also offers opportunities to find alternatives: this arises from more repairs typically being available and aircraft retirements. Retirements see more used engines and related material appearing on the market."

For instance, he states, with the market entry of A320neos and 737 MAXs, many CFM56 and V2500 engines will be retired in the coming years, creating an increased supply of surplus engines and used serviceable material (USM), which can be fed into cost-effective solutions.

"And the more surplus engines and USM is available in the market, the more flexible and cost effective it can become. At MTU Maintenance, we use such material in our mature engines programme instead of installing brand new and more expensive parts – especially if operators have engines facing their last run before retirement," De Stefano remarks.

Additionally, it is worth mentioning that vendor management is an important aspect with regards to material costs – key to both repair and scrap rate management and parts sourcing. De Stefano explains that having materials and repairs available at the right time, for instance through GTAs with OEMs and key suppliers, is imperative in achieving turnaround times for customers. "We have excellent supplier relationships and take a partnership approach to our dealings," he says.

For mature engine overhauls, in which CTS Engines excels, CEO Brian Neff says the ultimate sale price of a used serviceable replacement part can vary wildly between sources. "Therefore, it is critical for airlines and lessors to work with MROs like CTS who can rationalise the used serviceable part supply chain for mature engines and keep costs down."

For these USMs, Amar Chouaki AFI KLM E&M VP Business Development, Engines observes that this market is under pressure. "As for the repairs, developments can be extensive, but require specific skills and capabilities that develop gradually along with the engine lifecycle.

"Then, material costs management is fundamental for MROs to offer competitive maintenance solutions to the market, and for the airlines to have the ability to contain their cost of ownership," Chouaki states.

The 2017 engine parts market was an even more competitive space than that seen by Magellan in 2016. It is clear that operators, lessors and MROs are seeing the benefit of utilising USM in maintenance



Developing advanced engine material management systems is vital.
Photo: Magnetic MRO

on both legacy and current production engines. Material input can compose up to 90% of a heavy shop visit for an engine, as compared to around 50% for airframe maintenance, according to David Rushe, Director – Sales and Marketing, Europe at Magellan. So, as he specifies, the potential cost savings are quite evident, particularly given the pro-rata savings that can be realised in high cost components such as LLPs and HPT blades versus new parts.

One of the prominent discussion points at engine-related conferences this year is technical records. Despite the efforts of various industry groups, no defined list of tech records requirements exists to accompany the sale of an aircraft or engine. The levels of acceptance of records vary across the industry and it has put pressure on the Quality and Records departments in aftermarket firms, such as Magellan to ensure adequate records are in place to accompany the sale of a part and ensure its full value is realised on the market.

Operators can reduce physical inventories of material by turning the ownership of spare parts pools, to support the repair cycles of removed units, back to the MROs suggests Brian Bear, VP Business Development, North America at AJW.

He says by utilising advanced exchanges of inventory, this can result in excess inventory owned by the operator. "They, in turn, can sell this excess inventory to MROs or other operators. Another option is to sell or consign stock to aftermarket suppliers, such as AJW, thereby creating revenue opportunities - providing them with a flexible and innovative solution to monetise their assets.

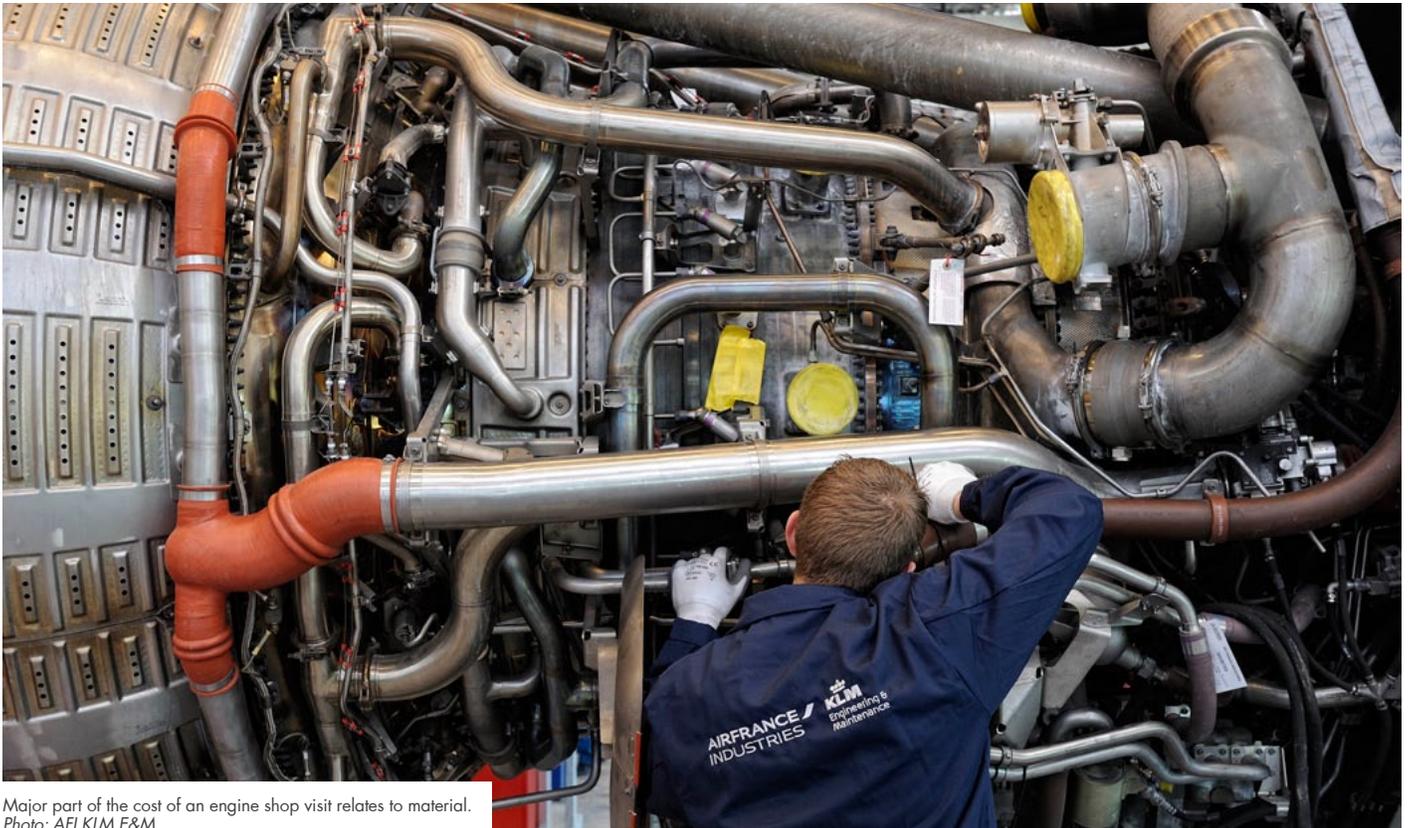
"Additionally, AJW takes full control of all removed material from an engine post shop visit and evaluates the potential for recovery, upgrade and saleability. If the engine can be salvaged by repair or upgrade, AJW will then sell the part into the market on behalf of the



Brian Bear, VP Business Development, North America at AJW



Rushe - A growing side of our business is consignment.
Photo: Magellan



Major part of the cost of an engine shop visit relates to material.
Photo: AFI KLM E&M

material owner on a split consignment basis as part of their material recovery programme,” Bear stipulates.

KLX Aerospace Solutions has been providing fastener and small assembly product to both engine OEM’s and MRO facilities for many years. This portfolio includes standard aerospace products, but also OEM proprietary part numbers.

When contracted with KLX, the burden of inventory management and ownership is shifted from the MRO to KLX, whilst still guaranteeing “100% reachback, “or availability of any piece part whenever needed, indicates Leiza Minchella, Senior Director of Sales, KLX Aerospace Solutions. “KLX establishes dedicated inventory at either the customer site or one of its 60 warehouses around the globe, and then works with the customer to design the best delivery solution.”



Leiza Minchella, Senior Director of Sales,
KLX Aerospace Solutions

Minchella explains that the mechanism for delivery of parts to the MRO mechanic can take many forms - from simple point-of-use bin programmes, to detailed piece part kits. “But, the single unifying element is quality parts available when they’re needed, where they’re needed,” she says.

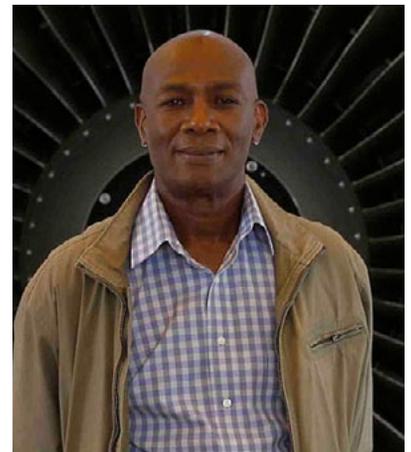
KLX also has an established process for managing customer-owned inventory, and through its e-commerce platform (ShopKLX.com),

MROs can decrease the operational cost of managing their parts and products. “It can help MROs access new customers by boosting brand awareness and availability for its niche products globally without any geographical limits. The ShopKLX.com platform offers MROs a scalable and proven e-commerce solution to meet the industry demand as well as customer requirements by introducing different sales channels and reaching market segments,” Minchella states.

Glenford Marston, General Manager of Aero Norway stresses that operators can work with MROs to closely manage inventories, and look at reducing such inventories based on each operators’ engine configurations. “Forecasting material needs, marketplace demands, and data analysis of stock levels are all important. Operators need to exercise flexibility to see revenue opportunities,” he remarks.

Surplus engines, modules and spare parts are valuable materials that can be evaluated to establish their current market value says De Stefano from MTU. “As an MRO provider, we are interested in all engine modules and parts. We purchase parts or provide an exchange service to reduce turnaround time for operators.”

Additionally, MTU Maintenance provides end-of-life and engine life extension services that can be interesting for asset owners.



Glenford - LLPs are the main material cost drivers of the shop visit.
Photo: Aero Norway



Filip Stanisic, Head of Engine Management Department at Magnetic MRO.

Engines with remaining “green-time” can be bought, leased or exchanged generating additional income for the asset owner.

There are also cases in which it is simply no longer economical to operate an engine. And asset owners look for exit management strategies. “One of which is a direct sale. But, the sum of the engine parts can be worth more than the engine as a whole. In these cases, MTU offers teardown and parts remarketing services. This can include individual work

scoping, the disassembly of the engine and the recovery of its usable parts, all the way to parts management and storage. The recovered parts can either be used by the customers themselves or consigned to MTU – which uses the material itself or sells it to third parties through its remarketing channels.

If operators wish to get involved in supplying their own material for shop visits—a position that CTS Engines strongly encourages—then it is best for them to concentrate on the “A” parts of an engine—that is the high dollar, high scrap items, such as core airfoils that account for the bulk of material costs, Mr Neff suggests. “It is not a good idea for operators to stock the ‘B’ and ‘C’ parts. Typically, operators are not focused on surplus material sales as they take up a lot of time.”

Magellan acquires much of its engine material through the acquisition of whole aircraft or stand-alone engines. “However, a growing side of our business is consignment, whereby Magellan manages the storage, repair management and sale of material from whole assets or packages of material,” says Rushe.

Magellan has enabled well established airlines, MROs and lessors to generate revenue from excess material. Another key trend witnessed in 2017 according to Rushe was renewed demand for older engine types, which may previously have been seen to be surplus requirement. Examples include the CFM56-3C1 and -5A models, the CF34-3B1 and the PW4000-94. “It is clear that operators are seeing the advantages of using these engines for prolonged periods amidst low fuel prices and with cost-effective maintenance strategies. The demand for these assets has in turn led to a hunger for applicable spare parts to keep shop visit event costs to a minimum.”

The role of life limited parts (LLPs) and parts manufacturer approval (PMAs) also come into play. Filip Stanisic, Head of Engine Management Department at Magnetic MRO says the situation with LLPs is very specific since for most widely used engines as CFM56-5B, CFM56-7B and V2500-A5 engines there are very limited number of used LLPs in the market. “This is directing a lot of operators to install new LLPs into engines, even in situations when planning is assuming that those parts will not be used till the end of their life, which is increasing the price of shop visit significantly. LLP related cost can be between 30% and 60% of the total cost of engine repair,” indicates Stanisic.

PMA material plays a much less important role in engine repairs today compared to previous times observes Stanisic. He says for engines like the CFM56-3, PW 4000 94-inch and CF6-80C2 engines there was a

lot of PMA material connected with hot section that could significantly decrease the price of an engine shop visit. But for more advanced engines but like CFM56-5B, CFM56-7B and V2500-A5 PMA material of hot section airfoils is almost non-existent. He points out that only HPT Stg.2 blade for V2500-A5/D5 engine was developed but it was not widely used, very limited number of sets were installed. “So, excluding CFM56-3, PW 4000 94-inch and CF6-80C2 engines there is no PMA solution that can bring the cost down. Moreover, in the current market environment where more than 50% of the most distributed engines like CFM56-5B/7B, V2500-A5 are leased – PMA parts are forbidden by the Lessors. This is the main reason why nobody was developing hot section PMA parts for these engine types.” Stanisic highlights.

LLPs are the main material cost drivers of the shop visit and these play a large part in varying costs. “Timing shop visits based on well managed maintenance schedules, combined with LLP availability can lower the costs. Depending on the PMA these can also help to lower material costs due to the difference in price to OEM parts,” adds Marston from Aero Norway.

The consensus by MROs is operators look toward reduced cycle life engine builds, obtaining life limited parts can provide dramatic savings compared to using OEM new parts with full life cycle limits remaining.

In 2017, AJW dismantled several first run engines to gain access to half price LLPs. “As these are the highest demand parts in an engine build and rarely available on the market, having these provided as USM gives engine owners a significantly lower cost over buying new LLPs,” Bear says.

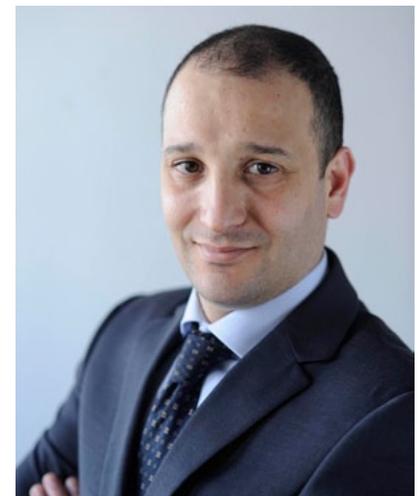
Additionally, in Bear’s opinion, PMA parts approval and usage in engine builds has increased significantly, which enables further savings on the overall engine build. “Demand for USM and PMAs continues to grow as they are increasingly institutionalised by the leading airlines.”

Chouaki from AFI KLM E&M sees that LLPs are in essence scrapped after a certain period. “It is therefore of the utmost importance that LLPs have as much stub life as possible. Then, when replacement is needed, depending on the targeted rebuilt life of the engine, used LLP parts may be used [remaining life] to optimise costs versus time on wing.”

Since it is common place that the price for a spare part when bought through traditional channels is significantly higher than the production price, Minchella says partnering with KLX gives the MRO shop access to the production price. “This is specifically beneficial for LLPs where KLX has established relationships with the OEM’s through a business to business operating system [Symphony™] allowing the customer to receive parts with the needed shelf life and not risk inventory in house becoming obsolete and unusable.”

Many engine OEMs and MROs are developing advanced engine material management systems and seemingly, these technologies can be used to manage and control material costs.

Minchella says as the need for quick, reliable information on aircraft



Chouaki says airlines are looking at predictable contained maintenance costs.



A350 component bleed air valve.
Photo: AFI KLM E&M

performance and maintenance needs has resulted in advanced systems to gather and assimilate accurate timely data, the need for efficient part availability solutions has grown to ensure OEM and MRO sites can react effectively to such data. Any advance in data availability - when coupled with a robust material planning system - will help balance the cost and availability of product.

"Using data analytics from the operator to the MRO will help visualise a better system to deliver forecasts," says Marston. He adds: "Predicting future needs of material types and market place availability, combined with flexible optimisation of shop visits, will further streamline the entire process at Aero Norway. When operators share their data with Aero Norway, it will enable us to work with them on the management of engines material and work scopes, so they are able to align their costs with certainty – thus improving their own efficiency and profitability."

Stanisic believes engine materials management systems can be beneficial especially with good collaboration between the operator and the OEMs or MROs. "It can bring good results," he notes.

Advanced engine material management systems can include customer stock management, management and consignment of surplus inventory, sale of surplus inventory, and disassembly of engines for monetisation lists Bearir. He says, as such, the focus is not on tearing down the engine to the piece part level, but on finding modular integrated and flexible solutions. "AJW's portfolio of services spans the entire process, from appraisal and analysis of the residual value, and the remarketing or release of the entire engine, to extensive parts management."

Adding parts management services can include the teardown of the engine, the repair of reusable material, the storage and reuse of engine spare parts, and the sale of surplus or otherwise redundant parts to third-party customers.

More and more, airlines are looking at predictable contained maintenance costs. "They are expecting MRO service providers to endorse the risk of maintenance cost discrepancies," Chouaki points.

"No MRO in the world knows an operator's fleet better than that operator," Neff from CTS points out. Theatres of operation, stage lengths, flight

crew thrust management, and load factors all can have an impact on the lifecycle of an operator's engine—"and nobody knows this better than the operator."

Therefore, Neff reckons it is a very good idea for an operator to target high value replacement parts, such as the "A" parts, that it knows it will need for future shop visits. "By predicting future material requirements, and sourcing high value parts attractively in advance to supply to an MRO, an operator can definitely reduce its overhaul costs."

Andrew Walmsley, President at Volo Aero concludes that effective management of material costs are key to the total cost of engine overhaul and management, and it's always connected to the stage of the assets life cycle, the length of time the asset will remain in operation and what if any return conditions are required to be met.

Walmsley: "An asset which is only at its first shop visit and will be operated for a significant period (both time and cycles) will most likely have new LLP's and material installed. It is important to look at the expected life remaining on LLP's after the next shop visit and the length of operation. It's a costly exercise to build an LLP module for -7B for 7,000 cycles and operate it for 5,000 cycles, the remaining 2,000 cycles become effectively worthless, in this case it would be better to buy used LLP's with 13-14,000 cycles (much less expensive than new material) and have an asset with 7,000 cycles which would have a strong after sale or lease market."



Walmsley says repaired material offers significant cost savings to new material.