

# MRO

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publications

March 2020 - [www.avitrader.com](http://www.avitrader.com)

## Predictive maintenance & inventory

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Predictive maintenance is one of the most prominent incoming technologies.  
Photo: TRAX

Unplanned maintenance costs airlines over \$20 billion a year. **Keith Mwanalushi** looks at predictive maintenance and the cost benefits for inventory management.

**T**he aviation industry is grasping for opportunities to reduce costs. According to data from EXSYN Aviation Solutions predictive maintenance is recognised by 66% of airlines as one of the most prominent new technologies to have entered the market by 2020.

Within aviation maintenance and engineering the aim of predictive maintenance is first to predict when a component failure might occur, and secondly, to prevent the occurrence of the failure by performing maintenance. Monitoring for future failure allows maintenance to be planned before the failure occurs, thus reduce unscheduled removals and avoid Aircraft-on-Ground (AOG).

Tying predictive maintenance to inventory management can have significant benefits agrees Mat Punter, Head of Repairs at AerFin. "Firstly, it allows the airline operator to schedule the maintenance in advance and have prior notice of the inventory required for the maintenance procedure. It also allows for the necessary supply chain requirements to be organised accordingly."

In addition, Punter says it allows the supplier to proactively align the inventory in advance of the maintenance work, rather than reactively responding to component failure and possible AOG requirements – "This should also allow the supplier the opportunity to secure more cost-effective solutions."



Mat Punter, Head of Repairs at AerFin

Another expected benefit of predictive maintenance, is that catastrophic component failures will significantly decrease, thus reducing the number of high cost repairs and BER events, Punter notes.

"The big challenge with predictive maintenance and inventory management is that the removal of components before a hard defect is reported currently means that there is no standard practice for the 145 workshops to follow for units that are currently serviceable and may pass CMM testing procedures. Looking to the future, the CMMs will have to evolve and develop to incorporate preventative and predictive maintenance processes, rather than the current procedures which only cover testing, found defects and standard overhauls," Punter speaks.

Matthew Kammerait, AAR's Director Digital Product Management feels that there are two types of "predictive" maintenance - both compelling, but only one of which is possible at scale today – "The type that gets the most visibility involves a connected sequence of people, connected devices, and data - linking operational, connected aircraft data to scheduled maintenance activity, in order to drive more proactive remediation."

That type, especially in an independent MRO context, requires a lot of integration and interconnectedness between multiple players in the operations and maintenance chain, states Kammerait. He says while more proactive sharing of operational data, AI/ML enabled platforms, and commensurate commercial agreements are all hot topics across the industry this type of predictive maintenance and the value it promises to create still lies mostly in the future.

The other type of predictive maintenance, however, is very much possible and a lot more real today. Kammerait suggests. "This type lies more within the four walls of the operator or maintenance provider and has to do with using some of the



Greg Hogget – Technical Director at AJW Group





Predictive maintenance should reduce AOG situations.  
Photo: Keith Mwanalushi

same underlying technology to drive a greater degree of optimisation and automation within the existing flow of work."

In the absence of predictive maintenance, Greg Hogget – Technical Director at AJW Group warns that you can end up in an environment where one holds an excess of inventory in anticipation of an unpredictable AOG event – "This accumulates into surplus stock and is a source of inefficiency for airlines, which AJW has a proven track record of eliminating. With consistent and accurate predictive maintenance planning, airlines and their partners can eliminate most of this uncertainty and plan for the strategic global positioning of stock, thereby mitigating potential operational disruption."

AJW supports its customers by mitigating this disruption using its inventory optimisation model, which is constantly being refined by predictive maintenance.

Clearly, predictive maintenance is all about 'proactive maintenance'. Hogget highlights that most aircraft do not have inbuilt technologies to provide predictive algorithms. Thus, AJW works with available datasets to simulate a realistic predictive maintenance environment.

"However, AJW does work with certain operators [such as easyJet] that are growing their fleet of predictive capable aircraft. When working with forward-looking companies like this, it is about working in partnership to develop a genuine predictive maintenance model that ensures the right parts get to the right place at the right time."

AJW is targeting a near zero AOG environment using its existing data and planning capabilities. predictive maintenance reduces the AOG demand and, as it builds a consistent data set, this can then be factored into the planning information.

"This isn't just about having the parts on the shelf within the inventory system, but rather an integral part of the overall supply chain solution. PM enables AJW to ensure that the logistics are efficient through its optimised route planning. It is looking at how we move serviceable inventory around our network to meet the predictive maintenance signs that are coming off the aircraft. It is more of a repairs ecosystem that surrounds the predictive elements rather than just about the components and the aircraft. It is an ecosystem that encompasses the total supply chain, in-

cluding warehousing and logistics," explains Hogget.

In the long term, predictive maintenance should hopefully allow for a collation of predictive removal data, notes Punter from AerFin. "This Big Data will allow for inventory management teams to analyse noticeable predictive removal trends and improve their effectiveness in reducing unscheduled removals and AOGs. This in turn will then lead to more components being removed on a scheduled basis and a reduction in unscheduled removals thus providing the supply chain the opportunity to position the necessary inventory ahead of the scheduled requirements on a more cost-effective basis."

Anthony Florian, VP EMEA airlines at Honeywell notes that challenges arise when operators settle for predictive maintenance platforms that provide significant historical data, but only gives advice on how to fix what's already broken. Ideally, he says predictive maintenance solutions monitor onboard equipment in real time and analyse historical data. "They use advanced analytics to predict which components will fail and when, as well as tracking assets and inventory, to maintain optimal levels, so technicians can address potential issues before there are major problems. At Honeywell, we have combined the capabilities of the connected aircraft and the Industrial Internet of Things to develop the aviation industry's first true prescriptive maintenance solution."

One airline used Honeywell Forge Connected Maintenance software to reduce auxiliary power unit (APU) failures. The airline was experiencing APU failures that costed an estimated \$24 million annually. Through using Honeywell Forge, the airline reduced delays and cancellations by 30 per cent, lowered repair times by 90 per cent, and experienced improved customer satisfaction, according to Honeywell.

"Excess stock is a depreciating asset that takes up both space and money while lying in the corner of a warehouse," Florian says. "With predictive maintenance, stock can be ordered and used more precisely. This means that excess stock numbers are dramatically reduced, freeing up cash flow for airlines."

To support purposeful buying and use of stock, Honeywell recently brought-in blockchain technology to the aerospace inventory market to deliver security, trust and transparency with GoDirect Trade online.



Chris Clements, Sales Representative at Swiss AviationSoftware

When using predictive maintenance to improve the prediction and utilisation of inventory stock, Chris Clements, Sales Representative at Swiss AviationSoftware Ltd sees two different data sets: "Predictive maintenance in itself will indicate what component should be replaced, but, if the available stock and all associated data is managed in an E&M software such as AMOS then this would be managed separately."

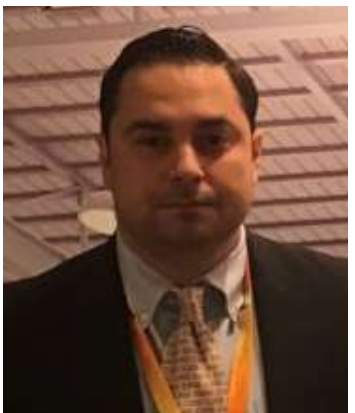
As Clements explains, AMOS has a function, 'Material Allocation', which allows the customer

to customise the allocation of stock and components on open orders to events using a rule engine. He says there are many factors that must be considered to utilise the available stock such as ownership, pool agreements, physical location, financial projects and additional part requests that already exist.

Clements: "AMOS allows the management of the customers stock and when events are updated by the likes of Aviatar then AMOS will immediately recalculate all relevant parameters to ensure the best utilisation of the stock. What must also be considered is the complexity of managing the configuration of the aircraft based on many factors such as SB/AD status or software installed. AMOS has the capability of receiving the 'predicted' component change instruction and ensuring that the correct part number is allocated or ordered according to the aircraft status. This remains a function that AMOS can perform based on the managed aircraft data as well as the stock availability, approved part numbers and vendors.

Clements believes that the very concept of predictive maintenance should also reduce the rate of unexpected activities because solutions such as Aviatar make use of not only OEM aircraft data to monitor aircraft systems but install additional sensors to increase the range of data available. "In the case of sudden and unexpected failures with no preceding trends then the fall back is of course as it is today with defect management and engineering providing trouble shooting support."

Predictive maintenance appeals to companies with the promise of fewer repairs due to regular maintenance, adapted to the production line, but what happens in instances of unexpected activities? Gilberto Ayala, Manager, eMRO Software at TRAX responds:



Gilberto Ayala, Manager, eMRO Software at TRAX

"In the case of airlines and MRO providers, unexpected maintenance problems and protracted downtimes can take a heavy toll on profitability and customer goodwill. In 2018 the FAA estimated the annual cost of delays to airlines and passengers at \$28 billion. Having a predictive maintenance system that is dynamic, that can incorporate machine learning algorithms, uses statistical analytics, and intelligence-driven planning can help overcome these unexpected activities."

Cliff Topham, Senior VP Sales and Business Development at Werner Aero Services says unfortunately in some ways with the movement from hard times to on condition management of components - there are still many instances of unplanned activities which domino into additional maintenance work.

Unexpected actives - or to be more specific - low frequency high impact events are still an area where greater collaboration and investment is needed, to really drive value in both maintenance and inventory management, suggests Kammerait from AAR.



Cliff Topham, Senior VP Sales & Business Development at Werner Aero Services

"This is one of those areas where data sharing among parties, even anonymised, can unlock a tremendous amount of value for everyone involved. The size of any one programme, MRO, or even operator may not provide enough data to drive enough productivity on these 'black swan' type events. As such, a broader pool of inputs, external data, and potentially causal factors are needed to better train the models and drive value creation. This is an area where we continue to invest and seek partners who share our aims of better data sharing and subsequent predictiveness and outcomes for all involved," Kammerait states.

Punter adds that currently, the process of responding to unexpected or unscheduled failures and removals means that the required inventory has to be sourced immediately and transported to the required location within the quickest timeframe available in order to avoid disruptions in the airline service - "It also adds further time constraints and pressure to the airlines' engineering and technical teams and may divert them from scheduled work that was anticipated and budgeted for. In addition, there are the costs involved with sourcing and transporting the inventory, which are inherently more expensive and challenging when working to a tight deadline, as opposed to providing them for a scheduled maintenance event."

Certainly, predictive maintenance is still a new technology and it may take some time to derive the full cost benefits for inventory management. The folks at TRAX believe that inventory management is an integral component of any aviation maintenance operation. "We have been consistently enhancing our software's maintenance and supply chain functionality for the past decades," says Ayala. TRAX will continue to do so with new technological advances that incorporate Artificial Intelligence, blockchain parts records, the use of Big Data, remote inspection, smart scan, machine learning, predictive analytics, and augmented reality. "The application of such technology is still in its infancy, so there will be a lag between the initial development and when the cost benefits will be fully achieved. Yet this should not take too long given that the capabilities exist, and the anticipated payback and motivation is great."

TRAX has pilot projects in place to develop and investigate opportunities in predictive maintenance technology. "We are working with our customer base to prioritise those areas that can derive the maximum benefit in terms of cost, safety and efficiency of operations," Ayala concludes.