



INDUSTRY FOCUS

Changing dynamics — MRO focus North America

North America's commercial-aircraft MRO industry is being shaped by several important trends which are altering the dynamics of the market, but which will also act to constrain the industry's growth over the next decade. *Chris Kjellaard reports.*

While growth forecasts for North America's commercial-aircraft MRO industry vary depending on one's geographical and functional definitions of the market (for instance, if Mexico is included) industry insiders agree several major trends are interacting to influence the market's shape and growth. In the short term, one of these trends will create a drag on North American MRO market growth and over the next 11 years it will act in concert with others to permanently alter the dynamics.

Virtually every forecaster sees North America's overall MRO market — airframe, engine, component and line maintenance — growing only very slowly over the 11 years to the end of 2026. For instance, Cavok, the MRO consulting division of consultancy Oliver Wyman, sees the North American MRO market — excluding Mexico — actually declining slightly in size over the next six years, from \$17.9bn this year to

\$17.7bn in 2021; and then growing at an average annual rate of 2.3 per cent over the following five years to 2026, to reach \$19.8bn.

Cavok forecasts that only the engine and line maintenance market segments will grow from now through 2021: engine maintenance at an average rate of 1.3 per cent annually and line maintenance at a rate of 0.6 per cent a year. Overall the North American MRO industry will experience an average annual growth rate of just one per cent over the 11 years from the beginning of 2016 through to the end of 2026, according to Chris Doan, a Cavok VP.

Airline re-fleeting dominates

Over these 11 years, the significant re-fleeting efforts on which all major US and Canadian carriers have embarked will dominate the MRO market, says Doan. During the lean decade that most major North American carriers endured

from 2001 until consolidation allowed them to impose capacity discipline and ancillary fees, some of the largest airlines had to allow their ageing fleets to age much more, to the point of economic obsolescence.

However, once these carriers started to make significant profits (in some cases, the biggest profits in the global airline industry's entire history), they began ordering new aircraft in large numbers. Most of these are either completely new types (the A350XWB, 787, Bombardier C Series and Mitsubishi Regional Jet) or they represent substantial technological upgrades to the aircraft which North American operators are now flying. Aircraft in this latter category include the A320neo family, 737 MAX, Embraer E-Jet E2s, and (for US airlines) the 777-300ER, though this type has been in service elsewhere for more than a decade.

Frank Berwerger, SVP sales for Lufthansa Technik (LHT) North Americas Holding

Corp, says the new aircraft entering the North American market will need less MRO overall than the airlines' current jets, because their new-technology structures and components will be more reliable. At the same time, new repair and overhaul technologies will boost North American MRO providers' efficiency and reduce MRO cost. Additionally, airlines will enjoy the traditional "maintenance holidays" that new aircraft provide.

Maintenance holidays are becoming longer, according to Doan: "Airframe maintenance will continue its trend of lower unit costs made possible with the new technology of composites and hybrid alloys used in the construction of new-generation aircraft. With their better fatigue and corrosion resistance properties, these advances have allowed intervals between airframe heavy maintenance visits to stretch out to as much as 12 years, while work content has contracted as well."

He warns that engines, while much more fuel-efficient, are operating at even higher temperatures and pressures, resulting in more expensive shop visits to restore and replace increasingly exotic and expensive material. Cavok forecasts this will mean three per cent average annual growth in North American engine MRO spending over the next 11 years.

Opportunities still exist

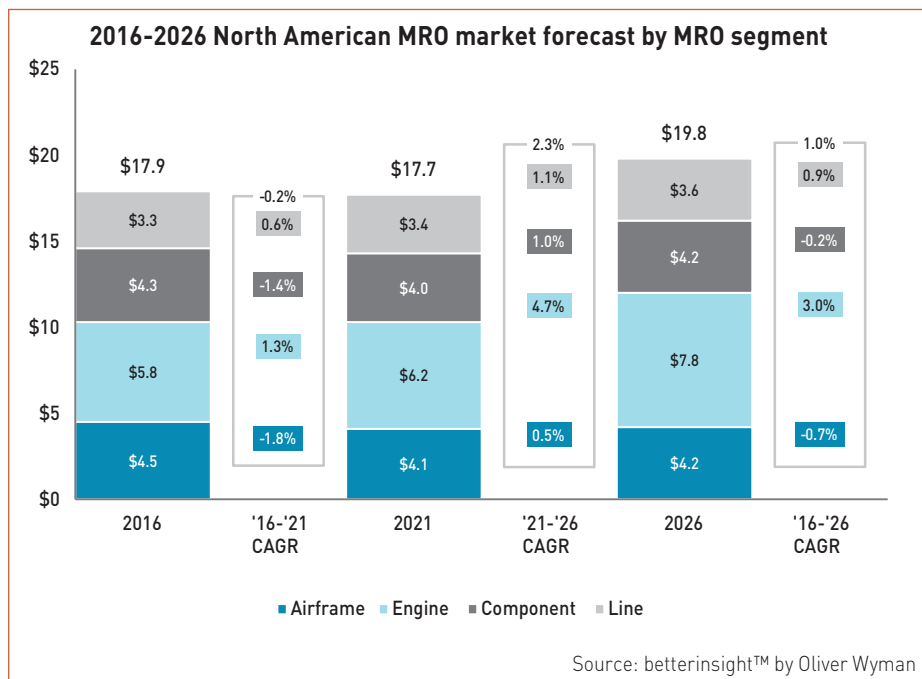
The North American MRO market growth forecast LHT uses differs from Cavok's forecast by including the Mexican MRO market. Today, according to Berwerger, the North America-plus-Mexico MRO market totals \$21bn annually, of which 38 per cent is engine maintenance, 20

"In terms of narrowbodies and regionals, with all the aircraft coming in and going out, we expect some moderate [MRO market] growth, in the single digits. But it's very hard to predict."

Dany Kleiman, AAR VP

per cent is component maintenance, 20 per cent is airframe scheduled maintenance and 22 per cent is line maintenance.

LHT sees North American MRO market size growing 3.3 per cent this year and 3.6 per cent in 2017. "Although the number of active aircraft will grow and North America continues to be the world's largest aviation market, the speed of growth is modest compared to other world regions," says Berwerger. "Still, we believe that there are significant opportunities for growth in the American MRO market... As a full-service provider with extensive experience and



recognised expertise in the MRO business, and with our 'airline genes', we are able to capture market share. Airlines not only want a partner who understands their operation but also one that is close to them, not just mentally but also physically, such as with production facilities."

As a result, LHT continues to expand its presence in the Americas. The company opened a new A320-family heavy maintenance facility in Puerto Rico in 2015 and is expanding its North American MRO capabilities for landing gear, on-wing engine services, components and composites.

OEMs design maintenance programmes which allow more work to be performed during minor A and B checks, to reduce the scope of work and aircraft downtime required during heavy C and D checks.

AAR reckons that the overall picture conceals considerable market complexity, providing opportunities for companies willing to tailor their services closely to individual customers' needs. "It's a different mix of work, now and in the future," says Kleiman.

Engine MRO is different

Growth conditions in the North American engine-maintenance market differ from those in the overall North American maintenance market, for a variety of reasons. One is that engine OEMs have a much stronger presence in their aftermarkets than airframe and component OEMs do in theirs. Since GE Aviation and Pratt & Whitney are based in the US and some of the CFM International joint venture's overhaul facilities are located there also, many engines from operators in other countries return to the US for overhaul and US carriers' engines stay there.

Other reasons for North American engine-MRO market growth are more specialised, as Rob Cords, president of US-based StandardAero Airlines & Fleets (StandardAero's commercial-aircraft engine MRO business) notes. "Often, the maintenance cycles of our customers will vary with the maintenance cycle in the overall market," he says. "This can occur due to the timing of when our customers take on aircraft and how they fly their aircraft, [determining] whether or not their cycles match with the cycles of the overall market."



A technician undertaking a Pratt and Whitney engine repair at StandardAero's facilities in Winnipeg.

Cords continues: "We can also see differences in our growth versus the market growth rates through various maintenance-optimisation programmes. These customised programmes alter the maintenance cycles assumed in market forecasts for the benefit of the operator and their specific flying characteristics, and more importantly their specific aircraft-ownership horizon."

On-shoring MRO

Another important trend the North American MRO market is experiencing is the "on-shoring" of widebody airframe heavy maintenance previously farmed out by North American carriers to shops in Asia, especially China, because these shops used to offer far lower labour rates. Now, however, labour rates in China and elsewhere in Asia have risen to the point where North American airframe-maintenance labour rates are very competitive. Also, by on-shoring their widebody maintenance North American airlines can keep tighter control of maintenance quality standards; and strict FAA regulatory oversight can largely be assured.

Doan says: "We estimate that roughly 49 per cent of all North American widebody heavy maintenance will be done in-region this year. This is up from 43 per cent last year. While it is difficult to say with certainty if the on-shoring trend will continue at the same pace... North American MROs that continue to invest in widebody capabilities now will be in a position to continue to capture work from operators in their

own region that have been sending work abroad, especially as the regional labour rates continue to march towards global parity."

AAR has made widebody on-shoring a key foundation of its strategy for overcoming the slow North American MRO market growth expected over the next decade. "What we are trying to do is ensure we capture some of the widebody market which was out-sourced, in-sourcing it to increase our slice of the pie," says Kleiman. "It is totally our view that [Asia's] competitive edge is shrinking, because of the labour rates and value proposition we can provide. We are strategically focused on this segment."

The company has shown its determination to be a force in widebody airframe maintenance by building two large new facilities specifically for such work. The first, at Lake Charles in Louisiana, opened in 2013; and the second, at Rockford in Illinois, is due to open within nine months.

Berwenger cautions that North American MRO providers should not assume the continent's airlines will necessarily keep increasing their on-shoring activity. "It may slow down due to a US dollar exchange rate which is unfavourable for US-based providers," he says. "European providers have now become a viable option for heavy maintenance of US widebody aircraft."

More consolidation

North America's MRO industry also continues to be shaped by consolidation: by mergers and acquisitions; the formation and growth of

MRO networks (usually OEM-affiliated); companies consolidating internally, where hangar space over-capacity becomes an issue; and by airline customers concentrating their maintenance spending on fewer providers.

This last activity may be particularly relevant in the engine MRO segment. "Decisions on where maintenance is being performed are concentrating around centres of economic influence," says Cords. "Airlines are investing in other airlines and creating more influence on where maintenance is performed. Mainline operators are becoming more involved in where regional maintenance is performed versus leaving it to the individual regional airlines."

He says that on new technology platforms, OEMs are signing MoUs and long-term contracts for engines not yet in service, although the location of that maintenance is yet to be determined. This could be dangerous, in his opinion: "Operators would be well-served to ensure a healthy set of MRO options exist in the market and take steps to ensure they survive. If not kept in check during aircraft purchase decisions, independent MRO options will dwindle over the next 10-15 years and it will take just that long, if not longer, to fully reverse that trend."

Consolidation in the North American MRO industry "remains prevalent", according to Cavok's Doan. The reason is complex, but logical. "As the negotiating power of the airlines has increased over the last decade, the OEMs have been compelled to offer heavy discounts for their equipment and have, more or less, been forced to increase their presence in the aftermarket in an effort to recoup the billions of dollars invested in research and development of the latest generation of aircraft and engines."

As a result, "small independent MROs are effectively being squeezed out as retirements of older aircraft increase and the new technology airframes, engines, and components represent a growing share of the aftermarket," says Doan. "However, in an effort to compete against the increase in aftermarket participation by the OEMs, independent MROs continue to consolidate, creating mega-MROs, many with a global presence, capable of competing directly with the OEMs."

Independent MROs are also attempting to consolidate internally by rationalising their facilities and services into fewer, larger, more capable hubs. AAR is an example: Last June (2015), it announced it would close its regional-jets-only maintenance shop at Hot Springs, Arkansas and centralise its RJ maintenance operation at its much larger facility in Oklahoma City, which handles mainline narrowbodies and regional jets.

North American MRO market consolidation is set to continue, in Berwenger's view. "Legacy airlines have in-house MRO capability, but now



A CFM56 engine in a test cell at StandardAero's Winnipeg facilities.

they've ordered five, ten or 15 787s or A350s and it is not worthwhile to invest in new in-house capability," he says. "The intervals between the scheduled checks for new types are twice, three times as long. Removal rates from their components have halved. That means per aircraft flying hour there is less work to be done, and that will have consequences. It will probably lead to consolidation in the market."

OEM participation

OEM participation is increasing, particularly in the engine and component MRO segments but also potentially in airframe MRO as well. "The engine market is more dominated by OEMs than the market for component or airframe MRO," says Berwerger. "Airlines send around 60 per cent of their engines to OEM shops. For new engine types we expect further monopolisation, as manufacturers are trying to take a bigger stake in the game. Also, for current engine types like the CFM56 or the V2500, OEMs have become more active in the aftermarket. The consolidation process will lead to fewer shops, fewer companies in MRO. Working as an independent MRO service provider will become less economically feasible."

LHT's strategy in the engine MRO business is not to combat this, but instead to partner with OEMs holding the intellectual property rights on engine designs and repairs. "We can contribute extensive engine overhaul expertise and cost effective... on-wing repair solutions to those partnerships," says Berwerger.

"Around 40 per cent of component MRO in America is in-house with the operator," he adds. "But we see a tendency that legacy airlines will concentrate more on their core operations, which offers opportunities to independent providers and OEMs. The component

manufacturer's market share is approximately 30 per cent."

LHT reckons airframe OEMs are aggressively marketing aftermarket services again. Cavok agrees, even though "OEMs currently hold less than 10 per cent of the North American airframe MRO market", according to Doan. "However, as new-generation aircraft with new-technology composites and hybrid alloys begin to demand maintenance, the OEMs are expected to significantly add to their share as they pursue aftermarket strategies pioneered in the engine and component MRO segments."

But past "OEM attempts to provide airframe maintenance was not a good story", says AAR's Kleiman. He thinks that in pursuing aftermarket business to take advantage of the intellectual property they own in their aircraft designs, airframe OEMs will seek airlines and MRO companies as network partners to perform repairs and re-engineering programmes.

Narrowbodies stay home

There is a widespread perception that North American carriers outsource most narrowbody airframe maintenance to companies in Latin America, where labour rates are cheaper and regulatory oversight isn't always as strict. But Kleiman says this isn't the case: "I would say, based on my knowledge of the markets in the US and Latin America, that the vast majority of narrowbodies flying in the US are being maintained in the US."

Doan agrees. "Contrary to the general belief that the vast majority of North American aircraft are sent abroad for work, most North American aircraft, particularly narrowbody aircraft, remain in-region for airframe maintenance," he declares. "It is estimated that less than 10 per cent of all North American narrowbody heavy

airframe maintenance is performed by shops in Latin America."

LHT does think North American airlines are sending "a significant number of aircraft to be serviced in Latin America's low-cost maintenance service facilities", but there is a logical explanation why its impression is different. Targeting US operators as its primary customers, it recently opened a new heavy airframe maintenance facility for A320-family jets in Aguadilla in Puerto Rico, which many think is in Latin America.

However, while located in the Caribbean and an island where Spanish is the dominant language, Puerto Rico is a territory of the USA; and the FAA, as the official airworthiness authority, has a considerable regulatory presence there. US carriers JetBlue Airlines and Spirit Airlines were the first two customers for A320-family heavy maintenance at LHT Puerto Rico; the FAA will ensure aircraft they send there for heavy maintenance will be overhauled as carefully as in the continental US.

Goodbye mom-and-pop shops?

All sources for this article say that as the technologies employed in new commercial aircraft, engines and components become more sophisticated and as OEMs become more active in the aftermarket, the opportunities for small, independent "mom-and-pop shop" MRO facilities will become increasingly limited. Although OEMs will form networks of licensed MRO shops to provide them with fast, reliable coverage throughout the world, they will seek large companies with deep pockets and substantial technological resources as partners.

"Older aircraft will be replaced by new ones which need significantly less maintenance, but high investment in staff training, new tools, new IT, new spare parts, repair technologies, etc.," says Berwerger. "All this requires significant financial resources, making it difficult for smaller MRO shops to stay in the game."

Kleiman thinks similarly: "Obviously, if you are not positioned properly to be part of an OEM network or make the capital investment [necessary] to partner, and also be competitive in quality and investment to support customers' programmes long-term, you will be out of play. If they can only do a simple analogue [component] repair, the smaller guys are going to go out of business. It will be very challenging for the mom-and-pop shops."

This may be hard for some to hear. But it appears increasingly inevitable that large size, lots of financial muscle, a substantial portfolio of service products and loads of technological know-how will be the tools required to prosper — and perhaps just to survive — in the 21st-century North American MRO business.



ENGINEERING & MAINTENANCE

Forecasting the future

The timely and responsive provision of parts and the efficient management of inventory remain vital components of the aircraft engineering and maintenance process. So, how do companies operating in the sector approach this process? How has inventory management changed in recent years and what are the latest technological advances? *Andrew Williams* reports.

For many companies working in the field of aircraft parts provision and inventory management, a key requirement is the need to adhere to a strategic and methodical approach. One example is UK aerospace company AJW Group. As John Avery, commercial director, explains, AJW provisions components in three main ways. Firstly, it targets specific requirements for stock, based on its 'growing business requirements,' which Avery says enables AJW to fulfil its high service-level commitments to contracted customers whilst also developing *ad hoc* business opportunities. This process is carried out on a continuously evolving basis, and in particular when the company wins a new contract — an event that requires a 'step change' in its stock position.

The second aspect of the AJW approach entails a thorough review of its stock position on a 'tactical' basis following key events. One example of such an event is when one of its components is scrapped, prompting staff at the company to make a decision over whether or not to replace it — daily decisions that Avery reveals result in a 'high level of expenditure due to business volume.'

Thirdly, AJW looks at packages of spares as well as aircraft and/or engines for part-out. According to Avery, this part of the process 'is the reverse of the first two procedures' because in these instances AJW acquires a fixed list of parts before having to work out how much they are worth to the company — 'as opposed to creating a pre-defined shopping list and taking it to the market.'

"We also have a large requirement for consumable and expendable parts, which we procure through forecasting future customer needs using statistical and other forecasting methods. AJW either buys these parts, has a consignment agreement to hold them, or we manage them on a call-off basis," he adds.

Elsewhere, Deepak Sharma, president — international supply chain at the UK division of aviation services company AAR (which is headquartered in the US), believes that the key to successful inventory management is the accurate forecasting of demand, which he says depends 'primarily on historical trends and the technical behaviour of components.'

In order to help it towards meeting this objective, the company utilises a bespoke inventory

management tool to plan its inventory requirement. According to Sharma, the AAR model is based on a procedure of finding the value of one or more key parameters 'in order to achieve the desired service matrix.' In doing so, he says the model calculates possible scenarios based on technical data and trends relating to global components — before applying this range of possible scenarios to an investment matrix as a means of achieving 'the most economical result with the highest level of availability.'

"With more than 60 years' experience in the aftermarket, including component repair and MRO, we have the knowledge and data needed to make strong forecasts. Another key aspect of our inventory management process is a global network of supply chain hubs — which helps us to ensure we can have the right part at the right place at the right time," he adds.

Technological advances

As ever, an important element of inventory management processes is the need to ensure that customer requirements are adequately met. According to Paul Horstink, SVP component



AAR's approach has changed from stock everything to stock the right parts at the right place. This has moved it from a traditional planning model to failure rate and demand forecast algorithm-based models.

services at Swiss company SR Technics, this service imperative drives every aspect of the company's activities. For him, this continual improvement ethos is essential in view of the fact that the company has more than 950 aircraft under contract and provides component pools both at the customer's base and at its logistics, operational and engineering centres in Zurich and around the globe.

"Everything we do is geared towards meeting customer needs. This means that we focus hard on continually improving the flexibility, cost-effectiveness and efficiency of our services. We are engaged in the complex business of maintaining, repairing or replacing unserviceable

customers to 'optimise their inventory control and sourcing' using ARMAC's state of the art inventory control system, known as RIOsys.

"There is currently also more focus on 'replace before fail' component management, which is designed to exploit new digital and wireless technologies to reduce aircraft time on the ground. We are also increasing marketing and selling total solutions — including potentially liquidating surplus stock — to other airline and MRO customers," he adds.

A focus on optimising inventory management and control process with cutting edge technology is also evident across the rest of the sector. At AAR, Sharma reveals that the com-

connectivity is now 'all pervasive,' means that parts providers like AJW are required to think 'how best to use it and on which devices.'

"The beneficial impact of technology on provisioning has resulted in a reduction of buffer stocks in the system. If AJW knows what stock our suppliers have on their shelves in real time, and we have the ability to directly ship with confidence, we can do the same job — or better — with less money tied up in stock. Ultimately we want to develop a scenario where consumption is in 'lock step' with provisioning," he says.

Increasing complexity

However, in spite of the undoubted benefits and efficiency gains accruing from technological advances, Avery is keen to stress that the ongoing introduction of new aircraft types continue to bring new challenges — and, as the technology and engineering gets better, he argues that the growing interest in protecting intellectual property in the aftermarket 'adds additional complexity.' As a supplier to a wide range of customers across the globe, he points out that AJW also faces the additional challenge of trying to integrate systems across a wide range of competences across the airline industry 'from airlines, to MROs to repair shops and vendors.'

"There is a rising expectation that it can all be done seamlessly. After all, that's what the internet is for isn't it? But the reality is more complicated. At one end, legacy software and systems are an enormous challenge because they are not really designed to share data or communicate with the rest of the network — unlike fully integrated solutions utilising the latest modern architecture and engineered to cover all connectivity options," he says.

"At the other end of the spectrum, a start-up business or airline probably hasn't even decided which system to get, or if they even need one. AJW has a very good web portal that can side step a lot of these issues from a technology perspective," he adds.

In terms of the other challenges facing the sector, Sharma believes that one of the major hurdles that all providers face is 'inconsistency and accuracy of data' — an issue that he says has been 'hard to overcome' in view of the fact that 'every operator captures data in its own way and is reluctant to share such data.'

Inventory investment plans

Meanwhile, Horstink points to the 'huge challenge' inventory management and parts provision operators face in reducing risk and providing the 'right services in the right place at the right time anywhere in the world'.

"Using a combination of customised algorithms and real-time digitally-fed information we are able to meet stochastic demands by better

"There is a rising expectation that it can all be done seamlessly. After all, that's what the internet is for isn't it? But the reality is more complicated."

John Avery, AJW commercial director

components every day — and also possess extensive logistical management and engineering capabilities," he says.

Horstink also highlights the fact that, in recent years, logistics and component management has become 'increasingly digitalised and high tech.' In order to keep up to speed with these technological advances, SR Technics has pursued an active acquisition strategy. For example, in 2014, it acquired the pioneering Irish software, component, and inventory management planning company ARMAC. In Horstink's view, the combination of the Irish outfit's software with SR Technics' expertise enables

pany's approach has 'changed from stock everything to stock the right parts at the right place.' In doing so, it has moved from a traditional planning model to failure rate and demand forecast algorithm-based models.

"We continue to make improvements to our proprietary inventory management platform and will soon be debuting mobile apps to make it even easier for customers to access," he says.

At AJW, Avery points out that the majority of recent technological changes have focused on the development of logistics with improved tracking via accurate data capture 'at every step in the process.' For him, the fact that data and

predicting the future needs of an airline's logistical and component requirements. This means we can substantially increase reliability and improve the supply chain performance. The RIOsys system and our very qualified and experienced staff enable SR Technics to manage this complexity," he says.

In an effort to ensure that it continues to keep up with developments in this ever evolving sector, Horstink also reveals that the company has been 'aggressively increasing' its global and regional footprint. For example, in 2014 it opened a centre of excellence for component maintenance in Kuala Lumpur, Malaysia — a location from which he says SR Technics 'can address the entire South East Asian Pacific region' for the test, repair, overhaul and modification of aircraft and engine components, including avionics panels, hydraulics, mechanical, pneumatics and electrical parts.

"We continue to invest in our systems, processes and people. Recently, for instance, we committed to making significant investments together with our leasing partner Sanad to fulfil the future needs of our growing presence in the Boeing 787 sector. Not least as a consequence of our major long-term integrated component services contract with Etihad Airways," he adds.

With more than 800 aircraft under management, Sharma points out that AAR 'continues to invest in inventory to support our large customer base' — with a specific focus on modern airframe and engine platforms for its rotatable pools, as well as consumable and expendable parts for its program offerings.

Meanwhile, Avery says that AJW views investment as a continuous process. "AJW supports a fleet of over 1,000 aircraft under power-by-the-hour contracts and adds new customers on a daily basis, so we have experienced and professional teams that monitor our stock, market values and changing customer needs 24/7/365," he says.

Key innovations and trends

So, what are likely to be the main developments and trends in parts provision and inventory

management technologies and processes over the next few years — and what does the future hold? For Horstink, the optimisation of what he describes as the 'procurement of availability' — a combination of 'owning, leasing, pooling and other strategic partner arrangements designed to provide inventory availability in the most financially efficient manner' — is not only essential for component availability providers, but also for SR Technics' customers' profitability and efficiency in a competitive marketplace.

"The RIOsys software system uniquely delivers this availability planning capability. Increasing material availability in general is going to be fundamental to ensuring the operational reliability of our customers' fleets — as well our ability to win their business. That is why we shall continue to improve or establish new regional and global logistics hubs and operational centres," he says.

In order for AAR to retain what he describes as its 'lead position' in the sector, Sharma predicts that the company will need to deliver a combination of 'exceptional service, proactive demand understanding and real-time visibility'.

"In terms of the innovations needed, AAR is working on digital technology that will provide operators access to parts at their fingertips with real-time visibility and just-in-time delivery," he adds.

Finally, Avery thinks that there is a 'growing imperative' for more predictive technology — which has emerged for two main reasons. The first is that the unit price of parts 'continues to increase generally well above inflation — and for new aircraft types there are some eye-watering price structures.' In his view, this means that the amount of money tied up in 'just-in-case' stock is 'ridiculous' and 'totally contradicts the culture and business ethos of all the low-cost carriers, let alone flag carriers seeking maximum business efficiencies. The second reason is that, as the OEMs are increasingly getting involved in the aftermarket, he is confident they will 'see the value in predictive data insights.'



AJW's Avery thinks that the amount of money tied up in "just-in-case" stock is 'ridiculous'.

"When they were handing out recommendations for someone else to spend money they had no motivation in making the change, quite the opposite in fact. But now they are spending their own money there will be a change in behaviour," he says.

"A question for the mathematically-minded is why do most OEMs use a 'normal' distribution to run their component forecasting model? The answer we suspect is because it is easy, not because it is right," he adds.

Looking ahead, it looks as though effective strategies to manage parts provision and inventory processes remain a central concern of companies throughout the industry — with ever more sophisticated prediction and forecasting technology likely to play an increasingly important role.



Thinking
Harness
Repairs?

Think CIA&D

Got wiring harness repairs on your mind? If you are looking for reliable repair services you can trust Co-Operative Industries Aerospace & Defense to deliver the results you need. With quality workmanship and responsive turn-times, CIA&D specializes in GE90, CF6-80C, CFM56-5A/5B/5C, CFM56-7B, PW4000 QEC and others. Contact us to learn more about the benefits we can offer.

Visit us at MRO Americas
Booth No. 2711



T: 817.740.4700 ■ E: solutions@coopind.com ■ www.coopind.aero