More airlines are examining the benefits of a fully subcontracted, PBH-style rotable support programme versus the traditional system of inventory ownership and in-house repair. The main elements and considerations of all aspects of such support programmes are examined.

The structure of rotable support programmes

An increasing number of airlines are swapping the traditional system of owning, managing and maintaining their inventories of rotable components for all-inclusive, power-by-the-hour (PBH) packages paid at fixed rates that are provided by specialists. The structure of these all-inclusive rotable support packages is examined here.

Rotable requirements

Components on aircraft are broadly divided between those that are used once and replaced with new items, and those that are repaired. Those that are repaired and circulated back through inventory stores and then installed on aircraft are termed rotable components, because they rotate through this cycle. They are sub-divided between on-condition and condition-monitored components.

On-condition components are kept on the aircraft as functioning units until they cease to function properly but there is no means to determine or pre-empt their failure. Condition-monitored components can have their operational function monitored, and with the appropriate data collection systems and algorithms, can have their failure predicted. This allows their removal before they fail to avoid the problems and operational delays caused by component failure.

Rotable and repairable components include heavy components, including the landing gear, wheels and brakes, auxiliary power unit (APU), and thrust reversers. These large items are managed and maintained separately to the smaller rotable components. Many of these are classed as line replaceable units (LRUs), and include: avionics, air cycle machines, and components of the hydraulic, pneumatic, electrical, water and toilet, and pressurisation and oxygen systems; components from the passenger servicing items, such as galleys, toilets and safety equipment; and the accessory and LRU components mounted on the outside of engines and accessed under the cowling.

Many of these components can be removed relatively quickly, and replaced with serviceable items taken from inventory stores during line and light maintenance checks.

The nature of these components is that many fail at random rates. In many cases their function is duplicated by additional components on the aircraft, especially those that have an impact on the safe operation of the aircraft.

The nature of component failure presents several difficulties. The first is that components sit on the aircraft and in stocks for a long time, and there is often a low turnover of parts. The nature of component failures and removals is highly stochastic, so removal intervals vary widely from the average interval. For example, an average removal interval of six months can have a variation of two to 11 months. This makes it hard to accurately forecast demand, and airlines ultimately have to provision against uncertainty, in contrast to many industries which can provide inventory against a predictable forecast. This philosophy of provisioning against forecast uncertainty is part of Armac's differentiation against other rotable forecasters.

These issues mean that airlines need to keep inventories of serviceable rotables at various locations across their route networks.

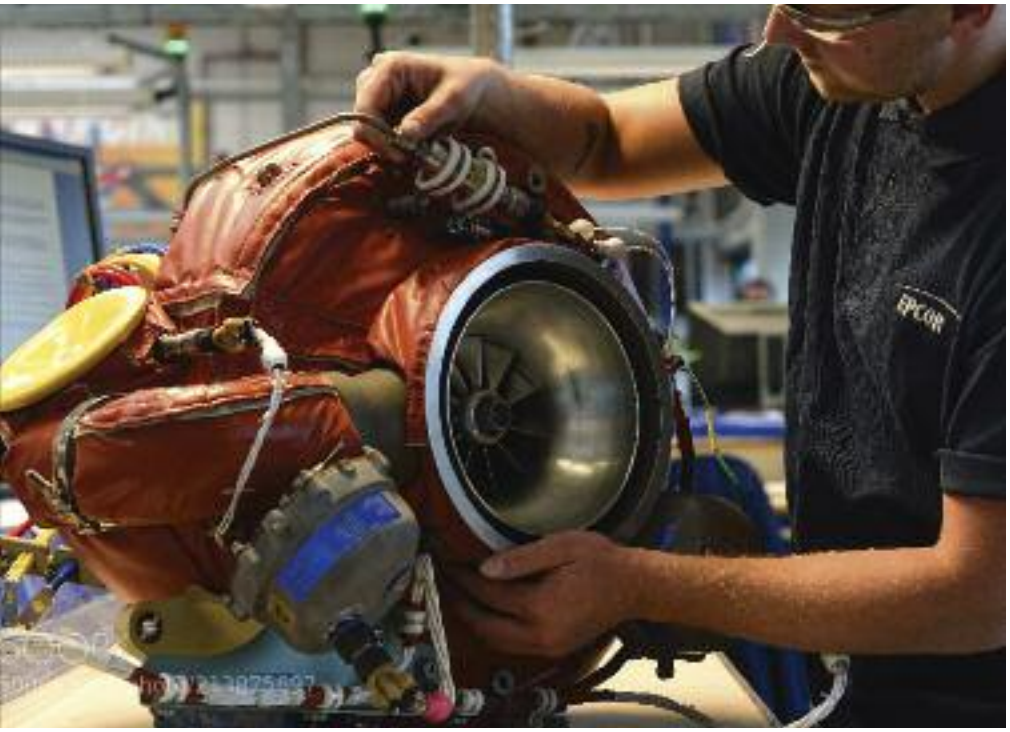
Traditionally, airlines would manage this by having inventories at their operational bases, as well as outstations that they have a large number of services to. Airlines have also organised themselves into sharing components for the same aircraft type at various airport hubs. The international airline technical pool (IATP) also allows airlines to avoid the expense of maintaining inventories at all outstations they operate to.

A high level of investment in rotable inventories, in-house logistical infrastructure, repair and maintenance shops, and inventory stores is required for the entire process to be managed in-house. As with engine management and maintenance, more airlines are seeking to outsource the management of rotable components. The solution for many airlines is to use an all-inclusive, PBH-style rotable support programme.

Rotable consumption

There are several elements of an aircraft fleet's operation where rotables are consumed; that is, removed due to failure or declining performance. Most removals occur during operation because components fail randomly. These can be indicated by failure and fault messages and codes on the aircraft's central maintenance computer. These codes can then be reported in flight via flightdeck communication systems, such as the aircraft crew and alerting system (ACARS), to the airline's ground departments. Problems with systems and aircraft performance can also arise in flight, and be reported in technical logs that are then transmitted during flight or handed to line mechanics after arrival.

Following diagnosis of the faults via manuals on the flightdeck, line mechanics will remove the faulty or failed component. This will be sent for testing to confirm and analyse the failure or fault before repair, while a replacement component will be installed on the aircraft after being taken from stores. In many cases this can be done relatively quickly, and the aircraft can be returned to service. Information such as the removed and installed components' serial numbers (S/Ns) needs to be recorded for the purposes of generating reliability and removal data, and maintaining a correct record of the aircraft's configuration. This can be automatically gathered using



Rotable components are high value items, and the nature of their failure is highly stochastic. The fundamental issue facing their inventory management is that spare units have to be provided against forecast uncertainty.

barcodes on each component. The information is often managed by the airline's maintenance and engineering (M&E) IT system, which can have the functionality to: fully track each component; raise requests for warranty payments; generate removal interval and reliability data; keep a record of each component's maintenance and modification history and status; locate each component at any point in time; and maintain a record of all installations on the aircraft. This data can then be used to constantly reassess and determine the inventory an airline needs for each component P/N and variant.

Modifications are released for each component P/N through its operational life. These modifications will upgrade the component, and result in a series of dash numbers and variants, each one improving the component's reliability and performance. The upgrade, modification and dash number status of each component, and those relevant to a particular fleet or sub-fleet, also have to be tracked.

Most airframe rotable and engine accessory components and LRUs are removed during line maintenance and the aircraft's operation. Light and hangar-based airframe maintenance checks, however, include system and functional checks, or component and system calibrations. These maintenance tasks can reveal, and result in the removal of, faulty rotable and repairable components. These can also be replenished from stores, but the extended length of some checks means that rotable and LRU inventories are not necessarily required to provide replacement items. Some component items can be repaired in the downtime length of the check and then reinstalled.

While stocks of rotable and repairable components and LRUs have to be held to prevent disruption of an airline's operation because of a shortage of components, there are several methods that airlines can use to minimise the quantity of components that have to be held in their inventories.

One of these is to group components into categories. The first division is between 'Go' components, which permit the aircraft to continue to operate despite failure or fault, and 'No-go' items, which prevent operation until they are fixed or replaced. 'No-go' category items can further be divided between items that can have their repair and replacement temporarily deferred, and those that absolutely require replacement. These categories and sub-categories mean airlines only require access to absolute No-go components at outstations in the event of a failure; while No-go and deferrable, and Go items are all required at major hubs and home bases.

First, inventories of deferrable items can be minimised if it is possible to locate replacement parts within the allowable deferred time.

The inventories of No-go items held at each outstation on an airline's route network can be further reduced by identifying those with a high reliability record, and therefore a small chance of failure. The split between on-condition and condition-monitored components is changing, and the portion of condition-monitored components is increasing, as techniques such as big data analytics and prognostics is increasing. The use of soft removal intervals for more No-go components therefore means that the risk of a rotable item failing at, or en route to, an outstation is declining, which reduces the stocks that have to be held at these positions.

Airlines can also avoid holding complete inventories, or minimise stock levels at outstations through sharing programmes. One is the IATP, which for a set annual fee allows components to be shared between airlines. In some cases, a penalty only has to be paid for borrowed components if they are borrowed for longer than a specified period. The conditions of component-borrowing and -sharing programmes can be installed on the component management modules in M&E systems. Alerts can therefore be raised to inform an airline that it needs to return a borrowed component within a certain number of days before incurring a penalty.

The same basic borrowing process can be organised within airline alliances, or even between competing airlines that operate common aircraft types. Engine original equipment manufacturers (OEMs) often provide some level of accessory and rotable component support to airlines as part of their total care support programmes.

Inefficiencies

While the techniques described can be used to minimise the quantity and capital cost of inventories held, there are also several factors that result in inefficiencies, and increase the amount of stock that has to be held by an airline.

The first of these is the traditional problem of no fault found (NFF). This is when components are incorrectly diagnosed and identified as being the items causing a system malfunction or failure. Each component has to be tested after removal, and the typical percentage of components that fall into the NFF category is 10-20%. This has to be taken into account when determining the amount of inventory required by an airline.

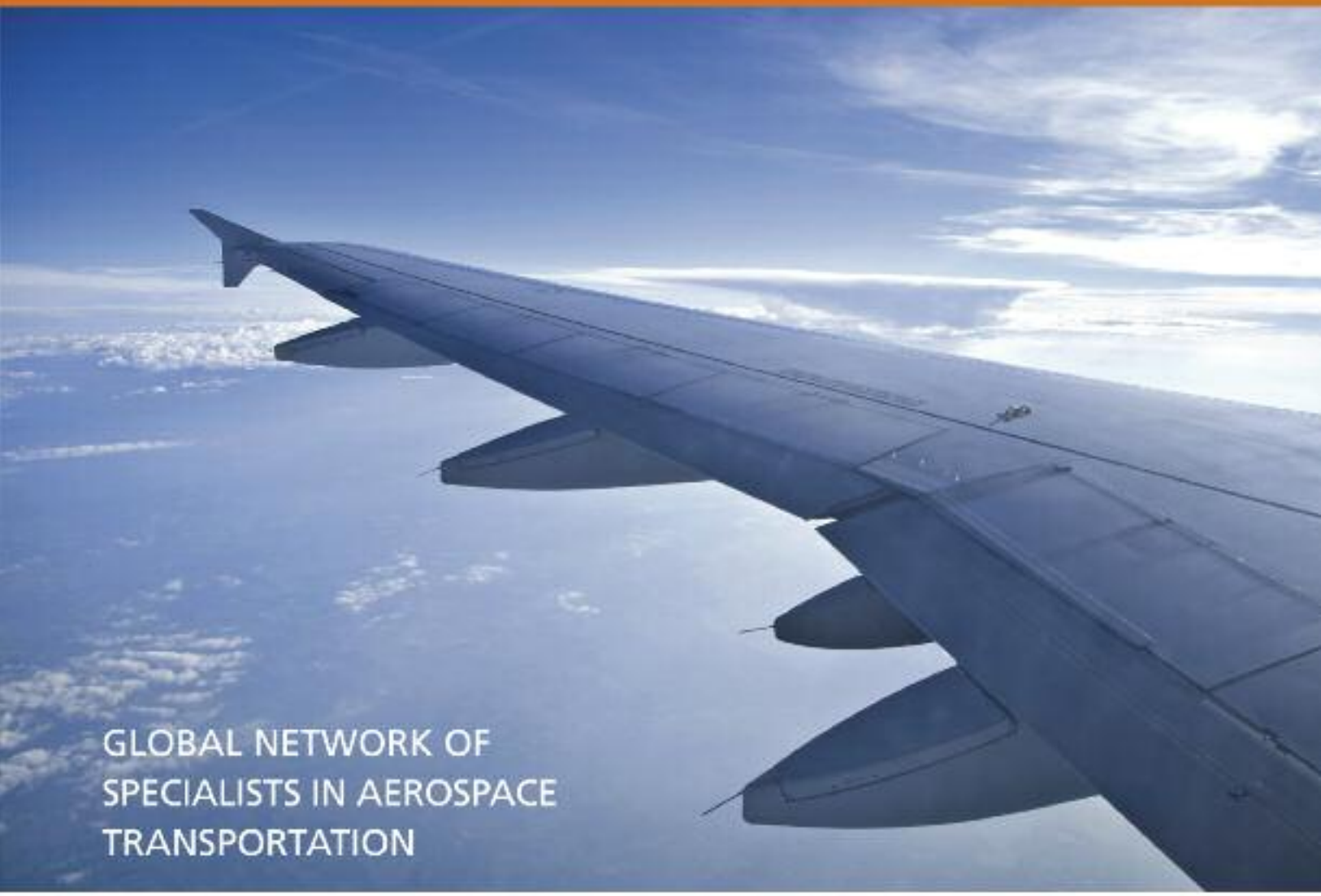
The level of NFF can be reduced through the modern technique of big data analytics and prognostics. Using more detailed data from a larger number of performance parameters means that a more accurate level of information about a component's performance and operation can be determined. This should result in more accurate diagnoses of component health.

Another factor leading to excessive inventory is surplus parts or irrelevant

Your parts have a destination

We know the way

Aviation Logistics Network



Do you have an urgent transportation challenge?

We're here for you 24 hours a day 365 days a year

ROYAL AERONAUTICAL SOCIETY
CORPORATE PARTNER

Contact us now on

24/7/365 AOG Hotline:
00 8000 264 8326

www.aln.aero

and out-of-date P/Ns and dash numbers being held in inventory stores. A particular P/N used for a fleet type will have a series of upgrades and modifications during its operational life. These will often change the aircraft line numbers (L/Ns) that it can be fitted to. Parts with older dash numbers often become obsolete because they can no longer be used on many or all aircraft L/Ns in a fleet, following the application of airworthiness directives (ADs) and service bulletins (SBs), which mean that the aircraft can only operate with higher dash number variants of the same component P/N. Also, older dash numbers are kept after older L/Ns of a fleet type have been retired and are no longer operated.

The rotable component management configuration of a M&E system can be used to track every P/N and associated dash number, and match the total quantity of each with the fleet size that it is relevant to. Moreover, the number of available items for each P/N and dash number at any one time can be identified. They can then either be modified so that they can be used, or sold as surplus stock.

Another cause of inefficiency is the change in aircraft type or batch of aircraft L/Ns on particular routes across a network. Many airlines have outstations on their networks where they have a large enough number of operations with the same aircraft type to justify having an inventory of No-go items and even some Go items. This is because they will get used, or the investment is not too large compared to the financial impact of an aircraft-on-the-ground (AOG) situation due to a failure.

Problems arise when an aircraft type, or sub-fleet, is removed from the route, but the airline fails to remove the related inventory held at the outstation and transfer it to its homebase or another outstation, or sell the stock.

Investment in rotables

The number of rotable and repairable serial numbers (S/Ns) installed on aircraft is 2,400-3,000 for most aircraft types. This includes airframe and engine rotables and LRUs, safety equipment in the passenger cabin, components in the galleys and toilets, and the in-flight entertainment (IFE) system. About 400 of these are usually maintained on a hard-time basis, and so usually replaced during base checks. The remaining components are maintained on an on-condition or condition-monitored basis.

The inventories of items held will be avionics, components such as pumps and servos, valves, regulators, aircycle machines, constant speed drives and integrated drive generators, and other complex components. Inventories will also include a few heavy components, such as wheels and brake units.

The quantity of rotable parts held in the home base inventory will literally be halved when going from a 100% service level to about 95%. The amount of inventory necessary for a 100% service level will be cost-prohibitive.

Between 500 and 800 different P/Ns will have to be held in various stores, either all in an airline's stock if its owns its stick, and split between a home base stock and a supplier's stores if acquired through a PBH-style contract.

Fleet size is a big determinant of the inventory required. The total inventory for one aircraft can be about $15 million for a single A320, but will only be about $1-2 million more for up to another three aircraft. It will be close to $20-25 million for a fleet of 20 aircraft, and just another $5 million or so for 30 aircraft. The investment per aircraft will therefore decline per aircraft as fleet size increase. This decline begins to level out at 40-50 aircraft, but has reached only $1.0-1.5 million per aircraft. That is, 5-10% of the investment required for rotable stock to support a single aircraft. These economies of scale illustrate why pooling and sharing is economic for several airlines which have small fleets.

Similarly, estimates for an inventory of total rotable stock for a fleet of 20-40 Embraer E-Jets is $0.5-2.0 million per aircraft, with a lower investment per aircraft being reached for a larger fleet. At the other end of the scale, an investment of $3-4 million per aircraft is estimated for a fleet of 10-15 A380s.

In addition to the capital cost of the inventory, several other cost elements have to be considered.

The first of these are the logistics of managing the components through the rotation cycle of testing, repair, and being sent to stores. This cycle is complicated by components being sent across borders and then back again to be tested and repaired with all the associated issues of customs and paperwork, and by components being sent back to the OEM for upgrades or modifications with all the repair and certification paperwork, and all the information required by the operator or component supplier to track and trace the components.

These logistics require an airline to invest in several layers of facilities and hardware, including staff to manage the process, transport equipment, and arrange transit via customs and security.

Some components can be repaired only by a very small number of shops in the world. This involves transporting high-value components across borders for repair, and then back again following repair.

"In fact up to 160 individual steps have to be taken between an airline ordering a part, and it being shipped by the supplier," says Ralph Perkins, managing director at Aviation Logistics Network (ALN). "The order has to be placed, its details have to be entered into the airline's accounting system, paperwork is generated, customs and security forms are completed, transport is organised, the component is packaged, and airworthiness certificates are collated and prepared."

The complexity of managing the logistics of shipping rotable components mainly relates to the many stages a part has to go through when being shipped between the airline and repair shop. The customs and security requirements in particular have to be pre-analysed and understood, and the channels used to get the fastest possible transit time analysed and arranged. "We have gathered this experience over years of arranging this process, and we have formulated the large number of steps taken into a set of standard procedures," says Perkins. "Airlines have various options for managing and arranging logistics, but subcontracting this activity to us is an option; and can be used as part of a third-party PBH rotable support contract."

The way parts are managed in transit depends upon their criticality. Parts that are categorised as Go items, or are No-go but a significant number of which are already available in the airline's inventory stores can be consolidated when it comes to preparing shipments. This will simplify the logistics by reducing the number of steps required to ship the parts, and generates savings. "Non time-critical parts have a transit time of four to five days," says Perkins. "The savings for this type of transit can be large when the different number of specialist repair shops is considered. It is a different issue for time-critical parts, since an expedited service is clearly more expensive. Another option is to use a scheduled airline passenger service, or for a courier to personally carry the components on a flight. Passenger airline services are only possible if all the customs and security issues for transit to the country have been pre-analysed and all necessary preparations have been made."

The second main element of maintaining a rotable inventory in-house is the testing and repair facilities and equipment. The variety of component types, combined with the long removal intervals and high repair and test cost of more complex and high-value components means that few airlines have

Following removal, rotable and repairable items have to be tested and then repaired. Up to 20% of removed parts can be in the no fault found (NFF) category. Repair of high-tech components is expensive, and requires high skill levels and a high capital investment in infrastructure.

all the test, repair and calibration facilities in-house for every P/N on each of their fleet types. The test equipment and training for technicians has a high capital cost, so it is uneconomic for most airlines to make the required investment.

Another cost element for rotable inventories is related to providing and operating warehouses and parts stores; and the insurance to cover against fire, theft and damage.

It is rare to find airlines that are prepared to make such an investment in the current economic climate and overall strategy of outsourcing major engineering and maintenance activities. This is even the case for airlines with large fleets.

Management with software

The management of rotable inventories can be improved with dedicated IT systems, such as the component management modules of M&E systems, or dedicated point solutions that interface with M&E systems. Dedicated IT systems perform all the management functions of tracking parts, generating removal intervals and reliability statistics, and keeping track of maintenance records and airworthiness certificates. In addition, they can optimise inventory holdings at each homebase and outstation to provide an airline's required service level while minimising the quantity of rotable stock, and so fine tune the investment in parts.

Examples of dedicated systems for optimising rotable inventory are Armac's RIOsys, The GAINSystems software used by AAR, and Spairliners' Assets Control Enterprise (SPACE) solution, a software jointly developed with Lokad of France.

A specialised system for optimising rotable inventories has to consider a large number of parameters to provide the correct information in terms of the quantity of each P/N at homebases and outstations. "The parameters that we consider when using RIOsys are component reliability, fleet age profile, the cost of each P/N, the forecast demand, aircraft configuration, aircraft utilisation, component criticality, and repair times and variances," says Michael Armstrong, chief executive offer at Armac Systems. "It is also important to consider the demand and supply network, since component delivery times are important when determining stock levels at each home base and outstation across an airline's network. The aftermarket is one source for purchased parts and components that has to be considered.

"Over the past five years, inventory optimisation has evolved, and data integrity is now an important element that allows better decisions to be made," continues Armstrong. "Another development is the emergence of predictive and preventative maintenance for improved short- and medium-term planning. The industry has a challenge to develop a pro-active supply chain to leverage this technology, and change its systems and processes. The predictive maintenance technologies and their application is still embryonic, however. Airlines that invest in data accuracy and analytics to drive completeness and continuous optimisation will gain a competitive advantage, reduced inventory costs, and achieve better asset utilisation."

IT systems will first keep a record of all rotable, repairable and hard-timed components installed on each aircraft. This will be on a tree-based structure and in accordance with air transport association (ATA) chapters and P/N codes. A further complication is that while each aerospace OEM will quote its own P/Ns in the illustrated parts catalogue (IPC), airlines will obtain components from various sources and have alternative P/Ns to the OEMs. All possible parts will be listed in the airline's approved parts list (APL), so there needs to be cross-references between each component installation position on the aircraft and all the approved P/Ns for each position. This process can be automated in an M&E or dedicated rotable management system.

IT systems will not only be able to locate the position of installed components on aircraft, but also list the S/Ns of parts being repaired or held in inventory stores, outstations or in transit. The tracking capability plays other important roles, such as listing the stocks held at each inventory store, and generating alerts to management engineers about the expiry of life-limited parts (LLPs) and about making claims for warranties.

A difficulty with managing rotables and repairables is that, for the several thousand P/Ns installed on a fleet type, airlines can use several hundred different third-party repair agencies. The tracking and status of a component will be lost while it is away for repair and in transit. Information on each component's repair and airworthiness status often has to be manually keyed into a M&E system when the airline receives it from the repair agency.

This problem can be overcome if the airline's M&E system is interfaced with the repair agency's IT system, and is easier still if the data that is exchanged is in XML format.

A benefit of using an M&E system for monitoring the progress of component repairs is that shop floor data collection (SFDC) methods can be used to accumulate man-hour and material consumption data for each component repair. This is useful for both airlines and specialist repair shops.

The use of radio frequency identification (RFID) tags enhances all the relevant elements of component tracking, and can include information such as repair and airworthiness status.

M&E and dedicated IT systems will use all tracking, aircraft configuration, and IPC and APL data to calculate the

stock required at each home base and outstation. Other information will also be required, including: No-go and Go classification; the aircraft type and sub-type flown to each outstation; the availability of components from pools and sharing agreements at outstations; and the required serviceability level to optimise the inventory that needs to be held.

"The GAINSystems software allows us to develop cost-optimised inventory plans," says Colin Craig, senior vice president business development of integrated solutions commercial, at AAR Corp. "The software allows us and our airline partners to invest in the appropriate amount of inventory to maintain operational and service level and reliability."

The RIOsys software considers all factors, including the price of each part in relation to its reliability and likelihood of failure, and its Go or No-go status. Optimisation of stock required is enhanced when the system, for example, identifies and alerts that parts held in inventory are getting closer to their expiry date. These will be hard-timed components, often safety-related parts, that need to be installed on the aircraft if they are to use their legal life limit.

Moreover, systems like RIOsys can be constantly used to re-calculate and assess the inventory required at home bases and outstations. Changes are constantly being made to route networks, aircraft utilisation and service frequencies, aircraft types and sub-fleets, and aircraft components, so a re-calculation of inventory is required every six months to avoid falling short of serviceability levels or having surplus stock. "In the past, re-optimisation was an annual exercise, but it is now a continuous process, because there will be removals, component scrappages, repair delays, spikes in demand, and parts in the wrong location," explains Armstrong.

A further way to re-assess stock levels is to determine which P/Ns should be bought as a priority by analysing the most economic way to maintain or increase the required service level.

Systems such as RIOsys can also perform 'what if' calculations, to calculate stock levels in situations such as a change in route network, operating schedule, or fleet.

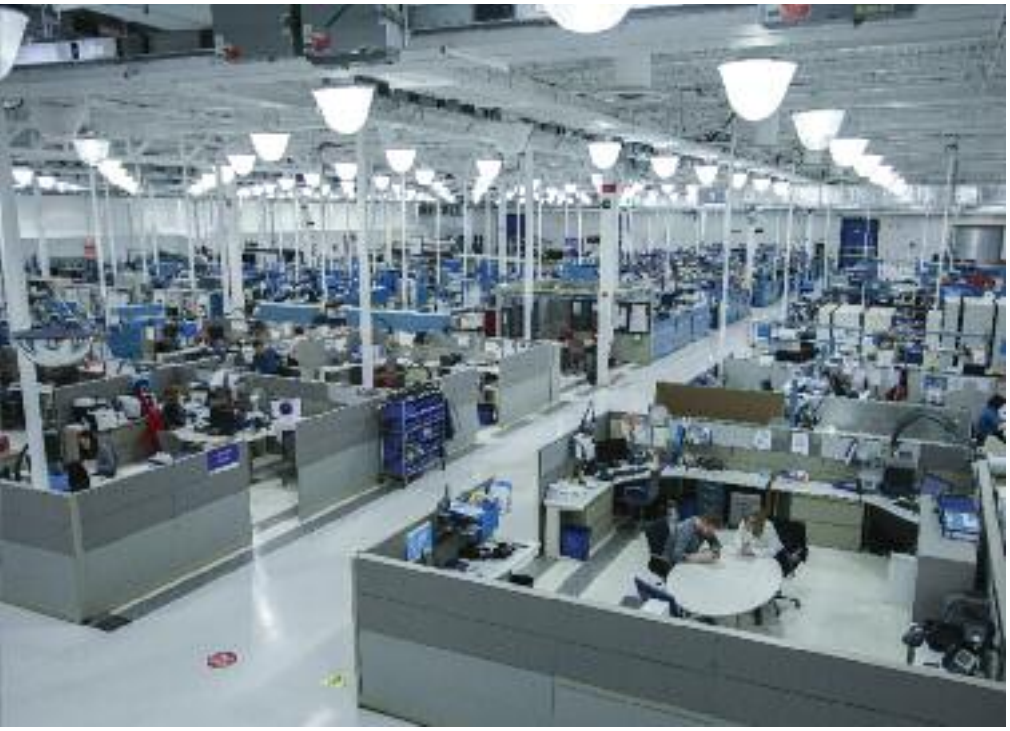
"The SPACE IT tool we use to estimate rotable inventories required for A380 and Embraer E-Jet fleets uses probabilistic forecasting methods, and a large number of parameters to estimate the inventory required," says Cornelius Dalm, head of sales account management and marketing at Spairliners. "This system has been successfully used to increase the airline's service level by 20%, while maintaining the same stock level.

"We also use SPACE for making quotes for PBH contacts, which include stock levels and pricing," adds Dalm.

Armstrong reports a similar improvement in inventory levels when using RIOsys, which is used by SR Technics, Iberia and Thomas Cook. SR Technics in turn uses RIOsys to optimise rotable inventory for 30 of its customers. "We typically see a reduction in rotable stock investment of about 40%, a 20% reduction in operating expenditure, and a 5-10% improvement in on-shelf availability time. This is all while maintaining or even improving service level," says Armstrong. "Other benefits are better transparency in decision-making, better budgeting, and management control."

Further optimisation

Systems are now used to optimise inventory on the main parameters of failure and removal interval, categorisation with respect to necessity of availability, total time for repair and transit to be returned to stores, and the configuration of the fleet and its rate of utilisation to assess the number of each P/N required at each home base and outstation. These features are now being



Total support PBH packages for rotable components will include the repair and management of parts and components. Engineering management functions include inventory requirement assessments, arranging transport & logistics, and managing ADs and SBs.

expanded to further optimise the process.

"First, predictive and preventative maintenance is making the task of assesment less complex," says Armstrong. "The overall effect is to make component failures less random and stochastic. More parts are being classed as condition-monitored, so fewer are on-condition. The increased application of data analytics is helping this process, but there are still elements of the process that are performed manually. These in particular are the decisions made by buyers and inventory planners and managers that are responsible for acquiring parts in the small percentage of situations where service level is not covered, parts are unavailable, and an AOG situation is encountered.

"In these situations the person responsible has to decide whether to borrow a part from an aircraft in maintenance, borrow a part from an airline, wait until a part is returned to stores from repair, or buy the item either new or used on the aftermarket," continues Armstrong. "Each choice has a cost and time implication, and the person responsible has to make a quick judgement, often by themselves, according to their own instincts. Until recently there have been no systems that can show the price of the part, and the time for it to become available for each possible acquisition option."

It would therefore be unclear, in an AOG situation, whether it would be better to buy a part, or borrow one from another airline. The two main parameters here would be price of the part and time for it to become available at the required location.

ARMAC has developed the capability to present all relevant information with respect to each acquisition option. "This has become necessary to further enhance the inventory optimisation process. There will always be situations where components are unavailable," says Armstrong. "This will be due to imbalances in stock, parts being in the wrong place, parts being returned late from repair, or situations where it is not possible to borrow a part. Most part buyers just react in these situations, but RIOsys has added this capability over the past few years."

Rotable support packages

The high investment in rotable inventories, test and repair facilities, and the need to maintain trained mechanics and an engineering team to perform specialist repairs have encouraged airlines to seek ways of sub-contracting some or all of the rotable management and ownership activity.

An increasing number of specialist providers are offering total support packages to airlines, mainly on a PBH basis. The main elements of these include initially determining rotable inventories required for the fleet being considered and its operation, providing the operator with a homebase stock of components solely for its use, providing the operator with access to a pool of stock that is accessed by several other airlines, and managing the repair and overall management of the components.

There are several suppliers of rotable support packages. The main providers in the industry include the largest global supplier of rotables SR Technics, AJW Group, AvTrade, AAR, and Spairliners. Several airline maintenance and engineering organisations also offer such services, and these include Lufthansa Technik and Air France Industries KLM Engineering & Maintenance.

Inventory assessment

The first step in providing a third-party rotable support package is to determine the size of inventory required. This starts with sub-dividing components into the three groups of hard-timed, on-condition, and condition-monitored components.

Assessing the inventory required is an initial process. All three of the main elements that are continually provided can be included in a support package, or airlines can just sub-contract some of them. One example is to pay a third-party supplier for a homebase stock and access to a pool stock. Another option is to own rotable inventory, but subcontract the entire repair and logistics process.

"Hard-timed parts can be excluded from the support package if an airline wants, because their replacement on the aircraft is predictable, and can be timed with an airframe check," explains Boris Wolstenhulme, chief strategy officer for the AJW Group. "Most parts are maintained on an on-condition or condition-monitored basis. The failure of on-condition components is random, and it is this that makes it complex to assess the inventory required."

Condition-monitored components have 'soft' removal intervals established for them, so the inventory of spare units required to support them is easier to predict. "The data analytics and health monitoring technology is pushing more parts from the on-condition category to the condition-monitored category," says Wolstenhulme. "This means there are fewer unscheduled failures and removals."

The key to a rotable support package is meeting the airline's required service level of dispatch reliability targets. Typical service levels are 90% or 95%, and mean parts are available on 90% or 95% of occasions when required. They are therefore unavailable on 5% or 10% of occlusions, and in the case of a failure a No-go item results in an AOG incident.

"Airlines do not specify a single service level, but instead have different service levels for different types of delay and situations caused by a component being unavailable," says Dalm. "A usual requirement is for a service level of 97%

Now in the Americas

Spairliners
Aircraft Component Care

Experts in E-Jet Component Care

Integrated Component Care for
Embraer E-Jet family.

AOG Desk Support
24 hours a day
365 days a year

Call Toll Free Number
+1 866-676-4129

We offer Integrated Component Care programs that guarantee component availability for E-Jet fleets with cost-efficiency and tailored to individual needs.

Our solutions provide you with the important benefits of independent repair shops locally situated in the Americas and the extensive experience of market-leading airline MROs in the E-Jet aftermarket business. With our integrated services and affiliated network you benefit from an increasing scope of local in-house repair capabilities and assets as well as competitive turn-around-times.

Spairliners
Aircraft Component Care

HEADQUARTERS
Spairliners GmbH
Sportallee 54b
22335 Hamburg, Germany
Phone +49-40-5070-65200
Email info@spairliners.com

OFFICE AMERICAS
4101 NW 20th Street
Miami, FL 33142 USA
Phone +1-305-894-5304

www.spairliners.com

A JOINT VENTURE OF:

AIRFRANCE / INDUSTRIES · KLM Engineering & Maintenance · Lufthansa Technik

An element of a PBH rotable support package is providing logistics support. This in turn includes arranging all transport and paperwork related to customs, security and airworthiness documents.

for No-go parts that would cause an AOG, and require the parts to be available within two to four hours. A lower service level of 95% is usually required for a part that would result in a critical delay; and a 90% service level is often required for a schedule when planning for a maintenance checks or for replenishment of home base stock, where a part can be provided in a few days. These service levels are customised for each airline. The service levels vary depending on route network, number of home bases, fleet size, and length of transit delays due to customs and logistical restrictions."

It is gradually becoming easier to prevent AOG incidents because of the change to a higher portion of condition-monitored parts that have predictable soft removal intervals.

While categorising components according to their likely or probable removal intervals is an element of the process, support providers have to consider all issues. "The main criteria include route network, all the parameters of the logistics of transporting components and arranging all associated paperwork, and the airline's schedule of operations with each fleet type," says Wolstenhulme.

Component failure rates and removal intervals need to be as accurate as possible, and this data can be supplied by the airline to the support provider. Data is more likely to be available for an aircraft type the airline has already operated for some years. "We have a large database of component failure rates, having provided this type of service for many years for a range of aircraft types," says Wolstenhulme. "There is a limited amount of data for younger and new aircraft types. It is sometimes also hard to have the data available for used aircraft types, because it is not always known when the components were installed."

Support providers

The AJW Group has several companies that include AJW Aviation, AJW Technic, AJW Leasing and AJW Singapore. "AJW is the new brand name for AJ Walter," explains Wolstenhulme.

AJW Group provides support packages for a variety of airline sizes and aircraft types, but its largest contract is for easyJet's entire operation in Europe for 272 A320 family aircraft. "We support easyJet across several main home bases and 36 line stations across its European network. We also supply its consumable components," says Wolstenhulme.

AJW supports all Airbus and Boeing types in production, and has just signed a 10-year contract with Bombardier to support about 2,500 of its business jets.

AJW has customers on all continents and supports 48 airlines with PBH rotable support contracts that operate a total of 500 aircraft, excluding the 272 that are operated by easyJet.

AAR provides LRU rotable support packages for the 737NG, 737 MAX, 767, 777, 787, A320ceo, A320neo, A330 and A350. It also supports Embraer E-Jets, the ATR 42, and Bombardier CRJ series. These services are provided globally, and it supports about 1,600 aircraft. This makes AAR the third largest provider of PBH rotable support contracts.

Spairliners provides support for the A380 and Embraer E-Jets. Set up as a joint venture between Lufthansa Technik and Air France Industries KLM Engineering & Maintenance for their combined A380 fleet, it has expanded its services to offer PBH rotable programmes to all A380 operators, and has added the Embraer E-Jets.

Spairliners' customers for A380 support include Qantas, Malaysian Airlines, Air France and Lufthansa. It has 11 E-Jet customers, including Air Dolomiti, Lufthansa Cityline, KLM Cityhopper and Kenya Airways. It also provides a standalone component repair service for E-Jet rotables to S7 Airlines in Russia, and a US carrier.

AerFin provides a rotable support package for Embraer E-Jets, with BA Cityflyer based at London City airport its prime customer. BA Cityflyer replaced Embraer with AerFin, which has calls its rotable support product 'Beyond Pool'. AerFin acquired components from ex-Saudia E-170s it disassembled and other sources. It is now the largest non-OEM source of E-Jet rotable inventory.

AerFin's service includes 24/7 AOG, the related logistics of parts, stocks at the homebase and outstations, and the repair and management of parts. Pool stocks are held at AerFin's London Gatwick depot. "We charge a PBH fee that includes pool access, repair and management, engineering management, and logistics and transport," says Chris Hooley, director of component services, at AerFin.

Main elements of a rotable support package are the positioning of homebase stock at the airline's home bases, and providing strategically positioned pool stocks at various geographical locations. A main inventory hub for the support provider for long-term stock adjustments is also added.

While the standard service is to provide access to pool stores and stocks for less critical parts, some airlines prefer to have a closed pool, which is a stock of rotables that is only available to them. "This can only be justified economically for an airline with a large fleet that has a consistent component configuration," explains Wolstenhulme. "A fleet of at least 50 aircraft is required for this."

Payment structures

There are several mechanisms for airlines to pay for each of the main elements of a complete rotables support package. The simplest system is for airlines to pay for the a homebase stock

through a leasing arrangement. Payment for access to pool stocks and stores, and the repair and management of included parts is charged on a fixed rate PBH type of basis. The fee charged would include overhead for warehousing and managing the inventory; and a fee for the repair of the components at all relevant specialist repair shops, and all the transport and related logistics. "We also include the inventory estimating and provisioning service in the PBH fees," says Dalm.

Craig says that AAR offers airlines flexibility with respect to payment mechanisms. Generally, we refer to homebase stock as main base kit, and we charge for this on a monthly lease rate basis that reflects the value of stock held. We can charge either a PBH rate or a fixed fee per month per aircraft for the pool inventory; and then invoice on a monthly and per flight hour basis for the repair, warranty management, and logistics element of the contract."

"The most popular approach for access to a pool of parts, and the repair and management element of the contract is to pay a PBH rate or a flat rate per month," says Dalm. "The homebase stock is usually paid for as a percentage of the value of the rotable stock. The repair and management element of the contract is most commonly paid for using a PBH rate. The repair and management fee will include warehousing and insurance; and the engineering management function of tracking components and generating removal interval and reliability data. The repair and management fee also covers paperwork, and maintenance and airworthiness certificates. We do, however, usually offer a separate PBH fee for the logistics of arranging all issues between the pool stock and the customer.

"Some airlines in the US prefer a closed loop contract, whereby they own their inventories," continues Dalm. "They only use their own parts and components, and sub-contract the repair of the components to us. It is also possible to have time and material, fixed cost per P/N, or a fixed cost arrangement for the entire inventory. These options mean that we can more or less offer a customised service for airlines."

Technical support

An additional element of rotable support packages is technical support, and this can be regarded as a fourth element of these types of contract.

One sub-element of technical support is the logistics related to organising transport, transit through customs and security, and organising airworthiness and maintenance certificates and forms. "We can provide this if customers need it, while others may provide the related logistics services themselves," says Dalm.

The main elements of technical support will be a reliability programme to monitor the removal intervals and reliability of components, update and advise on the appropriate AD and SB status of components, and troubleshooting problem components and systems with repeating technical problems. This last element can often be enhanced when provided by a third-party provider, since it will have experience and data from other airlines. "The inventory levels should also be re-assessed at regular intervals," says Dalm.

AAR, for example, offers a range of additional support products for PBH rotable support programmes. These include technical and reliability management that includes assessment of ADs and SBs, and continual inventory assessment and evaluation.

Additional consideration and arrangements have to be made to the costs related to assessing the inventory required and periodic re-assessment of inventory, and the cost of performing ADs and SBs. - *CHW* AC