Small and start-up airlines find that there are a large number of technical capabilities to have in place before commencing an aircraft operation. Setting these up requires experienced engineers, is time-consuming and expensive for small fleets.

Outsourcing technical aircraft management & line maintenance

Start-up, small and remote airlines have to consider a large range of technical issues in respect of aircraft management when commencing an operation. These include the process of taking delivery of aircraft, providing line maintenance and accessing rotable component support, providing maintenance control for the ensuing operation, having sufficient technical management to keep the aircraft in a state of continued airworthiness during operation, and sourcing maintenance providers.

This requires a large technical department of experienced engineers and mechanics, which will be expensive and difficult for a new or small airline to set up in house. These activities can all be outsourced to third-party specialists that benefit from the economies of scale gained from other fleets they support. Outsourcing also allows an operator to avoid investment in in-house capability and unpredictable on-going costs thereafter.

Airline considerations

There are many issues an airline has to consider in respect of technical management prior to launching an operation. The most obvious of these are all the elements of maintenance: line and base maintenance, component repairs and management; and engine maintenance. All of these can be outsourced to maintenance providers, which must not only provide continuous airworthiness compliance, but also maintenance costs that are acceptable and economic. Airlines have the choice of sourcing maintenance from single or multiple sources.

Component maintenance can be sub-divided into several areas: the heavy components of landing gears, thrust reversers and auxiliary power units (APUs); hard-time components repaired during base airframe checks; and LRUs. Components in the first two categories have to be repaired at a relatively infrequent level, but LRUs are continuously being removed from aircraft as they become unserviceable, while serviceable items are being returned to inventory stores. Unserviceable units would be removed by line mechanics and sent to the LRU provider for repair and later returned to the inventory stores. This process has to be coordinated and managed.

In addition to maintenance, airlines need to provide maintenance control during operation. This provides the link between operations and line maintenance, so that technical defects are recorded, monitored and dealt with as they occur during service and operation.

Airlines also have to consider the technical management of the aircraft. This starts with the recording of each aircraft's accumulated flight hours and cycles and calendar time during operation. Each aircraft's utilisation then has to be compared in relation to the maintenance programme, which also has to be selected and monitored to maintain compliance.

All maintenance tasks then have to be planned, while the lives of hard-time components have to be monitored and administered. The airline also has to monitor the reliability of its fleet, engines and components. All airworthiness directives (ADs) and service bulletins (SBs) that are issued must be followed and considered in relation to the fleet, as must its modification status. The performance of engines also has to be monitored and the data used to plan engine removal timings and maintenance events. Technical and maintenance records have to be kept.

Start-up and small airlines have to consider and plan all these activities, and the total number of personnel required will be large. Economies of scale are reached with large fleets, while small fleets will need to be managed by a disproportionately higher number of management engineers. This will result in high costs, and also requires a lot of resources and time to set up.

It therefore makes sense for small and new airlines to outsource all these activities to a specialist provider. These services can be paid for on a fixed rate per flight hour (FH) or month to provide airlines with a predictable cost. These items have to be considered in detail.

Aircraft acquisition

The technical management of aircraft starts with the acquisition process. "Small airlines should make special considerations for aircraft they are acquiring," advises Rick Fieldwick, operations director at Flyertech. "Airlines considering aircraft for acquisition must review all technical and maintenance records, and how maintenance status compares with the maintenance planning document (MPD). The status of hard-time components must also be considered, including life limited parts in engines. The aircraft's AD and SB status also has to be examined, as does its

One of the first issues to consider for a new operation is the supply and repair management of LRU rotables. Third party contracts can vary widely, and experienced teams can minimise the inventory required, as well as team up with other operations to achieve the best economies.

physical condition. Specialists can be called in to do borescope inspections on engines."

The overall maintenance status is used to negotiate an appropriate lease rate or purchase value with the vendor. This negotiation is the one of the first steps that small and start-up airlines should sub-contract to technical specialists. Some maintenance may be performed on the aircraft prior to delivery, but if any is left outstanding a credit will be given in respect of this against the aircraft's purchase price or first few lease rentals.

"It is usual in many lease contracts that the delivery requirements stipulate that the aircraft is free of major maintenance for a period of 2,000FH or one year," explains Fieldwick. "This means no major airframe checks, engine removals or component repairs will be required during this period that would interrupt operation. Once an agreement is reached between vendor and airline on the credit for maintenance status, the airline can take delivery of the aircraft. Smaller items, such as a battery check, have to be considered and it is preferable that these are also fresh at delivery. Credits should also be provided for items that are not fresh. We can negotiate a satisfactory technical or commercial solution for airlines in terms of credits against lease rentals."

Another important issue for airlines is lease return conditions," continues Fieldwick. "Many lease agreements stipulate that aircraft are handed back to lessors according to the MPD. This can be expensive if the aircraft has been operated under a customised maintenance programme and the lease term is short. The aircraft will have to go through bridging maintenance at the lease end to put it back onto the MPD, and so require a large amount of maintenance for which the lessee will have to pay. Selecting the maintenance programme at the start of the lease therefore requires technical advice."

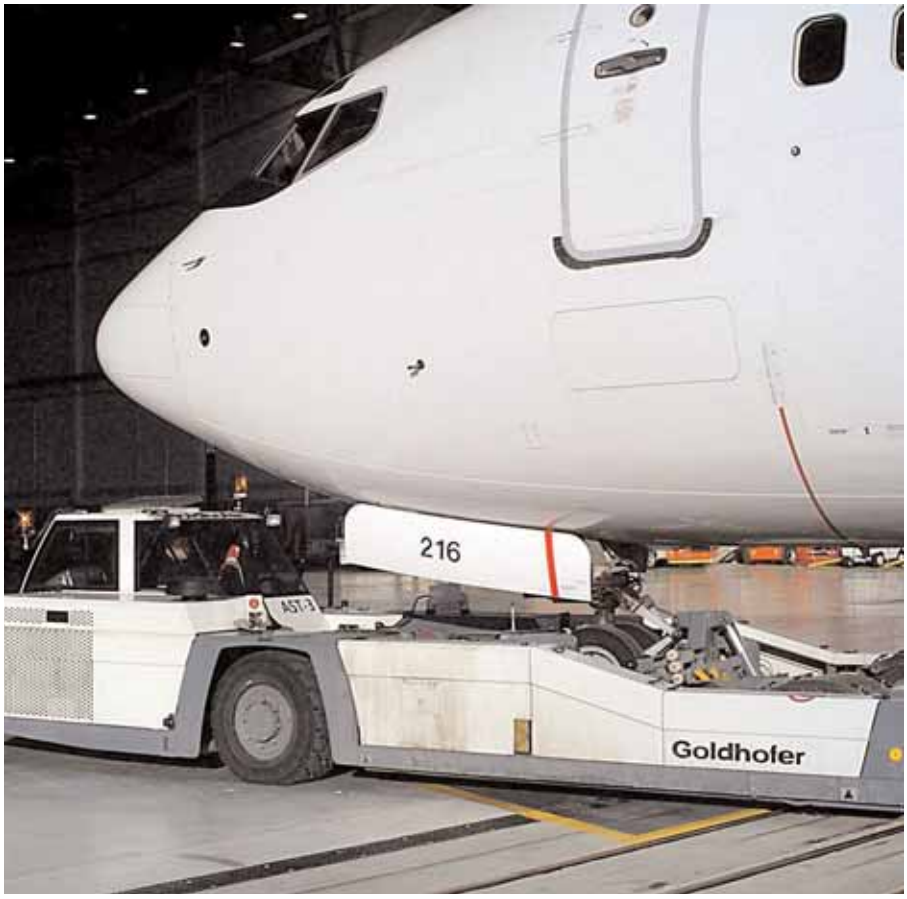
Starting operations

Although airlines can outsource many of the technical activities required to maintain a reliable operation, they nevertheless have to meet minimum legal requirements, that the airline has a chief executive, technical director and quality manager. "Most start-up airlines are based on the low-cost model and so look to have a minimal number of staff," comments Flip Martens, sales director at KLM Engineering & Maintenance. "The regulations that stipulate with what a European airline has to comply are laid out in Part M of EASA. These say the airline is ultimately responsible for the aircraft being in a continued state of airworthiness. Part 145 lays out the requirements with respect to maintenance, but an airline is of course allowed to sub-contract these activities. This activity can be given to a third party, and it is better if the third party has its own Part 145 approval. This third party is a service integrator in that it integrates all the technical requirements and activities for the airline, and can either do these activities itself or sub-contract them to other maintenance providers. The service integrator has to comply with the operator's Part M requirements. For example, KLM Engineering & Maintenance would have to comply with the equivalent of Kenyan Part M requirements if it was the service integrator for an airline in Kenya.

"The service integrator's functions extend to airline management levels," continues Martens. These are providing maintenance control, maintenance planning, engineering and aircraft technical management functions and keeping technical and maintenance records. It is possible in some cases for an airline to benefit from the service integrator's extended maintenance intervals in its maintenance programme or the same Etops clearance for an aircraft type.

"The airline requires a minimum of three people," continues Martens. "The first of these is the technical director, who has overall responsibility for the fleet. The second is the engineering director, who is responsible for maintenance control, reliability and maintenance programmes, and engineering management of the aircraft. The third is a quality manager, who is independent and makes sure the service integrator complies with the Part M requirements, as well as monitoring quality indicators such as technical despatch reliability and aircraft utilisation. All other activities can be handled by the service integrator."

The legal minimum requirements with which an airline has to comply vary around the world. While European carriers have to comply with JAR Ops 1/EASA Ops 1, airlines in the US have to comply with FAR Ops 1. "There are variations between European countries. In Switzerland the minimum requirement is just one person, but Germany requires airlines to have more" says Saad Khedher, head of technical sales at LTU. "As an example, we provided the technical director of Belair in Switzerland with an on-line system for him to check the status of his aircraft. We have our own computer system called PROTEMA that



Line maintenance requires up to 25 experienced mechanics at an operator's homebase that is commencing a daytime operation with a fleet of five aircraft. Additional staff are also required for spares logistics and maintenance control. These all have to be experienced. An airline can only develop its own line maintenance and maintenance control capability over an extended period.

manages all maintenance activities, and the technical director of Belair used it to monitor his fleet. This was in terms of day-to-day activity, list of deferred defects, short- and long-term maintenance status, and status with respect to ADs and SBs. This system allowed the technical director to provide information to the authorities whenever they enquired. Besides this, we provided all technical services."

Outsourcing considerations

Airlines have to consider maintenance activities, maintenance control and technical management of aircraft. "A service integrator can centralise the outsourcing of these activities," says Fieldwick. "We have done this for several of our customers, including Armavia in Armenia. We started by assisting them in acquiring two ATRs and with their delivery process. We went on to source an LRU support supplier, a component repair shop, a line maintenance provider, an engine shop and a base maintenance support provider. We also provide all technical management services. All these activities need to be monitored and controlled, so it is best for a service integrator, as a single point of contact, to manage them for the airline.

"Airlines are often encouraged to outsource all their different maintenance activities to one supplier, but we consider it better to tender different elements of maintenance to different sources to achieve an overall lower total aircraft maintenance cost," continues Fieldwick.

Line maintenance

Line maintenance activity can broadly be divided into that done at the operator's home base and that done at outstations. The most important is line maintenance at the home base, since this accounts for the largest part of the work. Airlines can often use a local agent to provide line maintenance, although airlines based at more remote airports may not have sufficient local suppliers. "One of our customers is Vim Airlines, based in Moscow. This airline operates the ex-Condor 757 fleet and uses a local agent to do its line maintenance," says Khedher.

Local suppliers are a cheaper option for an airline in many cases. A specialist maintenance provider would have to station line mechanics at the airline's home base, who would require accommodation and subsistence, and may also have higher salaries than local suppliers. Many specialist maintenance providers are West European or North American, while many small and new airlines are located in East Europe, Russia and the CIS, Africa or other remote regions.

Small and start-up airlines may consider organising their own line maintenance activities, but this can be complex and expensive. "First, an airline would have to deal with the complexities of getting its own Part 145 maintenance organisation," says Fieldwick. "The labour requirements for an airline's own fleet are quite high, especially for small fleets. The number of line mechanics varies according to whether the operation is a short-haul network with flights operating during the day. Transit checks would be done between flights during the day, and daily checks at night. A long-haul operation would have aircraft operating at night, and so transit and daily checks would both have to be done on the ground at the home base between flights. In some cases the daily checks would have to be done at the outstations. The minimum requirements for a two aircraft fleet are two people in each shift, with four shifts per day, meaning a total of eight line mechanics. One more line mechanic would be added per shift if a third or fourth aircraft is added to the fleet, taking the total number of mechanics to 12. Line maintenance would still be sub-contracted at outstations. A fleet of five 737s used on short-haul operations would be five mechanics used on each of the four shifts taking the total to 20. A fleet of two 767s or A330s for long-haul operations would require four mechanics on each of the four shifts taking the total to 16. The cost of providing these would be about £40,000 ($70,000) per mechanic each year plus the cost of tooling and equipment."

Martens agrees that the general rule is that two technicians are required on site at the home base during the day for

turnaround checks for a fleet of two aircraft. "More people are required for overnight checks for short-haul aircraft," says Martens. "In some cases an airline may have a mechanic on the aircraft and be supplied with a flyaway kit. This will include items such as starter valves and wheels. In many cases a lot of items can be left out of the kit if the airline is a member of the International Airline Technical Pool (IATP).

Some airlines may intend to have their own line maintenance activities, and need to train line mechanics on the job during the early phase of an operation.

"We may supply an airline based in a remote area, for example Kenya, with a core of three or four of our own line mechanics and then the remainder would be local employees that we train on the job," says Martens.

"Line maintenance also requires ground service equipment and tooling in addition to qualified line mechanics," says Khedher. "We can provide mechanics for start-up operators, and training courses to get them qualified and give them on the job training. We estimate an airline would require 20-25 line mechanics at its home base for a small fleet of three aircraft operating a 24-hour operation. This number would be spread over four shifts, since some would be required for overnight checks. Four mechanics would be required for the morning shift, another four for the afternoon shift and six overnight for daily checks. The remainder would be off duty or be spare mechanics for dealing with aircraft-on-ground (AOG) situations."

LRU support

Line maintenance goes in hand with acquiring LRU component support. There are many suppliers of LRU rotables to choose from. "We get quotes for airlines from a range of suppliers, and select the most economical and best service," says Fieldwick. "LRU rotable support is supplied to airlines on the basis that they are supplied with a home base stock and have access to a pool of remaining items. The parts in the home base stock are items with high failure rates or that are essential to operating the aircraft. All other items can be accessed from the pool. Airlines can pay fixed rates for leasing home base stock and having access to pool stock, plus fixed rates per FH for repair and management of parts."

There is also the issue of material logistics. Unserviceable parts that are removed from the aircraft have to be sent to the LRU supplier or repair agency for testing and repair, and have to be tracked. Repaired items coming back from the repair shops and LRU suppliers have to be checked for serviceable tags and correct paperwork, and returned to the warehouses. This activity also has to be tracked and recorded. Serviceable items must be taken from the warehouse or store and passed to the line maintenance department for installation on the aircraft. "This activity requires several personnel, and can often be done by an airline's own staff. It may only need one or two people for a small airline," explains Khedher.

Material logistics can also be outsourced. Fieldwick says it would require one materials purchaser and a storeman, each costing about £30,000 ($50,000) per year.

Maintenance control

The other consideration in parallel with line maintenance is maintenance control. This involves engineers dealing with technical problems that have arisen during flights, and determining when, where and how to deal with them.

"This is a relatively small requirement for a small airline, since an engineer with a radio can be sufficient for many minor operations," explains Fieldwick. "This may not even be required for a fleet of just two aircraft, and the airline's technical director can deal with these situations as they arise. An airline needs to start considering a maintenance control department when its fleet size gets to about 10 aircraft. One person can handle three to five aircraft, but a small team is required for a larger fleet. These co-ordinate information and activities between the team of engineers providing technical management, the line mechanics

and the spares providers or logistics personnel."

Khedher claims that maintenance control can even be done remotely by the service integrator. "We provide maintenance control for Vim Airlines using our maintenance control centre in Dusseldorf," he says. "LTU takes care of Vim Airlines aircraft after they have left their home base. Vim Airlines has its own maintenance control centre for problems that arise at the home base, but the LTU maintenance control centre takes care of problems that arise at outstations."

Fleet technical management

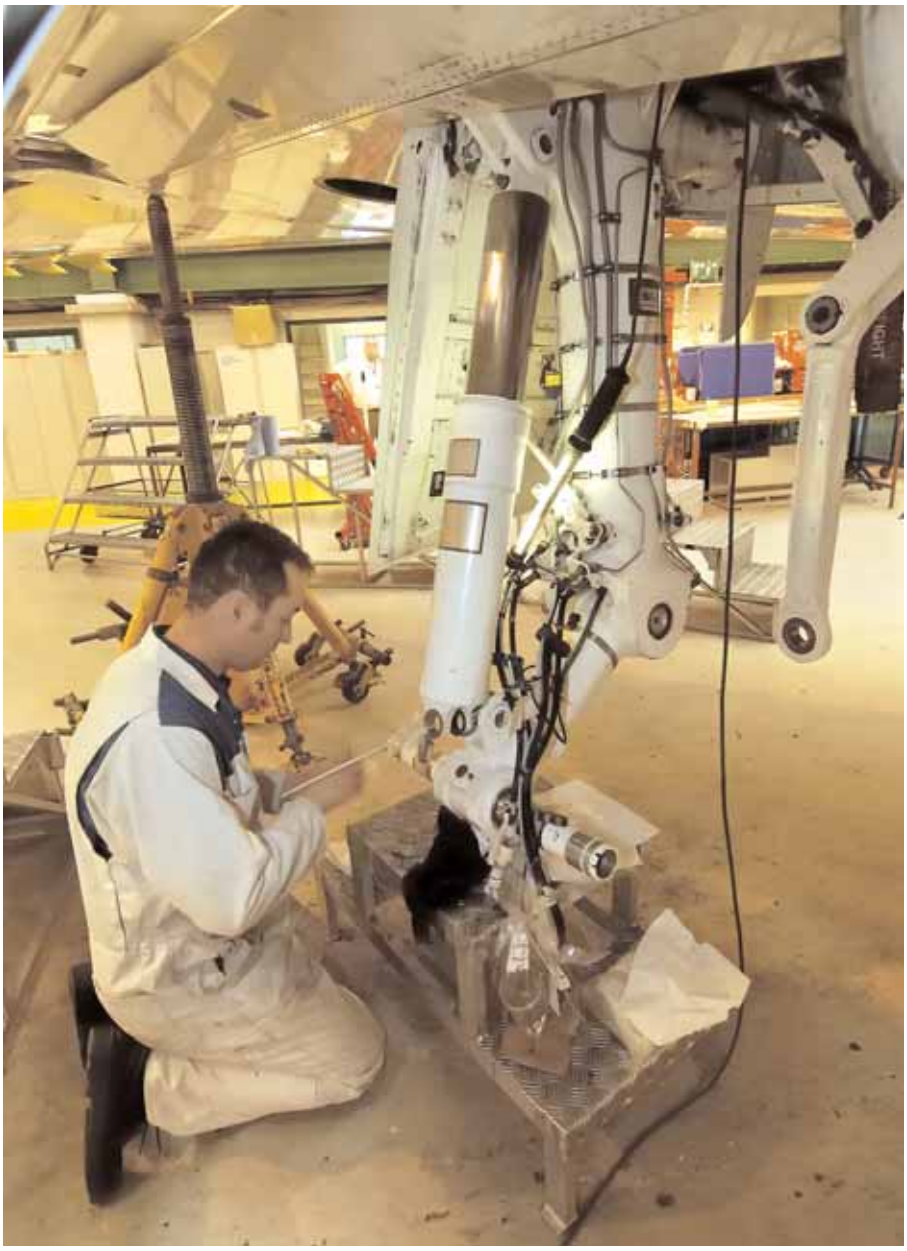
Fleet technical management is one of the largest considerations for small and start-up airlines. This requires a large group of experienced engineers, and will be the most difficult area of aircraft management for a small and start-up airline to do in house. While some small airlines can control their own line maintenance activities, the objective and function of fleet technical management is to keep the fleet in a state of continual airworthiness.

Fleet technical management involves many issues, including monitoring of aircraft utilisation and calendar time, development and control of a maintenance programme, planning of maintenance tasks and checks, administration and monitoring of life limited and hard time parts, aircraft reliability analysis, technical and maintenance records management, evaluation of ADs and SBs, and engine health monitoring and maintenance management.

Khedher explains that there are several things an airline has to have in place before starting an operation. "The first of these is a maintenance programme which has to be approved by the airline's local aviation authority, or the authority of the aircraft's country of registration. This development of the maintenance programme and approval process requires specialist engineers," Khedher explains. "Maintenance records also have to be kept by the operator, although this process can be delegated to the maintenance provider. The operator should still have access to maintenance records so that they can monitor their aircraft and provide information to their local authority whenever they request it. We do this with our customers using our PROTEMA system. The maintenance records are shown on our IT system, but we also keep hard records as required.

"Airlines also have to consider modifications and maintenance workscope definitions, and this planning can be done by the technical services provider. The technical services provider can also negotiate contracts for LRU support, component repair, engine maintenance contracts and spare engine provisioning on the customer's behalf," continues Khedher. "A relationship also has to be maintained with the airline's local aviation authority."

A further consideration is maintaining an up to date library of maintenance manuals. There are many different manuals to consider, including the aircraft maintenance manual (AMM), troubleshooting manual, fault isolation manual (FIM), illustrated parts catalogue (IPC), configuration deviation list, minimum equipment list (MEL), and many others. This can constantly change and an airline's engineering department is required to have several engineers engaged in ensuring all the manuals are up to date. "Airlines have to buy all the relevant manuals when starting an operation with a new aircraft type. In the past all manuals were hard copies and a large number of books and binders were kept. Manuals are now available on-line via the manufacturers' software. On-line manuals are always up to date, and are also available on CD-ROM and in pdf format," explains Khedher. "Boeing's manuals are sourced through myboeing www.fleet.com and Airbus manuals through www.aols.com. Airlines purchase on-line access to manuals and sign on-line for the documents. Airlines have to buy manuals on behalf of a technical services provider. While the on-line system has simplified it for many airlines, not all parts of the world have access to the internet yet. We provide all documents on laptop computers that are carried by the pilots so that they are available at remote



Fleet technical management covers a broad range of activities and is only cost effective for an airline to do in house when its fleet exceeds 20 aircraft. A small airline would need up to five engineers for a fleet of 10 narrowbodies or six widebodies. The same service can be provided by specialists, that manage large numbers of aircraft, using fewer personnel than an airline would need to employ.

outstations. Electronic manuals are also used by our customers Vim Airlines and Blue Panorama."

Another major issue for airlines to consider is reliability monitoring and engine health monitoring. Khedher estimates that a fleet of three aircraft might require seven to nine engineers for these tasks, depending on what software and communications they have at their disposal. "This again is high in relation to fleet size, and illustrates how a service integrator can reduce this cost with its economies of scale," says Khedher. "LTU does this function remotely and uses just two or three people. We charge a fixed fee per month that is related to fleet size. Economies of scale are realised with an increase in fleet size, but of course the number of people required is affected by the different fleet and sub-fleet types and the style of operation. Airlines have to carefully consider the aircraft they are acquiring. Used aircraft from different sources or aircraft supplied by different lessors often have different configurations. This not only applies to engine types and variants, but also to interior equipment, avionics and all different levels of rotable parts. This alone can incur large costs in getting aircraft standardised after they enter the fleet, but it also increases the number of engineers required to manage the fleet."

"Fleet technical management might be cost effective for an airline to do in house when its fleet size exceeds 20 aircraft," claims Fieldwick. "Between two and five engineers would be required for five or 10 737-300/-400s, and the same number of engineers for between two and six 767s or A330s. The cost of the engineers would be about £40,000 ($70,000) per year, but they would also need an IT system to assist them. All of the above can be outsourced to Flyertech for a fee of about £24,000 ($42,000) per aircraft per year for the narrowbody aircraft and £30,000 ($52,500) for the widebody aircraft." Flyertech provides technical management services for up to 50 aircraft for 10 different operators. "If an airline chooses to do technical management in house it will need to have specialist airframe, avionic and powerplant engineers," explains Fieldwick. "It would also require data entry personnel to input operational and maintenance related data into computer systems. Technical fleet management also requires the keeping of technical and maintenance records, reliability engineers, maintenance programme engineers and a technical services manager."

This whole activity not only requires a large team of experienced personnel and offices, but a computerised control system for managing the fleet. There are many products on the market, including MIRO Techology's AuRA, Ultramain, MXi, TRAX, and Avexus. Many maintenance suppliers have also developed their own systems. This includes LTU's PROTEMA system. Flyertech has developed its own in-house system known as FAME.

This alone will be expensive for an airline to invest in, and the operation of a fleet technical department only becomes economic with large fleets. "This is because a specialist engineer is required for each function, regardless of fleet size. As an example, an avionics engineer can manage a large number of aircraft, but one is still required for a smaller fleet of five," says Fieldwick. "There are examples where an airline with about 20 aircraft had a team of 15-20 engineers for fleet technical management, because of the need to have each type of specialist engineer. In contrast, we have 15 people managing in excess of 50 aircraft. This illustrates the economies of scale that are possible."

Martens makes a similar point with respect to the number of people a service integrator requires compared to an airline managing the process in house. "We supply technical fleet management services by having engineers based at the customer airline's home base. A fleet of just two long-haul aircraft requires 10-15 people, including a department for maintenance control. The same number of people, however, can handle up to 20 aircraft." AC