MRO software is expensive and its implementation can take many years. System users need to be clear about targeted savings and improvements, although many projects start with no real idea of how and when the return will be achieved. The potential savings are examined.

Making MRO software projects deliver

Selecting and implementing a new maintenance and repair operations (MRO) information technology (IT) system should be supported by a clear business case. The starting point is to set out the source and basis of projected savings, as well as operational improvements. Once the project is implemented, the forecast improvements should be measured at regular intervals so that further IT investments can be justified. These measurements should also be used to improve the new processes and functions in the new system. Where should executives look for savings, and which ones are likely to yield early 'quick wins' for such IT projects?

There are a number of cost savings to be made in airline maintenance and engineering functions. The chart *(see table, page 46)* shows the main cost areas that have yielded the biggest savings from applying integrated IT solutions.

The first two groups relate to materials: inventory ownership; and direct material costs.

Inventory ownership

Inventory holding has always been used to gauge efficiency. The objective is to hold the minimum of stock without impacting the operation. IT systems can help in four main ways. The first is a classic work-in-progress (WIP) reduction. The less material is tied up in the production process, the less stock needs to be purchased. Modern systems provide visibility of WIP status and the repair of rotables can be accelerated. Switching from legacy IT systems to modern ones can reduce inventory by up to 30%.

The second way is parts provisioning. Modern systems are more sophisticated at forecasting demand, and revise these forecasts and set the stock levels at their optimum point.

The third way is parts configuration and standardisation. This has previously been examined *(see IT strategies for aircraft configuration management, Aircraft Commerce, February/March 2005, page 47)* and the configuration management task has been shown to be complex. Modelling tools exist in modern solutions that can reduce the errors in ordering and holding the wrong part.

The fourth saving comes from identifying and eliminating surplus stock. "A good example of how quickly a new MRO system can pay off is in material management," says Ronald Schaeuffele, chief executive officer at Swiss AviationSoftware Ltd. "An operator with a fleet of 30 aircraft implemented our system, and the software recommended a sell-off of $2.5 of surplus inventory within a month of going live, after making a physical stock-take, looking at previous consumption data, and forecasting future demand."

Direct material costs

There are three main ways of reducing direct material costs.

The first involves improved engineering and reliability management in the maintenance programme. As shown *(see chart, page 48)*, the frequency and content of maintenance tasks affects total costs. Poor maintenance planning and work content will increase delays and cancellations, negating any improvement from extending check intervals.

Airlines often overmaintain their aircraft, and complete tasks well within their allowable intervals. They also perform redundant tasks. Some airlines never alter an aircraft's original maintenance programme, due to a lack of data or an inability to monitor reliability trends. Modern IT systems can provide the feedback necessary to allow an airline to lower costs by reducing direct material cost. Aircraft age and change configuration, so this target will move over time. Systems must provide continuous feedback to allow the minimum cost target to be maintained.

The next sub-category is warranty management, which can provide one of the quickest returns for an IT system. A modern relational database can advise users of opportunities to claim against warranty contracts. Data on actual component and structure performance is measured against contract data that is stored for the components, and variations are measured automatically.

The final sub-group of direct material costs that can yield savings is loan and pool management. Component pooling is becoming more common, but it is a complex management challenge. Modern systems can accommodate this complexity and avoid unnecessary pool costs. They track parts in and out of the pool, as well as contract costs.

A typical situation involves loan parts that are sometimes fitted in an emergency aircraft-on-ground (AOG) situation by borrowing from another airline. The costs can initially be small, but they grow exponentially if the part remains on the aircraft. One recent example from a BAe146 operator involved a borrowed flight management computer that was never replaced with another unit. The loan costs were never tracked and the airline ended up paying three times the list price of the component in loan charges before realising the situation.

Labour cost savings

A third contributor to cost savings is through reduced direct labour costs. This falls into three sub-categories.

The first is maintenance programme improvements, which is the same as

material management above. The second is more effective scheduling and control of engineers carrying out the maintenance tasks. The third area is the efficiency of engineers themselves, largely as a result of better provision of task card information and troubleshooting tools in an electronic form, linked together to provide quicker navigation. This includes access to documents like the aircraft maintenance manual and illustrated parts catalogue. Studies show that labour improvements can achieve savings of up to 40%.

Reduced overheads

The last main area where savings can be made is indirect or overhead costs, largely from cost reductions that come from removing non-value-added-tasks.

The first saving is due to the provision by modern MRO IT systems of single point-of-entry, validation of data, pick-list data entry rather than free format and process-driven flow of screens to guide users through data entry. Modern relational databases provide much easier data access and manipulation for management reporting and key performance indicator production. Less management time is spent chasing data from various systems to collate and produce management reports.

The second area of overhead savings involves passing integrated financial data across to accounting systems. Less time is spent gathering and re-entering data into a separate finance system.

The last area is management of non-aircraft assets such as tools and facilities like hangars. Modern MRO systems are fully capable of handling these tasks in addition to the aircraft.

Aircraft schedule operation

The final area of improvement derived from an integrated MRO system comes from aircraft schedule operation. These improvements are a combination of better maintenance planning, better out-of-service management and an improved deferred maintenance item process. The chart *(see page 50)* shows the main steps an airline should take to recover normal operations when something unexpected grounds an aircraft.

First, a modern MRO system will provide a detailed analysis of component reliability to prevent unexpected events occurring.

Second, tighter integration between the aircraft scheduling system and the new MRO tool will ensure that planning processes are synchronised, allowing enough time for preventative maintenance.

Third, modern systems will manage deferred maintenance more effectively, preventing the build up of deferred items on an aircraft.

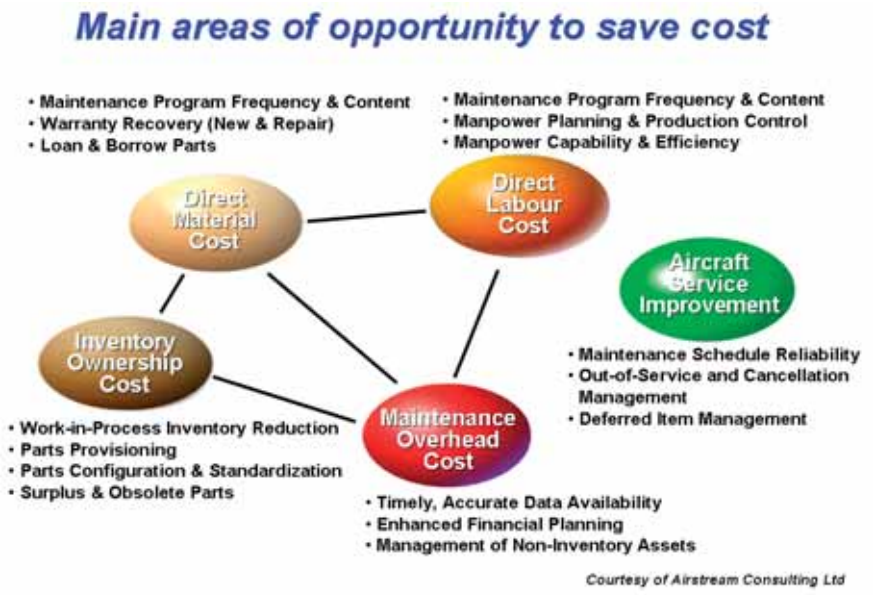
Finally, a modern MRO system will ensure the speedier delivery of parts and tools to the right place when they are needed to fix a failure. Studies show that an airline should expect a reduction of up to 15% in unplanned downtime.

Materialising savings

According to a leading IT consulting company, The Aberdeen Group, the best companies are leveraging Web, mobile, and machine-to-machine (M2M) technologies to better synchronise the four key pillars of supply chain management: process, people, parts, and data. A survey conducted in March 2006 looked at the main challenges faced by organisations with complex supply chains. The results showed that the biggest factors troubling management teams were lack of data (72% of respondents) and lack of systems integration (65% of respondents). These are common complaints in any aircraft maintenance department.

"We estimate an airline with a fleet of 35 aircraft will have a parts inventory of $70 million, for which a tracking system can generate annual savings of up to $1.6 million through improved warranty claims and other savings," says Mike Hickey of US-based IGTA. "Many airlines had poor or no data on the reliability of their components, so they were forced to keep an excess of inventory, often buying parts in an emergency if staff did not know exactly where parts were. These parts were then rarely sold again.

"The reliability of components goes in hand with no fault found (NFF). The occurrence of NFF on removed items can be as high as 50% of removals, so it has a huge impact on inventory required," continues Hickey. "NFF is a frequent occurrence with modern aircraft, since lack of knowledge of a new aircraft by line engineers contributes to components being incorrectly removed. NFF can be reduced by using various techniques to isolate faults. The problem with NFF is that it is warranty-related. Although the



Areas of cost savings that are achievable with new MRO software vary between organisations. In most cases one of the largest areas is reduction of overheads.

OEMs pay for repairs of components under warranty, the airline has to pay for the testing and transportation costs of NFF parts under warranty. One way to reduce NFF is by tracking parts and vendors with the worst NFF record to identify the root cause. Good knowledge by line mechanics also makes a large contribution to minimising NFF. Training line mechanics in troubleshooting to find other possible faults is a requirement for reducing NFF. While certain climatic conditions can increase the rate of NFF, there are also rogue units which cause problems. This is one reason for using systems to track individual components."

Loan items are another recurring problem at most airlines. "Without realising it, loan charges can mount up," says Schaeuffele. "Some of our customers have lost track of loans and paid five times the purchase price of the part because they left a loan item on their aircraft. Good loan management can reduce rotable costs by 1-3% of total annual budget, representing an easy quick win for a new IT system like our AMOS system."

Material costs can account for 20-30% of total maintenance costs. Airlines considering a modern IT system should expect inventory savings of 5-25%, based on various industry studies. Of course, if the airlines' starting point is poor, then the percentage will be higher. The savings will not be realised immediately, but some are worth focusing on. "Improved warranty management can save MRO organisations millions of dollars every year, and is generally an area ripe for improvement," says Chris Reed managing director from Trax. "One of our customers, AirTran, claims to have saved $5 million over five years just on better component repair warranties." These savings can obviously be significant and can easily pay for the initial investment in an IT solution.

Material management starts with good spares provisioning which can be an extremely complex process. Almost 90% of spares provisioning is unpredictable, and therefore difficult to manage. The complex parameters associated with spares provisioning result in a problem with millions of variables. Without sophisticated, dedicated tools the spares planner has the impossible task of provisioning for spares in this complex environment, resulting in poor fill rates due to shortages, poor dispatch rates of the aircraft and extended AOG downtime. There is also a tendency for over-investment because of surplus and dead stock and even continued purchase of that dead stock. Improvements in stock holdings of 15% are usual after the introduction of a new integrated system. Material distribution and handling is the next big area of savings. Efficient receiving and shipping management can remove a day or more from an item's turnaround time (TAT). This can be worth 2-3% of the total material budget and is another saving opportunity.

The management of part movements through a dispersed airline enterprise is complex. Deciding which parts to place where, and when, can seriously affect stock levels by as much as 10%. Overall, this makes it possible to reduce stock by 12%, saving several million dollars. As well as the improvement in handling and distribution, simple tasks like stocktaking can see significant benefits. Good physical inventory management, using modern IT solutions that provide cleaner data, can realise a 1-2% reduction in inventory costs and significantly reduce the overhead running costs of managing the warehouse. These cost savings alone could pay for a modern IT system over a period of three years.

Trimming the fat

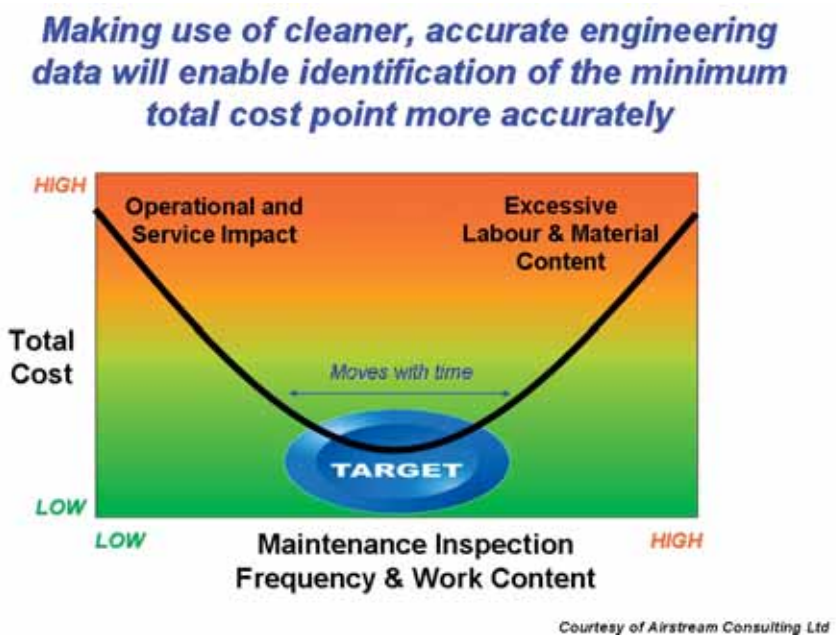
The third big area of benefit is a knock-on saving in procurement. Having more accurate, trustworthy forecasts means that stock can be bought more cost effectively ahead of time.

The final big winner is safety and quality. Modern IT systems generate much greater traceability and auditability, and are also likely to prevent the issuing of an invalid or obsolete part to a work order, something that older, fragmented systems struggle with.

Overall, material management is an area in which all modern MRO systems do well. There are even point solutions that can be integrated into legacy systems to produce immediate localised benefits in reducing inventory. Savings of 25% in inventory can be achieved by the best MRO software systems. Achieving these savings relies on a management structure. Computers themselves can never make the savings. Point solutions like ARMAC's are good at trimming the fat as close to the bone as is safe and economic. "RIOsys can increase fill rates and service levels by 20%, while reducing spares inventory investment by 40%," claims Micheál Armstrong, chief executive officer and founder of ARMAC. "These benefits and savings are achieved without any additional capital expenditure as the existing investment is leveraged."

Control and visibility are paramount to reducing costs. The TAT is vital to keeping overall costs low by ensuring a reduced amount of safety stock is needed to cover each component as it lies 'dead' in the repair loop. If days can be taken off repair TATs, and good control is exercised over repair quotes to actual bills, then savings can be made. Pooling is becoming a preferred alternative to direct repair management at a vendor. Unserviceable parts are simply put into the pool and repaired serviceable parts are taken out.

"Our solution supports pool management, which is a growing trend in aviation," says Jamie Cid, marketing & business development executive at Ramco Global Aviation Solutions. "Stock can be segregated and ownership controlled. The solution enables MRO service providers



Frequently airlines over-maintain aircraft. Mostly this is due to inaccurate and insufficient maintenance data from existing systems.

to enter into special contracts with their customers. Under these contracts the core items belonging to these customers can be pooled together and maintained in stock. The solution also supports exchanges of core items between various trading partners. All maintenance records are tracked before and after exchanges, depending on the type of contracts. All the fees, costs and invoices associated with pool transactions are automatically tracked, which can save airlines thousands of dollars a month."

Producing savings

As the chart shows *(see chart, this page)*, planning and engineering can work closely together to ensure maintenance costs are kept to an optimal minimum. This is illustrated by taking a theoretical inspection task that is carried out every 1,000 flight hours (FH) and costs $18,000 each time. If an aircraft flies 12,000FH per year, this task would be performed 12 times a year if 100% of the interval were utilised each time. In other words, the task yield would be 100%. This is unrealistic, however. If only 92% of the interval is used, the task would be performed on average every 920FH, and over the course of a year it would be done 13 times. So for one aircraft another $18,000 per year would be spent on this task. If a task yield of only 75% is achieved, the task would be performed an extra four times a year and a further $72,000 per aircraft would be spent. This is close to $750,000 for a fleet of 10 aircraft each year, just for this single small task. Multiplying this by all the regular small tasks it is clear that good planning can save a lot of money.

It is vital that a task does not exceed its allowable interval as a result of poor planning. Modern IT systems are capable of providing tools to enable planning to get closer to the allowable intervals safely. Some can even recommend an optimum mix of tasks for a specific downtime for an aircraft at a particular location. OEM tools like Airman are also helping to feed better planning data, including early diagnosis of adverse trends and unscheduled faults, so that planned maintenance is not derailed as a result. Cost savings from better planning can be close to $1 million each year.

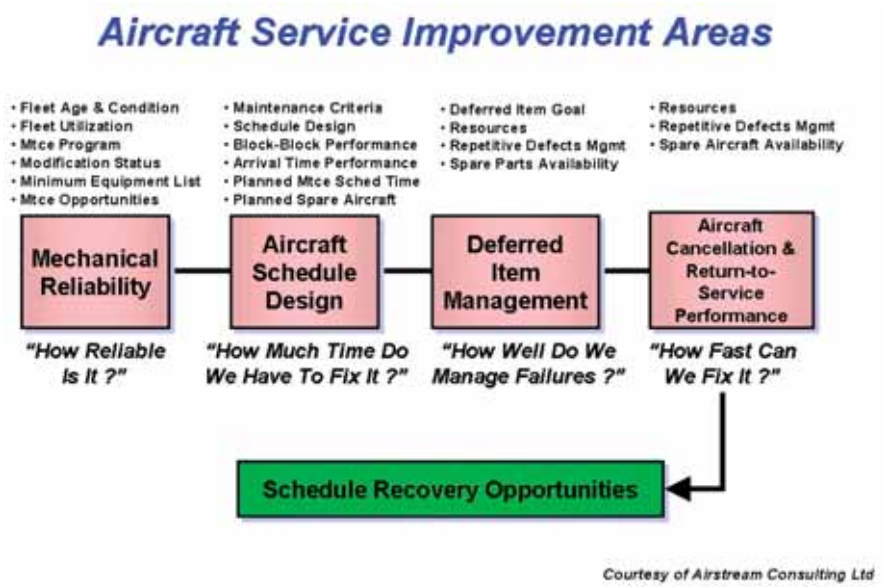
Savings are even larger in production in the hangar. Technology can aid the production management task in several ways. Data collection from, and data distribution to, the mechanic in real time on the shop-floor is crucial to improving hangar productivity. Studies by the US consultant Forrester and others have shown that up to 40% of a mechanic's time is spent on non-productive 'downtime', including tasks such as walking to the technical library and to stores to order parts. MRO systems can more than halve this time. Mobile technology *(see the application of handheld devices in MRO, Aircraft Commerce, October/November 2005, page 38)* has a large part to play in allowing these potential savings to be realised. One example is from Frontier, where time spent on inspection and evaluation to create non-routine work orders was reduced by 80% using a new hand-held solution from US-based Perceptive Inc. For its A320 fleet, with every 400 non-routine cards (NRC) created, 6,000 potential man-hours (MH) are saved. Using the handheld devices to create NRCs cut two days from a routine C check. The bottom line is always money related: the return on investment for the handheld project was satisfied on Frontier's second C check which yielded a saving of three days.

The NRC handheld solution cannot operate effectively in isolation, however. It must integrate with the MRO systems for technical records, overall work package management and material management. Production is another area ripe for point solutions. A good example is US-based 4SIGHT's hangar solutions. The company claims that there are big efficiency improvements to be gained, even for small hangars. For airline in-house hangars, downtime and reliability of return to operation are improved with these systems. For third-party work, this means lower penalty payments for late deliveries and better customer image. Hangar capacity is also enlarged, as aircraft move out of the way more quickly to allow the next aircraft in. Overhead costs are cut as less time is wasted on chasing status data and trying to decide what to do next. For third-party hangars, invoicing can be time-consuming and prone to errors. It is difficult for an in-house hangar to control costs. The result is that chief financial officers and customers get frustrated, while management lacks the information to make good, swift and effective decisions.

Engineering improvements

Engineering change management is one of the most complex challenges for an IT system, with multi-faceted financial and commercial decisions to be made. If a change is non-mandatory, for example, there is likely to be a detailed return on investment (RoI) case to be developed and argued. With the need to balance engineering changes with return conditions and dates for leased aircraft, this difficult task for engineering becomes significant. The opportunities to improve the process can also yield large savings in time and manpower, and well planned engineering changes can save millions.

Lufthansa Cityline is using SAP to generate savings. It used to take Cityline two to three days to get paperwork from various maintenance locations on completion of a modification. Data entry would add a further delay, so it could take a week for Cityline to electronically record that the work had been done. It now takes minutes without the need for paper to be moved. In 1990 Cityline had 12 people to manage the engineering process for its nine Fokker 50s. The fleet



Courtesy of Airstream Consulting Ltd

MRO software systems can assist daily operations managers to minimise the impact of maintenance defects in a number of areas.

has now grown to over 80 regional jets, and the engineering is managed by fewer than 30 people, meaning a ten-fold fleet increase with only a doubling of staff.

Real-life examples

"The biggest gains we have seen are in improvements in workflow," says Daragh Cunningham, warranty and projects specialist at Cityjet, and previously a reliability expert with Ryanair, using the same AMOS IT system for MRO management. "It is all about simplifying complex engineering and material processes and making them more logical. This leads to less duplication of manpower and effort. Data entry duplication is removed, so that the database is cleaner. Productivity of staff, direct and indirect, is increased. A good example of better process and data flow is an improvement we suggested to Swiss. When a mechanic requests a replacement part, the system now says how many times the same part has been issued to that aircraft tail number in the previous two or three weeks. This immediately alerts the mechanic, at the time of analysing the correct work, that there may be an induced fault in the unit from an upstream failure. Presenting proactive information at the right time to the right person, without relying on them delving into the database, shows how an integrated IT system helps productivity.

"Another good area of early payback at Cityjet was in material management," continues Cunningham. "Having full visibility of repair status and a supplier's contract performance enables the material and procurement team to keep on top of what can become an unmanageable supply chain. Added to this is warranty management which has saved us a lot of money at Cityjet. We never miss a chance to make warranty claims. I also introduced a new process, with the help of the AMOS system, to set up an electronic control point for rotables removed from the aircraft as unserviceable. Our reliability department reviews every part and holds it for a couple of days to check if the fault is cured or if it reoccurs. Known as a CURE, ship-or-save (SOS) or hold programme, this can reduce the NFF rate. We had an audit from Boeing, which was shocked by our 13% NFF rate. The industry average is over 20%. Through this hold programme, AMOS picks up rogue serial numbers that are failing frequently. I ensure that a repair vendor does not return these serial parts to us until they send me a strip and repair report and I am satisfied with the corrective action. Undetected rogue parts can also create a lot of hidden costs that affect schedule reliability, leading to other cost implications."

"Another key improvement is planning visibility due to an integrated maintenance and material system. Parts and tooling availability can be matched with human resource availability. We have never had an incident of scheduled work not being completed due to shortage of parts or tools at Cityjet," says Cunningham. "Quality and safety are reinforced with IT systems, and data integrity and accuracy are also improved. Airworthiness directives (ADs) and maintenance programme management are difficult areas to control. We can keep things tight with a modern IT system. One of the most overlooked benefits of IT systems is improved morale. While it takes time to embrace a new system and overcome the pain of implementation, all personnel will benefit from the removal of boring and repetitive tasks. People are happier with modern solutions, and it is difficult to put a financial value on that."

Scandinavian Airlines (SAS) has benefited from new IT solutions. In 2005, SAS identified the need to reduce IT cost as a percentage of revenue, from 5.2% down to near the industry average of 2.8%. This required a radical technology transformation to replace the variety of legacy in-house systems with a single, modern IT system. Management also saw the need to adopt industry 'best practices' throughout the maintenance organisation and needed an IT tool that would enable and integrate these business processes. SAS wanted to adopt OEM maintenance programmes to reduce costs, which meant moving away from custom, SAS-designed maintenance programmes. "Implementing our new IT solution has given us the system we need to strengthen our MRO operations and substantially improve efficiency and lower costs," says Ulf Nystrom, head of technical operations and Scandinavian Airlines. "This important IT initiative saves us thousands of dollars annually in systems operations and maintenance."

Summary

Every implementation project is different and will yield different returns. The main savings from introducing a new MRO system are generally in material management and are quicker to realise than others. Planning is a significant area of opportunity, but it is usually harder and slower to yield savings. Engineering is the hardest area to generate savings, but probably the most important for improvements in control and regulatory compliance. For facilities involved in heavy maintenance, the main area for improvement is in workforce efficiency. The majority of these efficiencies will come from a combination of productivity enhancements from easier to use software and mobile wireless hardware technology. The heavy maintenance environment is also an important area that can benefit from the application of specialist point solutions, integrated into the core MRO software system. Wherever the savings come from, they need to be measured and monitored at regular intervals after the system is live. AC