The complexity of maintenance schedules and inputs required for maintenance checks lends itself to require IT systems for planning. Various IT systems to plan airframe checks are on the market. Bernie Fitzsimons reviews what some of the systems available have to offer.

IT systems for airframe check planning

Hangar checks have always involved complex planning, because of the need to balance known requirements with the large volume of non-routine work that stems from inspections. Software vendors have taken various approaches to help automate the process.

Maintenance planning

As Avexus's director of research and development David Laing explains, planning, and specifically the compilation of a maintenance planning document (MPD), is the starting point for aircraft maintenance. The MPD is a structured document that details maintenance tasks and their intervals. It is also the standard used to derive the maintenance requirements of each aircraft.

Structuring MPD tasks with similar intervals into checks, gives the maintenance planner a clearer picture of the maintenance actions required during a visit. By grouping tasks into checks a more dynamic maintenance plan can be created which fits into an airline's operational requirements.

To facilitate this, checks are often sub-divided into check-sequences (That is A, B, C and D checks for example), which can be performed independently during different maintenance visits. Cumulatively, they ensure that all maintenance tasks are completed in the interval allowed by the MPD. This slicing of the MPD gives an airline the flexibility to have a larger number of shorter maintenance downtime periods, which can be more closely matched with the airline's operation.

Maintenance planning is carried out at various levels. An overall picture has to be generated for fleet planning, so that schedulers running day-to-day operations can see aircraft availability. Laing describes this as a rough cut of MPD requirements measured against aircraft utilisation, and compared to maintenance resources such as hangar space, available labour hours and other resources. As each aircraft comes due for maintenance, specific visit planning must be carried out, taking into account the unique features of that aircraft.

Visit planning matches the individual state of each aircraft against the MPD and so decides at a high level which check-sequence to perform. It also looks for any other tasks, outside the sequence, which are either required or which could be performed during the maintenance visit. Check visit planning should ensure high efficiency by performing all scheduled tasks and others that can be completed economically during the visit, or clear deferred defaults that might restrict subsequent operation. This is a complex activity, Laing says, and one that typically is performed in a largely manual effort.

Analysis of performing maintenance ensures that the material and resources to carry out each task can be marshalled and scheduled. Each task will require labour, perhaps with certain skill or approval requirements, and may also have a part or tooling requirement. Some facility and tooling requirements such as hangar space, jacks and gantries and expensive pieces of capital equipment can constrain the ability to perform maintenance.

Assuming primary requirements are available, manpower and availability of material must be planned. Manpower scheduling is complex in aircraft maintenance because of the regulatory environment under which it operates. Mechanics must have certain regulator-approved certifications. Airlines may require specialist certification and approval authority to be assigned to certain tasks for their aircraft in a third party maintenance repair facility.

Planning a maintenance visit continues after the aircraft has arrived and work is under way. Labour and material usage have to be logged against tasks, and the plan has to be monitored constantly and updated to reflect reality. Vacation, illness and late deliveries can all make a visit longer than expected. Managing this is difficult, and is usually done manually, since it requires integration of disparate data from separate systems.

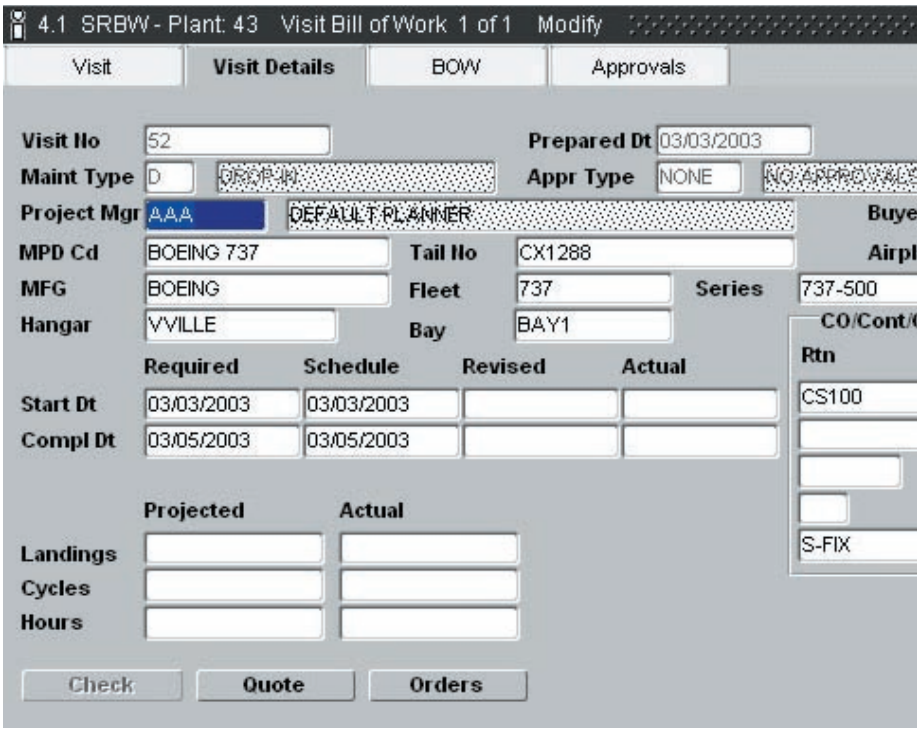
Avexus's Impresa

Avexus's Impresa, Laing says, tackles the requirements in maintenance planning and operation. Engineering data is captured and controlled by the MPD. Each MPD is effective for a given aircraft type, fleet and model, and effectivity is also provided down to the individual tail or serial number.

A fleet plan can be created as a master production schedule, which can then be used to drive capacity and material planning. For visit planning, Impresa can take the MPD information and the schedule from the fleet plan, enabling a work package to be configured for an individual aircraft visit. The software also provides a full suite of work management tools, including labour booking, attendance tracking, inventory control and parts supply chain.

Users of Impresa include Pemco Aeroplex, which supports the KC-135 variant of the 707 for the US Air Force, and Victorville Aerospace, the southern California commercial aircraft overhaul operation bought from BAE Systems in 2002 by a group of the facility's managers.

Avexus supplied a hosted version of Impresa to Victorville under an application solutions provider (ASP) license. In February 2003, Avexus announced an agreement with Jouve



Avexus's Impresa takes MPD information and schedule plan form the airline to configure work packages for an individual aircraft visit. The software provides work management tools, including labour booking and inventory control.

Aviation Solutions, under which the two companies plan to combine Impresa with Jouve's on-line technical document delivery applications.

New Maintenix module

Mxi Technologies has added a check planning function to its established Maintenix suite of software. Both Qantas and Delta Air Lines have signed for the new application.

Qantas selected Maintenix specifically to support heavy maintenance production planning and control and shop floor data collection, initially at its new 767 hangar in Brisbane. Matt Tobin, Mxi's vice president, marketing and alliances, says it was logical for the carrier to look at modernising its IT infrastructure to maximise throughput at the new facility. It is likely to be introduced at Qantas's other bases once it has been implemented at Brisbane.

Mxi's hangar solution provides total maintenance. "In a hangar check you want to make sure you have accounted for the work that might already have been done in a line maintenance environment," says Tobin. "Likewise, in a check it is often the case that you will do additional work."

"One source of additional work is deferred items from line maintenance and the referrals that need to be allocated to the right check, and we handle that quite elegantly," says Tobin. "You also need a link between check planning and engineering change management if you are doing some kind of campaign of engineering changes, perhaps in response to an airworthiness directive (AD) or service bulletin (SB). Maintenix enables the engineering change work associated with an AD or SB to be added automatically to a planned check."

"A third innovation in the new module is the use of web-based technologies to automate work flow," says Tobin. "This starts with the master planner using his interface to assign the work in the check. That work would show up in the supervisor's to-do list. The supervisor allocates individuals their work which they get when they log on to the system. If a task requires a quality assurance inspector, when it is completed by the mechanic and signed off, the requirement to review also shows up in the to-do list."

Similarly, if a mechanic finds something in the course of a routine inspection that requires an engineering input, such as the repair needed to deal with corrosion, the software allows the mechanic to push a button or click on a check box that asks for engineering to look at it. There is an automatic flow of data to the engineering group, and the requirement for engineering to look at this item shows up in their to-do list, all automatically."

"The reason why half the work is likely to be unexpected is lack of good record keeping," says Tobin. "You should be able to estimate a large part of unexpected or non routine work with a fair amount of confidence based on accurate and accessible historical data."

One important feature of the latest release of Maintenix, Tobin adds, and one selected by Qantas, is its support for wireless devices. There is clearly potential for increasing productivity by providing information at mechanics' fingertips through wireless devices. One of Mxi's customers is already using the technology in a line maintenance environment.

Mxi can offer electronic signature capability. "Having wireless devices is the first step towards a paperless environment. Electronic signatures are the second and necessary step to complete the process of eliminating documents," says Tobin. "This requires the regulator to accept your technology and processes, and we have actually delivered this to one of our customers, allowing the operator to remove its parallel paper system."

As part of its drive to reduce and even eliminate paperwork, Mxi has partnered with Jouve Aviation Solutions to combine Maintenix with Jouve's AirGTI digital document software. The latter is intended to provide automated access to technical documentation and work instructions.

Strategic asset management

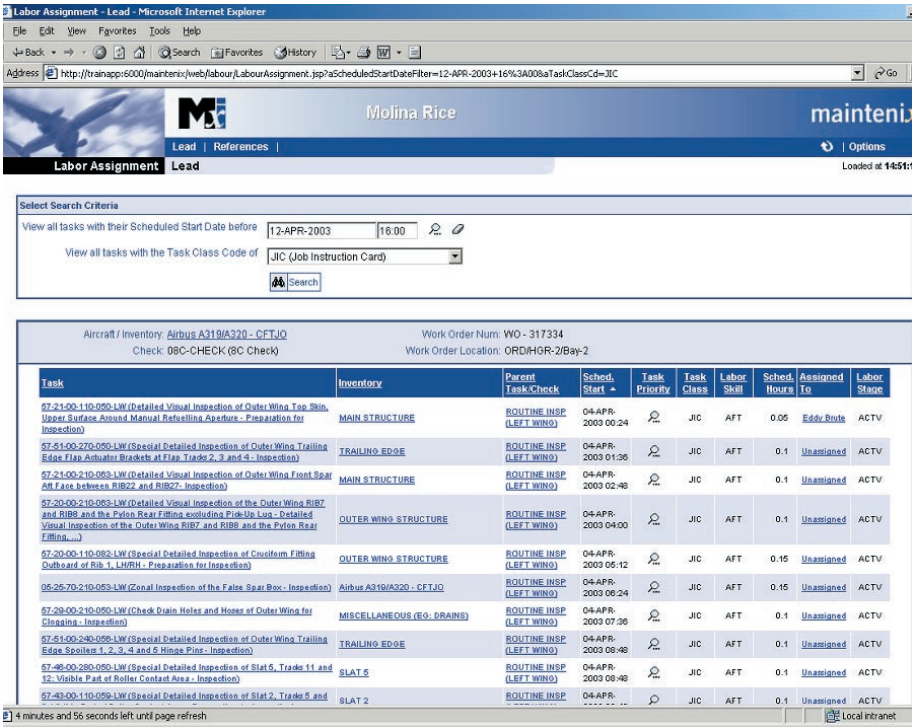
MRO Software makes a case for upgrading maintenance IT. Maintenance costs make up 12-15% of airline expenditure, and MRO Software calculates that maintenance costs have been growing at an annual rate of 7-10%. The results of enterprise resource planning (ERP) projects to date suggest airline maintenance operations should reduce costs by about a fifth.

These reductions would come from smaller inventory and operational costs, plus third party maintenance sales growth of 5-10% from improved service. These two could generate savings of 5-20%. Reducing inventory size and increasing turnover should see reductions of 5-20%. Labour efficiency, improved planning and a reduction in unscheduled downtime should cut operational costs by 10%.

There are gains to be made from inventory alone, MRO believes. Spares held in the global supply chain are estimated to be worth more than $50 billion. Eliminating slack in the system could reduce this by $5 billion. There would also be a reduction of up to $1 billion in the annual cost of carrying this inventory.

Atlantic Coast Airlines (ACA) has completed its implementation of MRO's Maximo. The US regional will use the software to manage all line and heavy maintenance activities for its 132 aircraft fleet, plus procurement and parts inventory handling at various hubs. Maximo is also integrated with ACA's financial applications and flight log system.

Mxi's maintenix software provides a total hangar solution. This accounts for all the work done in all sections of airframe maintenance and plans all tasks that need to be completed in a check. Maintenix automatically plans in engineering orders into checks, as well as using web-based technology to automate work flow. It also supports wireless devices.



MRO Software takes a strategic asset management approach to aircraft maintenance and check planning. Strategic asset management is an examination of an airline's aircraft, components, ground support equipment and the information technology infrastructure assets that are critical to its operation and bottom line performance. All are seen as contributing to the overall maintenance capability.

MRO Software's aviation applications specialist, Rob Powell, says safety and regulatory compliance form the backbone of its aviation offering, which focuses on reducing airframe maintenance cost per hour. The starting point is airframe configuration. There is a facility to create templates for aircraft configurations by type and then use them as the basis for the actual configuration. The configuration includes the component hierarchy, plus the scheduled maintenance hierarchy for the type. When the actual configuration is created it is populated with the airframe specific data. The configuration can be viewed graphically for ease of use.

Maximo is highly integrated, Powell says. The scheduled maintenance module can hold as many events as needed to support the aircraft, from daily through to major checks, plus ADs and SBs. The forecasting function is driven by flying hours, calendar time and cycles. A flight log module is populated with aircraft usage data, including engine and APU starts. This is either manually or through an interface with a flight operations system collecting data via ACARUS.

The data is then used to update the configuration hierarchy and the time or cycles remaining on-wing for components whose maintenance is defined by those parameters. This enables average utilisation to be calculated, and scheduled maintenance requirements to be forecast. There is no limit to the number of meters or measurement points that can be stipulated for each component, Powell adds.

Labour, materials and tooling, plus any other resources required, are tied to the scheduled maintenance requirement. Maximo can also provide work management control, Powell says. Work orders can be generated automatically, and non routine work added.

Maximo would interface with the job card generating system typically supplied on CD-ROM by the aircraft manufacturer. It is possible to create and manage the cards within Maximo, but this involves more work up front.

Purchasing & inventory

Scott Johnson, now senior product support executive with SITA, first encountered the Purchasing, Maintenance and Inventory (PMI) system which SITA added to its portfolio in July 2001, when he was with Mesaba Airlines in the late 1980s. The airline was one of the first users of the software (now there are 28), and he worked with all the system's modules as they matured. He has continued to use it, most recently as director of production control with Chautauqua Airlines. "I was in charge of overall planning as one of my functions," he says. "I used PMI as my baseline for getting the data I needed for heavy check scheduling and managing workload flow for my overnight hangar facilities."

The real benefit of PMI, Johnson says, is that it integrates everything from engineering to inventory control. Task requirements, or engineering orders in PMI terminology, can be inserted into the database, where they are attached to individual components or the airframe itself and tracked according to various limits: "It might be hourly, cyclical or calendar limits, or even a drop-dead date, or combinations of those limits, such as a generator that needs to be overhauled every 2,000 hours or every two years, whichever comes first."

PMI also allows flight utilisation projections to be added down to the daily level, with provision for seasonal variations, Johnson says. Customers would normally project that utilisation over a long period, such as 10 or 15 years, and then use it to run maintenance due and maintenance planning reports. "The maintenance planning reports take that utilisation database and determine, based on the amount of time that is remaining on a particular component, when it will be due for overhaul," says Johnson. "They can then run a maintenance due report and it projects the date when maintenance will come due on a particular component. With that, aircraft planners can effectively route in the maintenance that is coming due and schedule it and build work packages with it."

The work package functionality enables users to determine labour required and project part requirements, Johnson continues: "If there is an igniter change due on an engine, and it gets built into the work package, the pre-draw can be done, and when the planners build it they can choose whether they want to allocate the part. If they choose to allocate the part, and if inventory is showing as available in that maintenance base, it reserves the part and prints or displays this reservation. If the inventory is unavailable a shortage report is generated."

"Manpower requirements can also be allocated and built into a work package," says Johnson. "Cost is covered, too. If I am doing my budget for next year and I want to say what parts are going to be required, what value should I put on scheduled maintenance that can be gleaned from the system? The same applies if you want to know what parts were used on an unscheduled basis, the non-routine work generated from a

SITA's PMI system helps airlines avoid efficiency loss when meeting regulatory requirements by predicting labour requirements for particular work packages. It is also important in third maintenance negotiations.

discrepancy or even from the line, and the cost of these parts used. This is where we try to use the software to the best of its ability. We are accomplishing a regulatory requirement to comply with the maintenance programme, but we need to make effective economic decisions regarding our fleet and our manpower. That is really the core use of any software, and certainly what PMI does really well."

One potential development is a link with SITA's Fleetwatch flight operations module. "We are exploring the potential of merging these two worlds together to apply cross utilisation and cross reliability data," says Johnson. "When I worked in flight operations I liked to ask 'what is the aircraft telling us are its problems?' Delays and cancellations give an indication, because you are coming across technical issues with the aircraft as well as operational and infrastructure issues.

"Gleaning that information in most cases requires someone to manually go through and view the events, properly code them, and then populate a database. The maintenance IT solution and flight operations IT system hold some of this information, so getting them together usually involves some kind of middleman programming. We would like to see a module developed under the same umbrella to make it work. That is still under consideration within SITA.

"You may end up losing efficiency in order to meet your regulatory requirements and perform an inspection when it comes to heavy checks," says Johnson. "PMI helps you avoid this, because it tells you what your labour requirements will be if you do this particular work package, which is very important for negotiation. Even on a historical basis, you can look into PMI and say, 'I have done these types of C checks, what were my labour requirements going in, and after the fact, what were my non-routine labour requirements and what were the costs associated with them?' Long-term planning is different for heavy checks, because you really have to ask what slots are available and what do I have to do to get my aircraft in and out as quick as possible and still meet regulatory requirements for compliance."

PMI will do just that, Johnson says, generating spreadsheet data to support the planning task. "It is a very handy tool," he concludes, "and I would say for all of our customers it is a standard part of the business decision."

Other approaches

French software house Delia Systems was founded in 1996 to apply an artificial intelligence module to complex task scheduling. Air France Industries adopted Delia's Opti-Time operational resource planning (ORP) software in 1998 to help optimise its aircraft maintenance activities. The software is also used by TAT Industries to schedule long-term maintenance, by Emirates for line maintenance planning, and by aircraft manufacturers and other support organisations.

Opti-Time is designed to handle the sort of work involved in aircraft maintenance, which Delia characterises as a set of complex, multiple and interdependent tasks that need to be allocated several times and monitored closely. It is described as a dynamic schedule management solution that can respond to any unforeseen incident in a matter of seconds, by adopting the most optimal method. In doing so it endeavours to make the fewest possible changes to predefined actions.

Last October Comair became the 30th airline to adopt Trax Maintenance applications. The planning module of Trax Maintenance consolidates information from the engineering, technical records, operations schedule and inventory modules for output to the production module. It can forecast aircraft or part checks, inspections, modifications and maintenance and produce work specifications on-line in real time, the company says. It also monitors deferred defects on the aircraft, along with all other aircraft-related time-controlled items.

The mainstay of the planning module is the aircraft planning query, which allows for interrogation of the planning information on-screen in different formats. Additional reporting can show costs and overlay the material requirements for planned items against current and proposed inventory. Benefits of this integration include mix and match of the information from all the relevant modules to give an effective scheduling and project management tool, Trax says.

Other functions include the ability to track employee licenses for expiry dates, site capacity planning, and monitoring and updating of training course information to inform production/shop systems whether employees are authorised to carry out specific trade work. The aircraft flight schedule can also be entered for maximum accuracy in forecasting when controlled items will become due, otherwise average utilisation is used to calculate due dates.

Boeing has integrated the Maintstream software developed by its Canadian subsidiary, AeroInfo Systems, to its Enterprise One maintenance management portfolio. Last year Southwest Airlines implemented the FRC long-term forecasting module of the software, which has also been integrated with the portable maintenance aid (PMA) to ensure that the task cards issued in a scheduled maintenance package contain both the latest technical information from the OEM and the airline's own preferred maintenance procedures. AC