

Hangar check production management is based on critical path analysis. maintenance planning departments can arrange detailed check plans, only for them to be discarded soon after they are implemented due to unforeseen occurrences & additions. Software packages are available to put plans back on track & maintain production efficiency.

Systems for hangar production management

Completing routine, non-routine and emergent work is the essence of aircraft maintenance. Most hangar environments have a lot of scope for improving production in the hangar. IT solutions available to solve this problem are examined.

Production maintenance management is usually a reactive, high-pressure task. Manpower accounts for a large proportion of the cost, and it is a challenge to ensure that line mechanics are working efficiently. Mechanics have to be working on the right jobs and provided with the right instructions, parts, tools and engineering support at the right time if they are to complete work on schedule.

Initial production plans are quickly discarded when things do not go according to plan, after which it becomes a daily game of catch-up to manage the problems of late or out-of-stock parts, staff shortages or other unforeseen disruptions.

There are, however, a number of IT systems available to help turn reaction-type management into proactive management. There are both standalone systems and modules of fully integrated maintenance and repair operations (MRO) suites.

Technology can aid hangar production management tasks in several ways. Data collection from, and distribution to, the mechanic in real-time on the shop-floor is crucial to improving hangar productivity. Studies show 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 going to stores to order parts.

Technology now enables data to be managed in close proximity to the aircraft (see *The application of handheld devices in MRO*, *Aircraft Commerce*, October/November 2005, page 48), which reduces the downtime and improves several aspects of quality control. There is also more technology, some of which comes from the original equipment manufacturers (OEMs), to deliver documentation for efficient production. There are also systems for short- and long-term maintenance planning. This is really the start of the process for many airlines that complete their own heavy maintenance.

Framing the issues

One of the first challenges is for planners to decide the workscope in consultation with the production department. The workscope will depend on the available resources, parts and tooling, and the physical space in the hangar. For third-party maintenance providers, the workscope will be an outside negotiation with the airline, and will take the form of a contract. Indeed, many airlines with their own maintenance departments are moving to internal, signed contracts and service-level agreements. But this is where problems start to arise.

Between the initial plan and the final arrival of the aircraft some work emerges, service bulletins (SBs) or airworthiness directives (ADs) are added, and deferred defects are picked up. The production scheduler needs to have a quick and visible way of adding and viewing the possible impact on any additions or changes to the workscope.

The main concern is the exit date from the hangar. There may be stiff penalties for third-party providers for late deliveries, as well as serious revenue and operational disruptions from late aircraft re-deliveries to airlines.

The next challenge for production is to manage what needs to be done to keep the check on schedule. Most of this comes from experience of managing and dealing with the same aircraft models with the same maintenance work packages and the same emergent work. Much of the corporate knowledge lies in people's heads, and makes organisations vulnerable to staff turnover. The project plan quickly becomes obsolete, and real work planning is done through shift change or daily meetings. Progress can only really be gauged by the experience of shift supervisors, since data are usually manually collected and electronic data often lag behind reality by several days.

Integrated MRO software

The various MRO software vendors claim to have solutions to bring order to the chaos of the hangar. Each supplier has a different starting point. Some start from material management systems, adding production management later. Some are aimed at airlines that use third-party maintenance providers, and so the detailed hangar floor functions are less important.

Swiss AviationSoftware offers the AMOS integrated MRO software suite, which includes a graphically rich production and scheduling tool. This supports the production planning staff, enabling them to move single events, tasks and items via a mouse click to

achieve optimum sequencing and avoid shortages, while calculating the critical path in the process of moving tasks and items. "Though a sequencing of events is defined prior to production execution, the system allows any real-time update in the process of executing the work-package," comments Claudia Weiss-Giessler, vice president of marketing for Swiss AviationSoftware. "Execution of single events can also be updated in the system via wireless devices, such as tablet PCs or other media. It is important that the production controller can immediately assess the impact of additional non-routine tasks that need to be fulfilled in a given downtime. This is so that planners can foresee if the groundtime is sufficient, or if any measures have to be taken to release the aircraft on time.

"The goal of maximising aircraft utilisation while optimising maintenance activities has to be achieved. For the technical staff, a system of asking for engineering support has been introduced, which allows the technician to access complete problem follow-ups," continues Weiss-Giessler. "In case the problem is new, the technician may launch the problem or solution process while seeking advice from engineering staff. In addition, for technical assistance or background information, the technician can always navigate into the technical records of the aircraft or component."

Swiss says it is ready to launch electronic confirmation and signature in all AMOS modules in the first quarter of 2007. Swiss is in the process of embedding a fully integrated shift-planning and attendance system to increase the efficiency of the planning process. A first version of this new module will be released in late 2006. "The shift planning and attendance features, in combination with the facility management functions already integrated into AMOS, should allow the production management to take informed business decisions," says Weiss-Giessler.

Another impressive integrated MRO suite provider is provided by Russell Adams Limited (RAL). The RAL.NET smart client technology provides a clearer, intuitive mechanic's user interface with larger, clearer letters and fonts, and lends itself to touchscreen navigation.

In addition, the smart client .NET architecture provides some off-line capability if the wireless coverage goes down when deployed in the hangar on mobile devices. The integrated nature of the RAL tool is much like most of the other solution providers for the production scheduler. It takes template data for the tasks that have been scheduled and allows the tasks to be given a work order number. These are then allocated to mechanics, parts are pre-booked and issued, time is booked

against the job and task cards are produced. This last area of task card management (*see MRO IT systems for managing technical documents, Aircraft Commerce, June/July 2005, page 50*) leads to different technical solutions by each software vendor. Some opt to manage the cards inside the system, using Framemaker or Microsoft Word to hold the card details. Others choose to integrate with OEM systems, like Airbus ADOC, to manage the cards or use third-

party systems like Jouve to provide an enhanced software solution beyond a simple MS Word system.

The RAL system handles non-routine cards (NRCs) by creating links to the initial inspection card and allowing the system to database the resulting work. The system thereby 'learns' about the NRCs for the next check. It would be virtually impossible for a paper-based or small-scale MS Access system to do this. "For RAL, the first phase of the hangar

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The AMOS integrated MRO software system includes a graphical task planning tool. This helps production planning staff to monitor and resequence jobs as a hangar check progresses, always keeping in mind the critical path that determines whether the aircraft is completed on time.

process is the pre-production planning phase," says Gary Smith, operations director at RAL. "The defined work package automatically creates a parts list, tooling list and resource requirement that production can take, and start to prepare for the check. The part shortages are immediately highlighted, as is any conflict of mechanic resource or tooling. The cards can be printed off for the specific workscope, which defines the job that needs to be performed, and how. In detail, for example, the task will have a parts tab on the screen which will show what action is required for a particular part number. An instruction to exchange the part may be set in the template reference data. We can also set up stages for a task. This is useful for longer, more complicated one-off tasks, like the incorporation of an AD, which will have several steps to help the mechanic to effectively manage the work."

The aim of the RAL system is to shift the hangar production team's focus so that they proactively plan and control the check.

"We also see better phasing of the bigger checks, and sequencing of areas or zones on the airframe," claims Smith. "We provide a work order status screen that provides a traffic light chart, enabling management of the check by exception at all stages of production. This frees up the supervisors to think more clearly and take rapid corrective action to stay on schedule.

"The final piece of the jigsaw is the electronic time booking system. This is deployed on Panasonic Toughbooks at a number of our clients, and already incorporates fingerprint authentication of mechanics. The fact that we use the .NET

smart client framework means that the system can run off-line for a period of time, but still allow real-time data capture, so that supervisors can follow the progress of the check."

Other perspectives

One of the other fully integrated MRO suites, used by Virgin and Cathay Pacific, and soon to be rolled out at Emirates, is the Ultramain product. "One of the biggest challenges for hangar production staff is change to workscope," explains Dick Wallis, UK sales manager at Ultramain. "Many additions and changes are made to tasks between the planners defining the initial input and the aircraft being dragged into the hangar. A number of deferrals will usually be added. The real driver is the looming end date. The Ultramain solution allows production to look at what a facility can achieve with its workforce and resources, versus what it needs to achieve to stay on schedule. Capacity management across hangar bays is also handled, since this is important in a large facility. We use ADOC from Airbus as our standard job card system and this works really well for all aircraft types, including Boeing. It can be used in a standard form or can be tailored for the MRO facilities' needs."

The benefits of Ultramain focus on improved productivity. The system claims to remove unproductive downtime for mechanics, such as walking between work and the technical library, to the stores and so on. "The reduction in dead time for mechanics can be as high as 40%," says Wallis.

AuRA from MIRO Technologies has a maintenance work recording system

that can be deployed as a traditional 'after-the-fact' recording system or as a real-time 'point-of-maintenance' solution. Both models depend on the level of IT sophistication that an airline is able to invest in. AuRA holds template reference data for scheduled tasks for parts, labour and tooling and actuals are then recorded against tasks during work recording. Data entry can be through a traditional keyboard or through a swipe card, smart card or light pen.

After a hangar input plan is created and committed for production, production control uses the AuRA Work Package Management Desktop to manage the allocation of tasks and the recording and certification of work after completion. The responsibility for allocating work can be given to individual users or to team leaders in charge of small groups of mechanics for larger operations.

AuRA's Work Package Management desktop provides a processing tool that will help the planning group manage and maintain packages of scheduled and unscheduled maintenance. Light check work packages may be recorded completely with minimal effort. Heavy check work can be handled in a more sophisticated way and AuRA provides tools to group, display, and print work packages where multiple zones and access panels dictate scheduling and work recording. "The AuRA user interface is designed around business processes, rather than functional areas," says Jerry Magin, MIRO's commercial MRO sales director. "This allows AuRA to provide the information needed to carry out each part of the process, while allowing access to other data on a 'need-to-know' basis."

The majority of the key processes in AuRA are managed from 'desktops'. MIRO Technologies claims that these powerful functions bring together all the key data into one unified view for the user and make the management and visibility easier.

Point solutions

There are several specialist software packages that address some of the challenges of hangar production. Many

hangars look mainly for better planning, scheduling and specific sequencing of tasks to accommodate the changing nature of the aircraft check. Many organisations discard project plans soon after starting work, since they find it too hard to deal with constantly changing priorities and surprises.

Help might be at hand. 4SIGHT Technologies is a US-based provider that supplies a point solution to the planning and scheduling task. "There are two types of maintenance providers," comments Hernan Clarke, president of 4SIGHT Technologies. "There are those which have invested in MRO software, but struggle to make the investment work properly. Then there are companies which have limited systems and try to work around using MS Project and MS Access databases. Both types have trouble running their hangar efficiently. Mechanic downtime and overhead costs to firefight problems are high. The organisations are in a reactive, day-to-day, hand-to-mouth state. A simple hangar check may have thousands of scheduled tasks with dependencies between some tasks, like panel openings and closings and so on. Then add in personnel scheduling, tooling, parts and we already have a very complex situation to start with. Now add in unscheduled and non-routine work, part shortages, staff illness, and tooling allocation issues and it becomes impossible. That is why most organisations just give up and rely on daily firefighting and the experience of key individuals. But you cannot run a business in the long term based on one or two individuals. 4SIGHT Technologies has developed a solution to this issue. There are two main modules for hangar maintenance: Checkplan and PM PRO.

"Let us break it down into process stages," continues Clarke. "First there is the pre-planning stage. We need to analyse the agreed workscope for resources and parts, as well as physical space requirements and timing. We also take this first cut plan and produce an initial scenario or 'waterfall chart' for the check in Checkplan. We can either import it straight from an MRO package, or create a new one from scratch. We can apply smart templates in pre-planning, which we have evolved over time, to this starting position. These templates allow us to play a lot of intelligent what-if scenarios, not just with this aircraft but across bays with multiple aircraft. This is a very useful preparation exercise to ensure we are ready to hit the ground running when the aircraft is dragged into the hangar.

"Next, we have a simulation phase. This part of the system quickly models the effect of an unexpected event," continues Clarke. "For example, if a major modification package is delayed by

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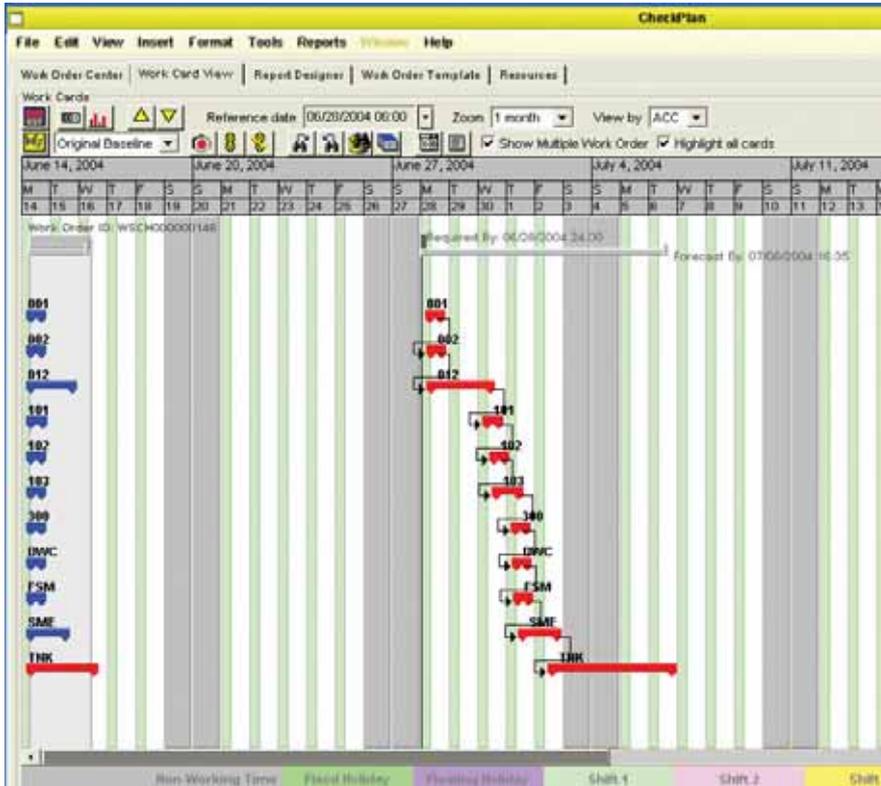
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a part, the simulation phase will analyse what the delay will do to the resource requirements for this aircraft, and how it will affect planned work in other bays. The system can also analyse the effect on the work schedule of finding severe corrosion as part of a schedule inspection card. The simulation module is called PM PRO. It enables the planner to take a new set of criteria, a number of non-routines for example, and simulate the knock-on effect of different scenarios. PM PRO

does this by taking historical data and creating a likely workflow scenario from the new set of tasks. The planner can play around with injecting different constraints into the plan to look at the effect. For example, it might be a date or resource constraint, or a combination.

"The new plan is then handed off to Checkplan software to re-prioritise and sequence the detailed job cards. This creates an already optimised list of tasks and resources, and a tactical workflow



for the new situation. Cards are sorted automatically into queues or 'buckets' which are pushed back out to the MRO software system, or straight out to the shopfloor control system. This allows the planner or hangar production management team to manage by exception. The system pushes production proactively, rather than people having to pull data out of it."

What are the big cost saving areas for systems like 4SIGHT? Clarke claims that there are big efficiency improvements to be gained, even for small hangars. For airlines, downtime and reliability of return to operation is improved. Efficiency improvements translate into lower penalty payments for late deliveries and better customer image for third-party maintenance providers. Hangar capacity is also effectively enlarged, as checks are completed in less time. Overhead costs are cut by wasting less time.

These systems are not just for large and deep-pocketed organisations. "We have started to target very small hangar maintenance organisations," says Clarke. "We now have a lease programme with one-year lease contracts on a pay-as-you-go scheme, which is attractive for smaller facilities. We can deploy on SQL Server as well as Oracle for larger requirements. We can also plug in to all the MRO software vendors, if they are open systems and use modern architecture, using standard XML or other protocols. It is a JAVA application, and so is flexible and quick to implement. We can have a client live in only a few weeks to a month. We have large facilities like FedEx using us in their maintenance hangar for

long-range planning and we are now close to concluding several deals for small facilities."

Countering this view, most of the integrated MRO vendors claim that these point solutions are unnecessary and unworkable. "Ultramain's integrated suite can pretty much cover what these advanced scheduling tools offer," responds Wallis. "The issue with them is how realistic and workable they are in practice. It is not enough to pull in raw data for scheduling. You also need to build in the inter-related constraints data, which can be a real headache. They also need to be continually adjusted once you have built them in. Also, Critical Path Analysis is not necessarily the correct approach for keeping a plan on schedule. It is one view, but by focusing on it you may miss other important parts of the jigsaw."

This view is shared by other vendors, but has not prevented airlines worldwide from installing 4SIGHT and smaller systems like Delia Systems' OPTITIME. MIRO Technologies is one vendor which seems to be backing both views. It works successfully with 4SIGHT on some military projects and may continue this collaboration into the commercial arena.

Mobility important

The article examining the application of handheld devices (see The application of handheld devices in MRO, Aircraft Commerce, October/November 2005, page 48) demonstrated that technology enables data to be managed in close to real time, reducing mechanics' non-

productive time. One of the few specialist point solutions available in the market to address the complexity of hangar production planning is Checkplan from 4SIGHT. Checkplan handles the huge amount of interrelations between tasks and job cards for an aircraft heavy check. The big advantage is the ability to model different scenarios.

It also improves aspects of quality control, particularly for material ordering and configuration control.

In the hangar, non-routine card management is also a crucial element to handle well. Perceptive Inc's Redstone solution is one of the leaders in this area. Denver-based Frontier Airlines recently deployed Perceptive's Redstone solution, and found that the time spent on inspection and evaluation to create non-routine work orders fell by 80%. That translated into a total of 6,000 man-hours saved for every 400 non-routines created. Two days were cut from a routine C check, and the return on investment for the handheld project was realised by Frontier's second C check which yielded a three-day saving. MRO vendors all support mobile devices to some extent, but hangar managers need to look carefully at the hardware costs and support issues before committing to this concept of operation. It normally involves a significant change in culture for staff, which can be the biggest barrier for any organisation.

Summing-up

The hangar is where most IT systems meet most of the users. While not an ideal place for delicate computing equipment and sophisticated software screens, the hangar is nevertheless the place where the technology can really be used to leverage quality and productivity improvements. Software providers have produced workable solutions for the hangar, but some provide more useable tools than others so care should be taken when assessing the software in this area. Also, there seems to be sufficient evidence to say that there is also a place for point solutions to either precede an integrated MRO suite, or at the very least to augment an integrated MRO system. Two areas of opportunity are NRCs and advanced production planning. They provide a compelling return-on-investment argument for a standalone investment that can be integrated into an overall IT strategy. [AC](#)

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