Component maintenance is a key sub-process of aircraft maintenance. The management of components in a repair shop can be one of the last areas to receive attention. Systems for component maintenance require specific functionality, and current systems available in the market are reviewed.

Component maintenance management systems

In an increasingly difficult commercial airline environment, many of the businesses supporting aircraft maintenance are feeling the strain. Component repair businesses are one of these core support pillars. For many of these businesses to survive, they have to become leaner and more flexible. Computer management systems will therefore play a central role in their long-term survival and proliferation. Ways of managing resources, managing finance, and serving customers in a more sophisticated and flexible way are now on the executive agenda.

Although there are a number of aviation maintenance, repair and overhaul (MRO) computer systems that are successfully finding markets with airlines and third-party aircraft MRO facilities, these large solutions do not always fit the different requirements of a component shop. Where are the differences?

Special needs

Component shops have specific requirements for a computer system. To begin with, shops tend to deal with components rather than assemblies, so they not need sophisticated configuration management of assemblies. This process is crucial for the aircraft maintenance process *(see IT strategies for aircraft configuration management, Aircraft Commerce, February/March 2005, page)* and means that the supporting information technology (IT) systems tend to be over-complex. Component shops do not, in general, need this type of capability.

The second main difference is that repair shops will generally have a large volume of items for work. In the main, it will be impossible for the repair shop to keep track of each unique item's history. This means that each time a unique serialised item is inducted into the repair process, the item data need to be initiated in the computer system. This leads to a heavy requirement for data input. It also requires a database scheme that can cope with creating new instances, of potentially the same unique item, over and over again. The database needs to be able to delete historical data to avoid creating problems of duplicate data in future. Aircraft maintenance IT systems are generally not set up to deal with data in this way.

The third main difference between repair shops and aircraft maintenance is that a faulty component will usually have several pre-defined repair scenarios. At key stages in the repair process, there may be decision logic that dictates the next branch of repair action to be taken. A component repair IT system needs to be able to model and enact these repair scenarios and have routeing logic based on data entered. Generally these repair scenarios will have pre-defined times (both total effort and span or duration), resources and costs. Shop managers will want to measure the shop performance against these key performance indicators (KPIs).

"Repair organisations have difficulties tracking each subcomponent as it travels through the shop," says Jocque Butler, aviation business specialist, at Mxi Technologies. "Information on life usage and maintenance history on each subcomponent is not easily accessible. This can lead to time being lost as a result of maintenance having to be performed much earlier than required. As with everything in aviation, most operators and repair shops work on the principle of caution: it's better to be safe than sorry. Lack of data or uncertainty around a repair item's status can translate into wasted component life and time which therefore equates to money lost. Many shops could substantially increase their throughput and decrease their operating costs if only they had an efficient and accurate tracking system that is easy to use."

Joined-up thinking

As with any maintenance activity, how the repair process integrates with the supply and logistics organisation can have a significant impact on efficiency and cost. Repairing components requires the co-ordination of resources, workload management, and parts such as rotables (items that can themselves be repaired) or consumables. Special tools or machines may also present bottlenecks and will need to be managed as a part of the total process.

This is another area with which a computer system can help. "Without streamlined integration between the component shop and the rest of the maintenance organisation," argues Butler, "requests for components are made through traditional, slow methods. This means that e-mails, phone calls or faxes are floating around the organisation, instead of on-line shop status information being fed directly to the supply department. A fully integrated system will automatically notify the shop when the component is required and create a 'pull' demand cycle through the shop. All this will happen in real time."

With globalisation, and the consolidation that is inevitably taking place in the component repair market, repair organisations are becoming larger and more geographically dispersed. In order to maximise the use of the distributed inventory of parts and labour, management needs to have centralised visibility and control of all these resources. The only real way to obtain this integrated view is to employ an IT solution.

Globalisation and the current economic climate also bring increased competition. To remain competitive, repair organisations need to be able to
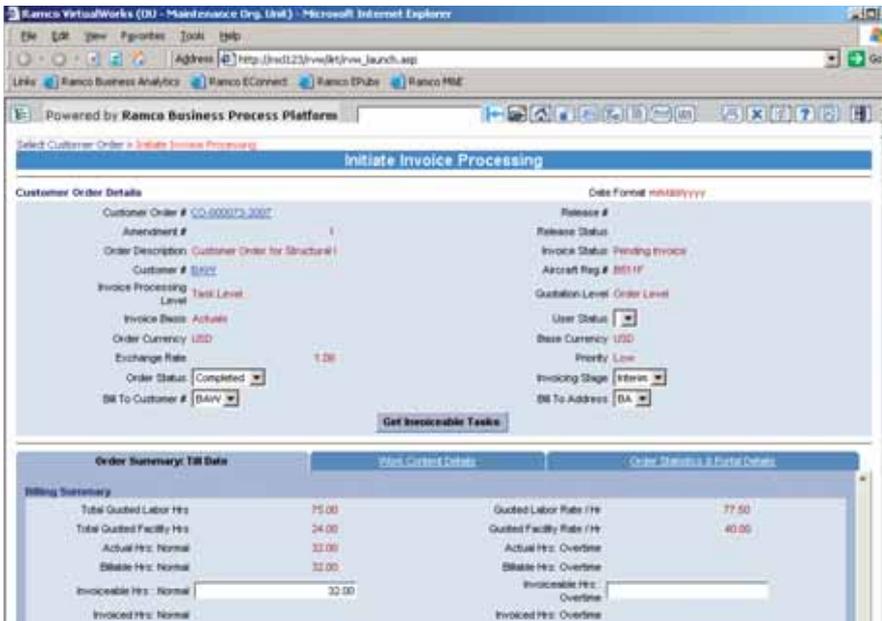
respond to customer demands. Airlines want flexibility and choice and expect ever greater degrees of access to information about their components. This results in even more complex and sophisticated repair contracts that must be effectively managed by the repair organisation. Customers also expect IT systems to be easily joined up. The drive is to reduce the amount of data re-entry when components are returned from repair, thereby reducing their own internal costs.

The drive towards systems integration is, to an extent, driving the IT strategies of the software vendors. Ease of connection means that more software companies must design and build IT architecture that is open, uses modern standard communication protocols and can be easily accessed over the internet. Most vendors have responded to this trend *(see MRO software technology strategies, Aircraft Commerce June/July 2007, page 58)* with new product development in Java or .NET frameworks. These systems can plug in very easily to other modern software systems.

This joined-up thinking is evident in Mxi's approach for example. "Since our product is a secure web-based system," says Butler, "the MRO organisation's customers may be given a log-in to the system to view information on their upcoming quoted work. They can approve or request changes to the workscope."

It appears that only a subset of MRO software providers focus on providing functionality for component shops. This could be due to the size of these customers, which is normally smaller than some of the airline or third-party heavy maintenance organisations. Or it could be the challenge of adapting the aircraft MRO solution to the special needs of component maintenance.

Systems large and small

One of the large system vendors that covers a wide range of aircraft maintenance processes is Ramco Systems. Component shops are one of their target markets. "Our solution offers the flexibility to cover the wide range of component MRO operations", says Tomasz Lorenc, Vice President at Ramco Systems global aviation consulting group. "This ranges from the smaller shops to complex assembly facilities like landing gear. The upstream MRO sales functions, such as order management, pricing and quotation, integrate with the component shop processes. Planners and sales users have access to view capacity constraints within the operations on a dashboard with traffic light indicators for tools, equipment, manpower and materials constraints. This provides control and efficiency to the process."

"Similarly all work execution information is consolidated in a single screen for invoicing. Additional work and non-routines reported during execution can be sent back to the quotation modules for customer approval. As with our other solutions, the component processes also tie in with other areas of the application like engineering, employee certifications, materials, digital signatures, external repairs, loans, purchasing, etc."

Other large players in the market are some of the enterprise resource planning (ERP) vendors. This is partly because the standard manufacturing-like capabilities that typically characterise these less specialist applications fit the component maintenance market well. The lack of as-maintained configuration-control requirements and the more 'production line' environment of a shop lend themselves to these solutions. SAP has a

number of large customers with the aerospace variant of its standard package. They tend to work through systems integrators (SIs) like Lufthansa Systems, Axon and others which configure the standard solution to fit each client's requirement. Many, like SAP with Netweaver, offer integration technologies to enable the component shop to offer a highly flexible customer-facing interface.

At the other end of the spectrum there are a number of smaller-scale solutions. Commsoft is a good example of this segment of the software vendor market. Its solution, OASES, is currently used by over 40 airlines, MRO facilities, technical records and parts repair organisations. Over the last two months OASES has been sold to airlines in Siberia and Australia, and to a major UK aerospace engineering organisation. The system has great module flexibility. Commsoft claims to offer competitive monthly pricing with the ability to react quickly to the special requirements, such as rapid start-ups, in the airline and aviation MRO marketplace. Based in Tiptree, Essex in the UK, it is a privately owned company that has been in business for over 30 years.

"Increasingly the airlines and MRO facilities want a choice of component repair organisations to satisfy individual customers," says Nick Godwin, business Development Director at Commsoft. "Systems like ours give key visibility on the component repair choices for price, turnaround time and overall value for money, working with various currencies. The challenge for the component repair organisations is to be responsive to this competitive environment.

"OASES is pretty comprehensive and comprises a number of integrated functional modules. Internal workshops, like an engine bay, are set up in the system and flagged as a workshop. Upon creation of a repair order to send a component to the workshop, our system recognises the workshop status. As well as creating the normal repair order within the database, it builds a works order for each unit on the top-level repair order. This works order is in turn used to book labour through our shop floor data collection (SFDC) modules. This is also used to demand spare parts to support the work through the inventory module. The work-in-progress (WIP) module is used to track what items are currently being worked in the workshops and to track the labour and materials expended to date.

"OASES contains various facilities to manage internal component repairs through workshops. Each workshop is defined to the system as a pseudo supplier. If the 'auto-allocate works order for each repair order' field is set to YES, the system will generate a new works order number for each line item on any repair order created for this supplier and/or location. The movement code, local warehouse, and estimated labour together with inspection times are set against the works order. A barcoded workshop cover sheet is produced which allows the user to requisition spare parts and, if required, record labour through the SFDC module.

"Using our solution, component repair customers can track the WIP status of their items and overall costs with labour and parts cost elements. A key element is the ability to track actual labour times spent in repairs versus the original equipment manufacturer's (OEM's) estimates. The customer can use these measurements to evaluate each component repair centre's performance to choose the best balance for the future."

Typical 'pure-play' MRO systems providers that sit in between ERP and small-scale solutions are companies like AMOS, MIRO Technologies, Mxi and TRAX. Most offer similar functionality for component shops, and Mxi is typical.

"The core foundation of Mxi's software was built to track components," observes Butler. "With a 'component-centric design', our system tracks the physical location, maintenance component requests, usage, upcoming maintenance, faults and history of work and transactions performed on an aircraft, engine, or subcomponent at the component serial number level. As components move through the organisation via cannibalisation, replacements, installations and so forth, all data tied to that serial number follows it within the system automatically. This tracking allows for easier physical traceability of components through the shop, notification of maintenance requests for that component, increased yield on maintenance deadlines, ease of investigation into the component's past history, and excellent reliability of data gathering.

A changing picture

Today, some modern MRO IT solutions are already able to provide repair businesses with better visibility and traceability of repair jobs in process. This in turn enables better management decision-making and more efficient use of the facilities, effectively providing a higher capacity for shops and increased automation and notifications to the affected parties. For those organisations which operate IT systems across both the aircraft maintenance process and the back-shop repair process, integrating shops into the line and heavy maintenance areas will allow for a fully developed real-time pull cycle to be performed. In other words, the next-generation IT solutions will enable the shop to provide 'just-in-time' parts to the heavy maintenance hangar or to the line maintenance environment for timely execution of maintenance work. This will significantly improve overall efficiency and reduce aircraft downtimes.

In future, repair facilities may see higher physical traceability of components through barcoding, radio frequency identification (RFID), and enhanced software systems. RFID is one of the main areas of technological advance. The key that will unlock the real benefits lies with the original equipment manufacturers (OEMs). Components need to be fitted with RFID tags at the outset in order for any computer system to operate. Currently there is no significant move by the OEMs to go in this direction, which will prevent advances for systems in this area.

Alongside any new IT system comes the opportunity to re-align processes. The latest trend is to utilise Six Sigma

OASES contains various facilities to manage internal component repairs through workshops. The parameters needed to specify and control workshops are set up in an easy-to-use form.

methodology and lean operations toolsets to improve quality and reduce lead times and costs. 'Lean' is a buzzword that is growing in aerospace maintenance operations, and is really a culture that drives businesses to eliminate waste and provide a smooth flow of information and materials based on the needs of its customers. At the heart of all these initiatives is the ability to get hold of good, accurate, complete and timely data. Six Sigma and 'lean' is an added drive towards investing in new and more flexible IT systems.

A different perspective

Coming from a completely different direction are the group of IT systems that were originally developed for small businesses trading in aircraft parts. Some of these businesses serve the general aviation market, but have successfully evolved into larger solutions for larger component businesses.

One of the big success stories in this category is Component Control. Based in San Diego, California, its core product, Quantum Control, is a specialist application designed for the aviation aftermarket industry. The product integrates most aspects of operations with a complete suite of modules that include: Quoting, Sales, Purchasing, Inventory, Shop Control, On-Wing Maintenance, MRO and Financials. When coupled with Internet Quantum (iQ), companies can offer their customers dynamic, web-based transactional support for both the buying and selling sides of their operation.

With over 400 customers worldwide, Component Control dominates the market for the smaller-scale component shops. The system is lighter-weight and therefore more affordable, training and

implementation are simpler, and the system can be brought live more quickly. The product set has a large number of different pre-packaged modules, and the user interface is very easy and intuitive, which is one reason for the company's success. The system covers customer account and contract management, through to shop control and repair order management, including invoice management. The system even has an e-bay Direct module, as a possible vehicle for selling and buying. These types of systems are well worth a very close look when considering buying new software.

Business benefits

Control and visibility are central factors in cost control in the repair process. The turnaround time (TAT) is vital to keeping overall costs low by ensuring that 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 TAT, and good control is exercised over repair quotes to actual bills, then there are significant savings to be made in this area. Pooling is becoming a favoured alternative to direct management of repair at a vendor. Unserviceable parts are put into the pool and a repaired serviceable part is taken out. IT systems play central roles in all of these.

IT systems usually bring flexibility as a side benefit to an organisation. "The key benefits that Ramco brings to component MROs are its flexibility, scalability and totally web-architected technology," claims Lorenc. "Our solution offers our customers the flexibility to pick and choose the processes to be implemented. This enables the smaller players to start small,

while at the same time providing them with unlimited scalability as their business grows. The complete web-architected nature of the solution enables us to offer 'Ramco as an SaaS (on-demand) hosted solution. This provides access to the application without any up-front investment in software, hardware or other supporting infrastructure." This ability to re-align processes, and fit the IT system around them, can make the difference between success and a wasted investment in software.

Financial improvements are uppermost in management priorities for introducing a new IT system. One large aerospace repair organisation saw improvements in the supply pipeline, with shop piece part delivery improved by 3% and supplier on-time delivery by 40% when it introduced a new IT system. The supply chain was also improved, with supplier lead times reduced by 15%. Recent history has shown that inventory reductions of 20-60% are typical, along with a corresponding increase in service level to the end customer. Some of this is down to process improvements, using 'lean' principles, and some to new IT systems.

"Using Mxi's integrated, advanced software," claims Butler, "an air force customer has achieved a 50% increase in usable component life through the shops, and has saved $10 million annually in spare parts costs as a result." These are impressive results.

"At PHI, a large operator and MRO installation, Ramco has introduced technology with full digital signatures using smart cards," says Lorenc. "This has completely eliminated paper records. Many of the shops were using master work orders to capture time and materials, and it was becoming difficult to figure out exact costs incurred on individual items. The new system was able to drive efficiencies and enable easy generation of individual work cards, and work execution reporting, while significantly reducing overall time away from work spent on the computer doing work planning, assignment and reporting."

Satisfying the customer

Cost-cutting is one business strategy. As in any business, aviation component-repair vendors thrive and grow on

Commsoft offer an affordable solution for the component repair market. Easy-to-use functionality is important.

satisfied customers. These customers are becoming ever hungrier for information on demand, in an accessible and easy-to-use format. One key area of automation and computerisation therefore is in the touchpoints with the end-customers' business processes. A good example of leveraging new technology to improve the 'front office' is provided by Ramco. "We provide a customer portal module," says Lorenc, "so that the MRO shop can configure limited access to their customers. The customers can log in over the internet and see the status of their orders, approve any additional work, accept or review quotations, and view their credit status."

This customer-facing aspect of a computer system is clearly a focus for software vendors.

Web technology is assisting in this push to make it easier for end customers to participate in the repair process. "Our system is designed for ease of integration to external systems," says Mxi's Butler. "We have an external maintenance adapter which allows for integration to a customer's system for real-time importing of approved workscope data directly into Maintenix."

Cutting your cloth

While a number of excellent modern IT solutions are on offer, can component repair organisations afford to invest in them? Is it possible to make a return on investment before the chosen IT solutions become obsolete and need to be replaced again? This is one of the hardest questions for executives to deal with when setting IT strategy.

"Business process re-engineering, using industry best practices, can be beneficial to any environment," says Butler. "If the software is designed around these best practices, smaller-scale environments can still reap the benefits of this methodology. With this in mind, Mxi developed a Standard Airline Solution (SAS™) based on over 10 years' experience working with some of the world's leading airlines, OEMs and MRO organisations. Recently, a project manager at a major airline implementing our solution said: 'When we approached the Standard Airline Solution model from Mxi, it simply made sense to us when analysing our business processes. This model has helped us to transmit the new
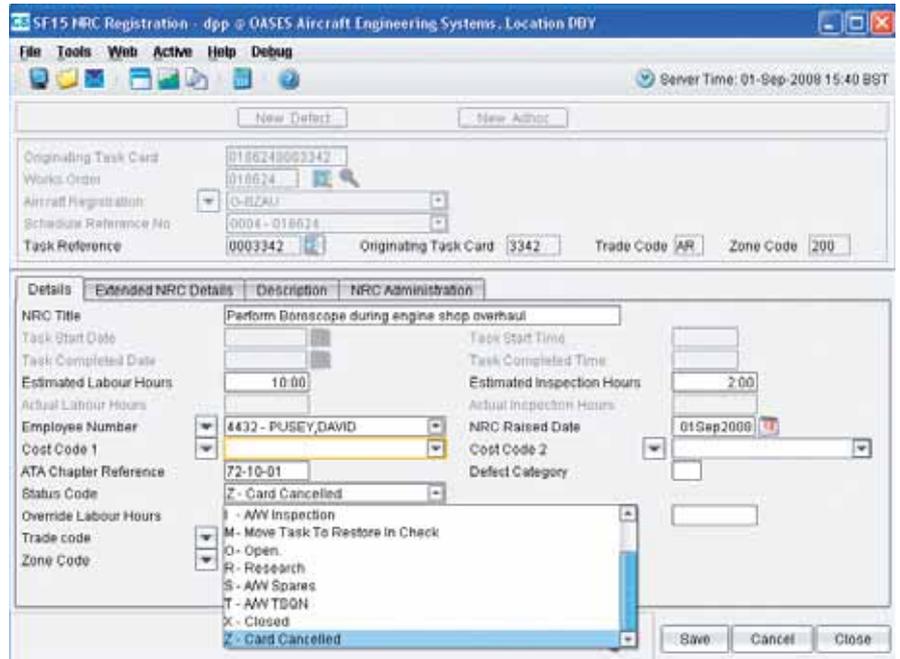
system logic into our organisation, as well as assist the business process mapping currently under way.' We also offer the system as a hosted application service provider (ASP) solution. In this configuration, the customer does not have to buy any hardware or software, and instead logs in and uses the system when needed. Everything else is managed and taken care of for the customer. This makes the solution much more accessible for smaller-scale customers."

In contrast to the mid-market pure-play vendors like Mxi, vendors like Commsoft offer a budget alternative, which is probably more affordable for the component repair market. OASES is sold in individual modules, which can act as a complete integrated whole. A key point in making the capabilities of a system to a small-scale environment affordable, is the ability to be flexible. Commsoft offers the option to price the system on the basis of the number of concurrent users, using a shared risk and shared reward philosophy with a monthly rental fee for licences and maintenance. This can significantly reduce the upfront investment and smooth cashflow, especially during the start-up phase of the system implementation. The price of the system also starts at considerably less than a mid-market system.

At the top-end of the market, price-wise, the full ERP vendors face a challenge. To make an investment case for such a system, a repair business must probably need to replace its entire human resources (HR) and finance system at the same time *(see Systems for managing finance and human resources in MROs, Aircraft Commerce, June/July 2008, page 55)*. Ramco's solution, for example, is highly modular. This allows the smaller players to start small, while still providing

them with unlimited scalability as their business grows. The complete web-architected nature of the solution makes it easy for its ASP offering, Ramco OnDemand, to be offered to the market. Like Mxi, this provides access to the application without any up-front investment in software, hardware or other supporting infrastructure. But one big advantage for the ERP vendors is that the full integration of finance and HR, if taken together, probably makes a compelling business case for many large repair businesses. Control and visibility to assist better decision-making are centralised in one 'version of the truth'. This is probably the reason why ERP vendors have prospered in the past with the larger end of the market. Whether this is set to change with the challenge of the pure-play MRO software vendors is yet to be seen.

In summary

The component repair business is very different to managing and supporting aircraft operations, so the needs for an IT support system are different. A number of ERP system vendors have been implemented in large engine shops and some component shops. Several of the pure-play MRO system vendors have developed capabilities much more closely matched to the repair process, however.

Smaller vendors, like Component Control and Commsoft, offer affordable solutions for smaller repair organisations. The option of a fully hosted ASP system is also worth considering when evaluating an IT solution. **AC**

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