Buying materials is one of the largest cost elements of all maintenance activities, making it prone to errors and inefficiencies. Systems to streamline this process are examined.

Systems to manage material procurement

Material and parts bought from outside a maintenance facility and services make up a significant proportion of an aircraft's budget for maintenance or maintenance repair and overhaul (MRO) operations. In some cases these can account for about 40% of maintenance costs, so they have naturally become a focus area for cost reductions. There are two areas of functionality that any MRO system must have to support the purchase of components and the management of outside repair services. In addition there are the supporting functions, such as invoice handling, warranty administration and vendor contract management, together with quality assurance of the supply chain.

The starting point

When other ways of satisfying demand for a part have been exhausted, the requirement is handed from the material management function to the buying department to find the best economic solution *(see Systems to monitor inventory and rotables, Aircraft Commerce, October/November 2006, page 54)*.

A good example of the interaction between material and purchasing is provided by Ramco, which is headquartered in India. Ramco is an enterprise resource planning (ERP) provider with an up-and-coming solution. It offers an integrated MRO suite which includes coverage of external material management. "Ramco's Aviation Solution has an advanced demand management engine that optimises stock levels across a multi-site inventory distribution network," says Jamie Cid, marketing & business development executive at Ramco Global Aviation Solutions. "Based on

forecasted due lists, the solution enables planners to review material demand in different planning horizons. Sourcing can be automated through pre-defined replenishment policies. The planner can see the full repair cycle, including jobs in progress, whether in the shops or with external repair agencies. Purchase orders (PO) can be generated automatically, using pre-defined company replenishment policies, or manually, based on the demand management engine's output."

The interconnection between an airline's material and purchasing departments is crucial to a smooth operation. Automating parts of this often disjointed process will lead to some savings, but more importantly this will provide more control, visibility and agility, and faster reaction times to aircraft-on-ground (AOG) situations. "The TRAX application sends an automated requisition to purchasing, and prints out a hard copy," says Chris Reed, managing director at TRAX. "The requisition will then be dealt with by the purchasing clerks according to priority. They can raise a full PO or use the quick PO option. The system can be set up with a number of rules to drive the procurement decisions, including who is the preferred vendor and whether a particular part needs a request for quote (RFQ) before purchase action. RFQs can be built on line and sent to each vendor by email as a PDF attachment or an MS Excel file. The Excel file is completed by the vendor and returned, so that we can re-import it into the application. This can also be sent using SPEC2000 in Version 8.0 of our product being released this year. The system will also raise a coloured flag against each RFQ response, indicating at a glance which is the cheapest quote or shortest lead time. The RFQ can be converted to a PO with a single click, and the vendor's details

entered. Economic order quantities (EOQs) will also be noted at this point for the vendor/part combination, based on data already set up in the part master record. If the component is part of an insurance claim, the details of the claim can be logged and the component added to it for future billing. A new feature we have just added is the survey or checklist. It is a mandatory questionnaire that a user must complete before the action is completed. In the case of a PO, the checklist might ask the purchasing clerk about company guidelines, safety issues associated with hazardous material purchasing, vendor performance, quality ratings checks and so on."

The purchase process

Once the purchase option has been decided, it is important that the process between the company and the supplier is quick, seamless and controlled. Vendor performance is critical in today's environment and many contracts are constructed around key performance indicators (KPIs). Tracking and expediting orders are tasks regularly undertaken by procurement staff, and in a pressured environment they need clear information from the computer system and easy-to-use functions to complete their tasks in a timely manner.

"Ramco's Aviation Solution facilitates vendor performance tracking by calculating three critical indices: quality, price and delivery," comments Cid. "These metrics are made available to purchasing staff during the purchase process. The quality index is computed based on parts rejected during the receiving process along with the total parts received, and provides information about how good the parts supplied are, including paperwork. The price index is computed for each part by considering

the lowest vendor's price, along with the price specified by any vendor for that part. This will be important when negotiating supply of parts and assessing RFQ responses. The delivery index is a measure of the supplier's reliability, and is classified into two sub-indices: a delay index; and early index indicating when parts were delivered against a promise date. Based on the values computed for each index, the system also calculates the overall index. These data are available on line to each purchasing clerk for use at any time to aid decision-making and supplier negotiations."

"Vendor performance statistics are available as a drill-through function from our procurement module," says Reed. "When a PO or RFQ is being raised or assessed, the clerk can click and drill down into the vendor's performance to date, and look at their suitability for continued use as a supplier. The native graphical tools provide the data in visual form as well, which helps summarise the data rapidly." MXi takes a similar approach but have an expanded set of criteria. "The Maintenix product tracks the history of every quote, purchase, invoice, and shipment from a vendor," says Matt Tobin, vice president business development at MXi. "Whenever an agreed price is changed, a delivery date is missed, an incorrect part is shipped, or any of many other possible vendor failings occurs, Maintenix tracks and records it. All of these data are then processed through a series of analytical tools to provide vendor performance summaries, which can be used in the vendor auditing and approval workflows to allow the user to 'unapprove' vendors that have been poor performers."

This is also the basis of the AuRA vendor analysis module from MIRO Technologies, a US- and UK-based MRO software specialist. "AuRA provides comprehensive vendor history, including late deliveries, warranty claims, repair orders, total deliveries, and average lead-time," says Mark Ogren, marketing director at MIRO. "AuRA provides comprehensive vendor performance history, both on purchases and repairs, for many different parameters, including: late deliveries; short items (not delivered); cycle time; reject time; lead time; and invoice matching. Within AuRA's 'vendor management' functionality is the ability to record and establish key logistical information at the vendor level, and also at each of the vendor's sites. AuRA also has point-of-contact information that includes name, title, phone, fax, pager, email and after-hours AOG support numbers. The profile also includes how the vendor or supplier ships goods: free on board (FOB); the carrier used; standard shipping time; method of payment; and so on. Using the integrated report-writer and on-line analytical processing (OLAP) data warehouse capability, sophisticated vendor ratings are provided as a management dashboard for users and executives."

Managing a supply chain effectively using good KPI data, and managing the contracts and advanced purchase options aggressively using a good control framework set by good software systems, can reduce a company's bought-out costs by 4-15%, according to various studies.

The software alone will not bring savings, but it will provide consistency and rigidity in the application of a procurement policy devised by management.

The outside world

A purchasing system at some point needs to cross the boundary from the internal world of the MRO organisation to the outside world of the parts

The Maintenix application can track and handle the receipt of purchased components. It holds all required regulatory data for audit and financial reconciliation.

suppliers. Our system is flexible and easily integrated for clients in the form of a web service," says Cid. "SPEC2000 messages can be transmitted as XML documents as prescribed by the Air Transport Association (ATA) or through the traditional EDI SPEC2000 text messages. With the advent of the internet, XML-based transmission is gaining widespread support. When connecting to SITA/AIRINC networks using the traditional SPEC2000 EDI text message files, Ramco uses a third-party SPEC 2000 software called 'Multilink EDI'."

The interface via SPEC 2000/2200 is an interesting area for discussion. Historically, older computer systems, mostly mainframe-based, required specific protocols so that they could send standard messages to the outside world. But how useful is it? "Although we have SPEC 2000 capability within our product," says Reed "only one of our customers uses it. Most customers communicate using email, fax and links to original equipment manufacturers' (OEMs) and suppliers' websites. The internet means that SPEC2000 is not as relevant as it was many years ago."

Another example of different internet strategies for communicating are the parts exchanges, such as Aeroexchange. Aeroexchange eliminates these inefficiencies by consolidating EDI, XML and web-based communications into a single hub, reducing the need for manual communication in the transaction life cycle.

It seems that the market is split on the relevance and importance of SPEC 2000/2200. Many airlines and MRO companies seem to prefer to have the capability when specifying the requirement in a tender for a new MRO software system, yet the evidence suggests that the need for, or indeed the benefits of

having, the capability are dubious. Other options like trading exchanges exist. The actual cost savings seem minimal.

External repair tracking

For external repairs, the process has some similarities to purchasing but has different significant additional requirements and subtleties. Mxi's Maintenix product allows a straightforward process for the creation and tracking of repair orders (RO). "Creating an RO is virtually identical to creating a PO, with the notable difference that the system ties a workscope to that purchase order," says Tobin. "As with a PO, quotes can be sought, and the order must pass through a user-configurable approval workflow before being issued. Once the RO is issued, it remains on a to-do list showing the outstanding ROs for materials or procurement personnel to monitor and track. At the same time, an expected inbound shipment is created, with an estimated time of arrival (ETA) set to match that of the agreed-to terms on the RO. This lets storeroom personnel know that they have to look out for the inbound shipment, since they also have a to-do list that monitors expected shipments and allows receipt against them."

Some applications provide detailed functionality for parts of the process, such as shipping of the repair part to the vendor. Ramco's system facilitates the tracking of the external repair loop. "The various stages in the external repair business cycle are easily identified, based on a repair document status which is updated on user action. The stages that are tracked in sequence are: the creation of the RO; specifying the terms and conditions for the order; releasing the RO for shipment of the item for repair;

shipment of the items, including specifying the shipping details; recording the acknowledgement for receipt of the items by the repair vendors' shop; recording the quotation received from the repair vendor for carrying out the repair work; authorising the RO to carry out the work as per quotation; and receiving the items after repair, leading to closure of the order. At each stage, the status of the RO and detailed data are accessible online."

Control and visibility are necessary to squeeze costs. The turnaround time (TAT) is vital to keeping 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. Significant savings can be made if days are shaved off repair turn times, and control is exercised over repair quotes to actual bills. Management should pay attention to this business area and function in its computer system.

The AuRA RO process automatically tracks all the relevant engineering data for the subject component or system. These data include all related part and serial numbers, component life limit counts, engineering order (EO) and airworthiness directive (AD) compliance state, warranty state, and so on. "Upon eventual return of the component or a comparable exchanged replacement part, AuRA captures all the details of the item returned," comments MIRO's Ogren. "This information is presented as a 'before and after' snapshot of the details. The details of the part shipped are compared to those of the part returned for every tracked component on the assembly, such as an engine. When a part is highlighted, the bottom section of the screen shows a comparison of the life limits on the part shipped and those on the part returned. For example, the returned part may be considerably older than the part that was shipped. Similar comparisons are made against EO/AD compliance history, and warranty status. Throughout the repair cycle, AuRA makes every effort to remind the customer to make the most of warranty opportunities. First, in the maintenance organisation, while processing the component removal action, the user is reminded if the component being removed is under warranty. When the

Repair orders are managed by AuRA using business rules to automatically pre-populate the order forms. Components under warranty are flagged to the purchasing department.


material co-ordinator is performing the turn-in transaction, again a reminder is presented to the user encouraging warranty handling. Finally, when the repair co-ordinator is preparing the RO, the system will automatically assume the user really wants to process a warranty claim. Improved warranty management is an area ripe for improvement that can save MRO organisations millions of dollars every year."

Reed agrees. "One of our customers, Airtran, claims to have saved $5 million over a five-year period just on better component repair warranties."

Pooling & exchanges

A variation on the standard repair business process is part pools and exchanges. Pooling is popular in some regions and works well for groups of airlines in the same region that are operating similar equipment. Each airline member of the pool contributes a portion of the cost of holding safety stock of the expensive repairable components. The pool may also sometimes be held by the OEM. An airline that wants to repair a part swaps an unserviceable component for a serviceable one from the pool. The unserviceable item is repaired and returned to the pool as a serviceable item. There are various contract clauses and charges for using the pool, for example limiting the number of items that can drawn in a specific time period. Exchange orders, including advance orders, work on a similar principle, but are directly between an MRO organisation and the repair vendor without pooling. As the term suggests, the repair vendor will send back a different part to the MRO organisation, sometimes before receiving the unserviceable part. Pooling and exchange present challenges to the software systems, including tight control of data recorded for regulatory purposes. Most cope well.

"Ramco's solution supports pooling of inventory for various trading partners," says Cid. "Stock can be segregated and ownership controlled. The solution enables MRO service providers to enter into special contracts with their customers. The ownership and maintenance costs involved for the pooled
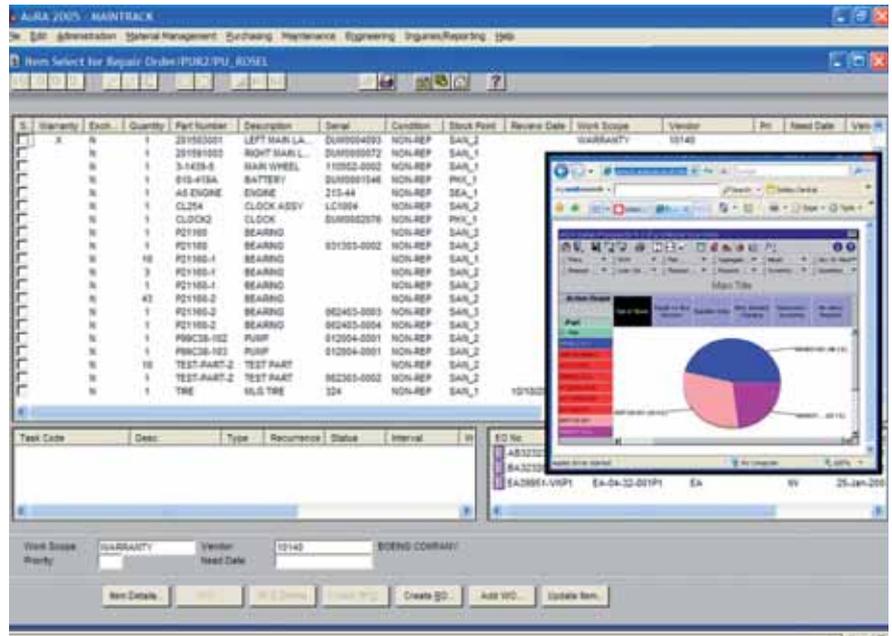
items together with the associated price can be tracked. The solution also supports exchanges of unserviceable components between various trading partners. All maintenance records are tracked before and after exchanges, depending on the type of contracts. Exchanges can happen just with an exchange fee or with repair expenses incurred on the unserviceable core."

MXi provides financial tracking through the exchange and pooling processes. "An exchange is really a variation on a purchase order in our system," explains Tobin. "This is where an unserviceable part to be returned serves as some or all of the credit towards the acquisition cost of the replacement part. Furthermore, exchange orders have a payment model, which allows the system to calculate late fees and accrued costs if return-by dates are missed and inventory is held longer than originally planned. Maintenix has a powerful inventory ownership model that provides a foundation upon which exchange and pooling logic is built. Knowing who owns the inventory at which stages of the process is key to providing a basis for tracking pending exchange returns. It further allows proper management of accrued costs and payment."

Loans in and out of an organisation are a fact of airline and MRO life, but are usually handled badly by most companies without the support of a modern IT solution. In some cases, a part can accrue loan charges of several times its purchase price because it has been fitted and forgotten. "We had a customer that said they paid for the TRAX system in three months just from improved loan tracking," claims Reed. "The system keeps track of a part that is loaned in and puts an automatic call out for a part to replace it when it is received in, alerting
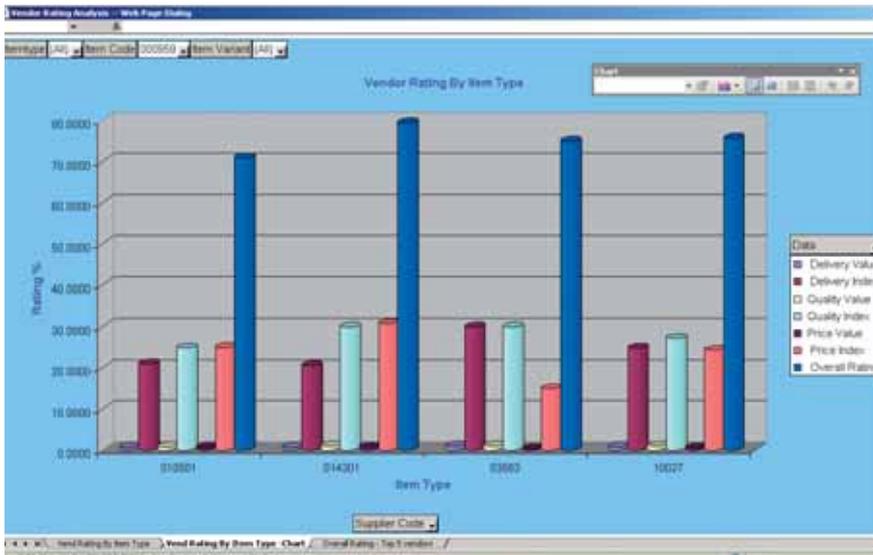
the material department to the fact that a loan item is still fitted."

End of the line

The final piece of the jigsaw for both POs and ROs is shipping and receiving. This is a straightforward process for most items *(see Systems to monitor inventory and rotables, Aircraft Commerce, October/November 2006, page 54)*. For some items, hazardous material (HAZMAT) requirements are an important consideration. "TRAX uses the International Air Transport Association (IATA) standard HAZMAT form when printing shipping documents for a part that requires special handling," says Reed. "It will also be flagged as HAZMAT throughout the transaction processes in the software. We also have connectivity to shipper systems like FedEx online, so that the actual location and status of a shipment can be monitored." The area of HAZMAT handling is very sensitive for aviation. "AuRA tracks and deals with HAZMAT items being shipped in a specific way," says Ogren. "An example is the requirement to ship HAZMAT parts using only preapproved shippers. It can hold complete material safety data sheets (MSDS) in the database, which are accessible from any part of the software process."

Tying up loose ends

The final important back-office function in the procurement and repair process, is to close the loop and check that the organisation is being charged for the right parts, quantities and services, at the right price. Most good software solutions can enter and match the invoices received with the original PO or

Vendor performance is a key criterion for supply chain management. RAMCO can measure and display these indicators on line to the end-user at any time.

RO and the receipt documentation within their own financial modules. This is known as three-way matching. Mxi is a good example. "When an invoice arrives, the Maintenix system initiates a three-way match among the invoice, the PO, and the receipt. The system allows a many-to-many relationship between POs and invoices, such that a single invoice could cover many POs or a single PO may be invoiced in increments. When reconciling an invoice, the user sees a simple screen that shows the status of the receipt, the PO line information such as cost, quantities, and so on, corresponding to that inventory, and the invoice details corresponding to that same PO line. The user can determine whether quantities or costs are inconsistent.

Taking a different approach

Of course, there is a completely different way to deal with bought-out and repaired components. Known as third party logistics (3PL), or in the military MRO arena as contractor logistics support (CLS), a vendor or OEM will take responsibility for ordering, stocking and delivering components as the airline or MRO organisation needs them. The investment in parts, systems and people to manage the spares lies entirely with the 3PL provider. They enter into a contract with the airline or MRO that builds in an element of risk mitigation and profit margin. In the long run the organisation buying the 3PL service may pay more, but it has lower financial risk with fewer fixed overheads and less investment. The key, of course, is whether 3PL will be able to deliver the service at an acceptable level of reliability and punctuality. The military experience indicates that it can. This has been the mode of operation in the US for many years, and is successful at increasing flight reliability and slashing costs. Some of the major players in military CLS, such as

AAR, also operate in the civil field. At the forefront in Europe have been some of the major airline MRO arms, like Lufthansa Technik and SAS Technical Services.

A number of criteria must be considered if this option is to be viable.

"The goal for 3PL is to provide better parts availability while reducing inventory levels for the customer," says Giacomo Squintani, campaigns and events manager EMEA at Servigistics. "We are currently implementing with a number of airframe manufacturers in this area, and we continue to see more opportunities. Eurocopter and ATR are two companies which have selected Servigistics. We are currently in the process of implementing at three global aircraft engine manufacturers, and are in discussions with a number of other engine shops. While results from these implementations are yet to be measured, we expect to achieve inventory reductions greater than 20%, as well as a sharp improvement in on-time overhauls or turnaround time. A major aerospace electronics provider has implemented Servigistics worldwide to optimise inventory levels and centralise planning for its spare parts network. The project included improved forecasting and provisioning and improved daily planning. The following benefits were obtained and documented: the service level to its end customer, a measure of reliability of service, increased by 8%; shop-piece part delivery improved by 3% to 94%; supplier on-time delivery was up by 40%; and the inward pipeline was also improved, with supplier lead times reduced by 15% with better forecast linkage to suppliers. Following its success in the electronics implementation, this company has decided to implement Servigistics across its entire aerospace division."

Experience has shown that inventory reductions of 20-60% are typical, along

with a corresponding increase in service level. Aerospace and defence companies experience worse service performance than other industries, despite significantly higher inventory levels. According to the Aberdeen Group, the industry averages 514 stockouts per year, against an overall average of 272, with efficiency levels of 101 in other 'high-tech' sectors. Aerospace firms and airlines are finally realising that service has historically been overlooked and underfunded from a technology stand point. The opportunity to reduce costs for most aircraft operators has put significant pressure on the OEMs. These macro trends will drive future investment in service technology providers such as Servigistics.

"Ultimately, all players recognise the need to drive down inventory costs by improving parts forecasting without compromising customer service," comments Squintani. "Technology is finally providing the tools and removing the excuses. Companies must now embrace the reality that service is going strategic, or accept the consequences of failing to deal with the change."

The OEMs are leading the way. Airbus has evolved its aftermarket over the years and the latest strategy falls under the Air+ marketing banner. Air+ includes a continuum of services that runs to a full outsourcing of materials, MRO services, training, engineering support and software. The Airbus modular spares service (AMSS) is an integral part of this. Airbus manages the spares stocking and logistics function for the airline or MRO. This is a strategy found in all the main OEMs.

In summary

Cost savings in the external procurement cycle are not huge, but there are some significant areas. Warranty management and loan tracking are two very quick benefits to be had from implementing a new system. Completely new procurement strategies are now available, by tapping into 3PL and OEM schemes, thereby circumventing the need to hold and procure inventory at all. This seems to be the way of the future. **AC**