

Mission critical

With the world's most demanding requirements for maintenance, repair and overhaul (MRO), digital design collaboration and track-and-trace, the aerospace and defence sector has it all. Brian Tinham looks at the issues and their solutions

aerospace and defence – probably the most exciting of the industry sectors as viewed from the outside. And from the inside? Well, a huge industry and a complete mix. On the one hand, leading edge technologies, processes and IT for designing, building, maintaining and managing some of the world's most advanced and complex mobile assemblies. On the other, a world dogged by the detail of technical, commercial and political regulation – and just as concerned with products built 60 years ago as yesterday.

Among the biggest, most interesting issues concerning this high spending and extremely varied global industry are: the challenges of MRO (maintenance repair and overhaul) with asset-intensive, mission-critical equipment and operations; importing lean ideas from the automotive sector but for what's often a highly engineer-to-order environment; and going entirely digital for collaborative design, development and visualisation. But there are also: the trend towards service-orientated, 'power by the hour' initiatives; relentless

important as functionality. And that in turn is one of the primary drivers for the industry's efficiency, collaboration and supply chain synchronisation and empowerment initiatives – and again the focus on lean.

Taking that point, lean initiatives are everywhere – in production, design, but also in operations. As Simon Holloway, formerly with Rolls-Royce but now manufacturing industry architect at Microsoft, says: "If you're an OEM, you have to carry whole sets of finished assemblies and parts spares to meet operator service levels because of production lead times – and sometimes that's from multiple suppliers. In defence contracts, for example, for every pair of engines you sell one spare. And it's similar in the civil case except that there are extra complications around servicing by Tier One sup-

"It's about changing to predictive maintenance by building in systems"

Simon Holloway, Microsoft

part, subassembly, operation and asset track, trace and audit requirements; integration for decision support and collaboration at a range of levels; and, of course, mobility and security.

From a top level business and IT perspective, it's also worth noting that the sector has seen serious consolidation so that it now feels like a relatively small community – certainly compared to automotive. It's now easy, for example, to identify the main aerospace and defence OEMs in Europe: companies like EADS, Airbus and Dassault Aviation. Equally, there are relatively few providers of large systems like engines and landing gear: players like Rolls-Royce and Smiths Aerospace.

Indeed, suppliers like Bombardier and Thales, with revenues in the \$10–15bn bracket, are among the sector's Top 10: well below comparable suppliers in the automotive market. All of which speaks to another significant change in recent years – that of massively increasing concerns for cost controls, now at least as



pliers like Rolls-Royce, or third parties that just do MRO.

“So the lean issue in MRO is, how can we drive that need for inventory down at the same time as maintaining in-flight service? And partly it’s about putting pressure on design so equipment lasts longer between services. But it’s also about changing to predictive maintenance by, for example, building in systems to pick up and transmit information during flight that predict when that equipment needs maintenance. Then you can pull some of the costs out.”

Equally, from the maintenance operations perspective, if equipment can be interrogated while still in flight or immediately after landing, before passengers have disembarked, not only can turnaround be faster, but parts availability and location scheduling can be better synchronised.

The technologies: intelligent sen-

sors equipped with RFID providing information to service technicians’ PDAs linked in turn to the operator’s or third party service provider’s MRO database.

Full mobile integration will bring up drawings, disassembly and assembly instructions, and flight and maintenance history for each specific part, assembly or module on that aircraft. It will also provide for inventory management and optimisation – also by location – for airlines, third parties or whoever. Holloway again: “And, rather than building and loading MRO spares production lines based on estimated failure rates and numbers of engines likely to be in service, now you can see real failure rates and share information across the network of everyone involved.”

New technologies

Jens Heitmann, head of systems and equipment standardisation at Airbus, and among the leading lights on the industry’s ATA (Air Transport Association) Spec 200 data management committee, is a strong advocate of such ideas. He sees uptake hinging on key developments like harmonising data and content for exchange between manufacturers, suppliers and airlines, as well as on implementing RFID transponder technologies and the Edge middleware and data warehouse infrastructures behind them.

“We have set priorities: products that have to be ▶



► maintained most frequently, like landing gear brakes that have to be changed every 200 landings. It will be good to capture data automatically and know that the right parts have been removed and the right approved parts have replaced them," says Heitmann. And he also refers to additional value from ensuring that the right information, with version, issue and history control, is in the right place at the right time – such as when airlines sell on their aircraft fleets, and the requirement then is for the up-to-date as-maintained position.

Currently, the data sources are mostly barcodes: moving to RFID will mean more and better data. Heitmann again: "For example, if there's a problem with an engine part, information will come from the transponders which, linked to a data warehouse, will provide maintenance manuals for that product directly with the as-maintained information... In fact, in the future we will have condition-based maintenance, with all the data we need coming from different systems via the data warehouse. It will take some more years yet, but it's coming: maybe on our next products, the Airbus A350 and the A400M military project."

"So from an IT perspective it's about using e-business tools with security"

Dave Williams, BAE Systems

And he sees the technology enabling similar improvements in production and the supply chain – and again potentially feeding back into engineering. "The level of data attached to products will improve our management of all sorts of aspects of our industry in the future. Think about airline baggage: today there is still quite a lot of missing luggage because the scale of information is missing. That can be changed."

Niall O'Doherty, head of EMEA manufacturing industry consulting at data warehouse developer Teradata, part of NCR, sees the combination of technologies not just being about improving flight readiness and the MRO supply chain, but also long term operations and support costs, all of which are very data intensive. For him, ideas like 'power by the hour' – with OEMs and/or third parties transforming themselves largely into service organisations that also manufacture – will depend on visibility and tracking down to aircraft, major assemblies, subassemblies, components, materials, manufacturers, batch, maintenance history and the rest over 30-plus years.

That means databases scaling to provide huge coverage and of different data types – including structured and unstructured data. "RFID will provide great steps forward over the next 10 years, but there's still a lot of hand-written repair dockets, maintenance schedules and so on in MRO. We need to take that data and convert it into structured text for data mining so that these organisations are able to do root cause analysis, predictive failure analysis and then more efficient MRO and supply chain scheduling."

Francois Richard, Microsoft's business development manager for manufacturing, calls it closed loop MRO, and points to feedback of that same information into product development. "You can consolidate data from different MRO databases showing the real things that are happening to components, engines, landing gear, instrument panels, whole aircraft, so that design teams working on new programmes can re-use the information... And you can share information the other way, for service engineers and MRO partners to get 3D visualisation of small 3D files. That's what Dassault has been doing with the Falcon."

Digital design

Moving on to engineering design, the headlines are of the big boys achieving full digital development of aircraft – as in Airbus developing order-specific variants of the A380 passenger and freighter planes using PTC's Windchill-based DMU (digital mock-up) with web links at customer sites, while Ukrainian Antonov develops its recently launched AN-148 regional jet entirely on PTC Cadds5i for design, Pro/Mechanica for analysis and Winchill for PLM (among the first in the world).

But while these are both extremely significant achievements – in the first case contributing hugely to much earlier customer collaboration and thus to reduced manufacturing lead times and better conformance, and in the second case, to improved design quality and time-to-market as well as longer term operational costs and logistics support during the aircraft's lifecycle – there is another story elsewhere.

Westland Helicopters, the UK end of Augusta-Westland in Yeovil, for example, which runs SAP for manufacturing, supply chain and business management, alongside Catia for the design environment, is one among many moving to fully digital product development – but also working with the technology to transform its existing, highly bespoke products for manufacturability and cost reduction.

Says supply chain engineering manager Tony Richardson: "Many of our products, like the EH101 and Lynx helicopters, are originally '70s and '80s designs for MoD cost-plus contracts... Today, with competitive contracts, we have to think more about cost. So design for manufacture is becoming much more important." Building for recent contracts like the Merlin (EH101 variant) and the older Sea King for the UK MoD thus involves much closer collaboration with suppliers around the world – whether that's for the cockpit instrument panel, flight crew mission console, or structural modules, like the cabin roof, canopy fuselage, main fuselage, engine cowls and landing gear.

However, digital or not, there's no escaping the real, variable world. As Westland's Jerry Prideaux says: "You can't get away from late drawing and definition changes. We're not building bog standard helicopters: we offer lots of complex configuration options and every customer has a different wish list, and can move the goalposts – even though the delivery date doesn't



Lockheed Martin

change. From a planning point of view it's a nightmare."

So for most revised helicopter programmes, the first few are development aircraft, requiring considerable interaction throughout with Westland's supply chain, which is currently moving onto a supplier web portal arrangement. The goal is getting as much right as possible in the supply and build phase to avoid substantial retrofitting – and thus further change – later. As Prideaux says: "[Suppliers] have to start work on preliminary drawings, so we need to feed final designs as quickly as possible." But retrofitting remains a fact of life, and it's the job of Westland's SAP/Catia combination to track multiple BoMs (bills of materials) to handle the inevitable complexities of change programmes.

Traceability

Which leads neatly into the aerospace and defence sector's near obsession with traceability, and some interesting observations and lessons that can result from the culture if the IT is there to support it properly from cradle to grave. Gardner Group, founded as an MBO in 2003, provides a full manufacturing service to the aerospace industry from its sites around the UK, with customers like Rolls-Royce, Airbus, BAE Systems and Goodrich – and group systems manager Gary Field says his IT helps with the company's competitiveness.

The firm went for an HRS Jobshop integrated ERP implementation: "Jobshop is on back of all stock electronic transactions, like materials and works orders, so that's all traceable. But costing is on the back of it too – it's one and the same thing." For him, that capability means not only the availability of full traceability, with coverage of every single material issue to every single works order, every single process, incoming GRNs, material cast numbers, all the release notes etc, but instant live production data for everything ever made whenever it's required.

"At our Ilkeston site, for example, which makes structures like brackets, ducted work, smaller fabricated components, combustion parts and spars, there are about 35,000 distinct part numbers," explains Field. "We might not get many repeats, but we still have to be able to build them, so nothing is archived and we can retrieve everything we need for a part we built five years ago just as easily as one we made last week. 100g hard drives, RAID technology and file duplication is cheap so you might as well use it."

He refers to it as a pervasive database, and says that to make operations really slick, it also provides, for example, an intelligent material coding system covering condition, size, form and associated data – avoiding the stock duplication issues that come from part- and issue number-related BoMs.

Returning to MRO, Dave Willams, operations support manager at BAE Systems' Mission Systems Support Group at the Rochester, Kent site, says that systems for security, mobility and efficient planning and scheduling remain key. His team looks after operational processes for repairing head-up displays, flight computers and equipment like ships' weapons platform stabilisers, where the issue is dealing with customer returns from the field and ensuring rapid turnaround and an optimised pool of spares and assemblies stock to meet availability SLAs (service level agreements).

"We have asset tracking systems so we know what equipment is available everywhere, and can maintain appropriate strategic stock sizes," says Williams. "That determines what needs to be achieved in schedules and lead times for the wide variety of products we see, and is able to fast-track them through our processes."

The group uses Manugistics Networks MRO system, which also tracks equipment through all the in-house processes from receiving to despatch. Repair history and audit trail data are then maintained on its UGS ►

The F-35 JSF (Joint Strike Fighter) next generation, supersonic, multi-role stealth aircraft designed to replace the AV-8B Harrier, A-10, F-16, F/A-18 Hornet and the UK's Harrier GR.7 and Sea Harrier

- ▶ Metaphase PDM (product data management) system, which goes back 50 or 60 years with VC10 and Tornado programmes still live. And there's an in-house developed rules-based database module that speeds up order management.

"It checks for previous repairs and pre-approvals and flags less frequent repairs where there might be issues requiring commercial and/or production engineering approval loops," he says. "It also tracks frequent returns and fault types. It's a great enabler to get disciplines built in, and it's freed up management time by giving us the visibility to focus on what might be going wrong."

Asset management

It's the MRO production equivalent of BAE Systems' global tools management system, which looks after jigs, tooling and test equipment, including equipment owned by the MoD and other government agencies on loan. That's around 300,000 units of very high value kit, all of which needs similar tight management, optimisation and traceability. Steve Frost, logistics manager, indicates that its Datastream (now Infor-owned) system is now running across all four Air Systems sites and all off-site locations within service providers who look after storage, distribution and manufacturing.

Investment in these systems is not only essential but valuable: "The biggest thing for us in the current climate is the trust factor," explains Williams. "It can affect National security. For example, Eurofighter Typhoon is a collaborative project with the US DoD a key customer. So from an IT perspective it's about using e-business tools with the right security and Public Key infrastructure so we always know who's accessing the system. And what we're saying is that people tend to look at anything that comes into the business of regulation as no value-added – it's a hassle. But actually it can be a key value-add because this is what customers come to BAE Systems for. They trust our security processes."

Frost concurs: "In terms of tracking accuracy for all tooling it's better than 95% – which is a massive improvement... We also closed a whole warehouse down because it allowed a massive disposal programme: we're talking about £250,000 savings there alone." And he indicates additional value: "It's made it easier for us to deal with programmes that have been run down and then have to be reintroduced – like Nimrod. It allows us to go back so we can focus on aspects that need management attention." ■

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DARA GETS INTO OPEN MARKET ON OLIVER WIGHT S&OP AND SSA/BAAN SYSTEMS

One of the biggest IT and business projects to hit the MoD's Defence Aviation Repair Agency (DARA) organisation was the result of opening the public sector to market forces – meaning competition for work that would formerly have been received by right.



DARA's Almondbank facility near Perth in Scotland provides maintenance, repair and overhaul (MRO) for transmissions and hydraulic components on helicopters and Tornado fighter aircraft. With no forecasting skills or systems in place and no reliable revenue data, DARA had to introduce some big changes fast to stand on its own feet.

The agency chose to implement a Baan ERP system (now

SSA LN) to establish better integration and automated business processes and to improve financial controls. But it also recognised that IT alone would not solve its problems: a major culture change was required. DARA engaged business change consultancy Oliver Wight to help it establish 'Class A' standard in business performance through sales and operations planning (S&OP).

Layers of management were removed, resulting in faster decision-making processes, while S&OP created meaningful forecasting, resulting in better customer service and improved availability of components and aircraft. DARA is now achieving in excess of 95% for on-time, in-full (OTIF) performance, compared with typical defence MRO installations previously achieving 60–80%.

DARA components director Geraint Spearing says that the holistic nature of the project was the source of success. "The transformation couldn't have been achieved by an ERP project alone. The work we've done with Oliver Wight has been absolutely crucial. The transactional processes are important, but you must take your people with you."

Cappgemini handled the Baan ERP implementation, and has now successfully itself re-tendered for the complete managed service – from facilities management to applications management, database management and help desk. DARA Almondbank head of operations Valerie Lungley says: "We upped the availability and reduced the cost by millions." And that's with taking into account MoD security and working on the MoD network – effectively a huge MoD cloud that connects all the MoD's LANs. ■

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