Structuring an M&E system with the functionalities that a specific user requires is a complex task. Besides functionalities, the buyer has to consider the ability of different solutions to interface with each other, and the enabling technologies that will be required for a system function.

Structuring a complete M&E IT system: the initial considerations

The many functionalities an airline or independent maintenance repair & overhaul (MRO) provider may need from a maintenance & engineering (M&E) information technology (IT) system makes choosing and structuring the right one complex. What functionalities does each system have, and which systems can interface with each other? Which systems should be acquired, and which enabling technologies are needed to make all systems work together?

What is clear is that no single solution on the market provides all possible functionalities. This raises many questions about what a user needs from an M&E IT system. What are its functionality requirements? What systems does it already have in place, and what additional systems does it require? Which areas of its operation require an improvement in efficiency, and which ones should be given priority? Which elements of the user's operation could continue to operate without a system?

The overall project is large, so it has to be considered in sections. The initial considerations are examined here.

Conventional structure

The conventional structure followed by many airlines with their M&E IT systems is a core system that provides the main functionalities. 'Point' solutions are used for specialist functions, which are then interfaced with the core system *(see diagram, page 60)*. Ideally, there should be no human or manual bridges between the core system and any of the point solutions.

Users may choose between a pure-play or best-of-breed M&E IT system, and an enterprise resource planning (ERP) system that has been customised to provide M&E IT functionality. There are 15-20 providers of pure-play systems, including Swiss Aviation Software, Trax, ADT, Aerosoft, Cambridge on-line, Cimber Air Data, Commsoft, IBS Software, IFR, MIRO Technologies, MXi Technologies, Rusada, Ramco Systems, and Ultramain *(see table, page 54)*.

The main providers of ERP systems are SAP, Lufthansa Systems, HCL-Axon, Oracle, and 2Moro *(see table, page 54)*. Ramco Systems has taken a different approach, and developed a holistic solution: an ERP system specifically designed for airlines and independent MROs.

There are several main issues for users to consider when choosing between the two main categories of system on offer *(see M&E solution selection: ERP vs best-of-breed, Aircraft Commerce, August/September 2010, page 43)*.

ERP systems have superior functionality for core business functions such as finance and human resources (HR). As they have been developed for all types of businesses and industries, they have to be adapted to acquire full MRO functionality. Pure-play M&E systems have been developed from the start to have dedicated MRO functionality, and some financial and HR capability. They then interface with the user's additional systems for more comprehensive functionality for core business processes.

The main issues when deciding between an ERP system and a pure-play solution are: functionalities; user-friendliness; affordability and price; adaptability; and implementation.

The main differences in functionality between most pure-play and ERP systems are limited mainly to the areas of finance and HR. ERP systems used by airlines are designed for all departments, not just M&E. The M&E functionalities of the core ERP and pure-play systems are similar.

Having selected the core system, the user then has to determine: how well its chosen system will perform particular functions; which other functionalities it requires; which point solutions best suit its needs and can be interfaced with the core system; and which enabling technologies are necessary to make the entire system function as required.

The functionalities of the core system fall into several modules, including: engineering; purchasing and logistics; maintenance planning; maintenance production; rotable component maintenance; inventory management; outsourced maintenance; technical records; tools and ground service equipment (GSE); quality control and assurance; HR; and finance *(see diagram, page 60)*.

There are links, or data flows, between modules and functionalities. One of the most important links, for example, is between the M&E system and the content management system (CMS) *(see diagram, page 60)*.

Engineering

The largest module in the M&E system is engineering. This has many functionalities, and the extent to which each M&E system performs these varies.

The first functionality is maintenance programme document (MPD) management and approved maintenance programme (AMP) management. This also applies to data relating to the corrosion prevention and control programme (CPCP) and the sampling

MAINTENANCE & ENGINEERING SYSTEM VENDORS

Pure-play M&E systems

Vendor	Product
AD Software	AIR Suite
Aerosoft	DigiMAINT & WebPMI
CALM Systems	CALM
Cambridge On-line	Navair
Cimber Air Data	AMICOS
Commsoft	OASES
IBS Software	iFlight MRO
IFR	AMASIS
MIRO Technologies	AuRA
MRO Software	Maximo
MXi Technologies	Maintenix
Rusada	Envision
Swiss Aviation Software	AMOS
Trax	Trax
Ultramain	Ultramain
Volartec	Alkym

ERP Solutions

Vendor	Product
2MORO	Aero-Webb
HCL-Axon	iMRO SAP
IFS	IFS MRO
Lawson	M3
Oracle	cMRO
Ramco Systems	Ramco M&E *
SAP	SAP R/3

* Hybrid ERP system for aviation sector.

Point solutions

Content & Document Management Systems

Vendor	Product
Aerosoft	DigiDOC
CORENA	CORENA
Enigma	Enigma 3C
Euroscript	E-FOS suite
IDMR	InForm & eMAT
InfoTrust	TechSight

Flight Operations & Maintenance Control

Vendor	Product
AIMS	AIMS
AMT Flightman	Flightman
Casebank	Spotlight
Lufthansa Systems	NetLine/Ops
Navitaire	Geneva
Osys	Core Wing
Sabre	Rocade + AirCentre
Smart4Aviation	Smart OPS

Aircraft Health Monitor

Vendor	Product
Airbus	AIRMAN-web
Boeing	AHM+ GOLDCare (787)
Bombardier	AHMS
Embraer	AHeAD

Engine Health Monitoring

Vendor	Product
General Electric	On Point
PowerJet	PowerLife
Pratt & Whitney	EMP
OSYS	Core Wing & Core Fleet
Smartsignal	CycleWatch

Engine Maintenance Management

Vendor	Product
AerData	EFPAC
AEROinformatics	JetEplan

Check Planning & Execution

Vendor	Product
EmpowerMX	FleetCycle
Omega	AMES
Perceptive	Redstone

Component Repair Management

Vendor	Product
Aeroxchange	AeroRepair
Aeroxchange	AeroComponent
Component Control	Quantum suite

Material Procurement

Vendor	Product
Aeroxchange	AeroBuy
Component Control	Quantum suite
ILS	ILSmart
PartsBase	PartsBase

Inventory Management

Vendor	Product
ARMAC Systems	RIOsys
MCA	Performance Management suite
Servigistics	Service Parts Management **

Maintenance Records

Vendor	Product
AerData	STREAM
ADS France	ADS
EMC	Documentum

programme.

Another functionality is the creation of the minimum equipment list (MEL) for each aircraft type operated. This requires a link with the flight operations maintenance control module.

Next, configuration management monitors which modifications and part numbers apply to which tail numbers in the user's fleet, and what parts and part numbers are interchangeable with each other. It also relates to the list of rotables installed on each aircraft.

The maintenance status of each aircraft's components and engines has to be tracked in relation to MPD/AMP management, using information on each aircraft's: accumulated flight hours (FH) and flight cycles (FC); previously performed maintenance; outstanding technical defects; component configuration; and airworthiness directives (ADs) and service bulletins (SBs) status.

Modification management relates to the filing of ADs and SBs as they are issued, analysing their applicability to each aircraft in the fleet, and deciding which ones to apply to which aircraft. It therefore requires a link to maintenance planning. In addition, an airline's own modifications and engineering orders (EOs), which must be approved by its regulatory authority, have to be managed.

Another functionality is powerplant management, which may be considered as a separate module, and included within engine maintenance.

The engineering module is responsible for regulatory compliance, ensuring that: task cards and checks are performed within limits; components are removed within life limits; the MEL is complied with; and reliability reports are filed. Lessors and aircraft owners will want to see that operators are compliant.

All airlines are required to maintain and file reliability reports, which helps them with their inventory management, and is also useful for the original equipment manufacturers (OEMs). There is therefore a two-way data feed between the two modules.

All reliability and regulatory compliance functionalities require links to other modules for data to be transferred. Those functionalities in the engineering module are required to analyse, store and file data with the relevant bodies.

Publications & documentation

The management of publications and documents supplied by all OEMs is so specialised that a specialised content management system (CMS) is needed, which interfaces with several modules of the M&E system.

There are only six main providers of CMSs: InfoTrust, Enigma, Aerosoft,

Corena, Euroscript and IDMR.

Alternatives to these are the OEMs' document management systems for their own aircraft. A mixed-fleet operator has to subscribe to several OEM systems.

A CMS is required for documentation management with any M&E system, since the latter do not have the higher functionality to run a complete CMS of their own. Ramco, for example, has the simpler functionalities of CMS, but if the user requires all CMS functions then a combination of core M&E system and CMS will be one of its first priorities.

A CMS takes all publications and documents from the OEMs, and the component configuration of each aircraft as it is delivered.

Documentation management starts with library management. All updates are received and passed on to all relevant functions within the M&E system, including the maintenance planning and maintenance production modules.

A dedicated CMS will generate all documents and publications electronically and will distribute them to all relevant stations. It also authors and updates documents.

Purchasing & logistics

A large function for any airline is managing the purchase of materials. This includes: ordering, forming purchase requests and orders; generating paperwork for purchasing and receiving; analysing documents and paperwork on received goods; creating and tracking repair orders; tracking borrowed or exchanged parts; and managing stores.

The module is also responsible for the logistics of transporting required parts to all the relevant maintenance facilities and shops, and all outstations. This requires links from the maintenance planning, maintenance production, inventory management and finance modules.

Material forecasting

Material forecasting is a complex process, covering materials, consumables, parts and rotables. An accurate forecast of the materials and parts consumption for all levels of maintenance facilities ensures that items are always available, but not kept in excessive quantities. Consumption forecasts need to be made for thousands of different parts.

Links are required with maintenance forecasting and production so that material and consumable consumption can be tracked and analysed. Planned maintenance events will help determine a consumption forecast.

Inventory management

Rotable inventory management forecasting is more complex, and requires several functions: initial inventory provisioning; inventory optimisation; provisioning of inventory at all maintenance facilities and line stations; repair management and logistics; warranty and insurance claims; sales of stock; and documentation.

Links and data are required from other modules that relate to: removal and failure intervals; tracking of parts; the cost of applying ADs and SBs; tracking AD and SB status; borrowed and exchanged parts; and tracking maintenance and repair costs.

Maintenance planning

Maintenance planning refers to line maintenance and airframe checks (engine and component maintenance is dealt with separately), and requires links with the MPD/AMP, and the FH and FC accumulated by aircraft. The module forecasts maintenance events, and has to be constantly updated as aircraft operate.

It also requires a data feed and links with the aircraft's maintenance status in respect of every task card and component life. Some hard-timed or life-limited parts

(LLPs) that are removed during airframe checks will need to have their lives tracked as part of the maintenance forecasting function.

Maintenance planning also includes adding outstanding defects, so a link is needed to the aircraft's technical log engineering module, and to the line maintenance and maintenance control modules, since decisions will have to be made about when to plan each defect into which particular line check.

The planning module requires data on materials and parts, manpower, tooling and facilities, so it must be linked with the materials forecasting, HR, and tooling and GSE modules.

Maintenance planning can also track the progress of each maintenance event against the original completion plan, and with the completion of task cards. This requires data feed from the maintenance production modules.

Maintenance control

Maintenance control monitors the outstanding defects in an aircraft's technical log, and determines which are no-go items, and which can be deferred. This requires an up-to-date list of defects for each aircraft.

There is also a link to flight operations, first with FH and FC data being fed from the aircraft to the M&E system, which in turn will determine what line and airframe checks are coming due. Also, no-go or uncleared defects prevent the aircraft from operating, so there needs to be communication from the maintenance control module to the flight operations module. The flight operations system also decides on which routes to operate the aircraft. Vendors of flight operations and maintenance control systems include Sabre, SITA, Lufthansa Systems and AIMS.

Technical logs have traditionally been paper documents, but electronic technical logs (ETLs) now allow defects and pilot reports (PIREPs) to be transmitted to a ground receiver via ACARS. This allows a more up-to-date list of defects to be monitored and permits more accurate and faster line maintenance planning.

Maintenance production

This module issues staff with the task cards and documentation they need to perform assigned work. It also monitors the progress of checks, and collects shop-floor data on each check's use of man-hours, materials, parts, tooling and GSE.

Monitoring shop-floor data can provide useful financial analysis. This requires data to be captured electronically, using barcode readers to scan the barcodes on task cards, and material and parts packaging.

Changing components during maintenance visits also has to be recorded and tracked, since it affects aircraft configuration and maintenance status. There are links between the engineering and inventory management modules.

Engine maintenance

The first function of engine maintenance is determining when to remove engines for shop visits, and then defining shop-visit workscopes.

The planning process tracks engine LLPs, which requires a data feed from aircraft and engine utilisation. To help decide the optimum removal dates, engine health management (EHM) data are also needed. These must be provided by the engine OEMs, since they do not permit M&E system vendors to duplicate the EHM functionality. The data will be sent to a ground unit via an ACARS or Iridium link, and are then analysed for information about the engine's health.

Workscopes have to be planned, and experienced engineers will understand the relationship between removal intervals, and the percentage of parts that can be repaired or have to be scrapped. They aim to minimise engine maintenance costs per FH or per FC by balancing the cost of

repairing and replacing airfoils with optimising the timing of LLP replacement via the optimum removal interval.

Most M&E systems do not have a specialised engine maintenance management functionality, so a point solution is required.

The engine management module also has to forecast materials, labour and other resources required for engines maintained in-house, and archive shop-floor data and maintenance records.

Component maintenance

Rotable components must be tracked in order to: generate reliability data and reports; monitor aircraft configuration; optimise inventory; and claim and manage warranties. This means all parts must be barcoded.

Hard-life or life-limited rotables must also be tracked so that they are removed during maintenance checks while they are within life limits. Utilisation and life data therefore have to be communicated to the maintenance planning module.

Rotable management also involves tracking and managing the modification status of components. This requires a link to the configuration management and AD and SB functionalities within the engineering module.

Shop-floor data are also required so that rotable repair costs can be monitored. This provides an element of maintenance cost data, and information used for material forecasting.

Component management is also used to maintain all related documentation.

The inventory management module will use data on: removal intervals and reliability; the time taken to test, repair and transport parts; the AD and SB status of each component; and rotable interchangeability.

Quality control & assurance

This module has two halves. Quality control performs inspections at all levels of maintenance, checking for adherence to part lives, and that rotables and other items are being correctly tracked, tasks are being done in the right packages, and the correct parts are being used. The user also has to ensure that they have all the right documents for all the parts and rotables they hold.

Quality assurance sets quality standards, by defining inspection and technical records standards, and ensures compliance with these standards.

Tools & GSE

Managing tools and GSE is a function within the engineering module, which involves assigning tasks to maintenance checks and mechanics. Tools management relates to materials forecasting, as well as purchasing, since new items are constantly required. The cost of repairing tools and GSE also has to be tracked, as does the age of equipment, in order to calculate annual depreciation charges.

Outsourced maintenance

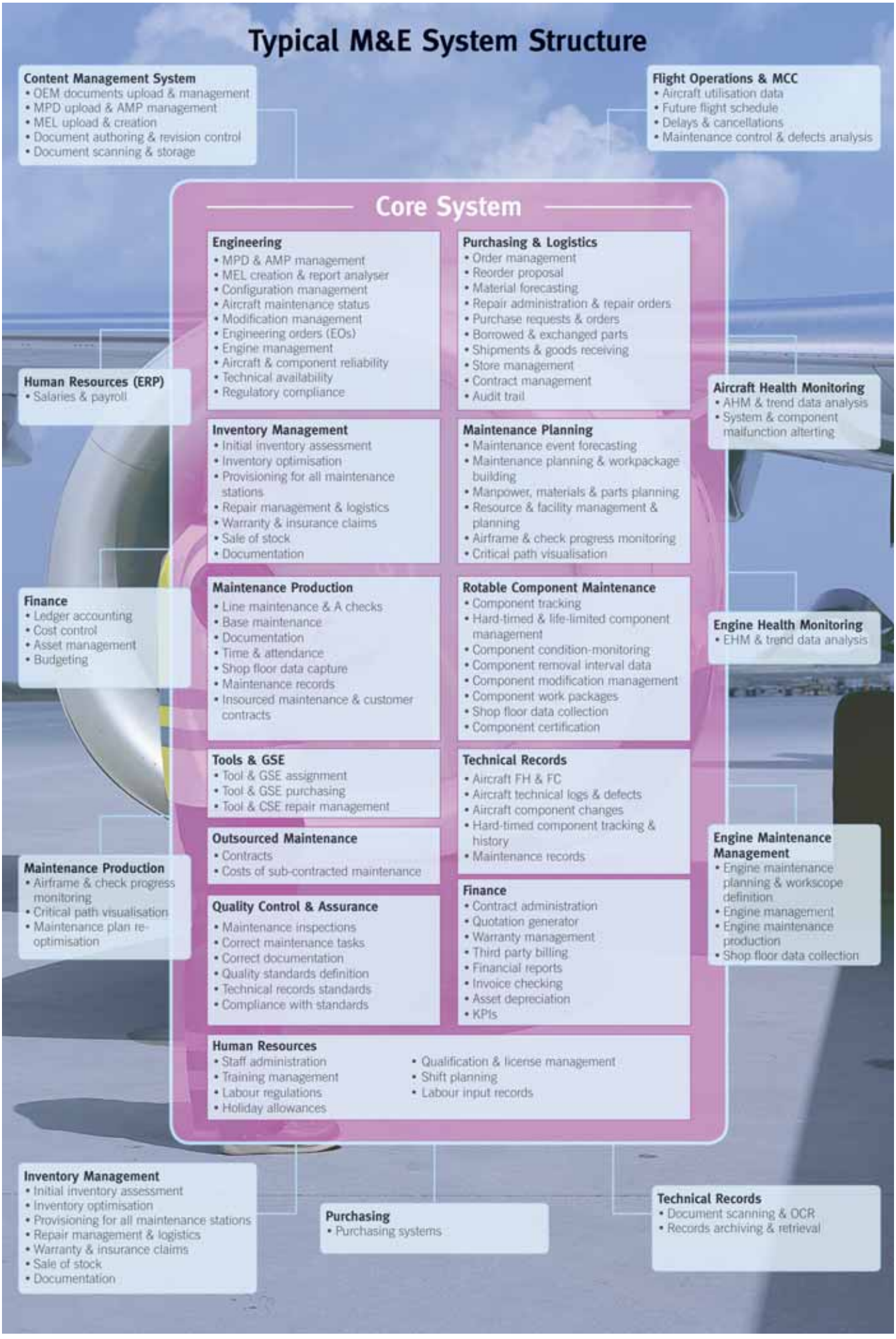
The outsourced-maintenance module manages all outsourcing contracts, and monitors the cost of work performed by third-party providers, using shop-floor and invoice data. This module needs links with the maintenance planning module.

Technical records

Most technical records are kept on paper. Most airlines and independent MROs have yet to adopt a fully electronic system.

Once task cards are completed and manually signed by mechanics, they are manually keyed into the user's M&E system.

Several systems are available that scan paper records and make electronic copies via an optical character recognition (OR) reader. These scanned copies allow fast retrieval and transmission of maintenance records.


Typical M&E System Structure
Content Management System
• OEM documents upload & management
• MPD upload & AMP management
• MEL upload & creation
• Document authoring & revision control
• Document scanning & storage
Flight Operations & MCC
• Aircraft utilisation data
• Future flight schedule
• Delays & cancellations
• Maintenance control & defects analysis
Core System
Engineering
• MPD & AMP management
• MEL creation & report analyser
• Configuration management
• Aircraft maintenance status
• Modification management
• Engineering orders (EOs)
• Engine management
• Aircraft & component reliability
• Technical availability
• Regulatory compliance
Purchasing & Logistics
• Order management
• Reorder proposal
• Material forecasting
• Repair administration & repair orders
• Purchase requests & orders
• Borrowed & exchanged parts
• Shipments & goods receiving
• Store management
• Contract management
• Audit trail
Human Resources (ERP)
• Salaries & payroll
Aircraft Health Monitoring
• AHM & trend data analysis
• System & component malfunction alterting
Inventory Management
• Initial inventory assessment
• Inventory optimisation
• Provisioning for all maintenance stations
• Repair management & logistics
• Warranty & insurance claims
• Sale of stock
• Documentation
Maintenance Planning
• Maintenance event forecasting
• Maintenance planning & workpackage building
• Manpower, materials & parts planning
• Resource & facility management & planning
• Airframe & check progress monitoring
• Critical path visualisation
Finance
• Ledger accounting
• Cost control
• Asset management
• Budgeting
Maintenance Production
• Line maintenance & A checks
• Base maintenance
• Documentation
• Time & attendance
• Shop floor data capture
• Maintenance records
• Insourced maintenance & customer contracts
Rotable Component Maintenance
• Component tracking
• Hard-timed & life-limited component management
• Component condition-monitoring
• Component removal interval data
• Component modification management
• Component work packages
• Shop floor data collection
• Component certification
Engine Health Monitoring
• EHM & trend data analysis
Tools & GSE
• Tool & GSE assignment
• Tool & GSE purchasing
• Tool & CSE repair management
Technical Records
• Aircraft FH & FC
• Aircraft technical logs & defects
• Aircraft component changes
• Hard-timed component tracking & history
• Maintenance records
Outsourced Maintenance
• Contracts
• Costs of sub-contracted maintenance
Engine Maintenance Management
• Engine maintenance planning & workscope definition
• Engine management
• Engine maintenance production
• Shop floor data collection
Maintenance Production
• Airframe & check progress monitoring
• Critical path visualisation
• Maintenance plan re-optimisation
Quality Control & Assurance
• Maintenance inspections
• Correct maintenance tasks
• Correct documentation
• Quality standards definition
• Technical records standards
• Compliance with standards
Finance
• Contract administration
• Quotation generator
• Warranty management
• Third party billing
• Financial reports
• Invoice checking
• Asset depreciation
• KPIs
Human Resources
• Staff administration
• Training management
• Labour regulations
• Holiday allowances
• Qualification & license management
• Shift planning
• Labour input records
Inventory Management
• Initial inventory assessment
• Inventory optimisation
• Provisioning for all maintenance stations
• Repair management & logistics
• Warranty & insurance claims
• Sale of stock
• Documentation
Purchasing
• Purchasing systems
Technical Records
• Document scanning & OCR
• Records archiving & retrieval

The technical records module and the M&E system keep a database of FH and FC data for each aircraft, a log and record of the defects that have accumulated on each aircraft, aircraft component changes, and a record of hard-timed components.

Finance

The finance module has several functions: administering contracts with customers and third-party providers; generating quotes for customers; third-party billing; creating financial reports on maintenance; checking invoices; depreciating assets; generating key performance indicators; and claiming warranties, which needs a link to the rotable repair and inventory management modules.

The finance module in a pure-play M&E system will not be able to perform all the finance functions of an ERP system. Most pure-play systems, for example, lack the functionality for paying salaries, budgeting and maintaining ledgers, and performing asset management functions.

Human resources

This module performs all staff administration functions, such as monitoring each staff member's qualifications and licence expiry data. Training programmes and re-licensing are also a main part of this module. These two functions are linked to the manpower and shift planning function in the maintenance planning module.

The HR module also has functions related to labour regulations, keeping records of time worked by each employee, and managing each employee's holiday allowance.

Most pure-play systems do not have the function of managing payroll and salaries, and managing staff that ERP have.

Specialist functions

The typical structure for an M&E system has a core system, with many of the functionalities described, together with specialist solutions for particular functions. These interface with the relevant modules of the core system.

Specialist solutions are required because of the complexity of particular functionalities. Most core M&E systems do not perform them as efficiently.

Documentation

The first main specialist function is documentation. M&E systems have the capability to upload electronic files from documents and manuals supplied by OEMs, but only for later generation aircraft. Electronic documents first came into the market in the form of SGML in the mid-1990s. Documents for the 777 and other Boeing aircraft that were in production at the time or since are provided in SGML format. This applies to Airbus aircraft, and aircraft and engines from other OEMs.

Documents for older aircraft and engine types were produced in paper format. These were later scanned and available in pdf format, but were non-intelligent documents. Electronic documents were upgraded to XML.

In addition, documents were written in several standards. Paper documents of older types were written in ATA Spec 100, while later types were in ATA Spec 2100 and iSpec 2200. New types will be written in S1000D.

Having documents in three different formats and written in four different standards causes management problems for airlines and maintenance facilities that

are dealing with a range of aircraft vintages. The process would be more efficient if all manuals and documents were created in a single format and standard. This is a product offered by specialist solutions from InfoTrust and Enigma *(see table, page 54)*, which also offer a maintenance task-card writing system, and an airline library update and management system. The InfoTrust system integrates with the core M&E system, and produces a list of parts, tools and drawings together with task cards.

Maintenance control

An airline's maintenance control centre (MCC) analyses the non-CMC codes that are manually written in Pireps and aircraft technical logs. Line mechanics in the MCC will analyse written logs, try to fix problems while the aircraft is on the ramp, and manually input unsolved problems into the M&E system. The faults and defects have to be analysed using electronic versions of the troubleshooting manual and fault isolation manual in the M&E system.

The delays and inefficiencies of the manual process are almost eliminated through the use of ETLs. These have non-CMC fault codes and defects keyed into them by pilots. The data are transmitted while the aircraft is in-flight, and are then picked up by a ground receiver, and sent to the M&E system, where the fault information can be analysed before the aircraft has even landed. The benefits of this include fewer delays in line maintenance planning, improved aircraft utilisation and despatch reliability, and lower line maintenance costs, all as a result of outstanding defects on an aircraft being up to date, and defects being planned into particular line checks at a more optimal time. Defects are also more accurately analysed, and maintenance inputs are not wasted.

ETLs are provided as specialist solutions by providers such as AMT Flightman and Skypaq *(see table, page 54)*, and by some core M&E vendors. KLM, for example, selected Ultramain's ETL for its 777-300s.

Other specialist solutions diagnose faults. Casebank Technologies' Spotlight is used by mechanics to troubleshoot and diagnose faults and defects.

AHM

Aircraft health management (AHM) tools are similar to those that engine OEMs provide for EHM purposes. The major OEMs' products are AHM by Boeing, AIRMAN-web by Airbus, AHeaD by Embraer, and AHMS by Bombardier *(see table, page 54)*.

These systems diagnose fault data from aircraft systems so that alerts can be given to systems or particular components performing out of limits. This prevents expensive system failures. The use of AHM systems requires a two-way flow of data and information between the OEMs and airline users.

EHM

EHM systems analyse engine performance data to detect problems and help predict the timing of removals. EHM products include On Point from GE, EMP from Pratt & Whitney, and Core Wing from Rolls-Royce subsidiary OSYS *(see table, page 54)*.

Engine management

EHM data received from specialist solutions is the first stage in engine management. The data can be presented graphically for engine managers to determine the best timing of removal.

Excluding engines that are maintained under fixed-rate-per-hour contracts, engine managers are responsible for timing engine removals, defining engine shop-visit workscopes, and optimising engine maintenance costs per engine flight hour (EFH) or per engine flight cycle (EFC). Despite this, few airlines have a dedicated functionality for this in their M&E systems.

Two examples of point solutions are AerData's EFPAC and AEROinformatics' JetEplan. EFPAC takes LLP life data, previous shop visit workscopes and the

The criteria for M&E system selection now goes beyond the functionality of the various choices available. Users also have to consider which point solutions are required and what enabling technologies are necessary to make an entire system function.

engine's maintenance status, ADs and SBs that affect the engine, and EHM data to determine the optimum time for removing an engine to obtain the lowest cost per EFH and EFC. The user can change the removal date, and EFPAC simulates the change in cost per EFH/EFC, taking into consideration the effect of the lengthened or shortened interval on the shop-visit workscope and LLP lives.

Check planning

Two specialist functions within check planning are job card production, and check execution and monitoring.

Updating the MPD/AMP, managing ADs and SBs, and uploading the content of task cards and manuals is a core function of M&E systems. It is also a specialised function of the CMS, and is a lengthy task when the manuals and documents are in a range of formats. The creation of electronic task cards, the addition of all relevant information and pages from manuals, and the distribution to all maintenance centres and mechanics is an additional specialised function of documentation specialists, such as Enigma and InfoTrust.

Monitoring a maintenance check's progress, having taken data captured from the shop floor, and displaying the progress visually is a specialist function provided by EmpowerMX, 4Sight and Omega *(see table, page 54)*.

Inventory management

The complexity of inventory management is illustrated by the fact that some airlines have reduced their stock holdings by up to 25% when they have made dedicated efforts to improve inventory management efficiency.

Ensuring the right amount of stock is held by an airline at all its maintenance and operations locations requires the module to identify that the correct part and dash numbers are held, accurate removal and repair interval data are used, and that borrowed and exchanged parts are returned within time limits. Ensuring the correct stock levels is complex, and requires accurate parts tracking.

Ultimately, surplus and obsolete stock can be sold, realising some of the largest efficiency gains and savings that M&E systems can provide, while improved warranty management can make further savings. Core M&E systems have the functionality for inventory management, but its specialised nature has led to the creation of point solutions: M3 by Lawson, RIOsys by ARMAC, and Quantum Control by Component Control.

Other considerations

An M&E IT system with all possible functionalities would cost so much that no airline could afford it. John Stone, director of product and market management at Ramco Systems, advises that airlines should consider the biggest improvement a core system or a point solution can deliver, and concentrate on this first, before adding other solutions. "The user needs to consider the systems they already have, and their type and size of operation. An airline with two aircraft can manage its documents by just printing them off from a CD-ROM, while a larger fleet will need a more elegant solution. A lot depends on which maintenance is sub-contracted, and which is done in-house."

An alternative to the conventional system of implementing a core system which then interfaces with several point solutions is to focus on using just point solutions that deliver the largest gains in efficiency.

While the list of functionalities and solutions is exhaustive, a lot of communication technologies and hardware need to interface the various point solutions with the core system. A fully electronic document management system means all task cards can be distributed to all maintenance and line stations electronically.

Electronic task cards and maintenance records mean the system needs to use electronic signatures, so mechanics would need kiosks or tablet computers to realise the full benefit of them. Remote kiosks and tablet computers need a wireless environment, and therefore more hardware and technology. All of this has the potential to generate savings, but it is complex, and has a high up-front cost.

Many authorities do not yet allow the use of electronic signatures, so users have to print off task cards and sign them manually. Paper records must be stored, and copies scanned for quick retrieval.

The constant evolution of technology is also an issue. New generation aircraft do not easily interface with core M&E systems, because their maintenance programmes are no longer groups of tasks, but individually managed ones. Another problem is that independent maintenance providers must be provided with tail-specific task cards, which puts further burdens on the M&E systems.

Summary

Structuring a complete M&E IT system is complex, with a choice of a core system, point solutions and the enabling technologies a user needs to meet its requirements. How the systems interface further adds to the complexity. The overall project is so large that it has to be split into sections. *Aircraft Commerce* will examine how sections of an M&E system should be structured in a series of articles in 2012. AC