**There are several complex issues for airlines and MROs to consider when transferring maintenance data and task cards backwards and forwards between each other. Consideration has to be given to what manual input is required, and what is technically possible for all concerned parties.**

# The practical problems of transferring maintenance data & task cards

Virtually every airline subcontracts some airframe check maintenance to independent maintenance repair & overhaul (MRO) providers. Moreover, an airline uses several MROs, and each MRO has a large number of airline and lessor customers.

An airline always has to transfer a large amount of data and documents to an MRO each time it subcontracts maintenance. This transfer presents different logistical and practical difficulties, depending on the format in which the data are sent and the cards are published.

## Data & card permutations

Maintenance data and job cards can be transferred from an airline to an MRO using two main ways: the traditional system of printed paper job cards; and the new technology of electronic cards.

### Printed cards

Three main methods can be used to generate printed paper job cards for the MRO.

The first involves the airline preparing the entire group of routine cards for an airframe check's workpackage by itself, and sending the printed cards to the MRO. This means it is relatively easy for the MRO, since it has no preparation work to do, and has to perform the requested routine tasks.

The second method involves the airline sending the relevant printed pages of all the manuals and technical publications. The MRO then has to carry out the laborious task of manually creating the routine cards itself, which creates a large amount of work for the MRO, since it has to physically and manually produce each task card. This is the oldest method of card production. It also means that the airline has to supply its own additions to the MRO, and provide instructions on where these additions are to be included in each of the standard original equipment manufacturer (OEM) tasks.

A third system when using printed cards involves the airline sending the MRO relevant pages from technical publications and manuals in pdf format. A large number of airlines keep their technical documents in pdf on their maintenance and engineering (M&E) information technology (IT) systems. This has become popular with many airlines following the introduction of OEM on-line task content and card management services that provide task cards in pdf format.

Again, an MRO will have to create non-routine cards by itself, and devise a system for shop-floor data collection (SFDC). The airline will reduce the MRO's workload of creating the task and job cards, since the pdf documents may already include the airline's own tasks and items. These pdf documents will either be created in the airline's M&E system, or be accessed from the OEM's on-line portal.

In any of these situations the airline has to collate all relevant and up-to-date information from each of the different technical manuals and publications when preparing each task. This includes editing tasks, since the majority of carriers include their own 'customer' tasks or at least some sub-steps and sub-tasks in the OEM's standard task that is detailed in the aircraft maintenance manual (AMM) and its approved maintenance programme (AMP).

A second major function is for the airline to produce a sequence of routine tasks in the relevant order for the check. A third main process is for the airline to create a picking list of parts and materials to perform the routine cards. This will be taken from the detail of the routine cards it has generated.

The MRO has two particular functions to perform in either of these situations. The first is to create non-routine cards as defects are found during the performance of the routine cards.

The second is that the MRO may have agreed to perform SFDC: recording man-hour (MH) and parts and material usage data. This is done by scanning barcodes on each task card at the start and end of each task to record the MH used. The MRO therefore has to develop a system of generating and attaching a barcode for each task and job card.

### Electronic cards

There are several methods of transferring data from the airline to the MRO for electronic task and job cards being created from airline data.

The main reason for choosing an electronic card system is for mechanics to perform maintenance with electronic cards published on a variety of devices, such as computer terminals, laptops, tablet computers and iPads.

This allows the cards to be signed digitally on the devices, with the advantage that it avoids the cost of scanning and archiving large volumes of signed paper cards so that their electronic versions may be searched whenever needed.

Another advantage is that findings and defects by the mechanics can be typed on the electronic card. This reduces errors and uses less labour than a system where findings written by mechanics on printed cards are manually entered into

the M&E system by clerks after the work package is completed.

Another advantage of an electronic job and task card system is that maintenance and technical records are more reliable and accurate. Fewer staff are needed to manage technical records, and it is also easier to trace items such as findings.

Despite these advantages, the electronic cards still have to be produced from raw data and content, which have to be updated and managed.

Generating task and job cards from managed content can also be economic in the long term, because many of the time-consuming and laborious processes of doing this manually are minimised.

The first option is for the airline to generate the cards itself. This happens in many cases already where airlines generate tasks for use in their own maintenance facilities, or when sub-contracting a maintenance check. This requires the airline to manage all the electronic content, and then publish the cards in a format that the MRO can use on its hardware. How the cards will be laid out in terms of physical size, design and style needs to be agreed in advance with the MRO.

The second option is for the airline to transfer all the relevant electronic data to the MRO, which then collates it and publishes the cards, either in a printed or an electronic format. There are more benefits if the task cards are kept in an electronic format.

## Task card preparation

There are several methods an airline can use to prepare task cards, when generating printed or electronic cards for use by a third-party MRO.

The first of these is to use standard OEM cards. These will be generated from information in the AMM.

For this purpose, the OEMs offer on-line document and task card management services. These cards are provided in a pdf format, and are accessed by the airline or its MRO provider.

The disadvantage of such a system is that the cards are standard OEM cards, so the airline is unable to add any of its own content. This has several disadvantages. For example, it is important to know whether a task is applicable to particular aircraft line numbers if items such as airworthiness directives (ADs), service bulletins (SBs) and engineering orders (EOs) have been performed on the aircraft.

The second method is for an airline to use the OEMs' more advanced card management services. Boeing provides its maintenance performance toolbox (MPT), and Airbus its ADOC system.

These advanced portal services allow an airline to manage its own customised content and task cards and author cards for its own special items. It can also include them as part of the standard card with the standard AMM instructions.

Some of the advanced systems provided by the OEMs also provide links between the various different manuals, such as the AMM and the illustrated parts catalogue (IPC).

The third option is for an airline to manage the content of each task card in-house. The relevant data to generate the task cards or the completed task cards are then sent to the MRO.

## Content management

Airlines will generate a full set of job cards when introducing an aircraft type into service. These will include all its own edits, plus additional details and sub-tasks.

These original task cards, however, never remain the same during the aircraft's period of operation with the carrier. Airlines face several issues within the overall process of managing data and generating task and job cards during the

years that the aircraft type is in operation.

The first main issue of task and job card management is the applicability of cards to particular aircraft line numbers. That is, tasks may have to be performed differently to specific groups of aircraft line numbers. There will therefore be a different set of task cards for each group of line numbers, and all sets relevant to the line numbers in the fleet have to be managed in the airline's M&E system. Applicability of a task to particular line numbers changes over the years of operation. The correct applicability has to be managed and held in the M&E system when planning a check for an aircraft.

Tasks may also be performed differently depending on whether an AD, SB or EO has been performed on the aircraft, or certain rotable component part numbers are installed on the aircraft. The airline's M&E system will therefore need to accurately track aircraft configuration, and to link tasks to rotable part numbers to assist in generating task and job cards.

Another issue is dealing with the revisions and updates that OEMs issue to the technical manuals every three or four months. These revisions may include changes to the parts and components that can be used for a task, or to the way a task is performed. These changes may only apply to particular line numbers and not others in the fleet.

Most airlines also like to make their own edits to standard job cards. These can be additions of their own separate tasks, or changes or additions to the standard procedures in OEM tasks. These edits may vary for certain line numbers for the same type of task.

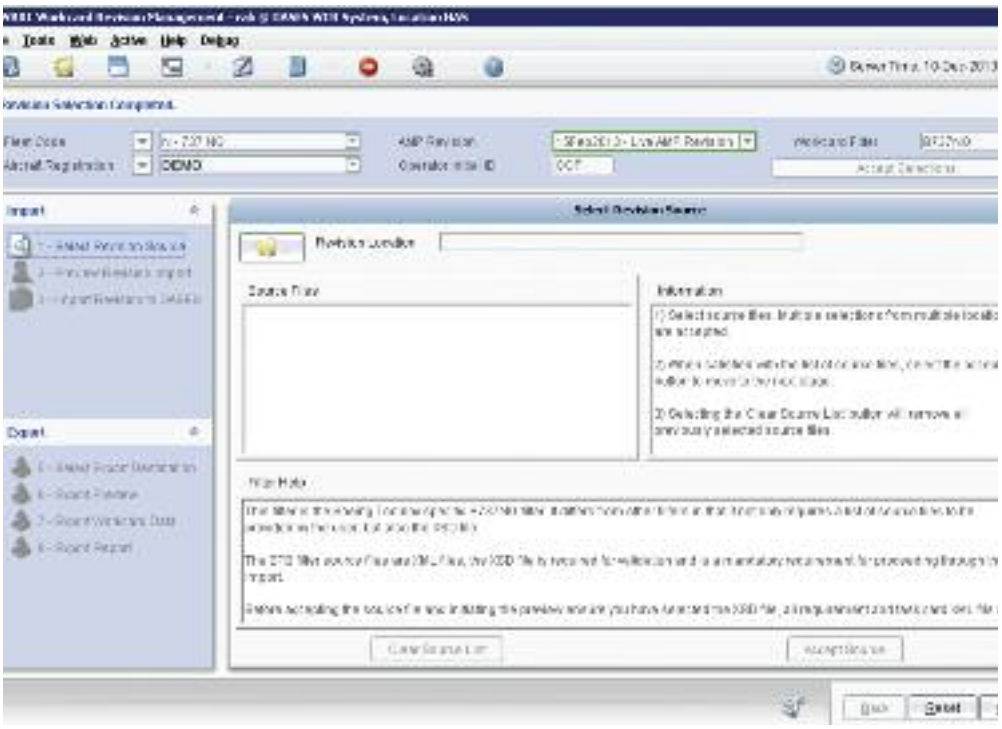
Airlines will also have their own individual tasks, separate from those listed in the AMM, so they have to keep an up-to-date catalogue of all task cards that are relevant to all groups of line numbers of each fleet they operate.

All tasks kept in the M&E system can have cross-references to other technical publications and manuals. This will include documents such as the IPC and the aircraft wiring diagram (AWD). The IPC, however, lists only OEM part numbers. Many airlines like to source part numbers that are alternatives to parts listed in the IPC, so they will have an approved parts list (APL) or master parts list (MPL) that shows all usable part numbers that can be used instead of a part in the IPC. Cross-references between each of the tasks kept in the M&E system and the APL or MPL will therefore need to be created.

Several details relating to each task can be updated over time as revisions are issued, including: the use of specific tools and equipment; the different ways a task is performed if certain tools and equipment are unavailable; and the different levels of mechanics' licences.

During the years of operating an aircraft, changes are made to task applicability, part numbers, tools, and task performance details. These changes come through revisions and updates in the technical publications and manuals provided by the OEMs, and are issued once every three or four months. These updates and changes will therefore have to be made to the affected and relevant task and job cards.

Further task data and content issues include the fact that some airlines use their own unique numbers for work orders, tasks and parts. This creates potential difficulties for the MRO, and adds work that has to be done by the mechanic when performing a task. Many larger airlines have their part numbering systems and unique part numbers. A mechanic will then have to spend time searching through a cross-reference manual of some kind to find the standard part number that is equivalent to the airline's unique part number. The same applies to work order and task numbers, and other items detailed in the task cards.



*Commsoft has developed capability for transferring maintenance check information and task card data. Its OASES system has an import page with guides the user to selecting the right source of data.*

A cross-reference manual or an electronic cross-reference system therefore has to be created for an MRO that works for any airline with its own numbering systems for parts, task card numbers and other items.

Besides ensuring that the correct content is on each task and job card, there is also the issue of physical design and layout. This first concerns the placement and size of items such as signature strips. There may be one or two for each sub-task, and they may be placed on the side or bottom of each task card.

There is also the issue of header information. This includes details such as aircraft line number and registration, and work order number. Problems can arise here, since some airlines have their own numbering systems that use a different number of digits to the OEM standard task numbers.

The airline and MRO therefore need to communicate with each other on task card design and layout.

## CMS utilisation

This process of managing all the data to ensure that each task and sub-task has the correct content requires a lot of management, and has traditionally been done manually. This process has been made easier with the document management functionality of the various M&E systems used by airlines. It is enhanced, however, by the use of a content management system (CMS).

A CMS basically has the functionality to allow the user to build structured, intelligent content in either standard general mark-up language (SGML), or extra mark-up language (XML). Content in these formats is intelligent, because it can be tagged. This means that the part number quoted on a task card, for example, can be actively linked to the IPC, APL or MPL, so that when the part number is changed as a result of a revision or an update in the IPC, APL or MPL it will automatically be updated in the task cards to which it is linked. These links have to initially be created manually, but then make management of content easier thereafter. Updates and revisions issued at regular intervals by the OEMs can cascade through the content of all publications, manuals and task cards held in the CMS database.

Structured content compares with unstructured or unintelligent content in printed paper or pdf formats. Updates and revisions to the content require more manual input.

In the case of a CMS, such as Flatirons Solutions' TechSight/X, the airline's MPD and AMP will be held in the database. That is, the task cards held in the database may be the standard OEM cards, the airline's authored and edited cards, or a combination of the two.

A CMS like TechSight/X is a flexible content management solution that integrates with the airline's M&E and other systems, and can be deployed in a number of configurations to meet the airline's needs.

"TechSight/X contains several powerful re-use models which reduce the effort to author task cards, and reduce the time and effort to reconcile those task cards with OEM and airline revisions of publications; this directly contributes to delivering the right information at the right time to the right people, increases airframe availability, and reduces margin for error," explains Charlie Pickett, pre-sales engineer at Flatirons Solutions. "TechSight/X allows the operator to write and revise task cards by reusing content from the aircraft maintenance manual (AMM) and other sources in different ways. Upon revision of that content either by the OEM, airline, or MRO, TechSight/X will either update task cards automatically, or will automatically kick off a workflow to initiate a review process for affected task cards.

"The author using TechSight/X will work with the content as structured XML data," continues Pickett. "Even though this is powerful XML content, it can be authored or edited in the same way as writing a Microsoft Word document when authoring in Serna, the integrated WYSIWYG TechSight/X editor."

In addition to the ability to author task cards by re-using AMM content, TechSight/X also allows the author to add standard content, such as warnings, cautions, notes, and other standard text which has been approved by the airline operator or regulatory authorities.

## Printed card transfer

The option of transferring pre-prepared task and job cards is usually chosen by airlines with small fleets. The simplest process is for the airline to use the OEM's basic on-line document and task service, and use the standard OEM task and job cards.

Another option is for the airline to provide customised versions of the OEM's standard cards.

"All of the task cards that exist for the entire maintenance programme of an aircraft type should be provided by an airline to its MRO in advance of any workpackages being prepared, so that it can incorporate them in its database on the M&E or CMS system it uses," says David Pusey, head of customer relations and project management, at Commsoft. "This will be necessary for the MRO to be able to quote for workpackages any time that it is asked to by the operator. These task cards can be held by the MRO in its M&E or CMS system.

"When the airline using our OASES M&E system subcontracts a particular workpackage or airframe check to the MRO, the airline provides a file in Excel format of the tasks to be included in the workpackage," continues Pusey. "This

file created by OASES summarises the tasks to be performed and will be indicated by the OEM's MPD task number. The MRO will create a new work order for the check in its system, and this will include some details of the check and of the aircraft. The MRO will then build a table of the tasks to be performed. This will include the MPD task number, and a brief description of the task. It may also have the airline's own reference number for a task. OASES will also create an exception report if a task number supplied by the customer is not identified by the MRO's system. If an airline has its own reference number for task cards, the MRO needs to have a cross-reference built in to identify which customer task number corresponds with which MPD number."

It is therefore easiest for the airline to use the OEM standard MPD number for each task, since the MRO's system does not need to have cross-references built in. "The use of unique task numbers creates complications for an MRO quoting or planning for a workpackage," comments Pusey. "If the arline is a long-term customer of the MRO, it will be easier for the MRO to create a database of cross-references."

Once the MRO has details of the workpackage, it will create a checklist to record administrative information for managing the check. This will include information such as the number of work cards that have to be performed.

"The work cards held on the MRO's database would then be printed off, and a header sheet created in OASES to attach to the front of these," says Pusey. "OASES can also be used to generate barcodes for each task to be printed on stickers. The barcode will have a number, the first part of which is the work order number and the latter part of which is the task card number. Each sticker can then be physically mounted on the task card for the purposes of performing SFDC if the airline wants the MRO to do it."

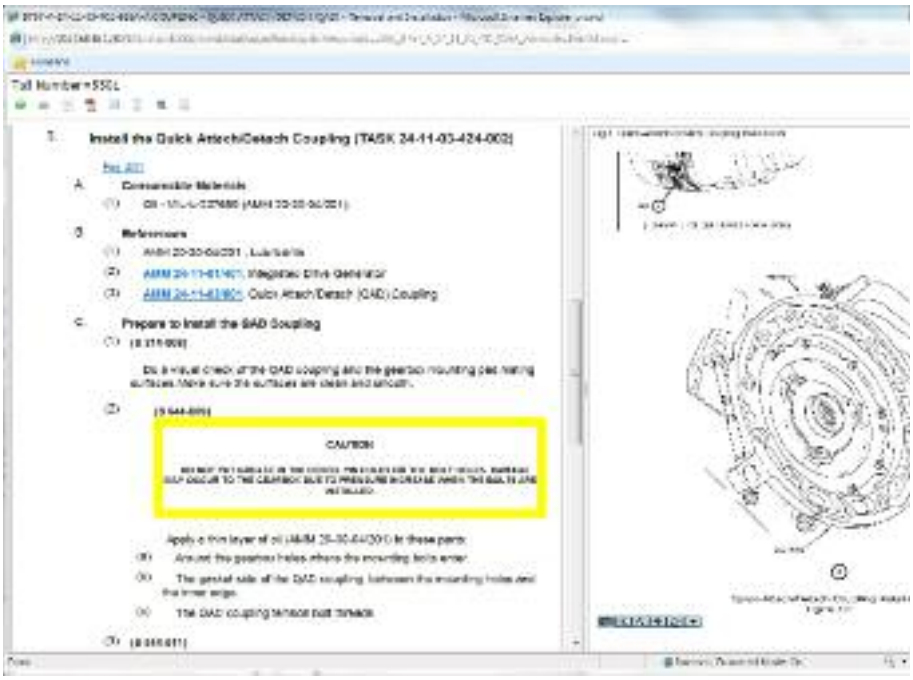
There is also the issue of the MRO preparing lists of information to help it prepare the task. One particular issue is a pick list of the parts and materials to be used during the check. "OASES can generate a large table of a summary of the workpackage," says Pusey. "The standard OEM task number and the customer's own unique task number can be listed in columns. Other columns will list the standard IPC or APL part numbers. OASES can only list the parts required for a complete workpackage if the MRO's database has a list of parts and part numbers that can be used for each of the tasks, and the tasks and parts are cross-referenced."

For this process to work, the MRO's database must have the task card numbers, the material and part number references, the manual and technical publication references, and the labour skills and tools required for each task.

Pusey explains that supplying all these data can involve taking the task cards in pdf files from the OEM, and scanning them into the M&E system. "OASES has a functionality that understands the standard OEM task card," says Pusey. "The pdf card is scanned and the content is populated on OASES's database. This can then be edited or added to by the airline to generate its customised task cards. OASES only produces a workpackage for a check using customised task cards, and never uses the standard OEM cards."

Sometimes, however, the MRO has to prepare the task cards and the work order, so it needs to have all the up-to-date information. The MRO can import the task cards from the OEM's on-line service, but it needs to have the master task card library as pdfs in its system.

It is possible for the airline or MRO to import the task card data as raw SGML or XML data from the OEMs' more sophisticated on-line data and task card management services, and then publish the cards in a paper format. Pusey comments, however, that this is more expensive than importing standard cards. All of Commsoft's customers have relatively small fleets, and all prefer to use the standard OEM task cards in pdf




*The authoring page of Flatiron's TechSight/X highlights content with a background to indicate that the content can be adapted to make a one-off version of a task card.*

*The coloured part numbers on task cards indicate that these are linked to other documents, such as the IPC.*

format.

The MRO also needs to have all the information relating to each task card and the overall work order, such as part numbers, labour skills for each card, etc.

Once these data are supplied to the MRO, it still has to build cross-references between standard OEM task cards and the relevant data for each task. This requires manual intervention.

Pusey explains there is a trade between using the OEM's standard pdf cards and having to manually provide all related information for each task and building cross references, versus having a more complex and expensive IT system that includes a CMS which reduces the manual work required. "There is a high up-front cost of building the links between task cards and various manuals and pieces of data in the CMS," says Pusey. "It will be cheaper to manage the data and revisions in the long term, but only if the MRO performs a large number of checks for the airline, or the airline operates a large fleet."

Regular updates of task card data can include changes to the part numbers that can be used for each task, or several tasks in the MPD and AMP. This may change to a different dash number or a completely new part number. Searching through each task card manually and editing each one would be laborious and time-consuming. "OASES can automatically filter out and list all the tasks in an aircraft's MPD and AMP that use a particular part number. The part number can then be updated to the new dash or part number. While this means that a change to all affected tasks can cascade through the system, Pusey comments that no OASES customer has yet requested this service.

## Electronic card transfer

While the traditional system of using printed task cards is the most popular, some airlines are adapting or considering a fully electronic system. These systems will support both viewing and signed on screen. The content to create the cards can therefore be sent from the combined M&E and CMS system to the devices on which they will be viewed.

While the traditional system of using printed task cards is the most popular, some airlines are adapting to, or considering, a fully electronic system. These systems will support both viewing and signing task cards on screen. The content to create the cards can therefore be published from the CMS to the devices on which they will be viewed.

"Flatirons Solutions has deployed mobile interactive electronic technical publication (mIETP) technology to maintenance organisations which allows the end user to access technical publication content on a tablet at the aircraft, or point of performance," says Pickett. "In addition to mIETP technology, Flatirons Solutions has also deployed electronic task card solutions which eliminate paper by allowing for electronic signature. We do not yet have MRO customers that receive data electronically from an airline and then generate the task cards on electronic devices. This is feasible, however, and several MROs are exploring this type of solution to increase productivity and airframe availability," continues Pickett. "This capability will make it easier for the airline and MRO to exchange task and technical publication content with each other, and also manage revisions and updates more effectively."

Once the data have been published by the airline or MRO in TechSight/X, a style sheet determines how the XML data appears on the device. "TechSight/X allows for the content to be written once, and then published out simultaneously to multiple outputs like PDF or HTML for instance, for consumption by airline, MRO, regulatory agency, or other audiences as necessary," Pickett explains. "This is possible because structured content separates technical content from styling, and so it is much more powerful,

intelligent content that is capable of being re-used, not only between technical publications and technical operations, or airline and MRO, but in many instances across the organisation to include flight operations, training manuals, and others."

## IT system differences

Despite the advantages of structured data provided by the technology of tags and links, there are still technological issues that prevent the seamless transfer of data between the different M&E and CMS systems used by individual airlines and MROs.

"It is not yet possible to have this ultimate push-button system of data transfer, because of differences in the SQL databases of the 20 or so M&E and ERP systems and six to 10 CMS systems," explains Thanos Kaponeridis, chief executive officer and founder at Aerosoft Inc. "This has nothing to do with the advantages that structured data offer (like XML). The differences between the different SQL databases of different M&E systems are such that one system may, for example, use 25 digits for vendor part numbers of components, while another system may use just 20. This presents a problem when transferring data from the first system to the second. This is because the second system will need to truncate all vendor part numbers (or create complex cross-reference tables), since it can only accommodate shorter part numbers. This could be the case where an airline sub-contracts a maintenance check to another airline or MRO. A maintenance check will involve the removal of a part (or many), and replacement with another serviceable unit. These changes have to be recorded. A record of the part and serial numbers of the removed and installed components is made on the electronic header sheet of the task, or in customised cases, within the task card steps. The information listed on the task card header sheets is populated from the M&E SQL database that manages the compliance of the airline's approved maintenance programme and the configuration of the aircraft.

"A reverse problem is experienced when the data are sent back to the original system operated by the airlines," continues Kaponeridis. "The system used by the party performing the maintenance will have recorded the removal and installation of a vendor's component using 20-digit part numbers. It will now have had to expand the part numbers of removed and installed components, and will have also assigned a 20-digit part number to the newly installed component. The data then have to be transferred back to the airline that sub-contracted the check. When this happens, the transfer process needs the functionality to correctly add back the five digits to the truncated part numbers of removed parts. They will also need the functionality to add the correct five digits to the 20-digit part number used by the sending system."

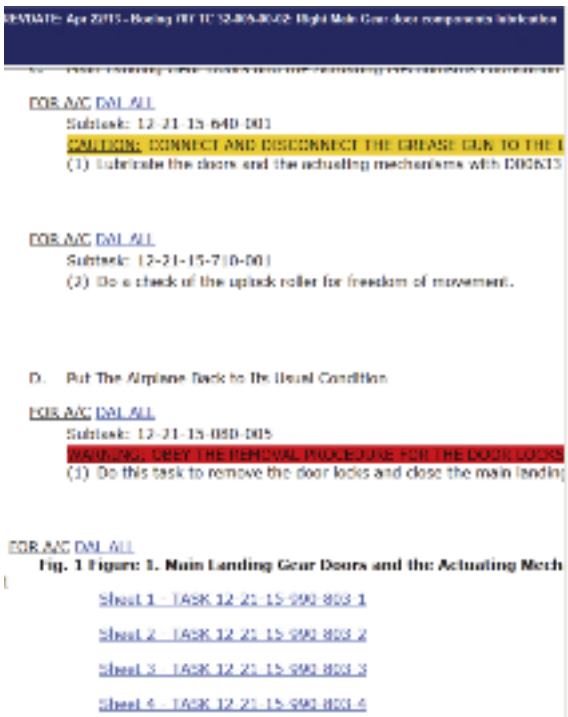
This is only one solitary simple example. Similar data structure inconsistencies exist between the mapping of task card numbers and their MPD references, and also with in-house task cards and other documents, such as EOs. Yet an electronic workpackage outsourced and containing anywhere upwards of 2,000 cards (some of which are about 20 pages long) can contain a wide assortment of such issues.

The fact that the interchange data stream may be in XML which can accommodate the different/varying structures and lengths, does not solve the mapping of 'many to few' and 'few to many'.

This problem arises because of a lack of an industry/international standard adoption by M&E system providers for the critical data types, to be used by all the different M&E and CMS systems that are available. "The Spec 2000 standard was intended to eliminate these very issues," explains Kaponeridis. "The challenge with Spec 2000 is that many of the definitions are too small or limited (relative to the internal designs implemented long time ago by various M&E systems), and some functionality was built well before the various Spec 2000 chapters were completed. They therefore do not get used by most airlines and MROs, and consequently they all devise their own systems, many of which inevitably use different data structure definitions." Even reliability data interchange is a 'super-set' of the Spec 2000 definition as used by the major OEMs.

Taking into consideration only the 20 top M&E systems and the 10 CMS systems, the number of custom transformations that could be required is theoretically 200 squared minus 200, which is a ridiculous number.

Several hundred of these transformation systems would literally



FOR AAC DAL ALL

Subtask: 12-21-15-640-001

CAUTION: DISCONNECT AND DISCONNECT THE GREASE GUN TO THE

(1) Lubricate the doors and the actuating mechanisms with D00633

FOR AAC DAL ALL

Subtask: 12-21-15-710-001

(2) Do a check of the uplock roller for freedom of movement.

D. Put The Airplane Back to Its Usual Condition

FOR AAC DAL ALL

Subtask: 12-21-15-080-005

WARNING: OBEY THE REMOVAL PROCEDURE FOR THE DOOR LOCKS

(1) Do this task to remove the door locks and close the main landin

FOR AAC DAL ALL

**Fig. 1 Figure: 1. Main Landing Gear Doors and the Actuating Mech**

Sheet 1 TASK 12-21-15-990-803-1

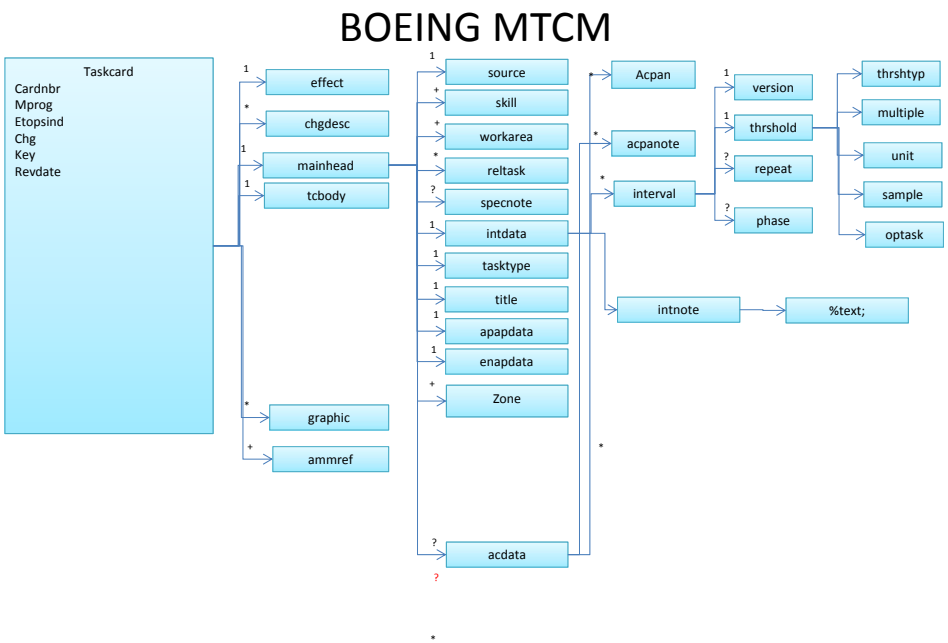
Sheet 2 TASK 12-21-15-990-803-2

Sheet 3 TASK 12-21-15-990-803-3

Sheet 4 TASK 12-21-15-990-803-4

*A task card, with structured content and linked data, together with an attached graphic.*

*The second picture shows a standard Boeing 'structure/DTD. Customers may modify this for their internal use to integrate with their M&E systems.*




have to be built for all practical M&E/CMS combinations to work with all other permutations of M&E, CMS and combined M&E/CMS systems so that data can flow between airlines and MROs.

There are further challenges between different technical document standards. A prime example is the evolving versions of S1000D and the three most prominent versions associated with commercial aircraft. "The earlier version 3.0 was used for the 787," says Kaponeridis. "The Bombardier C-Series has data supplied in version 4.0 of S1000D, and the A350 will use version 4.1 of S1000D. This presents a challenge for any airline that plans to operate both the 787 and A350, and/or the C-Series. This is because after version 3.0 of S1000D was defined, S1000D was significantly improved. An airline that has acquired a custom-implemented M&E/CMS system to handle the 787's data will therefore not be able to handle data for the A350 or C-Series without substantial changes. The airline would have to use a substantially modified system that can operate with the A350 or C-Series data. Conversely, however, an airline that has a M&E/CMS that can operate with S1000D version 4.0 and 4.1 data for the C-Series and A350, will also have to make special accommodations to use the 787 data in the same system." In fact, the reality is that most Tier-1 carriers will require systems that accommodate hybrid iSpec2200 and S1000D/multi revision systems with extensive 'in-house' customisations interfacing to their respective M&E systems.

In conclusion, the content for a workpackage containing several thousand job cards and EOs, comes from two different sources: the M&E System and the CMS system.

The M&E system provides 'specific visit-related information' and wants to capture visit-specific information back into the database. The CMS system provides OEM-originated (and airline customised) detailed instructions or approval steps. It is this 'combined bundle' that needs to move electronically, for example, from an airline to an MRO, and back to the airline, supplemented with airworthiness certificates for changes made to the configuration or components.

These two parties can have totally diverse systems at both ends, which simply do not have an industry-standard data interchange definition. Even utilising selective items out of Spec2000 and iSpec2200 and S1000D is not enough, due to the customised details which each end has implemented.

Such an interchange standard can be quickly built (but may be challenged to gain acceptance), but as a benefit it would require only one set of 'transformations' programmes at both the airline's and MRO's systems. As such, the airline or MRO need not know what the other party is using as a system.

Suppliers such as Aeroxchange have achieved procurement level ' interchange pipes', which are used by Tier-1 carriers (built mostly, but not exclusively, around Spec2000 and XML transactions) and are extending these to include the repair process and issuance of airworthiness certificates. Such offerings, however, do not yet deal with the 2,000 card workpackage challenge described above.

Furthermore, airlines and MROs should not have to 'pay' or depend on a single supplier to make it possible to seamlessly move data electronically back and forth. AC

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