NVABLE
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DIGITISING THE AIRCRAFT TECHNICAL LOG:
THE MOVE FROM PAPER

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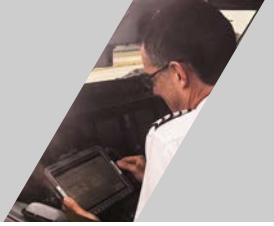
March 2016



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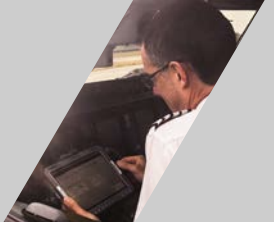
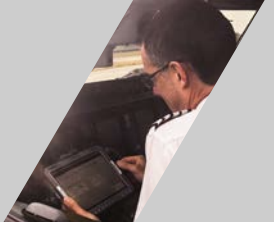




EXECUTIVE SUMMARY

NVable has world leading experience in aviation electronic technical logs

Despite the advanced application of technology in virtually every aspect of the aviation industry, there remain a number of key processes that have been stubbornly resistant to change.

One example is the Technical Log (or Log Book). There is now a growing trend in the industry to digitise this key process and it is an area where the team at NVable have world leading experience.

This paper:

- introduces the concept of the traditional technical log;
- the benefits of digitisation;
- the factors that should be considered as part of setting up an Electronic Techlog project.

It draws on and summarises the experience of the authors.

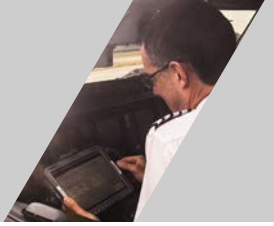
Cameron Hood – who led the technology team involved in the very first implementations of electronic techlogs through CoreData which was subsequently acquired by Data Systems and Solutions (at the time a joint venture between SAIC and Rolls Royce, which then became Optimised Systems and Solutions and is now known as Controls and Data Services). Cameron is the founder and owner of NVable who have developed a new platform that offers electronic techlog and more.

Rob Woods – who was involved in the implementation of the electronic techlog in MyTravel and subsequently Thomas Cook – at the time supplied by Data Systems and Solutions. He has experience of being involved in the "bleeding edge" of the introduction of new technology and has the battle scars to prove it.

Dave Cooper – who has been involved in the introduction of the electronic techlog across a fleet (initially the Data Systems and Solutions version) and a transition to a new electronic techlog (NVable). He has experience of the challenges in managing the changes and has particular insight into what is important in a solution.

Both Rob and Dave have real world experiences to share when electronic techlogs go well, and not so well.

DISCLAIMER: NVABLE PROVIDES AN ELECTRONIC TECHLOG AS PART OF ITS CONVERGE AVIATION SOLUTION. HOWEVER, THIS DOCUMENT IS NOT SALES LITERATURE BUT SHARES A GENERIC ASSESSMENT OF THE BENEFITS AND LESSONS LEARNED.



WHAT IS AN AIRCRAFT TECHNICAL LOG?

THE BASICS

The process of recording technical findings and maintenance actions in a technical log (generally shortened to techlog) is part of the daily oversight of the aircraft. Although the format and content of the techlog varies between airline operators the role it performs is fundamentally the same. At a minimum:

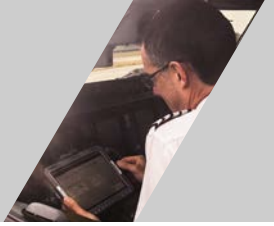
- The status of the aircraft is recorded prior to each sector flown. This includes departure and arrival location and times; fuel uplift and levels; oil and hydraulic fluid levels; defect status; any de-icing that has been applied; other regular line maintenance activities are usually recorded.
- The techlog remains with the aircraft. This means that engineers and flight crew are able to access the aircraft's maintenance record regardless of where they join the aircraft and regardless of the ability to communicate with other teams (e.g. MAINTROL) or systems.
- A copy of the techlog record is left on the ground prior to take-off. This serves as a record of the state of the aircraft prior to each flight.
- The captain is responsible for signing off each techlog record and by doing so is accepting the status of the aircraft as fit for flying.
- The line engineers are responsible for signing off each maintenance activity that is recorded in the techlog. By doing so, they are confirming that any such activity has been completed to the correct standard, and as such is released for service.
- The aircraft is not allowed to take-off with open defects. Therefore, all defects must either be rectified or deferred (in accordance with strictly monitored processes) prior to take-off.

CURRENT PROCESS

The techlog is responsible for recording the primary technical and operational data for each flight and is therefore a key data feed for many airline functions. The normal process within an airline will use a carbonless muliti-part pad which records multiple copies (on different coloured sheets e.g. white, pink, yellow, green) to record a techlog entry. The pads are specially printed to reflect the techlog layout of the airline and will have a unique number printed on each "page" to ensure that there are no gaps in the techlog records.

For the majority of airlines, the techlog procedure is a variation of the following:

- Complete the relevant section of the techlog; engineers will fill in maintenance tasks and fluid checks; the captain / first officer will complete the details of departure and arrival, along with fuel, de-ice and the final sign-off prior to flight.
- Tear off the appropriate copy of the sector record and leave with the ground staff. A new page in the techlog is then used for the next sector.
- Ground staff take copy to local office.



- At the end of the day; scan and email (or fax) the copy to the back office function of the airline. At some point (generally with at least a day lag) the data from the scanned/faxed sector record is entered by hand into the airline maintenance system.
- With Multiple Engineering bases for larger fleets all originals must also find their way back to the Head office for archiving.

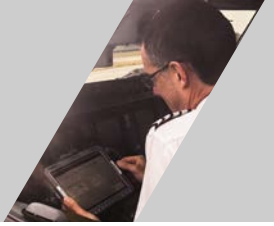
The various copies of the techlog will also be taken and distributed throughout the airline. For example, finance may wish to perform fuel reconciliation, another department may use the data to report on emissions, and so on.

If there is no techlog completed and left on the ground, there is no flight. It is as simple as that.

WHO IS RESPONSIBLE?

The airline is responsible for ensuring the techlog is being recorded according to their procedures. The format of the techlog form is important, however the focus of the Authority is procedural. It is the procedure itself that is certified by the local Aviation Authority and any changes need to be agreed with them.

The importance of this cannot be exaggerated. As one UK Civil Aviation Authority representative put it, “If there is no techlog completed and left on the ground, there is no flight. It is as simple as that.”



WHAT IS AN ELECTRONIC TECHLOG?

A DIGITAL RECORD

It is useful to be clear in thinking of the ETL primarily as a replacement of the actual paper technical log rather than a substitute for the entire process

In simple terms, an Electronic Techlog (ETL) is a replacement for the paper process described above using a computer (whether that is a laptop, tablet or some type of in-built device on the cockpit). The difference is that the information written on the paper forms is recorded on the computer and this creates a digital record.

An ETL has to satisfy all the same criteria as a paper techlog because it is performing the same function. So, for example, there must be a way to leave a copy of a sector record on the ground prior to take-off. However, it is useful to be clear in thinking of the ETL primarily as a replacement of the actual paper technical log itself rather than a substitute for the entire process. This must include the ability to appropriately "sign-off" the techlog as well as recording approval numbers.

Why make that distinction? The Aviation Authority which oversees the airlines AOC (Air Operating Certificate) will look to certify the aircraft technical log procedure. The fact that the airline uses and paper or electronic technical log is less relevant. The paper form itself is not certified by the aviation authority, but rather, approved for use in it. Similarly, an ETL will not be certified but can be approved for use.

Just as a good paper form design will make it simple for an individual to complete a form, and will also guide the to use the underlying procedure, so does an ETL. An ETL can provide more support to the user than paper and this is one of the potential benefits.

Being clear on this distinction helps to focus on the what the ETL actually needs to do.

There are a few ETL solutions in the market and they have the following minimum functionality:

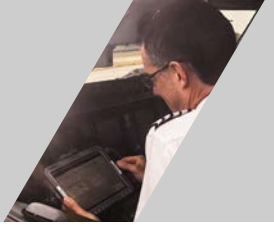
- Record the technical log data which is configured to a greater or lesser extent for the airline on a computer;
- Transmit the data from the computer to a server;
- Pass that data to the airline;
- Provide Live visibility of the data.

The conversion of the paper process does introduce new problems and these considerations should be part of an airline's assessment of where a particular solution is a good fit for their organisation.

POTENTIAL PROBLEMS

NEW MAINTENANCE TASKS

The ETL needs to be supported in operation and there are some additional tasks that should be considered. Unless the device is docked in the aircraft cockpit and charged, the devices (let us assume laptop or tablet PC) must be charged regularly. Depending on



the hardware this may be a battery swap or a physical removal and charge. It may also be possible to charge such devices on the aircraft.

The correct approach for an airline will depend on preference, aircraft type and even the view of the local Aviation Authority.

There may also be a requirement to regularly swap storage devices such as SD cards depending upon the airlines procedures.

COPING WITH TECHNOLOGY FAILURE

With a paper process there is little that can actually go wrong. A pen may be lost or run out of ink, but crews are always prepared for such eventualities. The paper techlog pad may run low on paper, but that is a simple matter of monitoring and restocking.

Electronic devices and the infrastructure to actually send and receive data creates a few more challenges:

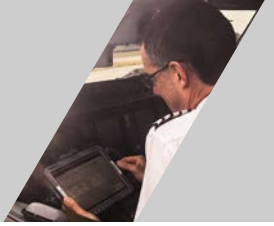
- **Hardware Failure** – the PC itself could fail. A line station is not an office environment. Paper techlogs are used in and around the aircraft, so ETLs need to be used similarly. This means more risk of dropping, water damage, dirt, oil, screen damage etc.
- **Hardware Loss / Theft** – although the aircraft is a controlled environment the risk of loss or theft is real.
- **Software Crash** – the software which is recording the technical log may run into a problem. The impact may be that the techlog cannot be recorded or, worse, the data it has already recorded becomes corrupt.
- **Cannot transmit data** – if the ETL depends on either the availability of a network to send data (e.g. Wireless Network; Cellular Phone Network; Satellite Network etc) it may not be available in a particular location at a particular time. The reasons can be many and varied, but the absence of connectivity is a frequent problem. If this is the way that the ETL leave “a copy on the ground” prior to take-off then there is a problem.

All these challenges are potential failure modes but fact they exist does not mean an ETL cannot deliver a good reliable service. It merely means that airlines should consider how an ETL solution defends against the problems and recovers from them if they do occur.

Those companies that have faced these challenges through implementing ETL systems will no doubt have many stories to tell about the success, or otherwise, of various solutions, and what they consider to be the best approaches.

HANDLING DATA

During normal operation the ETL data will generally be sent to the airline. The actual mechanism varies between ETL implementations but the end result is that the airline will receive a stream of data regularly. This potentially means opening firewalls, setting up FTP sites and managing the input of the data (either manually or automatically).



WHAT ARE THE BENEFITS OF AN ETL?

We will make a couple of basic assumptions that an ETL solution:

- Is able to reliability transmit the data collected as part of the techlog process back to some sort of data hub, and;
- That data hub can be accessed via a website that allows people secure access to the data gathered on the ETL. This includes the sector, defects, defect actions, out of phase tasks etc.

REAL TIME VISIBILITY ACROSS THE FLEET

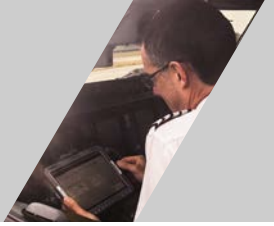
One of the key benefits is the ability to see an up-to-the-minute status of the whole fleet. This means that all the data collected in the techlog is available for various teams in the airline organisation making it simpler to control and plan. Having access to the data is like being able to open up a window into the cockpit, at any time, anywhere in the world.

- **Maintenance Control Centre (MCC)** – tracking deferred defects, hours/cycles and out of phase tasks becomes significantly simpler when the Maintrol team can see all the activities and expiry dates in real time. Managing AOG recoveries is greatly aided and speeded up with live first hand data too.
- **Third Party Maintenance** – for any third parties involved in the maintenance of the aircraft, having the ability to see (and print off) the sectors they have been worked on saves time. It also allows them to plan for receiving the aircraft at a remote station.
- **Continued Airworthiness**– from experience, we know that particularly from the point of view of the post holder, the comfort of being to see the status of each aircraft and know that they compliant is invaluable.
- **Line Stations** – having full visibility of the aircraft during the full day of operations allows for better anticipation and forward planning the day or nights maintenance activity.
- **Records Department** – the records department is able to be autonomous, not relying on other departments such as the MCC to pass on information.

REDUCED ERRORS

Even a simple technical log will have around 100 data elements captured in each sector (the number will depend on the complexity of the aircraft and the data the airline wishes to record). With a commercial airline typically flying an average of 4 sectors a day and assuming 300 flying days a year, that means there are (conservatively) around 120,000 pieces of data recorded per aircraft per year in the techlog. Over 2,400,000 for a fleet of 20 aircraft.

It is no surprise that a paper form introduces some errors when recording that data. Simple things like calculating flight times and fuel uplifts, even the quality of the hand writing can impact the accuracy of the data. Add the fact that the data is then manually typed into other systems, it should be no surprise that data errors creep in.



There are also occasional problems with losing a sector record as it makes its way from a station to the data entry. Resulting in a missing techlog sector.

An ETL introduces the possibility of:

- Automating calculations
- Applying basic validation rules
- Applying more complex business rules

These help to ensure that the data is accurate at the point of data capture. Some solutions may also integrate with a feed of data from the aircraft (for example, chocks on and off).

AUTOMATED DATA ENTRY TO MAINTENANCE SYSTEM

Closely associated with the data errors is the ability to automate data entry into the Maintenance system. The capability to transfer the digital sector record directly into the Maintenance system has many advantages, the primary one being that the data is very quickly available in the “system of record”.

Despite this being a main driver for ETLs, it has been difficult to achieve, with only a few suppliers having a live data feed into a Maintenance system on an operational fleet.

REDUCED TIME TO COMPLETE TECHLOG

Partly because of the automation and partly because an ETL should be simple to use, the time to review, transcribe and update the techlog is reduced. To a degree it depends on the selected solution, but there is evidence from some airlines that completing an ETL takes less time than the paper equivalent.

SIMPLER LINE MAINTENANCE MANAGEMENT

The data being easily available for all defects, defect actions and the equivalent for any out of phase tasks greatly simplifies the control of maintenance on the line. Some solutions have additional functionality to specifically plan and monitor line activities.

Generally, since the techlog data is input into the Maintenance system this becomes the source system for line maintenance planning. However, maintenance systems were not designed to manage line activities (they focus is on record control and hangar maintenance) and where there have been attempts to add such functionality it has often fallen short. This is primarily because:

- the feed of data from the line is not timely enough to be useful (i.e. a paper techlog), and;
- the underlying system is not designed for the more agile needs of line maintenance.

The result of introducing an ETL is the ability to plan activities on accurate, timely data.

ALERTING

As the data is passed from and ETL to the data hub there are opportunities for creating alerts. These can be categorised as **simple** and **complex**. For example:

- **Simple Alert** – send an email and SMS alert when a particular category of defect is raised, or when a defect is deferred.
- **Complex Alert** – send an email and SMS alert when oil consumption for an engine (calculated over a rolling 50 sectors) breaches a threshold (defined for that particular engine).

This type of functionality allows an airline to monitor their fleet in real time. Plans can be made to react to highlighted issue or prevent a problem developing which is a step towards predictive maintenance.

TIMELY DATA REPORTING AND ANALYTICS

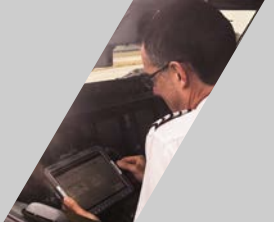
The data gathered in the ETL can provide insight into daily operations and go a long way to providing a foundation for weekly SLAs and monthly reliability reports (other streams of data would be required to produce full reliability reports). The key difference between analytics driven from the Maintenance system fed by a traditional techlog and one based on an ETL is timeliness.

With an ETL in place either the ETL solution itself or the Maintenance system the analytics can be driven from current data – this allows the various teams in the airline to be proactive.

Some examples of analysis include but are by no means limited to:

- Defects
  - Repetitive/Recurring Defects
  - Defects by Aircraft; ATA Chapter; Station
  - Engineer report (all defects and defect actions involving an engineer)
  - Recurring part replacement
- Fuel
  - Fuel reconciliation
  - Burn by from and to station combination
  - Summary for emissions reporting
- Oil and Hydraulic Fluid
  - Engine monitoring (oil consumption patterns)
- Personnel reports
  - An ETL will often be able to identify users that have completed certain tasks (engineering and flight)
- Dashboards

An extra hour or two of effort that a skilled line engineer is not doing clerical work



- Operations room monitoring
- Executive overviews

EFFICIENCY

The key efficiency that most people think of when considering an ETL is eliminating manual data entry. Whilst this is an important efficiency gain it is by no means the only one.

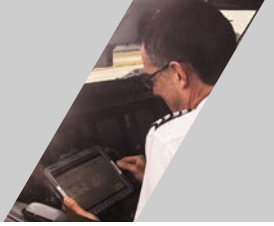
- Line engineers no longer need to send out paper techlogs (using whichever mechanism). Although this would generally be a task kept to the end of the day, it is an extra hour or two of effort that a skilled line engineer is not doing clerical work. The impact is not that hour alone but the interruption to other work
- In the normal paper techlog process updating Maintrol on an issue is mainly via mobile phone and email. This is purely because Maintrol will not have visibility of the activity recorded on the techlog. Once visibility is provided Maintrol and focus their efforts in ensuring the day is going to plan. The line engineer will still be on the phone to Maintrol – but discussing something that needs focus, not merely reporting back.
- The addition of line maintenance planning (functionality offered by some ETL solutions) reduces the need for Line Engineers to go back and forth to the Line Office, printing task instructions etc. The time this takes can be considerable, depending on the airport, the gate location and the office location. The functionality additionally simplifies the planning task for Maintrol.
- Capacity Planning- Daily defect meetings and shift handovers that ensure optimised work load capacity planning become cognitive, efficient and informed.

COST REDUCTION

A paper techlog process is not cost free. Carbonless mulitpart pads with an airline's techlog form printed along with unique numbering is not cheap. There are also generally costs associated with sending a techlog page back for processing.

It is true that there are new costs associated with running an ETL, however a thorough analysis demonstrates an overall benefit when the hard costs are taken into account, along with the efficiency improvements and the benefits from the improved visibility of the aircraft status which makes it possible to proactively manage the daily activities.

At first pass the business case for an ETL can appear weak. This is often because departments within the airline look at it in isolation. When the impact is analysed across the airline and the benefits analysed – you can be assured that the business case adds up.



KEY CONSIDERATIONS FOR AN ETL IMPLEMENTATION

Assuming there in sign-off on the internal business case there is only the small matter of how to go about implementing an ETL.

PROJECT SCOPE

There are many airlines that embark on an ETL project that never manage to get passed the initial assessment stage. Why? Because the project team ends up juggling the competing requirements of the organisation. These are often good ideas but are essentially new requirements. That is to say, it is not something that was done with the paper techlog.

This causes unnecessary problems for the Project Team and the changing requirements become an insurmountable issue.

That is even before the local Aviation Authority becomes involved. Many of the good ideas may also cause problems from their point of view.

So, our advice:

- The first step is to replace the paper techlog with an ETL – that's all. Don't make the brief any more complicated than this (Bells and Whistles can come later).
- Find a solution that does that well and offers flexibility for the future. The first hurdle is implementing a replacement techlog that is acceptable to the airline and the authorities. Keep it simple.
- At each juncture, when asked to add more functionality, compare it to the paper techlog. How does the airline accomplish the same thing at the moment? Does it need to change? If it is not needed place it outside the scope of the initial project.

That is not to say that certain changes cannot be introduced from the outset. However, these should be a conscious divergence from the current process and for specific business reasons. Once those changes are agreed – the scope should not change.

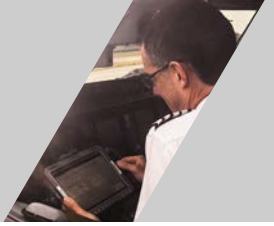
It is also worth noting that the internal project team will make a huge difference to the success of the implementation. The right team will be able to drive the project with a clear vision and will not be side-tracked by scope creep. Sometime the key stakeholders are not the obvious choices. Perhaps involve both a "champion" and a "sceptic". As long as it is approached in a professional manner this can provide balance. As an aside, in our experience, a converted sceptic is often the best project champion you can have.

CHOOSING A SOLUTION

There are a few ETL solutions in the market and many more EFB solutions that claim to have an integrated techlog component. What should an airline look for?

FIT FOR PURPOSE

The fundamental requirement is that the solution is fit for purpose. This is why the focus of the project is important. If you are looking for a solution that is a hybrid of a Flight



Bag, a techlog and a handful of good ideas, then you are creating a headache. Not just in finding a solution but also in having it accepted by the Authority.

If, on the other hand, you are focused on replacing the paper techlog with an ETL. The question of whether a solution is fit for purpose becomes somewhat simpler. It also becomes simpler to talk about internally (within the airline) and with the Authority.

As has been highlighted earlier, there are a few areas which are different for an ETL and have to be considered to determine whether a solution is fit for purpose (see Potential Problems). Questions to ask to cover these are:

- How is the tablet PC (or laptop etc.) going to be charged? On the aircraft? Via battery swap? If by battery swap are there charging banks available to have at the line stations? What issues does that cause at the line stations?
- What happens if there is a software failure? The solution must provide multiple mechanisms to recover from problems such as software freezes and data corruption.
- What happens if there is a hardware failure? Again, how the solution copes with these situations is vital. It is a quick thing to replace an ETL? Is there a backup and recovery mechanism? Should there be a store of spare units and where should that store be?
- How does the solution cope with not being able to transmit data? Whilst software crashes and hardware failures may be rare, it is almost guaranteed that some locations will be impossible to transmit from.

It is one thing to write a software solution that captures some data. It is quite another to create a solution that Is globally supportable in an operational environment.

PROVEN

It is not always possible, but ideally a solution with a proven track record should be sought. This should ensure that the solution has been tested in real world situations. If also means that the supplier knows how to support a solution in service. This latter point is key. It is one thing to write a software solution that captures some data. It is quite another to create a solution that Is globally supportable in an operational environment.

A SOLUTION THAT FITS

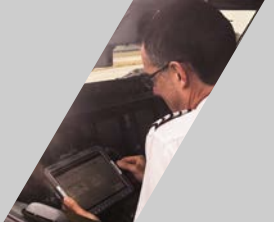
We are not going to discuss the specifics of the ETL solutions in the market. When we say “a solution that fits” we really mean “a solution provider that fits”.

You do not have to dig deep to find examples of airlines with bad experiences. The relationship with an ETL supplier is going to be long term. The airline wants it to be long term because they want stability, but it should also be a good experience. You want as little to go wrong as possible, which means looking for a supplier that takes pride in what they offer.

Choose wisely.

PLAN YOUR ROLLOUT

On the one hand, introducing an ETL has similarities to any project implementation, so we will not focus on the general activities. However, there are some specific considerations for an ETL rollout and these are discussed below.



INVOLVE THE AIRWORTHINESS AUTHORITY

This is obvious, but the timing is the important thing. Each Authority has a slightly different stance on solutions like the ETL, and each local representative also has their own view.

So the decision on when to engage the Authority has to be up to the airline because they will already have a working relationship. However, earlier involvement in the project will help ensure that the solution meets their requirements and will simplify the acceptance of the new approach.

As mentioned above, focusing on a replacement of the paper techlog should simplify discussions.

DUAL RUNNING AND REPORT

As part of the implementation the Authority is likely to request a dual-running trial. This simply means using the both existing paper techlog and the new ETL for a defined period. The duration will vary from Authority to Authority and will change as more ETLs are introduced. The purpose of the dual-running period is to compare the data captured through both mechanisms and demonstrate that the ETL is fit for purpose.

ON-GOING MAINTENANCE PREPARATION

The decision on how the ETL will be charged and maintained will have been taken.

If the airline is charging batteries at stations, then appropriate preparation tasks should be underway:

- Battery charging banks ordered
- Extra batteries ordered (for swap outs)
- Specific instructions to flight crew and line engineers regarding when batteries should be swapped

If the ETL will be charged on the aircraft, then a similar set of instructions should be agreed on when the ETL should be places on charge.

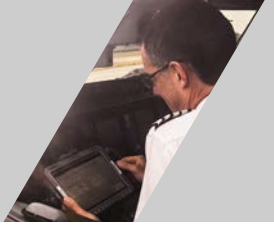
HARDWARE SELECTION/PURCHASING

The hardware to be used by the ETL will depend on the chosen solution. However, lead time for ordering PC Tablets etc need to be planned into the implementation project. This will commonly involve purchasing (with variations depending upon the solution):

- Tablet PC / Laptop (one or two per aircraft, depending on the solution, and spares)
- SIM card per aircraft
- Printer for fail over
- SD cards for backup and recovery

TECHLOG PROCEDURE ADJUSTMENT

The Techlog procedure will need to be amended to cater for the failure scenarios and maintenance actions (such as battery charging). The failure instructions will depend upon the chosen solution.



TRAINING

The degree of training required (and type) will depend upon the airline. However, the ETL solution should be relatively intuitive to use. Remember that the solution should be sympathetic to the existing techlog procedure unless the airline has chosen to alter it. So the ETL should feel familiar to the crew.

The common approaches are:

- Classroom training and demonstration
- Video or online presentations
- Hands on use in crew rooms

DATA PREPARATION

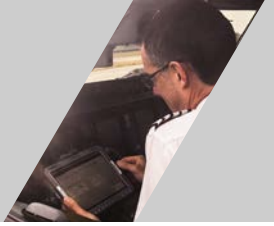
A techlog will normally have a history of sectors for the aircraft. This allows the crew to look back at sectors and defects. The ETL is no different and as part of the implementation preparation some sector history will need to be loaded for each aircraft. This will usually be sourced from the records of the Maintenance system (but may be manually entered from scanned records). The number of sectors to hold as history is defined by the airline.

GO LIVE

We suggest going live in phases focused around a common pool of flight crew (for example, the short haul aircraft). This is really driven by the logistics of introducing change and taking this approach allows the airline to focus training effort of a group of employees. It is not quite as simple to target a group of line engineers and the reality is that all the line engineers working at the stations (for the chosen phase) will need to be trained.

During the go-live day someone (or a team depending upon the volume of aircraft) should be stationed at each hub to perform the ETL implementation. The implementation team will be responsible for the preparing the ETL for the go-live sector:

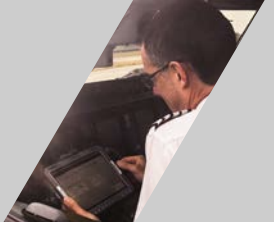
- The team will have a schedule of aircraft arrivals for the hub.
- An ETL unit will prepared for deployment on each aircraft coming through. Each unit should be charged, connectivity set up and ready for going live. Each should also be pre-populated with the appropriate aircraft history.
- The history will not be complete (because of the lag in inserting the data into the Maintenance system) and the implementation team will need to input sectors from the paper techlog in preparation for go-live.
- Once the history of the ETL is current the unit will be ready for go-live.
- The ETL is handed to the captain and the implementation team should (if possible) stay as they complete their first sector.



CONCLUSION

So the question still stands. Why is Aviation so far behind other industries when it comes to digitising and transmitting live records? What are business leaders really scared of? The business solutions are available now and thanks to many lessons learned in the early days by industry pioneers it has all become a whole lot simpler.

Jump in the water…Its nice in here!



About NVable: NVable was established in 2005 as an independent software consultancy. We aim to add value to our customers' business and we have consistently delivered solutions where others have failed. In 2012 we introduced our aviation solutions with the Electronic Techlog as a key element. Our team was involved in creating the first Electronic Techlog in the world and are experts in the field.

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