A Roadmap for an Airline Implementation of Electronic Logbook / Technical Log

1st Edition – April 2024

International Air Transport Association

Operations, Safety, and Security

Flight and Technical Operations

Digital Aircraft Operations Initiative

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EXECUTIVE SUMMARY

This document is intended to provide a roadmap for the implementation of an aircraft Electronic Logbook (ELB) or electronic technical log (eTL) with an airline [1]. It is mainly focused on third-party COTS products; however, some information can serve as guidance for in-house solution development.

The purpose is to share knowledge that has been sourced from industry experts to assist airlines in making the transition to replace the paper **Technical Log Page (TLP)** with an electronic alternative and covers all aircraft logbooks used in normal operations, these include the following:

- Technical Log
- Flight/Journey Log
- Deferred Defect Log (Hold Item List)
- Fuel Uplift Log
- Flight Acceptance Log
- Cabin Log

While often not the focus of current ELB/eTL products in the market or the initial scope of requirements for airlines, typically a paper Technical Logbook will also include:

- Dent and Buckle (damage) Chart
- Notice to Crew (for maintenance information to the crew)
- Line Maintenance check accomplishment

All airlines use some or all of the above.

These paper-based systems generally multi-copy books with several carbon copies for each TLP/sector. The carbon copies of each TLP are eventually distributed around airline departments which can take several days. The paper TLP pages are completed and certified by cabin and cockpit crew and line engineers with a traditional inked signature. Due to handwriting and language issues, they are often very difficult to read by the typists. They frequently have incorrect or missing data that has been accidentally omitted but still certified. Back-office staff have learned to interpret and maybe guess what the Pilot or Engineer intended to record, and they then input this corrected data into the relevant MRO/CAMO systems as required. Another burden is the need to manually transfer information from one document to another, for example, transferring findings from cabin log to technical log. Over the years airlines have introduced digital systems to partially replicate TLP data, e.g., an ACARS feed into the operations or MRO/CAMO system. However, the paper systems generally still exist as these are the legal record, they also continue to provide a level of historical comfort. This introduces an additional problem as the paper system and partially electronically captured data may not match or are not up to date. Accurately recorded workflow-controlled data can easily be captured by an ELB/eTL with prefilled text options, which should then eliminate all the paper log books and associated forms. This also provides key data such as component TSN/TSO info, which enables the prompt and efficient return of U/S spares to suppliers, which therefore assists in avoiding late component

return fees. The ELB/eTL completed TLP data, commonly termed the Station copy or Golden copy, must be left on the ground before flight. It is the legal record of the aircraft's status before it embarks on its next journey, if there is an incident this data will be the first maintenance information to be analyzed by the relevant investigation or safety authorities.

Key takeaways from this paper include:

1. An ELB/eTL is more than a page of paper, it is a system with connections and dependencies. Therefore, it is common sense to consider a similar conversion from paper to electronic format for all types of logbooks mentioned earlier. It is noteworthy that the Cabin Maintenance Log, whilst often a separate paper log, will be used to record airworthiness-related defects and should be considered in a paper Tech Log replacement decision.
2. The TLP certifies the legal airworthiness condition of the aircraft before each flight. As such a copy of the signed TLP must be left on the ground before flight, be it electronic or paper. This must be understood and accepted at the airline's Senior Executive level before they authorize an ELB/eTL project. This makes the eTL process and the application more complex to achieve than may be initially expected.
3. An ELB/eTL is a "Disruptive Technology" – It directly affects all pilots, line engineers, and Maintenance Control Center personnel like troubleshooters and how they record their work. It has significant benefits but, like most things requires financial investment as well as effort. It is also a long-term commitment with a supplier, but if done right the savings and other advantages deliver a key value.
4. An ELB/eTL is used in "Front Line" operations in the cockpit, cabin, and on the line, often during short turnarounds. If the ELB/eTL does not work well, then it may cause additional stress in the cockpit before departure – this means there is a pilot workload consideration.
5. An ELB/eTL is an engineering function although often seen as an IT or Flight Operations project. The key stakeholder is the engineering department. In some cases, we can also see a supply chain department as the one responsible, however with a strong engineering lead in it. The beneficiaries, on the other hand, include a large circle of airline roles.
6. Local CAA support and approval is essential to ensure a successful implementation. To have a low-risk implementation the solutions selected should have successful EASA or FAA-approved operations.
7. Device and operating system selection may have consequences outside of the ELB/eTL project requirements as, over time, devices may be used for other applications. Compatibility with the organization's IT setup must be considered.
8. Many ELB/ETL benefits rely on integration with downline systems. Seamless integration with other systems, including Maintenance, Operations, Fuel, and other airline management systems is highly desirable.
9. Depending on your operation, it may be beneficial to phase your implementation to achieve CAA Operational Approval in the shortest timescale. Consider initially replacing just the paper Tech Log. The (apparent) need for system improvements and additions should be much clearer after ELB/eTL experience is gained.

SCOPE

IATA represents some 320 world commercial airlines from 120 countries; therefore, this document is intended to aid when considering implementing an ELB/eTL for the full range of airlines flying today, including:

- LCC's
- Regional Airlines
- National Carriers
- Network Carriers
- Cargo Operators
- ACMI providers
- Charter Airlines
- Corporate/VIP Operations

In addition, there are some hybrid military/commercial operations for which this roadmap is also applicable.

PURPOSE

To provide airline-oriented guidance on the following ELB/eTL implementation challenges:

- CAA Approval
- Project Budget, stakeholders, business case
- Class of device/Hardware selection
- Operating System
- System Provider selection
- Software selection
- Required training
- System implementation strategy

SECTION 1 – LOOK BEFORE YOU LEAP – WHAT TO DO FIRST?

The move toward paperless operations has been exponential in most industries. Although also true in some isolated areas of aviation, the overall drive to change remains very slow. If we review the position today, some 15 years after the ELB/eTL concept became viable, there are very few airlines that have successfully adopted an electronic Technical Maintenance and/or cabin log. To determine what is required to implement an ELB/eTL successfully – and to achieve the intended benefits – it is useful to reflect on the challenge and reasons that many previous attempts have fallen short or have been abandoned:

- Reliable form of connectivity or data-sharing for the legally required Station Copy to be recorded off aircraft before dispatch.
- The high cost of hardware and certification for installed equipment (class 2 and 3 era requiring certification)
- The conservative approach to electronic records by regulators [2]
- The assumption that an ELB/eTL should be mainly an application on a pilot-attached EFB when the paper tech log has never been in a pilot's flight bag.

Aviation is a very conservative and safety-based industry. Whilst this can be frustrating for those introducing new technology to aviation, a risk-based culture with associated regulation is the reason why aviation is the safest form of transport, so we should embrace the regulation.

Successful applications that meet the business needs and regulatory requirements must be designed for the 'real' environment in which they are used with sympathy to tight turns, human factors, and operational resilience. At first look, the paper logbook looks like a few forms that are straightforward to replace as a small project for an airline's IT department. Not so. The paper log itself is just one part of a well-established defect management system that reaches across many stakeholders and connects with many downline processes and systems. In addition, each airline has a slightly different approach to the same process of managing defects. This means that, if an airline decides to build its own ELB/ETL, then it should be prepared for an in-depth study across many departments, a significant amount of Subject Matter Expert input, and a high risk of cost and schedule overrun – or, more likely, a big cut in scope which results in never quite realizing the business case or user adoption.

Where to begin?

There is a popular misconception that all an airline needs to do is create an electronic form on a tablet, that can be transmitted back to the airline computer system, and this will suffice instead of the paper forms. There is a long list of airlines that have followed this path and a correspondingly long list of expensive failed ELB/eTL projects. From an outside point of view, this is an entirely reasonable mistake. It is after all a paper form that is being replaced and tablet technology has existed for many years, that in other industries has worked perfectly well to replace simple paper forms.

Big misunderstanding - we are not talking about a simple paper form!

The paper Aircraft Maintenance Log often comprises two separate books carried with the aircraft: The Aircraft Technical Log and the Aircraft Cabin Log. Some defect reports from the cabin log will need to be transferred to the technical maintenance log. Some operators have additional defect logging books specifically for IFE, and some record the journey (flight times) separately The Aircraft Technical Log page (TLP) is a document that is completed for every sector/leg of the flight. The TLP is used by qualified Maintenance staff to certify that the aircraft is Airworthy with a CRS (Certificate of Release to Service) and the pilot's Acceptance for Flight. It should be noted that many operators use the Tech Log to record other information that is not necessarily defect-related.

There are two key points to note:

1. The current technical condition of the aircraft must be available to the crew before and during the flight. This includes outstanding (carried) defects.
2. An authenticated record of all maintenance activities carried out since departure of the prior flight must be available 'off aircraft', i.e., the Station Copy.

Before approving an ELB/eTL project

General considerations that should be accepted at Airline Senior/Board level are:

Consideration	Explanation
An airline ELB/eTL Project is "Disruptive Technology". It affects all pilots, line engineers, cabin crew, MOC/MCC/OCC and CAMO staff.	The paper-based processes within an airline are deeply engrained, many of the users routinely complete small sections of the forms as part of the larger chain of events to achieve an aircraft turnaround and certify each flight sector. Experience has shown that often many of the participants do not thoroughly understand the whole process, they only have awareness of their step in the chain. Introducing an ELB/eTL requires all the cabin, cockpit crew, and line engineers to be re-trained. Training time and logistics should be considered. ELB/eTL workflow design is a key factor in simplifying the training burden. Note that 3rd party providers must also be accommodated from both a training and access control/certification perspective.
The Technical Log is mission mission-critical system. It is in constant essential use for	It is a requirement that all outstanding deferrals and a history of previous sectors' maintenance actions are always available to the flight crew (the number of sectors varies between authorities). A paper Tech logbook is not going to 'fail' in the same way that a mobile device could, thus consideration must be given to handling ELB/eTL equipment failure, particularly with single device operations.

front-line operations by all cockpit, cabin crew, and engineers.	Consideration must be made to the ELB/eTL hardware, to ensure that abnormal/backup processes are included in the company procedures manual. Depending on the architecture and approach offered by the ELB provider, this may require additional spare holdings.
If the ELB/eTL system works poorly it increases cockpit stress, especially during short turnarounds, and has an associated delay and pilot workload	It will likely be the first time that an airline has implemented an ELB/eTL solution. It is understandable if the change in user acceptance and change management effort acceptance across a wide user demographic. For this reason, the ELB/eTL selection and implementation team must include staff with expert knowledge of the processes being digitized i.e., experienced IT- and data specialists working closely with Tech Ops experts with regular input from Flight and Cabin crew. An experienced ELB/eTL supplier should be able to demonstrate how their product can replace the existing paper logbook functions as well as explain the options and benefits that an ELB/eTL provides such as *electronic signatures*. The electronic devices that we are used to have various methods of user identification and validation. Some are excellent enhancements to the inherently insecure 'squiggle' signature used with paper, others may add burden or be inappropriate for shared devices, e.g., biometrics. There is often an expectation that an ELB/eTL should fix all the problems experienced with paper. Improvements are indeed many, but the management of user expectations is key to keeping the scope under control. An ELB/eTL will provide significant business benefits due to increased data integrity, real-time integration with your M&E system, and electronic technical records. Overall, data entry effort should be reduced by at least 50%. Inevitably, there may be one or two new pieces of information to enter – or even to get right due to validation. User groups will need to understand and accept this criterion. Some ideas will consider bio-metric identification such as fingerprints, and even facial recognition. It is also essential to avoid the so-called "specification creep" causing delays to the implementation and extra expense.
An ELB/eTL implementation project has a relatively low cost with a very achievable ROI and a significant	It should be recognized from the outset that implementing an ELB/eTL solution is not going to be financially justifiable on just paper processing savings. However, the additional consequential savings due to real-time visibility and increased data integrity are manyfold. With highly reliable, low-cost domestic mobile devices now largely accepted for aircraft use, the costly Class 3 certified installations of the past 15 years are now a

airline efficiency improvement potential. Traditional software purchase or subscription-based pricing?	thing of the past, an ELB/eTL solution is a relatively low investment in comparison to the potential savings. Further, an implementation can be in within months with no aircraft modifications or STC required. This will greatly accelerate the ROI. There are four basic cost elements to an ELB/eTL installation, 1. The hardware cost 2. The software subscription fee 3. The data fee 4. Onboarding or installation costs, which can be incurred altogether or separately In comparison, the subscription option could have relatively low start-up costs but will incur an ongoing monthly tail fee for the life of the system. The capital purchase option means the airline may have a higher implementation expenditure but a lower annual subscription cost. It cannot be said that one option is more cost-effective than the other. It will depend on the airline's negotiation with the provider and if mobile devices are already in use for other reasons. The majority of EFBs currently operated are on the iOS platform. If this is the case for an airline, there will already be an organization (EFB administration) managing devices, purchasing, and support and probably a company-wide data plan from one of the global suppliers. The new e-Sim capability will further simplify data connectivity to devices. As wider mobility usage is adopted, devices may be used for multiple applications so the airline-purchased option may be more appropriate. In comparison, if an airline requires a turnkey solution that does not require multiple applications on the same device, then a supplied device may be attractive and appropriate. The year cost of ownership may be similar, but this is very much down to fleet sizes and negotiation.
Digital ELB/eTL data, .xml, and/ or .pdf files will replace the TLP "dirty fingerprint" copies. They must therefore be acceptable to respective airline leasing	Regulators and Lessors are now realizing the efficiency savings in aircraft transfers with digital data. However, it is wise to consult stakeholders. Experience has shown that leasing companies prefer a digital "clean" fingerprint instead of the traditional "dirty" handwritten paper records. However, this cannot be assumed in advance and every airline will have its leasing arrangements, so agree to the new ELB/eTL clean fingerprint records with the lessors before embarking on an ELB/eTL project.

companies for aircraft end-of-lease (EOL) hand back.	
Long project timescale – 6 to 12-month implementation period and 5 to 10-year life expectancy.	It is rare for an ELB/eTL project implementation to take less than 6 months. Large operators with multiple fleet types and/or multiple AOCs have taken up to two years although familiarity and acceptance by regulators is starting to reduce timescales. Once up and running it will become critical to the efficient operation of the airline. As with any IT system in aviation, the barriers to exit are high so long-term considerations should be made. Due to a significant rise in demand recently, new ELB/eTL suppliers are entering the market. Considerations should be made as far as: • Experience in the market and expert knowledge. • Independent ELB/eTL product or M&E extension product • Company stability • 24/7 support availability • Service level guarantees • Development roadmap • Scalability • Provided hosting architecture
Project success will be determined by achieving the respective Approval from the local CAA Consider building this contractually with the ELB/eTL supplier.	As the "aviation world police", the CAAs come in all shapes and sizes. Some will be very supportive of a proposed ELB/eTL solution and may encourage and assist the process. Others may interpret the EASA or FAA guidelines with conservatism and include additional local regulations in their requirements. This might include IT-related regulations for digital/electronic signatures that are not normally associated with aviation. The airline must realize that the regulatory approval process can extend implementation time.
	Engage with the CAA as early as possible. **Involve them at the heart of the project.**
	Keep the CAA well-informed regularly at all stages of the project. Having the positive support of the CAA will enable the all-important "Letter of no objection" (LNO) or Operational Approval to be granted in the shortest possible time, allowing for quick and efficient trials and subsequent rollout of the system to the airline fleet.

Real-time data availability sent from an ELB/eTL provides an off-aircraft advanced view of performance restrictions	**ELB/eTL enables pilots to look at the aircraft status before arriving at the aircraft.** With a paper TLB flying in the cockpit, operational staff only have access, when entering the flight deck. Advanced awareness provides time to plan early reducing the chance of delays and enabling a reduced defect life cycle.

SECTION 2 – DEVICE AND OPERATING SYSTEM SELECTION

ELB/eTL selection should not start with a potential supplier, device, or operating system. Computer systems are improving all the time and software is fast to write. Moore's law tells us computers double in capability every 2 years, it can be assumed from the outset that the technology is available and getting better all the time. The high-level issues that should initially be considered are:

Operating Environment

The paper logbook rarely leaves the aircraft. It is a book and is treated as such as far as being kept clean and dry. An ELB/eTL device has the capability to take photographs and access other information such as AMM, IPC, TSM, and MEL. It is therefore more likely to be used around the aircraft. Whilst this raises the risk of contamination and damage, airline experience has shown that with suitable covers, cases, the mobile devices in use are generally not damaged or contaminated in normal use.

Be aware that the selected ELB/eTL device, when put into service is not going to be cared for by a single user. Instead, it will largely live in the cockpit and on the line and be used by multiple Pilots and Engineers all over the world in various climates every day. As a result, the devices will be abused. They will be dropped, occasionally sat on, subjected to coffee spills, etc. They will likely be used above and below the wing.

Class of Device

Whilst the categories have changed, for clarification the class 1, 2, and 3 EFB device classification is included. Class 3 has been largely phased out as OEM-provided equipment due to cost, with just a few production aircraft being delivered in 2024 with installed avionic-grade EFBs. This is necessary to consider because, over the last 20 years, the major aircraft OEMs got involved. [3]:

Class	Description
1	Portable Electronic Device (PED) such as a laptop or tablet
2	PED, but interfaced into the aircraft systems
3	Installed aircraft system with aircraft type design approval

With many lessons learned and behind us an industry, there is a rapid move to the adoption of Class 1 solutions, which are typically carried as loose equipment being stowed in a convenient location. This is often in the space where the old paper Tech and Cabin were stowed. These loose equipment devices are generally not provided by the Aircraft OEMs but instead by the airline or the ETL provider as part of the service package.

Device Security

Unless the eTL application is provided ready and installed in a device as part of the supplier package, airlines will be responsible for ensuring that access to approved applications is maintained. This is typically achieved with a Device Manager of the airline's choice. It should be noted that security ELB/eTL providers' end-to-end system, including the ground-hosted service, should be considered as well as the client app alone. It should not be possible to get into the Operating System, to wander around the file system, or launch an internet browser to post on social media or play games. To prevent data corruption built-in security measures by both, software and hardware providers need to be in place. If such built-in measures are not available, a total lockdown of the device should be considered.

As of 2023, the three major mobile operating systems are:

O/S	Considerations
Apple iOS	Apple's iOS proprietary operating system is developed exclusively for Apple devices. Applications deployed via the App Store must meet performance and compatibility requirements to ensure stability and usability. The hardware choice is limited to iOS products. iOS upgrade compatibility is predictable. In comparison, Android and Windows must support a variety of third-party hardware sources. When the iPad arrived, in 2010, the iOS device quickly became the preferred unit for most EFBs, and that situation is still true today. It is estimated that more than 80% of pilot EFBs are Apple iOS. The percentage is lower for Engineering users but still a majority. Tablet devices including life span are a point to be considered. In aviation terms mobile devices should be considered as consumables with a life of 3 to 5 years but there is still a cost. This is considered similar across all quality device types.
Android	Google's Android Operating System is the most used platform of the three worldwide but has not yet been, or is likely to be, widely adopted in Aviation. For example, flight deck EFB usage is very rare. Google develops Android in-house and then releases the source code to the Android Open-Source Project. This means that the code is publicly available for anyone to create a copy and customize. This makes Android the most 'IT configurable' of the three operating systems, and it is essentially free to use. Android runs on a wide variety of devices and can be locked down as required using the "Dedicated Device" features.
Windows	During recent years, Windows has become mobile and touch screen friendly, depending on the hardware device selected This is due to the advent of the Universal Windows Platform (UWP) app model, which has made Windows 10 a competitor to iOS and Android regarding touch functionality. This makes Windows a viable choice for an ELB/eTL. New versions of LTSC

	are only released every 3 years, but each release is fully supported with security updates for 10 years – and never any "Feature Updates". Windows 10 can be run on a very large range of devices, so the hardware options are numerous. It can be heavily customized and locked down to a single app using "Kiosk Mode" however this restricts the device to a dedicated use.

All three operating systems could be used for an ELB/eTL if correctly configured, although, essentially, customers have a choice between Windows and IOS. Historically ELB/eTL Vendors have only offered software compatible with a particular operating system, which in turn restricts the choice of hardware devices or drives the decision toward any device already used by the operator. More recently ELB/eTL suppliers are producing their applications for both iOS and Windows mobile. Suppliers that have developed in both native iOS and native Windows will provide an overall better user experience than a single application written for both.

In terms of device selection, many mobile devices have the potential required capabilities for an ELB/eTL:

1. Mobile data network - SIM card LTE/4G
2. Touch screen
3. Wi-Fi / Bluetooth for potential integrations with other devices & systems.
4. Power and charging
5. GPS (or other location services) for location tracking
6. Removable backup storage usually in the form of an SD card or USB drive (IOS13 or later).
7. Native Peer-to-peer OS function

In terms of gaining CAA approval, a consideration might be that is to show authorities as a part of establishing the backup process, that the device must be able to store data in more than one local hardware location. This is essential as operational data loss due to storage hardware failure is unacceptable.

SECTION 3 – CAA APPROVAL

There are 3 elements to a successful ELB/eTL project.

1. Getting internal business case approval.
2. Selecting the best solution option for your situation
3. Getting all the end users onboard including pilots, and engineers along with MCC, OCC, CAMO etc.
4. Gaining CAA approval.

Early engagement is the key to CAA approval.

It should be noted that the eventual success of an Airline ELB/eTL project is ultimately dependent on achieving CAA approval. There have been several failed ELB/eTL implementations because the airline involved could not achieve local CAA approval and eventually the project just dies of old age simply waiting for that golden bit of paper, the "Letter of no objection" (LNO) or Operational Approval to cease to use the paper system.

Whilst CAA bodies around the world tend to use EASA or FAA guidelines as the basis of their own local regulations, the interpretation can be quite different when related to new technologies. Whilst acceptance of electronic records and e-signatures is more widespread than even 5 years ago, an eTL/ELB should still be considered as a new technology.

Delay in achieving CAA approval for an ELB/eTL project must be considered as the **highest project risk** and should be clearly specified and thoroughly mitigated in the project risk assessment. For less mature products, there is a risk of not achieving Operational Approval for a considerable time, if at all.

CAAs around the world are composed of very highly qualified and experienced individuals. They are dedicated aviation professionals and want to see safe and efficient airlines operating under their jurisdiction. The dedication and professionalism that the CAA can provide should be considered a benefit for an ELB/eTL project. Mutual recognition of this at an early stage will assist in ensuring a successful outcome.

Careful consideration must be given to selecting the ELB/eTL Project Manager. Choosing someone the CAA respects is a very good start. If a mature and comprehensive ELB/eTL project is presented, then the CAA will see the potential system improvements. Individuals should be aware of the weaknesses of paper-based TLP systems and generally quickly grasp the benefits of an effective ELB/eTL replacement. However, recognition and agreement may not necessarily align with legacy local regulations which may be a constraint.

The CAA's wants to see quality sector data recorded that is readable and verifiably complete. However, they understand that new electronic systems come with risks, so they will look hard for all the potential new system weaknesses.

How to achieve CAA Approval?

With e-signature and electronic records becoming more common, local regulators may have already produced guidance material. Even so, if it is your first time to implement an eTL, it may be

your regulator's first time too. It is advisable to include CAA in project conception and keep them informed regularly. Give them a chance to express an opinion and agree on the roadmap to be followed. As with many approvals, the focus for the CAA will be on the robustness of the process, reliability of the chosen application compliance with technical records, and non-repudiation. Your presentations and updates should reflect the audience's interests. Avoid complications for the CAA. The CAA will have to be confident that the eventual solution is fully fit for purpose before they give approval to discontinue usage of the paper systems. Endeavor to make it easy for them.

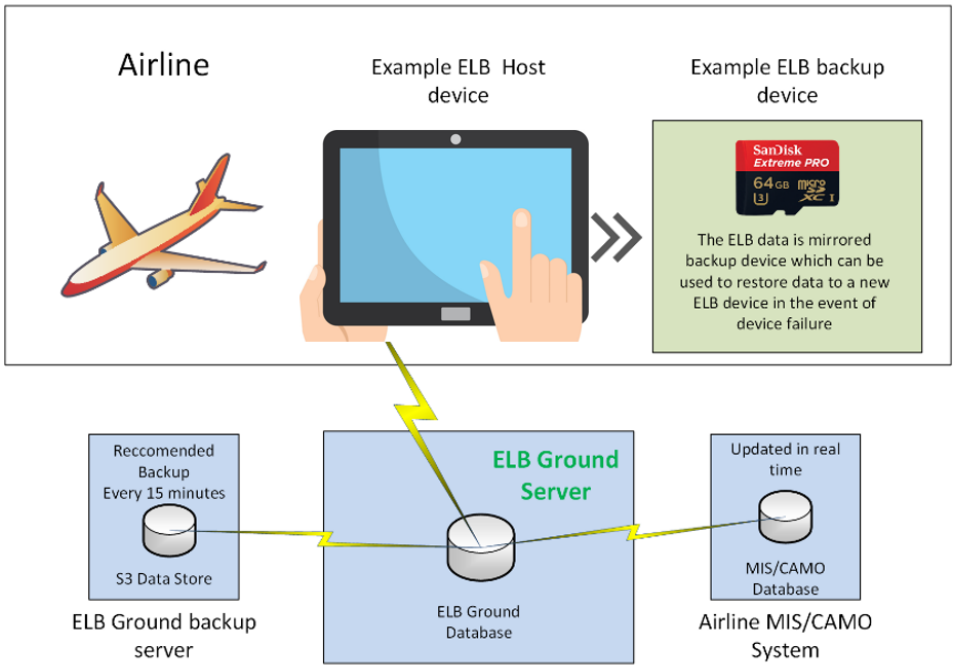
To facilitate this, focus on initially just getting approval to replace the paper system even though there will likely be temptation to fix so many ancillary issues on the way.

Issue	Response
Legal considerations for gaining approval for electronic signatures.	This is probably the biggest question regarding getting an ELB/eTL solution approved by a CAA. Resolving this question requires some social engineering and culture change. Explain the system to the team at CAA based on proven and legitimized technologies in your jurisdiction. Also, insist on gaining approval for implementing and approving all ELB/eTL signatures to the same current approved and legal paper-based standard, or standard applicable to electronic technologies approved in your jurisdiction.

Print or other approved procedure for non-electronic transmittal of completed TLP data prior to flight.
 	
The system must leave a copy on the ground.
	It is imperative that any ELB/eTL solution facilitates an authenticated copy of the completed TLP including the pilot's aircraft acceptance record being left on the ground prior to departure. In normal operations, this will be an electronic update of the central ground system repository often referred to as the 'Golden Copy' with an indication on the aircraft ELB/eTL device that the information has been received by the ground system repository.
	Before discussing Abnormal Operations (loss of connectivity there is a key point to note:
	The objective of the Station Copy is to have a record of aircraft maintenance and release available in case of an aircraft incident where the onboard copy may not be recoverable. This Station Copy does not have to be recorded in the central repository at departure if there is another electronic or paper copy available. This could be on another device, on media, or as paper. The paper could be printed or a manually copied version.
	
	The following methods have or could be adopted by various ELB/eTL providers:
	• Printed output from the ELB/eTL
	  ○ Flight Deck printer installed EFB or Mobile connected via AID.
	  ○ Standalone printer USB or Bluetooth either carried on aircraft or held at the station.
	• Removable Media with a confirmed Station Copy

	○ SD card ○ USB/Lightning-connected • Peer-to-peer sync ○ Device-to-device synchronization where the synced device remains on the ground. • Paper fallback ○ The information entered into the ELB/eTL is rewritten on a paper log page and signed. a Station Copy is left on the ground and a copy is left on the aircraft. What happens if an electronic copy cannot be transmitted? Your eTL/ELB provider should have a solution for this situation. Whatever solution is provided, this will be of key interest to your regulator in achieving compliance in a 'no connectivity' situation. One or many of these options should adequately cover the case of loss of connectivity for aircraft dispatch and should be demonstrated and accepted by the relevant CAMO and CAA. Precedents and demonstrated operational experience will obviously assist in this process. Whilst each method has its merits, expediency in producing a Station Copy will avoid disruption as the final release is likely very close to the Flight's STD. A robust print or alternative solution must be in place that can be adopted and carried out quickly when this scenario arises.
Failure modes, potential data loss, and recovery	The ELB/eTL device by design will have an inbuilt memory. The CAA will normally require assurance that the TLP data will not be lost. In normal operations, the device being used on board (either aircraft attached, or pilot attached will be connected to the ground system repository with regular (if not real-time) updates. Data is therefore replicated continually. When connectivity to the Ground System is not available due to connectivity loss or when Airborne (ELB/eTLs without AID or pax Wi-Fi integrations), there is a risk of data loss in the following ways: Hardware Failure • The risk of hardware failure depends on the hardware being used. IOS ELB/eTLs must be used on iPad or iPhone with very reliability figures. Windows ELB/eTL hardware will depend on the quality of the device chosen but reliability can also be very high. Application Software Failures

	• The failure of the application where data is irrecoverable will be dependent on the robustness of the design and the experience of the supplier. Device damage causing irrecoverable loss of data. • There are many robust cases and toughened devices available in the market. The choice is a balance between resilience and weight/cost. In practice, operators are not seeing levels of damage that might originally be expected. Damage resulting in irrecoverable data loss is very rare. [Irrecoverable data loss would be where the data has not synchronized with any other eTL/ELB device, the ground server, or removable media when the device failure occurs]. Device loss through left or misplacement • Of all the risks of data loss, a misplaced or stolen device is the most likely event, although would need to be in combination with a lack of connectivity prior to the device going missing. If a device is missing and the data entered since the last update has not been replicated off the device, then the data will be lost. Having an internal backup, e.g., an SD card will not mitigate the loss if the device is lost (the SD card will be lost too). ELB/ETL systems where continual peer-to-peer sync with other active devices is the best protection in this scenario. Although the risk of failure is relatively low, in the event of device loss or failure, the backup device or process should be capable of restoring the data to a replacement ELB/eTL device. This restore process should be possible for a new or spare device on the aircraft with or without an internet connection. The more expedient then the less likely to cause a delay. iOS devices do not have removal media so a peer-to-peer ELB/eTL design providing dispersed replication to all devices is a good choice. In this design, any device can be made a master quickly without data loss. If an onboard NFS/AID node is available, then the replacement device can be synchronized without ground connectivity.
Ground server: multiple and frequent cloud backups are required with full monitoring to ensure successful	The ELB/eTL devices in service will transmit ELB/eTL data to a ground server. The ground server architecture should be designed such that it is not a potential single point of failure for the ELB/eTL system. If an airline chooses to host on-premise, then this should be considered. If a SaaS service is selected, then the ground system architecture should be reviewed by your IT department. All data on the ELB/eTL should be transmitted to the ground server, so in the event of a total loss of the ELB/eTL device and associated Cockpit

backups are always occurring	backup, a new ELB/eTL can be quickly configured, and data populated from the ground server or another device. The ground server architecture should be backed up regularly. Good practice is to have incremental backups every 15 minutes and total backups at least every 24 hours. If hosted on, say, AWS or Azure, then highly resilient designs can be provided. This should be reviewed. A mission-critical design should not be taken for granted. It is normal practice for the ELB/eTL ground server to forward the TLP data into the airline MRO/CAMO system, so most of the journey and defect data is therefore also effectively being saved in the MRO/CAMO system (and its associated backups). 
Demonstrate Fault Tolerance with built-in System Redundancy and Fall-back procedures for all aspects of the system	In aviation, we apply the principle of having multiple redundant options for mission-critical systems. An ELB/eTL is a mission-critical system as the aircraft cannot legally fly if it fails. Pragmatic and sensible backup options must be easily available and able to be used at short notice. They should have little or no impact on aircraft operations. All failure scenarios should be considered and recorded in the project Risk Analysis. Suitable mitigation procedures must be put in place for each failure scenario. Some examples of mission-critical failure scenarios are: • ELB/eTL device failure • ELB/eTL transmission medium failure • Loss of connectivity

	• Ground server failure • Maintenance Information System failure The potential failure scenarios will of course be identified respectively for the selected solution.
Proven Data Security and required encryption	Within Europe, there are legal obligations about GDPR [5] and the privacy of personal data. Some elements of the ELB/eTL inevitably are personal data in that the ELB/eTL solution will need to have available all Pilot and engineer authorization codes along with their names and probably their email addresses. An ELB/eTL solution will need to be able to demonstrate to the CAA that all data is securely protected, both on the ELB/eTL device and backup device in the cockpit but also on the ground servers. All personal data such as names, passwords, PIN codes, Authorization ID's, etc. must be encrypted "at rest and in transit". This means they are encrypted at the database field level and whilst they are passing through the internet. If PIN codes are being used these should be hidden even from the system administrator.
Endeavor to minimize the Parallel Running period	CAAs generally require a demonstrated Parallel Running period, during which the legacy paper system is the primary system in use, but the ELB/eTL solution is running in parallel. This is required to demonstrate that the ELB/eTL solution is fit for purpose and robust enough to take over as the primary solution on completion of the parallel running period. In the early days of ELB/eTL systems, the CAAs generally insisted on a 6-month parallel run period. This was extremely difficult to carry out, as essentially the workload for the Pilots and the Engineers is double whilst the parallel run is being carried out. As now, multiple COTS ELB/eTL solutions have been approved around the world and are in use, it is currently possible to negotiate with the CAA to reduce the parallel run period to a minimum. This is particularly true if the selected ELB/eTL solution is already approved by the CAA with another local airline operator, or near a neighbor CAA. Applying the earlier advice of engaging with the CAA at all stages of the ELB/eTL selection and implementation process should give the CAA confidence to support the airline with a pragmatic and short parallel run period. With established ELB/eTL systems that already have multiple CAA approvals, it is currently possible to reduce the parallel run period down to

	as little as a few weeks or even avoid it completely with a monitored start of productive use with a small number of aircraft. The parallel run needs to be carried out with a representative sample of the airline fleet, preferably with all cabin/cockpit crew and engineers for a discreet fleet or operations base of an airline. It is often not considered a representative parallel run if individual pilots and engineers are using the ELB/eTL one day but not the next.
Exactly how will approval be granted to eliminate the paper system except as an emergency backup system?	Approval is granted by the CAA as a "Letter of No Objection" (LNO) or "Operational Approval" to cease to use of the paper logbook system as the primary aircraft log. This allows for the ELB/eTL to become the primary aircraft log, with the paper system as an emergency backup. This is a very important point and is often misunderstood. **The paper system is not eliminated when introducing an ELB/eTL. The paper system remains a legal method of operating the aircraft as a backup contingency in case of ELB/eTL failure.** Some paper systems do not lend themselves to being used as an alternate system and in some cases, airlines evolve the paper system to be a simpler alternative that is only required in an emergency and records only the minimum legally required data in the event of an ELB/eTL failure. There is a requirement for a Standard Operating Procedure (SOP) to be in place to switch between the paper and ELB/eTL solution for an aircraft. Equally an SOP is required to switch back from paper to ELB/eTL. Factors that must be borne in mind when switching between paper and ELB/eTL include: • Next TLP Sequence number • Outstanding deferred items • Hours and Cycles remaining to next servicing or deferred item expiration.
Full Equipment and software documentation, equipment IPC's, User manuals, hardware approval documentation for cockpit use	In cases, where the device selection criterion is the use in a harsh environment, the CAA will need to be furnished with all the appropriate hardware documentation for the chosen ELB/eTL solution. This may include the DO- 160 [4] certification for the hardware to be used in the cockpit, along with any lithium-ion battery certification that is required to international standards. This should be readily available from the supplier. Although not required for airline-procured devices, if the device is supplier-furnished equipment (SFE), then the vendor supplying the ELB/eTL solution should also supply an IPC for all the hardware supplied, including any printer or Wi-Fi backup solution.

	This IPC should be approved by the airline quality department as part of the supplier approval process and will be used by the airline to request consumable spares for the ELB/eTL solution during its service life. The information presented to the CAA should be collated together into the form of an indexed document, with easy-to-understand chapters and sections. This will in turn speed up the CAA's understanding and demonstrate that the airline is well organized and ready to proceed.
Keep it simple – For approval minimize initial system complexity – just replace the paper and get that approved and rolled out	The final point is a re-addressing of the first point in this section. Minimize the initial scope for the ELB/eTL solution to just replace the paper system. Ensure that in the first instance, the process is simply going from paper to electronic. There are lots of additional desirable functions the approved ELB/eTL can be adapted to in the future, but the leap from paper to electronic can be challenging across a wide user demographic. Unnecessarily initial complications can lead to a delayed implementation. After the approved ELB/eTL has settled down in service, it is then possible to move from electronic to digital and embrace additional benefits for the airline, but the best advice is not to try and do this in the first phase. Get the basic ELB/eTL solution approved and accepted use first and then build on that foundation to go truly digital.

SECTION 4 – SUPPLIER AND SOLUTION SELECTION

Although eTL/ELB adoption has been surprisingly slow across the industry, the pioneers have already absorbed the early pain. Mature solutions are available from experienced suppliers but the change management across a user demographic of pilots, engineers, cabin crews, and 3rd party MROs should not be underestimated.

An ELB/eTL system is too high-risk a project to be subject to the whims of internal politics.

Experience shows that a small team (maximum six people) of respected experts representing all affected departments will provide the most effective team. It is recommended that the ELB/eTL project is led by engineering and not flight ops for the simple reason that engineering has the most to gain from an efficient ELB/eTL- after all, the Technical Log is a maintenance document.

For coordination purposes, identify internally or recruit a high caliber **focused, and persistent** project manager. This is a multi-department project. Don't allow internal politics/actors within the airline to compete for control.

Allocate "Chairman level" solution selection responsibility to the project manager so they can impose authority over the competing airline jurisdictions for the sake of the ELB/eTL project.

The project manager should have direct access to the airline executive management and should have a demonstrable commitment from the top level for the system implementation.

Put in the time and expense to comprehensively research the market. Are there already approved ELB/eTL solutions with the respective local CAA or a nearby similar Authority?

Site visits for reference purposes on potential solutions are essential. Bear in mind you are asking a huge favor, sometimes from a competitor. Try to spend at least two days to get real knowledge.

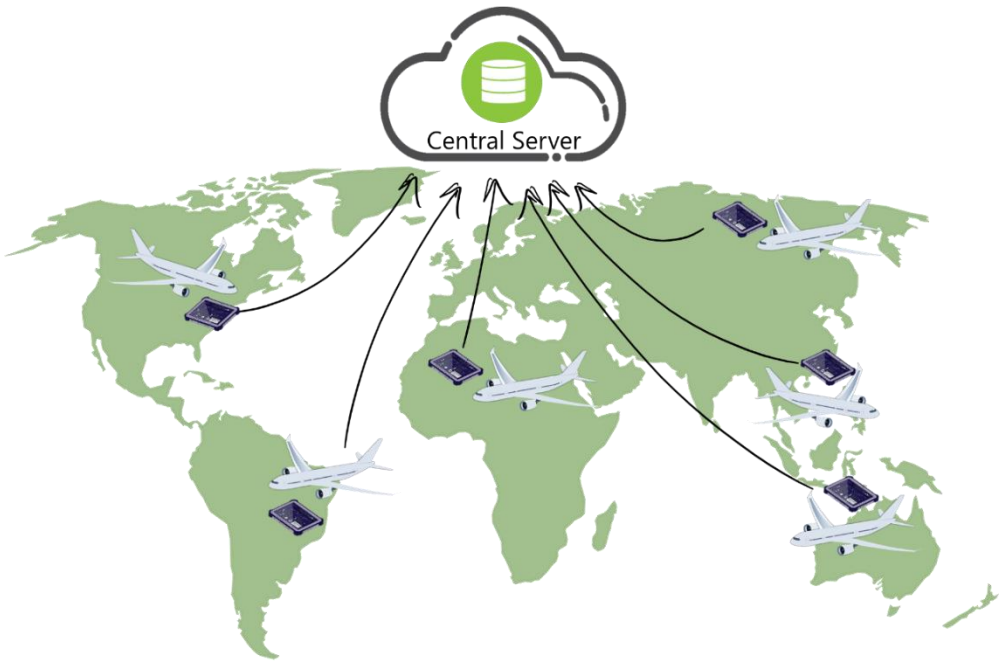
Create a "Terms of Reference" for the project that clearly specifies what to look for in a potential solution. Typically, the qualities to look for are:

Quality	Requirement
Look for a solution that can be integrated. Opt for a solution with clear accountability	It is essential to ensure the selected ELB/eTL can be integrated with other systems of your airline's operations. This means keeping in mind the big picture of interdependencies and connectivity capabilities of MIS/ERP and other applications. Make sure the components of your solution are compatible. Don't get your centralized control server hosting independent of the ELB/eTL solution provider. Demand a holistic solution from a supplier who is willing and demonstrably able to contractually manage, maintain, and warrant ELB/eTL solutions.

Should be fully able to operate for multiple sectors offline when necessary.	Remember that a digital or paper copy of the certified TLP must be left on the ground prior to every flight. Ensure that even without an internet connection available this requirement can be met to allow the aircraft to depart unimpeded by the ELB/eTL or the availability of an internet connection. Don't select a solution that relies on an internet connection for moment-to-moment use. In many parts of the world, the internet is still unreliable and may be turned off at a moment's notice for nefarious political reasons. In addition, commercial Internet Service Providers (ISP's) will occasionally go down for technical reasons or just because of human error. A UK national mobile data provider for 32 million customers failed for 24 hours during December 2018. This sort of event must be assumed will happen again. Any ELB/eTL solution that totally relied on that ISP would have had a serious problem,
	it is essential the ELB/eTL can operate normally without an internet connection if necessary for multiple days/sectors
	The ELB/eTL tablet should have a native ELB/eTL client installed that will operate normally with or without an internet connection. When a connection is available the ELB/eTL tablet should benignly transmit the queued sector data without interrupting the user experience or aircraft operation.
ELB/eTL software should be designed to be compatible with the hardware it is running on. Look for Tablet Touch Software that is Fat Finger Friendly. This will make the app fast and friendly to use.	For devices that are intended to be used in the cockpit and on board avoid tablet solutions that have not been designed for normal human finger touch use, or that have been designed for use on a laptop pc with a mouse and keyboard. For other devices, make sure it is user-friendly and goes well with the software. The software should have been designed and optimized for the tablet screen size and real estate that it is being used on. Good hardware solutions will work if the user is wearing gloves. It is a good consideration to **not** rely on a stylus. These go missing and can fail. The touch areas of the screen for each entry should be big enough so the user gets it right even if they miss a little with their finger placement.
Look for an easy-to-use solution that is suitable for	English is the worldwide accepted language for the airline industry. However, it is necessary to consider that most airlines are composed of staff where, for many, English is not their native language.

the required demographic of users.	The solution user interface should present an internationally instantly understandable graphical user interface. Clear crisp icons should immediately communicate what they mean to any ethnic audience with minimal need for specific language skills. The ELB/eTL app should be as simple to use as any standard phone app. Consider airline staff age ranges, language skills, eyesight, and mobile device use capability. Intuitive design is of great value. Instantly understandable icons and graphics are of huge benefit.
Demand fast immediate app response times. Carefully verify. The ELB/eTL should be demonstrably as fast or even faster than the paper logbook system.	The ELB/eTL will be heavily used during aircraft turnarounds. These are often very short – sometimes 30 mins or less. Modern low-cost carrier program for as little as 25 minutes for a turnaround. The ELB/eTL app should not slow down the sector turnaround process. App touch software response times should be expected to be relatively instant for each tap. The user should not be able to tap ahead of the app being able to respond. Avoid or score down solutions that have hourglasses or whirly gigs/loading spinners to tell the user to wait because it is doing something! Verify this carefully for the considered solution with current users in the field.
Require consistent use of color that follows internationally accepted cockpit instrument design principles and conventions.	There are internationally agreed conventions for cockpit instrument design. Part of this is the use of color where the use of red, green, and amber in accordance with the traffic light principle is standard. Insist on the solution following industry standard UI presentation. This will facilitate training and user adoption for the new ELB/eTL system. The ELB/eTL device should be easy to use in all lighting conditions (bright sunshine or darkness).
Configurable System	Good systems are by design easy to configure for an airline's needs. Try and avoid systems that require costly modifications for new aircraft models or reveal or hide every small tick box/button or entry field. Features should be easy to turn on and off. Devices in the field should automatically detect and implement the system configuration changes the next time they synchronize with the central server.
Workflow that is driven to force a correct sequence of operation and strong data validation.	One of the problems with the paper process is that you can fill the paper TLP form out in any order you please. It is not unknown for the crew to populate the landing fuel levels in advance of landing, as they know roughly what they will be, and it will speed up the process on arrival. An ELB/eTL should have a stubborn workflow-driven process by design.

By design aspire to substantially reduce data entry error.	Enforcing an intelligent workflow process also enables data validation to be carried out, so for example if you cannot enter the landing OOOI time before the takeoff time then it can be enforced that the landing is after the take-off and in addition to the calculated flight time is appropriate for the sector flown.
Ease of use for quick employee pickup and simple adoption	Selecting a simple system will impact user adoption which in turn will have a significant impact on training and user acceptance. Getting this right will contribute towards shortening the project timescale and minimizing cost.
The solution should include the provision of comprehensive Mobile Device Management (MDM) for the ELB/eTL devices. Including cloud control to monitor all hardware and data comms.	When the ELB/eTL devices are released into the field, it is usually very inconvenient to get them back again. They will live in the Cockpit and sometimes spend time in the Line Engineers office, but they will always be airside. An airline will need a stock of spare devices, which should be treated as LRU rotable parts. If a device fails, then it should be a simple process to swap out the defective unit and replace it with a serviceable one from LRU stock. This process should take a matter of a few minutes maximum and ideally will be accomplished by using the backup medium, e.g., simply swapping an SD card from the failed device to the new unit and booting it up. It is very easy to lose track of the serviceable and failed units in the field, particularly those used for training or system familiarization. For the above reasons, an airline or the ELB/eTL supplier must have a comprehensive MDM solution in place. It should be possible to track all the ELB/eTL devices, including when and where they were last online. The devices should be serial number controlled and have a robust part number/serial number label clearly affixed to the unit for anyone to read.
Software updates and Version Deployment.	It will be necessary to update the devices on the line and in the cockpit/cabin on a reasonably regular basis, roughly every 6 months is not unusual. This is required to allow new features to be designed and implemented as the ELB/eTL system evolves. It should not be necessary to visit the device to perform the update. Instead, the update should be discovered by the device when it is connected to the central server. It should be quietly downloaded in the background whilst the device is operating normally. At a sensible point, the update should be applied to the device, it should take seconds, not minutes and the user should barely notice. The version update status of all the devices in the field should be easily viewed on the MDM and central admin server.

	A good system will allow an update to be applied to the fleet and then the Administrators should be able to sit back and watch the update roll out across the fleet as the devices in the field talk to the central server and quietly download and install. A good system will come with a comprehensive ELB/eTL software version Numbering policy and a robust deployment mechanism that enables devices in the field to receive software updates in a benign manner and without interruption to aircraft operations.
Centralized application management for system configuration	One simple design for an ELB/eTL system is shown below:  In this model all the devices in the field communicate back to a central server, or to ground server and then to central server from where they are administered. This is often referred to as middleware, as the data from all the devices around the world is collated here and then transformed and communicated on to other airline systems as required. It is from this central middleware that new models and registrations can be setup, all transmissions can be monitored and all users on the system can be managed.
Centralized access to all sector data for system monitoring,	The central server could have a web portal so administrators in the airline can log in to see the status of all devices, including the last known locations along with all sector data and defects. Prior to TLP data being communicated to other airline systems, such as the MRO/CAMO or Operations system the data received from the ELB/eTL

auditing and TLP printing when required	devices should be automatically audited to ensure accuracy and identify any erroneous data that may have been entered by the pilots or eengineers. This is conventionally carried out by comparing the ELB/eTL data with data from another "Authoritative Source", such as ACARS, AFIRS, flight schedules, and sector city pairs along with known or expected flight timings. Depending on the architecture of the system, if the ELB/eTL data is within prescribed parameters, then it can be assumed as correct and immediately communicated to other systems as the "Single Source of Truth" for the aircraft OOOI/utilization data. If an anomaly is detected, for example, the flight time is way too long or too short, then the flight should be put into temporary stasis, and presented for manual audit, usually to MCC/Maintrol. At this early stage, any ELB/eTL error entered by the pilot, crew, or engineer can be quickly corrected before it is communicated to other systems.
Reporting and Data Exports	The ELB/eTL is collecting very valuable data. It should be a simple and secure process to extract the data to something like or machine-readable format, so the data can be used throughout the airline for analysis and standard reporting.
Airline back-office applications and MRO/CAMO system Integration.	It is estimated that 50% of the cost-benefit of an ELB/eTL system is derived from its ability to seamlessly integrate with other systems, including Maintenance, Operations, Fuel, and other management systems. It is therefore sensible to select an ELB/eTL solution that is agnostic and is designed to integrate freely with other systems. It is sensible to avoid an ELB/eTL that is tied by design to a specific MRO, CAMO, OEM, or other Operations system.
	It is good practice for System Integrations to be ATA SPEC 2000 Chapter 17 compliant.
	However, it should be kept in mind that not all desired data might be included in the spec.
Should not be aircraft OEM-specific. Should be able to be used across a mixed fleet and for multiple AOC/Operators.	Airline fleets are for good reason generally composed of models from more than one OEM. Even a long-haul carrier that only flies distant routes and could easily get away with one type, will usually opt to compose the fleet with models from at least two OEMs. This is in effect an insurance policy against the failure or grounding of a type, but it is also a bargaining chip to be played when ordering replacement aircraft from competing aircraft OEMs. Hence contracting an ELB/eTL solution from an OEM is a risky strategy, of course, the OEM will say their solution will work for all the competitor aircraft types, but pragmatically this should be taken with a large dose of salt.

	Bear in mind the long-term requirement for the ELB/eTL system and how difficult it will be to replace or adjust if the fleet mix changes, it is not sensible to end up with multiple ELB/eTL solutions in the same airline.
Easy auditable handling of corrections both on the client and in the back end	Once the system is in operation then there will be a vast number of transactions. An average short-haul aircraft (B737/A32X) will communicate up to 10 transactions per sector, so a busy aircraft will transmit 50+ times per day, including the OOOI/Sector data, plus the refuel data along with any defect recording and rectification along with the all-important flight acceptance signature for the next sector. **We are all human and mistakes will happen.** It is quick and easy to fix a mistake on a paper logbook, so should be the case for the selected ELB/eTL. The process should in theory mimic the paper correction process where an error is scored out, certified, or signed for and the amended data is clearly recorded in its place. A full audit trail for the correction should be available on both the ELB/eTL device and on the central "Middleware" server. If, however, a mistake is not identified on the current TLP, then by convention it should not be corrected on the ELB/eTL device for a previous sector, any more than it would be acceptable to amend a historic paper tech log page in the paper book. Instead, it should be a simple process to correct the data on the central middleware server, this corrected data can then be communicated back to the ELB/eTL device. Ideally, the incorrect data should be identified and corrected before it is sent on from the central middleware to the other MRO/CAMO and Ops systems, but if this does not happen then robust procedures need to be in place to communicate any data corrections to all other systems that have already received it.
Data Retention and ability to change ELB/eTL Suppliers.	There are legal requirements concerning how long ELB/eTL records must be kept before they can be destroyed. In addition, if the airline wishes to change their ELB/eTL system supplier then the previous system ELB/eTL data will need to be kept available to maintain the records history for the fleet. This may be in the form of a complete data export from the old system or by keeping access to the old records in the old system in a read-only archive-type format. When selecting an ELB/eTL supplier ensure these points are contractually arranged in an agreement.

SECTION 5 – ELB/ETL SYSTEM IMPLEMENTATION

During supplier/solution selection, a project plan should be contractually agreed.

Currently, an ELB/eTL is governed by the same FAA and EASA regulations as an EFB. The ELB/eTL is considered in the regulations as a constituent part of the aircraft EFB system, this is another result of the legacy from when the aircraft OEMs got involved.

Point	Consideration
Risk Assessment	A Risk Assessment should be created at the outset and be part of the cost-benefit analysis prior to system selection. The CAA will want to see that this is a working document that is being continually updated as new risks are identified and mitigated during the project process.
Project Plan	During ELB/eTL system selection a proposed Project Plan should be requested from the ELB/eTL Supplier. At this stage, it will be very high level but should contain all the necessary steps, from contract signature through training, trials, and estimated CAA Approval date. For a small single fleet, and by using the advice in this document, it is now possible to complete an ELB/eTL implementation within 6 months.
Training Plan	During ELB/eTL system selection a proposed Training Plan should be requested from the ELB/eTL supplier. This plan can be very high level, but it should include a syllabus that describes the necessary courses that will need to be created and completed during ELB/eTL implementation. The Training Plan should cover training for engineers, pilots, cabin crew, MCC/OCC, technical records, and system administrators. Generally, the largest element of the Training will be CBT carried out online by all affected staff. The pilot, engineer, MCC, OCC, and technical records training CBT is usually the same course, to give all users a broad understanding of the system. A good practice is to nominate an administrator (and deputy) from each affected department. The Administrators should understand the process and be able to create new aircraft models and registrations across the fleet. They should also be able to manage employees for authorized signatures on the ELB/eTL as well as manage user access to the website that controls the system and allows all TLP data to be viewed in read-only mode by all users.

Airline operations and engineering procedure changes.	It should be recognized that the paper system procedures for pilots and engineers are not entirely being eliminated. The paper system will always be the ultimate backup system to be invoked in the case of total ELB/eTL system failure. New procedures need to be created for completing Ops and engineering processes via the ELB/eTL. Both the old paper procedures and the new ELB/eTL procedures will be legally available to be used at any time. One important new procedure that will be required is the process that occurs when swapping between the Paper Process and the ELB/eTL for an aircraft registration. This is often referred to as the "Revert to Paper" Procedure, and it should also contain the process that is followed to switch back to ELB/eTL.
Implementation in accordance with (IAW) EASA AMC 20-25 [6] or FAA AC 120-76D [7] ED Decision 2019/008/R [8] Consider Future regulations that are being developed.	Even though Portable Electronic Devices (PED's) are now ubiquitous in the Cockpit, there are currently no dedicated guidelines on how to approve an ELB/eTL solution. For example, in EASA AMC 20-25, ELB/eTL's are classified as part of the EFB application, making the ELB/eTL just one of the functional options that can be installed on a PED in the cockpit. To be approved for operational use ELB/eTL's undergo the same approval process as EFB's with operational assessment or airworthiness approval depending on the application type. ELB/ETL's are usually put into the Type B application group. The ELB/eTL solution and procedures approval requires both OPS and CAMO/Part145 CAA Inspectors to assess and approve the ELB/eTL system. The lack of extensive and comprehensive guidelines has been recognized by EASA when talking about ELB/eTL's. An EASA Notice of Proposed Amendment (NPA 2016-12) has been created and adopted (via Opinion 20/2017) to improve the clarification with regards to EFB and ELB/eTL system approval. Crucially there is now clearer guidance on the Electronic Signature requirements. The objective of the NPA was amongst others, to review AMC 20-25 based on experience gained so far by competent authorities and solution providers to enable simpler certification for EFB and ELB/eTL systems. The fiercest ELB/eTL-related discussions have been around Electronic Signatures, Data Protection and Back-up Solutions.

	The new NPA proposes that in the future, EFB/ELB/eTL software applications may be approved by EASA by means of a European Technical Standard Order (ETSO) Authorization. It is expected that ELB/eTL solution providers will seek to get ETSO authorized, where applicable, which will simplify the approval process for airlines choosing ELB/eTL solutions.
Ensure careful project phasing. Stick to the plan and avoid moving goalposts.	Always keep it simple. Be very careful to avoid project "Specification Creep" - doing extra functionalities, going out of budget, and timelines. Control the initial scope of the project. One small change may lead to multiple other changes, ruining the project. Whenever a contentious issue is identified in the ELB/eTL process always ask the question "How do we do this on paper?". The project manager should always invoke their authority to override adventurous system changes. Once the ELB/eTL is live and in approved use there will be plenty of time to introduce new features that leverage the functioning ELB/eTL and enable the airline to go truly digital, but do it step by baby step.

SECTION 6 – THINK ABOUT THE FUTURE

The selected and hopefully successfully implemented ELB/eTL will be a long-term commitment for both the supplier and the airline.

The solution will need to be monitored and maintained 24/7/365.

Some important points to consider are:

<table>
<tr><th>Point</th><th>Consideration</th></tr>
<tr><td>Long-term device hardware and operating system support will be required.</td><td>If a Class 1 (portable) device is selected, then it needs to be recognized that the device be used by many people both above and below the wing, so will be exposed to various climate conditions.
If a decision is made to select devices with increased durability consideration should be given to IP65-rated devices, then this implies a Windows OS. Below is a quick guide to relevant IPs of which ratings are shown below:
<table>
<tr><th>IP Rating [9]</th><th>Protection against (all include “dust tight”)</th></tr>
<tr><td>65</td><td>Nozzle projected water.</td></tr>
<tr><td>66</td><td>Heavy seas or powerful jets of water.</td></tr>
<tr><td>67</td><td>Quick immersion in water.</td></tr>
<tr><td>68</td><td>Complete continuous submersion in water</td></tr>
</table>
The operating system also needs to be supplied with a guaranteed life and support package. As with any other avionics system, it is standard that software updates will be applied, and this is also relevant for the device operating system.</td></tr>
<tr><td>Long-term ELB/eTL software application support will be required.</td><td>The airline should be aware that the ELB/eTL software is separate from the device hardware and operating system. It is possible that the ELB/eTL software may be available from a supplier for a range of operating systems or devices.
In the long term, for example, in 5 or 10 years, new device hardware and operating systems will become available.

It is good sense to select an ELB/eTL software provider that can demonstrate an active R&D process that embraces the philosophy of “Continuous Improvement”.
Systems within the airline will also change. The airline MRO/CAMO/Ops systems may be updated or replaced, ensure your ELB/eTL provider is, if possible, MRO/CAMO/Ops system agnostic and can demonstrate a wide range of integration with all airline's back-office</td></tr>
</table>

	systems and will be able to adapt the ELB/eTL solution as the world evolves during the lifetime of the system.
24/7/365 mission-critical telephone, email, and remote device access support required.	As a mission-critical system, the ELB/eTL users will need robust rapid support that is instantly available 24/7/365 for all pilots, engineers, and MCC/OCC. Look for a provider that understands MCC/OCC and the time-critical nature of their work. The ELB/eTL provider should be keen to establish a good relationship with MCC/OCC and there should be trust and respect between the parties. A good ELB/eTL provider will offer this as standard. Ensure this is not just a phone number to an outsourced call center, but a direct connection to technically informed ELB/eTL Supplier support staff, who have access to the MDM solution and the middleware to check all transactions and any error messages. A good ELB/eTL provider will have the ability for their support staff to remote control the ELB/eTL devices in the cockpit and take over the device to investigate and resolve any issues.
Future software development and updates – the system must stay at the latest technology levels and contractually avoid obsolescence	As technology improvements become available the ELB/eTL provider should be able to quickly offer them as benefits, for example with regards to hardware and comms the supplier should already be considering the implications of 5G.
Plan to move from Electronic to Digital	It is a good practice to start the digitalization with M&E system. When it comes to ELB/eTL system the first task is to get rid of the paper and it should be kept as simple a process as possible with the minimum of "bells and whistles". When the ELB/eTL is approved and in use the airline can start to consider going from electronic to digital. For example, integration with aircraft systems to record fuel and oil levels from the aircraft bus or reading the OOOI times directly from the flight computers. At this stage, all paper documents around the aircraft operations should be targeted for replacement, and the functions built into the ELB/eTL system. For example, filing a "MOR" or a "Bird strike" report should be done from the ELB/eTL device and electronically transmitted on to the required back-office systems.

Companion Applications and devices	At some stage, the ELB/eTL system may become server-based on the aircraft and eventually even cloud-based. Companion applications should already be being developed or available for tasks such as opening and closing defects, cabin logs or even fuel uplift integration with the ground fuel suppliers. These companion applications and devices will often be apps on phones or other tablets. They are not "mission critical" as the relevant functions can always be carried out on the ELB/eTL, but they will improve efficiency and productivity if intelligently introduced.
Lessor's perspective	If the solution is implemented on a fleet that is leased, a few contingencies must be considered. It is likely that the lessor requires the option for the lessee to remove the system at the lease end, as the next operator (lessee) may want to replace the previously used ELB/eTL system with their own system. In the case where an STC is issued for a minor change that authorizes installation (and de-installation) of the system, such STC should be EASA or FAA-approved (following the type certificate compliance of the aircraft). It is also important that the ELB/eTL application should be capable of generating outputs that are readable without a specific proprietary program or reader. As an example, one output format should be close to a paper format (e.g., PDF), another format that enables a subsequent operator to load the fault history into their system (e.g., XLS, CSV, XML).

CONCLUSION

The main conclusion is very simple – the time is right, so get on with it!

The transition to digital ELB/eTL for the aviation industry is inevitable. Good solutions are out there and being benefited from by knowledgeable and experienced airlines. The rest of the world looks at the aviation community with respect but is confused as to why airlines are moving slowly with respect to aircraft logbooks.

As an industry, we should try to change that.

We hope this document helps.

GLOSSARY

TERM	MEANING
ACARS	Aircraft Communication, Addressing and Reporting System
AFIRS	Automated Flight Information Reporting Systems
ACMI	Aircraft, Crew, Maintenance, and Insurance
AID	Access Identifier
AMM	Aircraft Maintenance Manual, a document that details all maintenance procedures for an aircraft
ARINC	Aeronautical Radio, Inc.
CAA	Civil Aviation Administration
CAMO	Continuing Airworthiness Management Organization
CBT	Computer Based Training
CRS	Certificate of Release to Service
EASA	European Union Aviation Safety Agency
EFB	Electronic Flight Bag. Tablet or laptop that carries flight manuals, performance data, and other information required to support flight crews in pre-flight preparation and inflight
EMM	Engine Maintenance Manual, a document that defines all maintenance requirements for an aircraft engine
ERP	Enterprise Resource System
ETSO	European Technical Standard Order
FAA	Federal Aviation Administration
FAR	Federal Air Regulations. The Regulations that govern air operations under the jurisdiction of the United States of America

TERM	MEANING
GDPR	General Data Protection Regulation, is a European Union regulation on information privacy in the European Union and the European Economic Area.
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization. International organization with responsibility for the development and publication of international air operation Standards and Recommended Practices
IPC	Illustration Parts Catalogue
LLC	Low-Cost Carrier
LLP	Life Limited Parts, aircraft parts that have defined time limits for operational use, at the end of the life cycle must be replaced with new or refurbished parts.
LRU	Line Replaceable Unit
MCC	Maintenance Control Centre
MEL	Minimum Equipment List
MIS	Maintenance Information System
MDM	Mobile Device management
MOC	Maintenance Operations Centre
MOR	Mandatory Occurrence Reporting
MPD	Maintenance Planning Document, a document that details aircraft maintenance planning procedures and requirements
MRO	Maintenance Repair and Overhaul functions related to aircraft repair and servicing.
M&E	Maintenance and Engineering
NSF	Network-Specific Facilities

TERM	MEANING
OCC	Operations Control Center. Centralize command and control facility for management of overall airline operations for the transition from schedule Planning, day of operations, and near-term future planning. Sometimes called Global Operations Center – GOCC or System Operations Control Center – SOCC
OEM	Original Equipment Manufacturer
OOOI	A method for determining the "Out," "Off,". "On," and "In" (OOOI) times for an aircraft, based on parametric data sampled in the aircraft. "Out" means out of the gate, "Off" means off the ground, "On" means on the ground, and "In" means in at the gate
PED	Portable Electronic Device
ROI	Return On Investment
SaaS	Software as a service. A method of software delivery and licensing in which software is accessed online via a subscription, rather than bought and installed on individual computers.
STC	Supplemental Type Certificate
TLP	Technical Log Page
TSM	Trouble Shooting Manual

BIBLIOGRAPHY

[1] EASA, "Acceptable Means of Compliance," 2022. https://www.easa.europa.eu/en/downloads/21091/en

[2] FAA, "AC 120-78A - Electronic Signatures, Electronic Recordkeeping, and Electronic Manuals," 2016. Available: https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_120-78A.pdf

[3] "Advisory Circular Subject: Use of Portable Electronic Devices Aboard Aircraft," 2017. Available: https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_91.21-1D.pdf

[4] RTCA, "DO-160," 2010. https://do160.org/

[5] Intersoft Consulting, "General Data Protection Regulation (GDPR)," *General Data Protection Regulation (GDPR)*, 2018. https://gdpr-info.eu/

[6] "Easy Access Rules for Acceptable Means of Compliance for Airworthiness of Products, Parts and Appliances (AMC-20) - Initial issue & Amendments 1 - 21," *EASA*, Jun. 23, 2023. https://www.easa.europa.eu/en/document-library/easy-access-rules/online-publications/easy-access-rules-acceptable-means-0?page=19

[7] "AC 120-76D - Authorization for Use of Electronic Flight Bags," *Faa.gov*, 2017. https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentid/1032166

[8] "ED Decision 2019/008/R - Transposition of Provisions on Electronic Flight Bags from ICAO Annex 6." EASA, 27 Feb. 2019, www.easa.europa.eu/en/document-library/agency-decisions/ed-decision-2019008r

[9] IEC, "IP ratings | IEC," *www.iec.ch*. https://www.iec.ch/ip-ratings

ACKNOWLEDGMENTS

This document has been developed by the industry subject matter experts within the IATA Digital Aircraft Operations Initiative.

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