EFB technologies & solutions continue to develop. One major development is that Class 1 systems are beginning to be approved for use in all phases of flight. Industry regulators are planning changes to classifications which airlines will need to consider when selecting a system.

The latest developments in EFBs & selection of the right solution

There have been significant advances in Electronic Flight Bag (EFB) technology and functionalities in recent years. The European Aviation Safety Agency (EASA) has suggested that these changes have been driven by commercial and technological developments taking place outside the aviation industry.

The rapid evolution of tablet devices such as the Apple iPad and Samsung Galaxy Tab has had a considerable impact on the EFB solutions available to airlines. The speed of technical advances means that the EFB landscape is constantly changing. EFBs are becoming more sophisticated and have gone from simply storing and displaying manuals to hosting applications that can be used for performance calculations. This article will identify the benefits that EFBs can bring to airlines, along with some of the key issues to consider before selecting the appropriate EFB solution. It will also summarise current EFB hardware and software classifications and identify future developments in this area.

What is an EFB?

The Federal Aviation Administration (FAA) defines EFBs as "an electronic display system intended primarily for flightdeck use that includes the hardware and software necessary to support an intended function".

These functions include: displaying data, such as charts or manuals; and performing calculations, such as those related to take-off and fuel reconciliation. Some of these functions would previously have been carried out using paper references. According to the FAA, "physical EFB displays may use various technologies, formats and forms of communication. An EFB must be able to host Type A and/or Type B software applications."

Hardware

EFB hardware has generally been classified into three different types.

Class 1 EFBs are not fixed or mounted to an aircraft, have no data connectivity with the aircraft, and can only be temporarily connected to an aircraft power source for battery charging purposes. They can be consumer-off-the-shelf (COTS) -based portable electronic devices (PEDs). This includes commercial tablet devices, such as those produced by Apple or Samsung, along with any number of laptop computers.

Initially they were not permitted for use during critical phases of flight. Recently there have been developments in this area involving various methods of securing Class 1 devices that in some instances has led to approval for operation at all times. Class 1 solutions can host Type A and/or Type B software and do not require airworthiness approval.

Class 2 hardware devices are attached to a mounting on the aircraft flightdeck. They can also be COTS devices, are normally portable and do not require any tools to remove them from the cockpit. Class 2 EFBs can be used in all phases of flight. Data connection with the aircraft is permitted for the purpose of receiving data from aircraft systems through a certified interface. According to the FAA, data upload from the EFB to aircraft systems is only authorised if the Aircraft Interface Device (AID) has been certified for such operations. Airworthiness approval is required for the EFB mounting. Type A and/or B software can run on Class 2 systems.

Class 3 EFBs are installed avionics equipment that require airworthiness approval. These systems are capable of hosting Type A, B and C software applications. Data download from aircraft systems is possible for Type A and B software. Two-way data exchange is permitted for Type C applications.

Software

Three types of EFB software have previously been identified.

The FAA and EASA define Type A software as pre-composed, essentially non-interactive presentations of data previously presented in a paper format, and generally used in non-critical phases of flight.

Examples of Type A software include browsers displaying information, such as the air operator certificate (AOC), maintenance manuals, aircraft parts manuals and service bulletins (SBs) and airworthiness directives (ADs).

Type B applications are defined by the

American Airlines is one of the first airline to have an iPad-based Class I solution to be approved for use in all phases of flight. The system is used on its 777 fleet.

FAA and EASA as dynamic and interactive, and capable of manipulating data for operational requirements. This software may therefore be used during the critical phases of flight, providing that it has undergone the appropriate testing.

Typical examples of Type B applications include the aircraft flight manual, flight operations manuals, electronic technical log (ETL), meteorological information and electronic aeronautical chart applications. Performance calculation tools are also classified as Type B software. They may be used for functions such as take-off, approach and landing, power setting and weight and balance calculations.

Type A and Type B applications do not require airworthiness approval.

Type C applications are essentially approved avionics software. Their main functions relate to communications, navigation and surveillance. Examples include an airport moving map display (AMMD) showing own ship position, and applications that support controller pilot data link communications (CPDLC). According to EASA's proposed classification, they also include any application that can be used to check, control or deduce the aircraft's position or trajectory.

Benefits of EFB solutions

The first key benefit normally associated with implementing an EFB system is the removal of paper from the aircraft. Replacing paper manuals and charts with a portable tablet device can reduce weight on the aircraft and subsequently decrease fuel burn.

In addition, replacing paper with integrated digital systems throughout an airline's operations, cabin and maintenance processes can improve efficiency and cut costs. "The aircraft flightdeck is the last frontier of business integration," says Ralf Cabos, managing director at Flight Focus. "With EFBs airlines are finally able to bring the cockpit into their IT workflows for the whole organisation." It is worth noting that to achieve a fully paperless cockpit the airline will need to implement a solution that permits an EFB to be used in all phases of flight. Communications for the EFB will also have to be addressed appropriately.

Other benefits relate to more precise performance calculations. "Before EFBs, pilots carried out performance calculations, such as those required to establish take-off thrust, on a manual basis using paper charts and tables," explains Pierre-Yvan Pecunia, TopWings marketing director at Thales Avionics. "The figures in these charts and tables are generally rounded and on the conservative side. EFB software provides more optimised calculations based on real- time parameters." This might allow pilots to use lower power settings for take-off, and subsequently result in reduced engine maintenance.

In terms of maintenance, the electronic technical log (ETL) on an EFB can result in several significant benefits. Pilots are required to write down perceived aircraft technical issues on paper tech logs. "The pilot tears off a copy of the tech issue he has written up and hands this to a maintenance representative," explains David Abbott, vice president of business development at Ultramain. "This is then given to a data clerk, who will try to match the fault with a code in the fault reporting manual, and then enter the code into the maintenance and engineering (M&E) IT system. The problem with this manual process is the potential for human error. Illegible handwriting may cause the wrong issue to be entered in the system."

An ETL can reduce the possibility of human error by allowing the pilot to select the fault from a number of options on a menu as it occurs. This can then be transmitted to the ground so that the maintenance department can potentially have the required parts available when the aircraft reaches the gate. The obvious benefit of this is that it minimises the potential for costly delays.

EFBs also have advantages in the passenger cabin. Not only can they remove paperwork, but they can also provide a loyalty function. Using reservation information stored on a portable EFB, cabin crew can identify the history of an individual passenger and therefore their service requirements and preferences.

EFB vendors

The market for EFB hardware has been drastically influenced by recent developments in consumer tablet technology. Products from the likes of Apple and Samsung are now genuine options for airlines considering an EFB solution.

Other suppliers provide tailored hardware and certification solutions, including navAero, Goodrich, Esterline CMC and Astronautics. Boeing and Airbus also have their own solutions available. There are also a growing number of companies that offer services for EFB mountings and certification.

The EFB software market is also growing in size. There are a significant number of suppliers emerging who specialise in one or two applications. Some functions, especially electronic charting, have a limited number of providers, the main ones being Jeppesen, Lufthansa Systems and Navtech.

Ultramain, Flightman, International Flight Support (IFS), Skypaq and Osys are among the suppliers of ETL software.

Developments in tablet technology have increased airlines' options for EFB solutions.

"Our efbTechLogs software allows a pilot to transmit fault codes instantaneously from the aircraft to ground-based M&E systems," explains Abbott. "The Ultramain software provides sophisticated defect identification support to help pilots identify the correct fault codes. We provide a complete paperless techlog process from start to finish, including back office maintenance functions. This can save costs and time, with replacement parts waiting for the aircraft when it arrives at its destination. Using the old paper system, it could take up to 36 hours for a fault code to be entered into an M&E system," adds Abbott.

Some vendors provide a wide range of software modules on integrated platforms, including Aviovision, Flightman, FlightFocus, International Flight Support, Osys and Sabre Airlines Solutions.

Aviovision's Aviobook platform provides a modular software structure that allows an airline to create a customised EFB solution. It can be used for on-line and off-line functions on desktops, laptops, tablets, iPads or cockpit-installed units. Available software modules include: the Aviobook base; tools; operational flight plan (OFP); briefing; weight and balance; Charts; Perfo (aircraft performance function); reports; library; electronic check list (ECL); and globe, a graphical flight information application. The Chart and Perfo modules are provided by third-party suppliers.

Flightman provides its Flightman™ application suite, an integrated set of EFB applications that can be run on any hardware class and allows the exchange of data with airlines' back-office systems. Flightman believes its array of software products offers a complete EFB solution spanning flight operations, engineering and cabin processes. Software modules include the electronic journey log, electronic flight folder, eTechlog, fuel performance, weight and balance and performance calculations. Also available are the large content manager, forms designer, cabin surveillance, passenger relationship management, and ground administrative manager. The latter allows the centralised management of the system, and can provide business intelligence from the data flowing off the EFBs.

IFS provides its Paperless Flight Bag (PFB) EFB software product for Class 1 and Class 2 devices. The PFB solution can be delivered for Type A and B software for Class 1 units. For Class 2 devices Type A, B and C software solutions can be delivered. "Type C software solutions connect to the aircraft's Flight Management System (FMS) and ARINC 429 data bus for the automatic import of live flight data," explains Jens Pisarski, chief operating officer & vice president of sales and marketing at IFS.

The PFB platform is available for iPad and Windows 7- & 8-based devices. Both solutions offer fully integrated software modules, including: a document management and library function; take-off performance data calculations (on-line or off-line based); landing performance data calculations (off-line based); weight and balance with electronic sign-off; and electronic flight planning with integration to third-party flight planning providers. Other modules include a voyage/journey log reporting function, a techlog option and an electronic flight reporting system. There is also the capability to include applications from third-party providers, such as those for charts and maps.

"Too many airlines are shopping for individual applications rather than considering their EFB software platform strategy as a whole," says Jens Pisarski. "The advantage of having a fully interfaced software platform such as ours is that the hosted applications can communicate with each other in a seamless workflow. Many pieces of data will be automatically populated in the appropriate software modules. For example, data from the flight planning module will feed into the weight and balance application. This will automatically feed the performance calculation module. Even the report templates will self-populate. Where you have a non-integrated system based on many individual applications they may not necessarily be able to communicate with each other. The user may have to jump between four or five different applications and keep entering data in different modules manually. Such individual EFB applications are not typically able to store the calculated data on a back-office server. Even if some do, the problem is that the data are typically spread out across a number of systems which is not ideal for any operator," adds Pisarski. "The most important part of any EFB software platform is that the software installed on the EFB units has a strong and powerful back-office engine with device management capabilities and the ability to store all imported and exported data and all flight data uploaded from the aircraft's cockpit."

Flight Focus provides all components needed to establish a complete, vertically integrated EFB solution. Among its products are: Class 2 and 3 hardware; a hardware/software product connectivity platform for Class 1 hardware; a software platform; design approvals for window mountings; EFB, IFE and combination servers; and a satellite transceiver. The software and hardware platforms support tablet-based devices operating under iOS, Android or Windows along with other Class 2 and 3 hardware. The software modules include flight data management, aircraft performance, weight and balance, flight planning, crew communications, central

A fully integrated Class 3 EFB system is the most sophisticated in terms of software functionality.

dispatch and flight following. The latter is a real-time situational awareness tool.

"We are trying to standardise our hosting platform to meet emerging EFB software interface standards," says Ralf Cabos, managing director at Flight Focus PTE Ltd. "We believe that airlines should be able to easily switch application providers. We usually provide our hardware/software platform completely open, so that the customer can add any third-party application they want."

Until recently there were no standardised software interfaces for EFB systems. This can cause problems when trying to integrate applications from multiple vendors. In November 2012 ARINC specification 840-2 was published to define interface protocols used by EFB software applications.

Flight Focus has adopted a unique approach to selling its integrated EFB solution. "We basically provide the option to outsource the implementation and operation of an EFB solution, whether it is a Class 1, 2 or 3," says Cabos. "The customer signs a contract for a certain period of time, and we supply and manage the implementation of the required hardware and software. There is no upfront charge, and the customer pays a monthly fee instead. We provide approvals, a hardware and software platform, take care of integration, allow customer-managed applications but guarantee lifecycle costs." This includes issues such as hardware component obsolescence, where hardware is upgraded in line with advances in technology. Flight Focus also manages the subsequent amendment of approvals. The launch customer of this service was Air Asia.

Another service provider in the EFB implementation market is Thales. The company does not currently produce its own EFB hardware or software, however. "Through our TopWings offering we act as an integrator," explains Pecunia. "We can work with hardware and software suppliers to manage the implementation of an airline's chosen EFB solution. We provide programme management; design and training; operational approval; and installation support," adds Pecunia.

Methods of communication between EFBs and back office systems also need to be considered. "This is a key issue for which there is no straightforward answer today," explains Pecunia. "There is no means of ensuring 100% communication reliability. Currently airlines can use 3G and Wi-fi connections when on the ground. The former can incur high roaming charges, however, and the latter requires installation of an antenna. SATCOM is an option when in flight, but can be expensive, while ACARS is limited in the amount of data it can transmit. Some operators use USBs to upload data to an EFB before a flight and download data on landing before saving it on the USB and transferring to office-based systems. At Thales we recommend a combination of communication functions with USBs used for backup purposes," adds Pecunia.

Goals of implementation

One thing that all providers agree on is that an airline must decide what they want to achieve from implementing an EFB solution before they start thinking about which hardware or software solution they require. "Hardware and software is only the tip of the iceberg," explains Pecunia. "There is much more required for an efficient EFB programme."

"A typical EFB project comprises 25% hardware, 25% software and 50% internal procedure and policy considerations," says Pisarski.

Airlines have to decide what business processes they want to improve. "For most airlines the first stage of implementing an EFB solution involves replacing paper with electronic solutions," explains an FAA spokesperson. "The next stage is data integration." The key areas of the business for which these changes must be considered are operations, cabin processes and maintenance.

As far as EFB solutions are concerned there is no one right answer. "navAero has more than 40 airlines in its portfolio, and we cannot recall a single one that has built its business plan on the same reason as another," says Simone Giordano, executive vice president at the navAero Group. "The structure of each airline varies so much that it is almost impossible to identify a single common business approach to justify EFB implementation."

Costs & other considerations

The cost of different solutions can vary considerably. Generally, the more capable the system, the more expensive the hardware. The development of COTS devices, such as iPads and other tablets, has brought hardware costs down. For a basic Class 1 solution this may only be $500 per device. The hardware costs of a Class 2 solution have been estimated at $10,000-40,000. Most of this relates to the Supplementary Type Certificate (STC) required for the EFB mounting device. Fully integrated Class 3 systems are by far the most expensive with hardware estimated to cost $100,000-200,000.

In terms of testing, the portable devices used in Class 1 and 2 solutions do not themselves require airworthiness approval. They must, however, be capable of demonstrating non-interference with other aircraft systems, comply with battery safety criteria and environmental criteria in the form of decompression testing.

Class 2 solutions should be validated to ensure non-interference and isolation from certified aircraft systems in terms of

their data connectivity. Class 2 devices also require airworthiness approval for their mounting devices.

Class 3 integrated systems require full airworthiness approval. Type A and B software does not need airworthiness approval, but it does require operational approval. Type C software requires both airworthiness and operational approvals.

EASA has identified how EFBs "are now providing applications that are likely to substitute some functions that were traditionally residing on the avionics side of the aircraft". Certification issues may be one reason that airlines are beginning to use applications on portable EFB devices.

The pace of development in tablet performance means that they are becoming consistently more capable. Airlines can upgrade their COTS devices with improved versions every few years at relatively little cost. "Integrated avionics systems are not as easy to upgrade with higher costs and the re-certification issue to contend with," says Knut Aabo, commercial director at Aviovision.

Some suppliers recommend a graded introduction to an EFB solution. "We generally recommend taking a three-step approach to implementation," says Aabo. "First, the operator needs to set up or adapt the required infrastructure to manage its EFB capabilities. The next step is to migrate the reports and manual functions from paper to the EFB. When they have gained this capability they can then move on to more interactive applications such as flight planning."

"The ultimate aim in most EFB projects is to achieve a fully paperless cockpit, including e-route manuals," says Pisarski. "This currently requires a Class 2B solution (Class 2 hardware with Type A+B software), but this is not easily achieved in one step. Our experience shows that the test phase might be twice as long for a complete PFB solution as for a Class 1B solution. This has the same software modules as the 2B configuration, minus the e-route manual. We often recommend starting with a class 1B solution which, depending on the number of software modules to which an airline subscribes, may only take six to eight months to implement. A Class 2 solution, including an electronic chart application, may take 12-14 months. After six months of operating a Class 1B solution the airline could upgrade to a more capable Class 2B. This approach makes it possible to spread investments in the EFB and EFB hardware mounting over a longer period of time," adds Pisarski.

By starting with a less complex solution and demonstrating to the local aviation authorities their ability to carry out safe operations, an airline may also be able to save time on future operational approvals for implementing a more advanced EFB capability.

"Any operator that wants to replace paper on the aircraft with an EFB solution has to undergo a six-month validation process," explains an FAA spokesperson referring to requirements in the US. "This usually allows them to iron out any kinks in their processes. It is certainly easier for an operator that has used EFBs in the past to potentially avoid a further six-month approval process when upgrading its solution."

Training is also an important consideration, because all flightcrew and other airline personnel that will be using EFBs will need an appropriate introduction to the hardware and software. Starting with a less complex solution before later migrating to additional capabilities can have the added benefit of allowing users to familiarise themselves with systems on a more manageable number of software modules.

Class 1 capabilities

Continued advances in COTS-based technology such as tablets have led to confusion about EFB class classifications. In December 2011 American Airlines became the first carrier to receive

Consumer tablet devices are now available as platforms for EFB solutions, and can be acquired for as little as $500 per device.

approval from the FAA to use an iPad-based Class 1 solution in all phases of flight on its 777 fleet. This includes flight manual and terminal chart functions.

EASA and The FAA have moved away from their initial classification that Class 1 devices had to be stowed during critical phases of flight. They are now starting to permit the use of such devices in all phases, provided that they are properly secured and viewable, but not mounted in the Class 2 sense. Secure Class 1 devices do not need an STC, but they still do not have any data connectivity to the aircraft. American Airline's securing system is based on a Velcro solution.

"The most important feature for the future of EFBs could be competition for traditional Class 2 hardware installations from Class 1 devices adopting securing methods that might potentially lead to approval in all phases of flight," says Pisarski. "Several operators in the UK and Switzerland already have such approval for Class 1B systems. These are based on securing the hardware to the pilot's knee. Meanwhile in Europe we will shortly see the first suction-cup-based Class 1B applications, which might also achieve approval for use in all phases of flight."

To further add to the confusion, there are inconsistencies in the testing requirements and approvals granted by different national aviation authorities. This can mean that a certain hardware/software combination may receive operational approval in one country, but not in another. "There are countries in Europe, such as Romania, that will not even process EFB implementation," says Pisarski. "There are differences in testing requirements from country to country, even within the EASA-regulated area. A good example of this are the battery and decompression test requirements of the hardware units. In the Netherlands, for example, the national CAA accepts US documentation for the battery and decompression requirements, and testing of individual hardware units is not required. In other countries the national aviation authorities require that each unit is decompression-tested and test-labelled individually, which obviously adds costs to the EFB project."

Future developments

"Previous attempts to easily categorise different EFB solutions for the benefit of aviation authorities and airlines have not been that successful," admits an FAA spokesperson. "We have been working with EASA to improve this, and have decided to move to a classless architecture. This means that the current hardware Classes 1, 2 and 3 will be replaced by classifying EFBs according to whether they are portable or installed."

Although the FAA and EASA have slightly different definitions in some cases, one thing on which both regulators do agree is that EFB functions should be limited to a hazard classification no greater than minor. This means that in a worst case scenario a failure of the EFB system would lead to nothing more serious than a slight increase in the pilot's workload.

Following on from this, only Type A and B software will be classified as providing an EFB function, while applications previously classed as Type C will now be considered as avionics systems, with the exception of the AMMD function, which has the ability to display own-ship position when on the ground, and will be included as a Type B application.

"The FAA plans to implement these new classifications by the end of 2014," adds the FAA representative. "This will open up the debate about when a device is portable or installed. By our definition if the main processor or brain of the system is installed on the aircraft, then it is an installed system. The FAA's position when considering EFB policy is that the hardware device is far less important than the software it hosts and the functions it can subsequently perform."

Summary

The evolution of COTS-based tablet devices has had a significant impact on available EFB solutions for airlines. An EFB solution can lead to benefits in three main areas: operations, maintenance and in the cabin. The benefits of an EFB solution include removing paper from the aircraft and integrating data with back-office functions. Airlines need to consider the advances they want to make as a result of implementing an EFB solution before considering hardware and software options.

The rate of technological advances has led to changes in EASA and FAA hardware and software classifications, which has caused some confusion. The regulators now plan to replace existing guidelines with portable and installed hardware classifications. Only Type A and B software will be considered as providing an EFB function. Airlines must keep abreast of both continuing technological changes, and subsequent updates to regulations when setting out their business plans for EFB implementation. AC