

# The Age of the iPad

BY MARIO PIEROBON



© Chris Sorensen Photography

**The tablet computer — especially the iPad — is increasingly in use as an electronic flight bag.**

No other piece of equipment in the recent history of aviation technology has become as popular with pilots as quickly as Apple's iPad tablet computer, which increasingly is being used as an electronic flight bag (EFB).

Airbus and Boeing both seem convinced of the role the iPad and other tablet computers will play in the future of information management technology for air navigation. In early 2012, Airbus CEO Tom Enders said the iPad is "changing the way pilots interact with the aircraft" and that the "impact of such products, from outside the world of aviation, is starting to dictate what people expect from us, and we can't ignore that."<sup>1</sup>

In July, Airbus launched an iPad EFB solution, "FlySmart with Airbus," that includes apps (applications) with which pilots can compute performance calculations and consult Airbus flight operations manuals. Airbus plans a second set of iPad apps that it said "will add more performance, as well as load sheets, flight folder and navigation charts applications."

Boeing also recognizes that the iPad has "gained rapid, unprecedented popularity as an EFB in all aviation market segments."<sup>2</sup> Jeppesen, a Boeing subsidiary, has developed a charting

app that the U.S. Federal Aviation Administration (FAA) authorized for use in February 2011. In December 2011, American Airlines was the first airline authorized by the FAA to use Jeppesen charts on iPads in all phases of flight; and many air carriers are evaluating mobile EFB platforms that include iPads, and are using simulator and in-flight studies to help develop procedures and training programs, and to validate the use of the equipment in all phases of flight, according to Boeing.

The iPad's success does not come by chance. The technology debuted when flight operations departments already were considering EFBs but had been limited by the often-prohibitive cost of EFB hardware. The much lower acquisition cost of the iPad seems to have enabled a speedier transition to EFB technology.

Because of the recent evolution of EFB technology and the expected large-scale introduction of mobile devices onto the flight decks of commercial airlines, the FAA recently released Advisory Circular (AC) 120-76B containing guidelines for the certification, airworthiness and operational use of EFBs (ASW, 5/12).

According to definitions in the updated AC, the iPad can be used as either a Class 1 or Class 2 EFB. Class 1 EFBs are not typically

**The FAA requires each operator to apply individually for approval to use the iPad as an EFB.**

mounted to the aircraft, and they are not connected to aircraft systems for data. Class 2 EFBs typically are mounted, but can be easily removed from their mounts by the flight crew, and they may connect to data ports (wired or wireless) or installed antennas. iPads cannot be Class 3 EFBs, which are permanently installed in the aircraft.

According to the AC's definitions, the iPad is capable of hosting Type A and Type B software applications. Type A applications are intended primarily for use during flight planning on the ground or during non-critical phases of flight. Type B applications provide aeronautical information required to be accessible at the pilot station and are intended for flight planning and all phases of flight.

Because the iPad already is used by many flight departments as an EFB during all phases of flight, there are few, if any, issues with regard to the iPad's certification. However, the FAA requires each operator to apply individually for approval to use the iPad as an EFB. Therefore, operators must consider the safety requirements set forth in the AC, especially those dealing with issues of long-standing concern such as electromagnetic interference, rapid decompression and the human factors/automation issues.

### Non-Interference Testing

For some time, there has been concern that an iPad, as a transmitting portable electronic device (T-PED), could interfere with flight deck avionics. In particular, it has been reported that "Apple uses a capacitive touch screen, which detects a finger electro-statically and is susceptible to electromagnetic interference."<sup>3</sup> Within the pilot community, there seems to be a consensus that this concern is overstated.

The FAA, however, says in the AC that "to operate a PED during all phases of flight, the user/operator is responsible for ensuring that the PED will not interfere in any way with the operation of aircraft equipment." The AC describes two non-interference testing methods, either of which may be used by applicants.

Method 1 comprises two steps. Step 1 requires an electromagnetic interference (EMI) test in accordance with RTCA/DO-160, the standard for environmental tests of avionics hardware published by RTCA, formerly known as the Radio Technical Commission for Aeronautics.

"An evaluation of the results of the ... test can be used to determine if an adequate margin exists between the EMI emitted by the PED and the interference susceptibility threshold of aircraft equipment," the AC says. If Step 1 determines that adequate margins exist, then Method 1 is complete. Step 2 testing is necessary only if Step 1 identifies inadequate margins for interference. According to the AC, Step 2 testing is specific to each aircraft model in which the PED will be operated. The operator must test the specific PED equipment in operation on the aircraft to show that no interference with equipment occurs from the operation of the PED. "Step 2 testing is conducted in an actual aircraft, and credit may be given to other similarly equipped aircraft of the same make and model as the one tested."

Method 2 calls for "a complete test in each aircraft using standard industry practices," the AC says. "This should be to the extent normally considered acceptable for non-interference testing of a PED in an aircraft for all phases of flight. Credit may be given to other aircraft of the same make and model equipped with the same avionics as the one tested."

The need for each operator to receive approval for iPad operation as an EFB, and in particular the need for each user/operator to conduct EMI testing, has prompted the emergence of companies that supply customized testing, which could be an option for operators that do not have the necessary in-house testing expertise.

### Rapid Decompression Testing

iPads meant to utilize Type B software applications in pressurized aircraft must undergo rapid decompression survivability testing that complies with RTCA/DO-160. Tests are not



required if only Type A software applications are used, if alternate procedures or paper backups are available, or if the iPad is meant for use in unpressurized aircraft.

With regard to decompression testing, the AC says that “similarity of a particular EFB to a unit already tested may be used to comply with this requirement. It is the responsibility of the operator to provide the rationale for the similarity.” Soon after its release in March 2012, the iPad 3 was tested successfully for rapid decompression at 51,000 ft equivalent altitude, the maximum service ceiling of business aircraft.

Interestingly, in a video available online from Jeppesen, the company recommends that “if an EFB is involved in an actual rapid decompression event on an airplane, it is probably a good idea to remove that EFB from service, at least for use during critical phases of flight.”<sup>4</sup>

### Human Factors Issues

The AC contains a section dedicated to “EFB system design considerations” that touches on the human factors/automation issues associated with using the iPad as an EFB.

In addition to the iPad’s user-friendliness, Apple’s tablet is appreciated in the flying community because of its battery life, the stability of its applications and the fact that the approach plates are well lighted and easily viewed by pilots, even at night.

One of the benefits of the iPad is the potential for reduced workload. In fact, the AC requires that “the EFB software design should minimize flight crew workload and head-down time.” The document includes instructions to “avoid complex, multi-step data entry tasks during takeoff, landing and other critical phases of flight. An evaluation of EFB intended functions should include a qualitative

# SAVE THE DATE BASS 2013

58TH ANNUAL BUSINESS AVIATION SAFETY SEMINAR

APRIL 10–11, 2013

FAIRMONT QUEEN ELIZABETH HOTEL  
MONTREAL, CANADA

FLIGHT  
SAFETY  
FOUNDATION

NBAA

supported by

CBAACAA

For details, visit our Web site at [flightsafety.org/BASS](http://flightsafety.org/BASS).

To register or exhibit at the seminar, contact Namratha Apparao,  
tel.: +1.703.739.6700, ext. 101, [apparao@flightsafety.org](mailto:apparao@flightsafety.org).

To sponsor an event, contact Kelcey Mitchell, ext. 105, [mitchell@flightsafety.org](mailto:mitchell@flightsafety.org).

To receive membership information, contact Susan Lausch, ext. 112, [lausch@flightsafety.org](mailto:lausch@flightsafety.org).

To advertise in *AeroSafety World Magazine*, contact Emerald Media.

Cheryl Goldsby

[cheryl@emeraldmediaus.com](mailto:cheryl@emeraldmediaus.com)

tel: +1 703 737 6753

Kelly Murphy

[kelly@emeraldmediaus.com](mailto:kelly@emeraldmediaus.com)

tel: +1 703 716 0503



assessment of incremental pilot workload, as well as pilot system interfaces and their safety implications.”

Lino Palumbo, a training captain at Air Canada Jazz who flies Bombardier CRJs, offered specific examples of the iPad’s benefits. “The 100/200 model is an early model with a very critical wing with many restrictions and also an airworthiness directive on the flaps. It requires precise performance calculations and frequent use of company manuals to calculate these restrictions. It is very tedious to look for this information in three different manuals. Most of these can easily be carried on an iPad for quick reference, and — even better — a company application, custom-made, can be created to even more precisely compute performance numbers. In flight, the iPad can also be used to calculate cold weather temperature corrections. Flying in cold regions like Canada implies that often approaches are flown in temperatures well below 0 degrees C; these approach altitudes do not take into account the temperature and can make you fly lower on approach than the actual altitudes. Corrections are normally calculated with a chart, but now this can quickly be done with this application.”

### Digital Charting

Some charting applications not only reduce pilot head-down time and workload, but also enhance situational awareness because the iPad graphically overlays the position of an aircraft on a chart. “During taxi at a busy airport with multiple taxiways, it was always difficult to see where you were on the airport,” Palumbo said. “With the iPad, you can now expand the taxi charts so that you can see the taxiways better. There is also a function allowing pinpointing where you are exactly on the taxi chart. This can aid the pilots to reduce errors and taxi safely to and from runways, reducing runway incursions.”

The International Air Transport Association (IATA) also sees advantages in using electronic charts rather than paper ones. “Paper

charts are frequently removed from the flight deck (for update, etc.), [are] far more easily lost once removed from the binder, [and] more easily damaged or destroyed,” said Perry Flint, IATA’s head of corporate communications for the Americas. “Paper charts are cumbersome and not easily accessible; accessing them at a time of high workload can create a distraction for the crew and a lot of head-down time. By contrast, EFB data are easily and quickly located by a few finger strokes and minimal disruption.”

### Updated Information

Additional safety and operational benefits can be obtained if the transition to iPad technology is managed to ensure pilots have the most up to date information available on their devices before flying. “An iPad should be used as pre-flight, in-flight and post-flight tool,” Palumbo said. “The typical day of a pilot should begin by reviewing all weather and NOTAMs [notices to airmen] pertaining to the flights of the day. MyRadar and AeroWeather applications can be used for the most updated weather information. As a pilot, you can receive live radar images at your location and destination to make accurate decisions. ... With AeroWeather, you can view the latest TAFs [terminal area forecasts], METARs [aviation routine weather reports] and NOTAMs of multiple airports at the same time. It also gives you headwind comments for the runway, a very useful tool to determine any crosswind components for takeoff and landing. Personally, I also keep all my Jeppesen approach plates using the Jeppesen application. As [pilots], we all dread doing these important updates, [but] we now can have our plates up to date with the latest amendment. This reduces time and errors made during amendments.”

iPad technology also may contribute to enhanced aircraft operational performance.

“The accuracy of the average performance calculation completed by the EFB is clearly superior to the average performance calculation completed by hand,” Flint said. “The EFB



**‘The iPad can also be used to calculate cold weather temperature corrections.’**

is capable of storing huge amounts of information that now becomes instantly available to crews, information that was either previously available but not easily accessible even if the source was known, or simply not available because of space/weight constraints on the flight deck. Not only do EFBs contain chart data and performance information, they also contain all sorts of other relevant aircraft and company information, all available easily in one location. This is of incalculable benefit at times of non-routine operations.”

### Understand All Ramifications

In 2002, Sanjay S. Vakil and R. John Hansman of the Massachusetts Institute of Technology said that, in the past, “most accidents were caused by problems with the physical skills involved with flying the aircraft, or through errors of judgement. The new problems involve issues of management of the complex aircraft and associated automation systems. Within the set of errors attributed to flight crews, automation problems are emerging as a key safety area.”<sup>5</sup>

The authors also noted that, “in the absence of a simple, consistent and communicable model of flight automation, pilots appear to create their own models of the flight automation. These ad hoc models have several shortcomings. The most obvious of these is that the models may not accurately reflect the actual systems. Further, since these models are created independently by individual pilots, specific ad hoc models may not be accurate.”

While these remarks were originally made when EFBs were not yet a major flight deck instrument, they nevertheless apply to the additional automation introduced by iPad technology.

A Boeing 747 captain and flight instructor who retired from a major European airline more than 10 years ago shares the concern about the development of inappropriate mental models and provides an interesting perspective: “The younger generations of pilots will have little, if any, difficulties adapting to the iPad. However, the risk for this category of pilots is that [if] they

accept this technology without a critical spirit, trusting it blindly, ... they will be totally without backups and appropriate skills in case of a total EFB system failure. On the other hand, older generations of pilots are likely not to trust the iPad as a new piece of equipment and favor their instinct instead”.

The importance of carefully transitioning to iPad technology is not to be underestimated, he said, adding, “If an operator is to transition to EFB technology and/or to become almost totally paperless, it is fundamental to proceed gradually and with a lot of training (including simulator time) related to the introduction of the new system.”

In laying the groundwork for the transition from paper, the AC says that “at least two operational EFBs are required to remove paper products that contain aeronautical charts, checklists or other data required by the operating rules” and that “the design of the EFB function requires that no single failure or common mode error may cause the loss of required aeronautical information.” The recommended gradual implementation of iPad technology implies a transition time during which proficiency in the new technology is built and a current paper backup is in the airplane.

### Future Functions

In the future, the iPad will have other functions on the flight deck.

In a white paper titled “The Value of Back Office Integration,” IMDC, an in-flight technology consulting firm, noted “an increasing awareness that the data recovered from the aircraft is growing in significance as EFBs assume a more important role in maintenance operations.”<sup>6</sup>

In 2008, Boeing introduced the Electronic Logbook (ELB), which “connects the airplane systems to the airline information technology infrastructure, providing data to the appropriate departments that allow them to strategically react to airplane problems. This knowledge helps the airline schedule the airplane operation so that all deferred faults can be resolved during a time when the airplane is available, thereby



**‘No single failure or common mode error may cause the loss of required aeronautical information.’**



reducing costs,” Boeing said.<sup>7</sup> The Boeing Class 3 EFB “has evolved from a simple flight bag replacement to a generalized computer system that can link information provided by airplane systems, flight crews and cabin crews to the airline when the airplane is remote from the airline home base. Integrated with the Boeing ELB, it provides real-time administrative information from the airplanes to the airline so that the airline can make high-value operational decisions.”

The trend for EFB-enabled data transfer from the aircraft seems to have started and the iPad could be part of that trend. The next challenge for the iPad will likely be consistently enabling the seamless, paperless transfer of information from the aircraft to an airline-hosted ground system. ➔

*Mario Pierobon works in business development and project support at Great Circle Services in Lucerne, Switzerland, and was formerly with the International Air Transport Association in Montreal.*

## Notes

1. “iPad makes its way to the Airbus cockpit” Airbus, *Noticias Airbus* No. 140 January–February 2012.
2. “Operational Efficiency of Dynamic Navigation Charting” The Boeing Company, *Aero Quarterly* Q2 2012.
3. “Advancing Vision”, Graham Warwick, *Aviation Week & Space Technology*, May 14, 2012.
4. Jeppesen and Garwood Labs Rapid Decompression Test – Jeppesen Training (Published on March 23, 2012), <[www.youtube.com/watch?v=xvQAUyMBeiY](http://www.youtube.com/watch?v=xvQAUyMBeiY)> [accessed Aug. 20, 2012].
5. Approaches to mitigating complexity-driven issues in commercial auto flight systems, Sanjay S. Vakil, R. John Hansman, *Reliability Engineering and System Safety* 75 (2002) pp 133-145.
6. “The Value of Back Office Integration” Electronic Flight Bag (EFB) White Paper, IMDC (NA).
7. “Electronic Flight Bag: Real-Time Information Across an Airline’s Enterprise”, Boeing, *Aero Quarterly* Q2 2008.

# HELP US MAKE FLYING SAFER.



Your tax-deductible contribution to the Flight Safety Foundation endowment through the Combined Federal Campaign (CFC) supports the work of aviation safety professionals worldwide.

Flight Safety Foundation ([flightsafety.org](http://flightsafety.org)) is the only non-profit organization whose sole purpose is to provide independent, impartial, expert safety guidance and resources for the commercial and business aviation industry. Practices for safe operations are researched, initiated, and actively publicized and distributed by the Flight Safety Foundation.

However, there is always more to be done. This job is never “complete.”

***Please consider a gift to the Flight Safety Foundation Endowment.***

*Ask your CFC campaign manager or human resources department how to set up your contribution.*

*The CFC is open to Federal civilian, postal and military employees. Your tax-deductible gifts to the Flight Safety Foundation endowment can be made by check or ongoing payroll deductions during the campaign season, **September 1–December 15.***

*Use your powers of deduction to improve aviation safety.*