

Whether they are simple laptops or fully installed and certified devices, computers for pilot reference and calculations appear destined to enter aircraft cockpits. What follows are recent developments that support the inevitability of electronic flight bags.

By David Jensen

In the July 2002 issue of *Avionics Magazine* (page 35), we reported on the accelerating electronic flight bag (EFB) market. Since then, the market has shifted into an even higher gear. This burst of activity was triggered in large part by the Federal Aviation Administration's (FAA's) publication on March 17, 2003, of the advisory circular, 120-76A. The document gives operators a road map for the transition to a paperless cockpit by providing, according to the AC, "an acceptable method of compliance for the certification, airworthiness and operational approval of both portable and installed electronic flight bag aircraft computing devices."

The advisory circular received added clarification with the approval in late June of the DO-257A standard and by research conducted by the Department of Transportation's Research and Special Program Administration, Volpe Center (more on those topics later). Although EFB technology's rapid revolution undoubtedly will force further modifications to AC 120-76A, the advisory circular is being used by EFB developers and installers, and is described as "95 percent complete," according to one EFB user.

The AC's publication encouraged FedEx, a pioneer EFB user, to equip its entire fleet with electronic flight bags, according to Bob Bouchard, the express freight carrier's Titan Project engineer. (The Titan Project involves implementing EFBs, among other new technologies, in FedEx aircraft.) For 12 years, FedEx pilots flying MD-11s have been making performance calculations on laptop computers powered by AA batteries. Now, over the next two years, the carrier will be fitting pilot access terminals—for stowing and recharging laptops—to its fleet of 320 aircraft: Airbus 300s and 310s, Boeing 727s, MD-10s and DC-10s, as well as MD-11s. "The AC has helped us work beyond the MD-11 installations," says Bouchard.

Further proof of the EFB industry's acceleration was Boeing's decision this summer to offer electronic flight bags as a forward-fit option in, initially, three of its models: B777, B737NG and B747-400. The airframe manufacturer also announced its inaugural EFB customers, KLM Royal Dutch Airlines and Pakistan International Airlines. (See our coverage of Boeing EFBs in next month's issue.) Boeing is working with in-house partner Jeppesen to provide a variety of options, from Class I to Class III EFBs. At this year's Paris Air Show, Boeing showed mockups of Class III EFBs for the B737NG and B747-400, and presented a working Class III electronic flight bag in a B777-300ER

(extended range) on static display. Astronautics Corp. of America produced the screens, which it calls "pilot information displays."

Meanwhile, Spirent Systems announced in June that it had obtained a supplemental type certificate (STC) for its AvVantage EFB on the A330. Australia's Qantas Airways is equipping the A330s it has on order with Spirent's Class II system.

More than air transport operators are climbing onto the EFB bandwagon, however. The Universal Cockpit Display Terminal (UCDT-II) has been approved by the FAA on about 10 business aircraft, including the Falcon 10, 20 and 50, the King Air 350, Boeing Business Jet, and Bombardier's Challenger and Global Express. And Universal Avionics Systems Corp. is "in the process" of having the EFB display certified in the Cessna Citation and Gulfstream aircraft, according to Don Berlin, the Tucson-based company's vice president of marketing and support.

CMC Electronics' CT-1000G EFB, which is factory installed at Gulfstream, has been fitted to helicopters, as well. "Bell/ Agusta helicopters used for paramilitary missions—police and emergency—have our system installed," says Jean-Marie Begis, CMC's director of aeronautical communications products.

In the military market, the UCDT-II also has been certified on the U.S. Air Force's RC-135. And Boeing is proposing an EFB for the Air Force's 767 Tanker program.

The electronic flight bag market delivers unique sales opportunities at a time when much of the aviation industry faces an economic slump. Equally unique is the advisory circular that will help enhance that opportunity.

AC 120-76A is "very open," says John McGraw, FAA's manager of the Flight Technologies and Procedures Division of Flight Standards, describing one unique feature. "It's an open architecture AC [in which] we are able to include new functions without revising the AC." The AC lists 75 functions that EFBs may perform, but McGraw says, "Those are just examples, and that's not an exclusive list."

The advisory circular for EFBs also includes guidelines for certification approval and operational approval in a single document. "This feature hasn't been as common in the past as it is now and will be," claims McGraw.

"We also committed to a six-month turnaround, which was pretty quick, considering some big changes were made," he adds, as another unique feature to the AC. McGraw refers to the time between the decision to update the original AC and the publication of the revised AC 120-76A on March 17.

The changes were facilitated by the intense work of McGraw's division and were supported by the Air Transport Association's digital display working group (DDWG). Established in 1994, the DDWG is made up of representatives of FAA and the aviation industry. "What's refreshing is that this is, I believe, the first AC to be truly crafted

collaboratively, between FAA and industry," says Brian Uskoski, DDWG chairman and flight technical and operations engineer with JetBlue Airways.

Generally, according to Uskoski, changes to the AC involved a shift from "an [equipment] certification emphasis to an operations emphasis [in which] you try to adopt technology to do the things you want to do." McGraw agrees that FAA "recognized that, initially, some technical issues had to be completed. We initially put the AC out, recognizing we had to take care of further issues," he adds. "So there was a shift in emphasis, but it was intentional."

A significant issue — Uskoski calls it a "sticking point" — was partially resolved by RTCA's recent approval of the DO-257A standard. The issue involves establishing a technical standard order (TSO) procedure to allow "ownership position" to be shown on a moving map display of the airport surface on a Class II EFB.

The highest-class EFB, the Class III, is "avionics grade." It requires approval by FAA's Aircraft Certification Service and must have DO-178B, Level C, or higher software (applicable for navigation and primary flight displays), and this allows an aircraft symbol indicating ownership to be displayed on a moving map. However, Class II EFBs generally are portable, commercial-off-the-shelf [COTS] computers that use Type A or B hosted application software, which does not require DO-178B compliance. The certification expense between the two EFB classes is significant.

The ownership issue "required the most work and is taking the longest time to resolve," says McGraw. Some in FAA worried that pilots would use the ownership symbol and moving map on an EFB as a navigation tool. Thus the function would require avionics-grade reliability, equal to that of safety-of-flight systems. But users not wanting to swallow the expense of a Class III EFB, argue that the ownership function would simply be used to enhance situational awareness, i.e., as a reference, no different from viewing a Jeppesen or National Aeronautical Charting Office chart. It would not replace eyes-out-of-windscreen viewing, they contend, and thus an EFB's failure would not adversely impact safe operations.

Enter DO-257A, which Working Group 4 of RTCA Special Committee 181 recently completed. It was approved for publication by the RTCA Program Management Committee on June 25. The original DO-257 covers standards for the depiction of moving map data on displays. "We initially revised DO-257 to include airport surface and vertical profile displays for installed equipment. However, with the expressed need for EFB criteria for these capabilities, the airborne flight equipment flavor of the standards was considered by some to be too stringent," says David Nakamura, chairman of SC-181. "The major hurdle in completing DO-257A was to develop standards that, if applied to EFB applications, would have reasonable criteria for the intended function, associated hazard class, and criticality level.

"This was accomplished by removing the airborne criteria and establishing less demanding criteria, depending on EFB application and function," he adds. The more

stringent airborne criteria will appear in the appropriate equipment TSO. This revision to DO-257 "removes road blocks to the TSO process" for EFBs with Type B software, according to Uskoski.

Most human interface issues have been addressed in Version 2 of the Volpe Center report titled "Human Factors in the Design and Evaluation of Electronic Flight Bags." Working with the DDWG since 1998, Volpe Center produced the report to support AC 120-76A (visit www.volpe.dot.gov/opsad/efb/index.html). The document hasn't been finalized but "needs to be finalized by the end of this fiscal year [Sept. 30]," says Dr. Divya Chandra, engineering psychologist and the report's project lead.

Nevertheless, the document already has been "widely distributed," she adds. Jeppesen, for example, uses the report "as base input for [its] requirements interface design," according to Mike Pound, with Jeppesen's marketing services.

Version 2 includes the many comments drawn from responses to version 1, which was released in September 2000, prior to the advisory circular. "Version 2 has much more depth and detail," says Chandra. "As a result, the report was expanded from 90 pages to more than 150 pages." Version 2 provides detailed guidance on such topics as training, portable EFB stowing, workload, keyboards and other means of user input, and EFB installation, as well as software considerations, such as use of icons, alerts and reminders, and audio.

The report does not offer design standards for EFBs. "What we're showing are the tradeoffs that need to be made for a system's design," Chandra explains. The report also is not meant to "resolve contentious issues," such as use of color on EFB displays, she adds. "But we are trying to make people aware of the complexity of electronic flight bags and what needs to be considered when using them."

The Volpe Center report gives guidance in an easy-to-follow format that includes, for each interface issue, equipment recommendations and human interface factors to consider when choosing equipment. It tells of possible risks with an interface and provides questions an evaluator of an EFB might ask, says Chandra.

Given the ever-changing EFB market, does Volpe Center plan a version 3 of its EFB human interface guide? No, says Chandra. Version 2 "is a long document and what we want to do next is condense the report and make it a tool that field evaluators can easily use," she explains. "We want to categorize the issues and set up topic areas that can be used by people who are not human factors experts." The tool, initially a concise paper document, is scheduled to be available by Sept. 30, according to Chandra.