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COCKPIT COMEBA

Cockpit display retrofits improve safety and efficiency, reduce maintenance costs and enhance reliability of legacy business and transport aircraft

By Vicki P. McConnell

With the current backlog for new aircraft extending to more than a year's wait, more business cases are being made to retrofit avionics into legacy aircraft. Cockpit display retrofits, featuring all-digital avionics, are putting legacy aircraft on par with the newer models.

"Cockpit retrofits are a high priority," said Ron Hall, with avionics sales for Duncan Aviation, Lincoln, Neb. "We're adding people and tooling and producing instrument panels better and faster."

In the United States, manufacturers including Honeywell, Rockwell Collins, Universal Avionics, Integrated Solutions & Support and Sagem Avionics, in conjunction with aviation services companies such as Duncan Aviation that integrate and install complex systems, are meeting the demand with new avionics packages offering the latest functionality.

Cockpit retrofits can take the form of gutting the existing cockpit to install all-digital glass instrumentation or upgrading communications, navigation, surveillance and air-traffic management (CNS/ATM) capabilities.

For legacy aircraft owners and new entrants, whatever level of retrofit chosen can improve safety and efficiency, reduce maintenance costs, increase reliability and provide flight crews with enhanced situational awareness.

"It's a good time for retrofitting the avionics in legacy aircraft," said Tim Rayl,

senior director of marketing for Rockwell Collins Business and Regional Aircraft Systems. "Legacy owners are reconsidering retrofits to boost the value of existing assets, extend avionics lifecycle and enhance overall aircraft performance."

Hall said the defining moment for cockpit retrofits traces back five years ago when flat-panel display systems (FPDS) became both certifiable and affordable to the operator. Achieving supplemental type certification (STC) for a new system installation, however, involves a significant cost to the developer. The answer ranged from \$35,000 for a single element in a FPDS, to \$150,000 to \$250,000 for an Electronic Flight Instrument System (EFIS), to several million dollars for a complete glass cockpit with new autopilot and flight management system (FMS). STC cost management varies depending on OEM and integrator contracts, which also determine who retains the certificate.

In July, *Avionics* reported on glass-cockpit offerings by Garmin International, Avidyne and Chelton Flight Systems for the lower echelons of general aviation, both for new aircraft and retrofit. Below are retrofit developments reported by U.S. avionics OEMs and installers for higher-end business and commercial aircraft.

Avionics OEMs

Configured with three or four active matrix liquid crystal displays (AMLCDs) and compatible interface to the flight management system, Attitude Head-

ing Reference System (AHRS), Traffic Alert and Collision Avoidance System (TCAS) and more, Rockwell Collins' Pro Line 21 integrated display system (IDS) is designed with an open architecture to allow for a building block approach that accommodates a customer's budget as well as future equipment requirements, Rayl said.

Rockwell Collins, based in Cedar Rapids, Iowa, began working with integrator Landmark Aviation last year to retrofit the Pro Line 21 IDS in a Dassault Falcon 50 trijet, including installation of an integrated flight information system (IFIS). Among other functions, IFIS positions an aircraft on the approach plate in real time while in the air, the company said.

One of the key challenges in the retrofit is the autopilot interface, which Rayl said requires special attention to operational nuances in different autopilot systems.

Of course, owners can purchase new autopilot and integrated FMS options with Pro Line 21, which is considered a full avionics retrofit. Through Landmark Aviation's Springfield, Ill., MRO center, some 24 Falcon 50s have been retrofitted with Pro Line 21 or are currently in the completion process.

"We believe the end result of various Rockwell Pro Line 21 IDS and full retrofits are a comprehensive set of capabilities that can resemble those of new factory aircraft," Rayl said.

A four-display IDS retrofit starts under \$700,000 installed (with IFIS), if

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utilizing existing radios, FMS and sensors, the company said. The electronic charting function provided by IFIS is, in Rayl's opinion, "the first step toward paperless operation." IFIS also enables Nexrad graphical weather capability via XM weather broadcast or Universal Weather's request/reply service.

The Pro Line 21 IDS supports future airspace requirements for Required Navigation Performance (RNP), Reduced Vertical Separation Minimum (RVSM) and Automatic Dependent Surveillance-Broadcast (ADS-B), Rayl said.

Universal Avionics, Tucson, Ariz., has found success in the FPDS retrofit market through the ability to interface to a wide variety of avionics, including air-data systems, flight guidance systems, radars, radios, TCAS, Terrain Awareness and Warning System (TAWS), radio altimeters and AHRS, from multiple vendors. This flexibility makes "virtually any aircraft a candidate for Universal's EFI-890R retrofit," said Paul De Herrera, Universal Avionics vice president of marketing.

The adaptable FPDS architecture supports from one to five large-format displays, including optional engine instrument display. Currently, more than 15 supplemental type certificates are available; the versatile architecture encompasses aircraft ranging from single-engine turboprops such as the Pilatus PC-12 up to transport category aircraft such as the Boeing 737.

Aircraft customers today are well educated and demand the latest in technology and features, including graphics, video and synthetic vision, De Herrera said. Universal Avionics' Vision 1 Synthetic Vision System (SVS), already Part 23 and 25 certified, is supported by the company's EFI-890R flat-panel displays.

"Universal's TAWS, with three distinct high-resolution views of terrain and application server unit with electronic charts and own-ship position, plus broadcast weather, provide further retrofit options, along with the company's WAAS-capable FMS, radio control units, and Uni-Link air-to-ground datalink," De Herrera said. "This equipment answers customer needs for RNP, LPV (localizer performance with vertical guidance) approaches and other CNS/ATM functionality."

With increasing customer interest in multifunction display



Rockwell Collins' Pro Line 21 integrated display system installed in a Dassault Falcon 200.

Photo courtesy, Landmark Aviation



Universal Avionics flat-panel displays can be seen in Stevens Aviation's Lear 25 instrument retrofit.

Photo courtesy, Stevens Aviation



Innovative Solutions & Support Integrated Primary Flight and Navigation Display in ABX Boeing 767.

Photo courtesy, IS&S



Part of C-130 cockpit retrofit for the Dubai Air Wing includes CMC Electronics' fully integrated, CMA-900 multisensor Flight Management System.

Photo courtesy, CMC Electronics

Vision Upgrades Gain In Popularity

With the continuous stream of changes in imagery and graphics related to CNS/ATM systems (some mandated and some technology driven), avionics manufacturers and installers identified synthetic vision systems (SVS) as the "hot spot" in both retrofit and new aircraft sales.

The first certified SVS was Universal Avionics' Vision 1 system. Honeywell's offering is the Synthetic Vision-Primary Flight System Display. Rockwell Collins has an IPFD SVS in development and expects certification in the fourth quarter. IS&S likely will install its first SVS on a PC-12 this year.

Along with SVS, Stevens Aviation's Ivan Wilson said more infrared camera equipment for runway clarity and security will be available in the near future, along with enhanced glass clarity for FPDS products.

Duncan Aviation's Ron Hall described a text message system being developed for clearances that would overcome international language barriers. Landmark Aviation's Gary Bosemer identified a migration of electronic engine indicators into display retrofit programs.

Meanwhile, the spate of recent STCs continued for "upgrades to the upgrades" with all manner of CNS/ATM functionality. From Duncan Aviation, there are modifications for RNP and EFIS replacement on King Air 300 and 350s; from Landmark Aviation, installation of Pro Line 21 IDS for the Falcon 200; from Honeywell, Primus Epic to FMS modernization for RNAV and GPS; from IS&S, FPDS and EFB upgrades on PC-12, B757/767, Citation and Eclipse Very Light Jet; from Universal Avionics, the first STC for its EFI-890R display retrofit on a Gulfstream G-III; and from Stevens Aviation, amendments to Learjet 25 STCs for the Learjet 35 avionics package retrofit. — Vicki McConnell



Universal Avionics' Vision 1 Synthetic Vision System offers an egocentric, or pilot's, view (shown) as well as an exocentric wingman's view.

Photo courtesy Universal Avionics

installations, Universal offers its own building block approach for retrofits. The Universal MFD-890R has an identical part number to any display utilized in a complete cockpit retrofit.

"When conditions support a full retrofit," De Herrera said, "the MFD is merely incorporated into the package, thus maximizing the customer's investment."

Honeywell's Primus Epic Control Display System/Retrofit (CDS/R) is another open architecture FPDS being installed by integrator Landmark Aviation, based in Tempe, Ariz. In May, Honeywell received Technical Standard Order (TSO) approval for Phase IV of the product, an improvement to the multifunction display and FMS interface functionality.

"This TSO represents a further enhancement of CDS/R that will allow us to provide pilot's charts and maps, and uplink weather," said Chad Cundiff, Honeywell vice president for Crew Interface Applications. New features include split mode and independent pan and zoom control of the electronic chart windows.

Honeywell offers the FPDS retrofit on 15 different aircraft models. Cundiff said an advanced file graphics system will be released this month providing pull-down

menus with specific airport maps.

Innovative Solutions & Support (IS&S), Exton, Pa., said it spent considerable time analyzing the obstacles to avionics upgrades in the commercial transport market, identifying a major concern with one customer in controlling out-of-service down time required for modifications.

On the customer's Boeing 757s and 767s, lost aircraft revenues reach \$70,000 or more a day. "So a retrofit or modification of 20 to 25 days would certainly prohibit even the most beneficial flight panel display program," said Mike Glover, director of IS&S's Cockpit/IP (Cockpit Information Portal) flat-panel display programs.

IS&S worked with the aforementioned customer and an integrator to craft a retrofit architecture that would interface with as much of the airplane as possible to achieve the FPDS upgrade, plus offer a transition to a Class 3 electronic flight bag (EFB) using the same forward field of view display technology. The initial retrofits took four days. Today, STC'd B757 and B767 installations can be accomplished in three days for about \$350,000, inclusive of the FPDS and installation kit, the company said.

Glover said IS&S has seen strong customer demand in the last three to five years for its air-data products, especially in support of RVSM compliance. The package to accomplish RVSM involves an analog-to-digital interface upgrade for the altimetry system, and an upgraded alert system.

IS&S now has equipment in RVSM service on more than 7,000 aircraft. On the Pilatus PC-12, IS&S digital air-data modules provide both the Cockpit/IP FPDS and required RVSM flight information. The company also has developed an optional display feature for RNP.

Another special "human factor" improvement from IS&S is a zoom function to make the display formats and charts larger and easier to read.

"This function is standard and being expanded across all the Cockpit/IP FPDS," Glover said. "We believe having this type of data available to flight crews will grow in popularity with operators and regulatory bodies."

Avionics Installers

Gary Bosemer, Landmark's director of avionics marketing and development, described his company as a pioneer in

RVSM retrofits on aircraft such as the Cessna Citation and Gulfstream II/IIB.

"Each airframe has unique demands for RVSM, so we review the entire existing avionics suite and interface with flight control systems," Bosemer said.

He estimated retrofit of Rockwell Collins, Honeywell, Universal and IS&S display systems takes between 8 to 10 weeks, and a major retrofit averages 14 to 18 weeks.

Don Paolucci, director of GPS/FMS at Montreal-based CMC Electronics, said his company's integration services for RNP have involved upgrades to the navigation source such as GPS, or in some cases, complete replacement of the entire navigation system, including FMS and displays.

"A basic functionality in ADS-B is available now, in the form of output to external ADS-B equipment of ARINC 743A GPS position/velocity/time data," Paolucci said. "The FMS also provides 'intent bus' information, which could be applicable. The harmonization of Euro-control Mode-S Enhanced Surveillance and ADS-B requirements will be an additional challenge."

With its Glass Box project, Duncan Aviation had completed or started 35 Honeywell, Rockwell Collins and Uni-

Sagem Makes Inroads

Sagem Avionics, of Grand Prairie, Tex., a subsidiary of France's Sagem Defense and Security, has been making inroads in the cockpit retrofit arena in this country.

The company recently announced orders from the Riverside County, Calif., Sheriff's Department and the Los Angeles Police Department for display upgrades of their respective Eurocopter AS-350 A-Star helicopter fleets. Sagem Avionics, Eagle Helicopters of Spokane, Wash., and Soloy Aviation Solutions hold a supplemental type certification for the AS-350B2 equipped with the Soloy engine and Sagem's Integrated Cockpit Display System (ICDS).

Sagem Avionics was incorporated in 1989 as SFIM. The parent corporation of SFIM was acquired by Sagem SA in 1999, and the com-

pany's name was changed to Sagem Avionics in 2004. That year, Sagem Avionics acquired ARNAV, of Puyallup, Wash., adding integrated cockpit displays and satellite communications to its product line, as well as a U.S.-based production and R&D facility.

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In addition to its work on helicopters, Sagem Avionics has teamed with General Dynamics Aviation Services to provide the ICDS for Gulfstream II/III, Falcon 20/50, Hawker 700/800 and Challenger 600/601-1A business jets.

Late last year, Sagem Avionics said it would triple the footprint of its Grand Prairie facility "to accommodate new endeavors." The company said staffing at Grand Prairie and Puyallup had increased by nearly 40 percent in 2006 alone.

versal FPDS retrofits for stand-up cabin bizjets, including Falcon, Hawker, Astra, Challenger, King Air and Gulfstream III aircraft. Hall estimated 20 installations will be done this year.

"We must satisfy the customer's preferences while also taking into account cockpit details such as radius, interferences, even bracketry and instrument panel structure, all of which must be certified within the STC," Hall said. "We've been known to agonize over panel layout

for several weeks in the exercise of making everything fit. And it's our experience that this attention to extraordinary detail is becoming the norm."

Ivan Wilson, vice president of engineering and business development with Stevens Aviation, Greenville, S.C., said avionics upgrades account for more than 40 percent of the company's revenue.

Stevens, an aftermarket dealer for Rockwell Collins and Universal Avionics, developed a number of retrofit packages

for Beechcraft King Air turboprops, as well as Beechjet/Hawker, Bombardier and Cessna aircraft, utilizing both Pro Line 21 and Universal Avionics equipment.

After developing retrofit packages for the Learjet 25 — Universal Avionics' large-format FPDS and single FMS with GPS, TAWS, Radio Control Unit, enhanced surveillance and Uni-Link flight information system, dual Rockwell Collins' AHRS and Honeywell Vertical Profile Radar — Stevens Aviation recognized the need for a similar package for the Lear 35/36 fleet.

For the retrofit prototype, Stevens purchased its own Learjet 35. That way, no customer would have a plane out of service during the first STC installation.

Neil McGrail, Stevens Aviation chief operating officer, said the company was actively evaluating similar STC projects for its other customers "with fleets of 10 to 50 aircraft looking to increase the percentage of on-wing time."

The Learjet 35 prototype install should be completed in the fourth quarter, he said.

McGrail reported backlogs of more than 30 King Airs slated for Universal Avionics retrofits and 25-plus Pro Line 21 retrofits into legacy aircraft. **avs**