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SPOTLIGHT:

Innovations and open systems pace FVL and the current fleet

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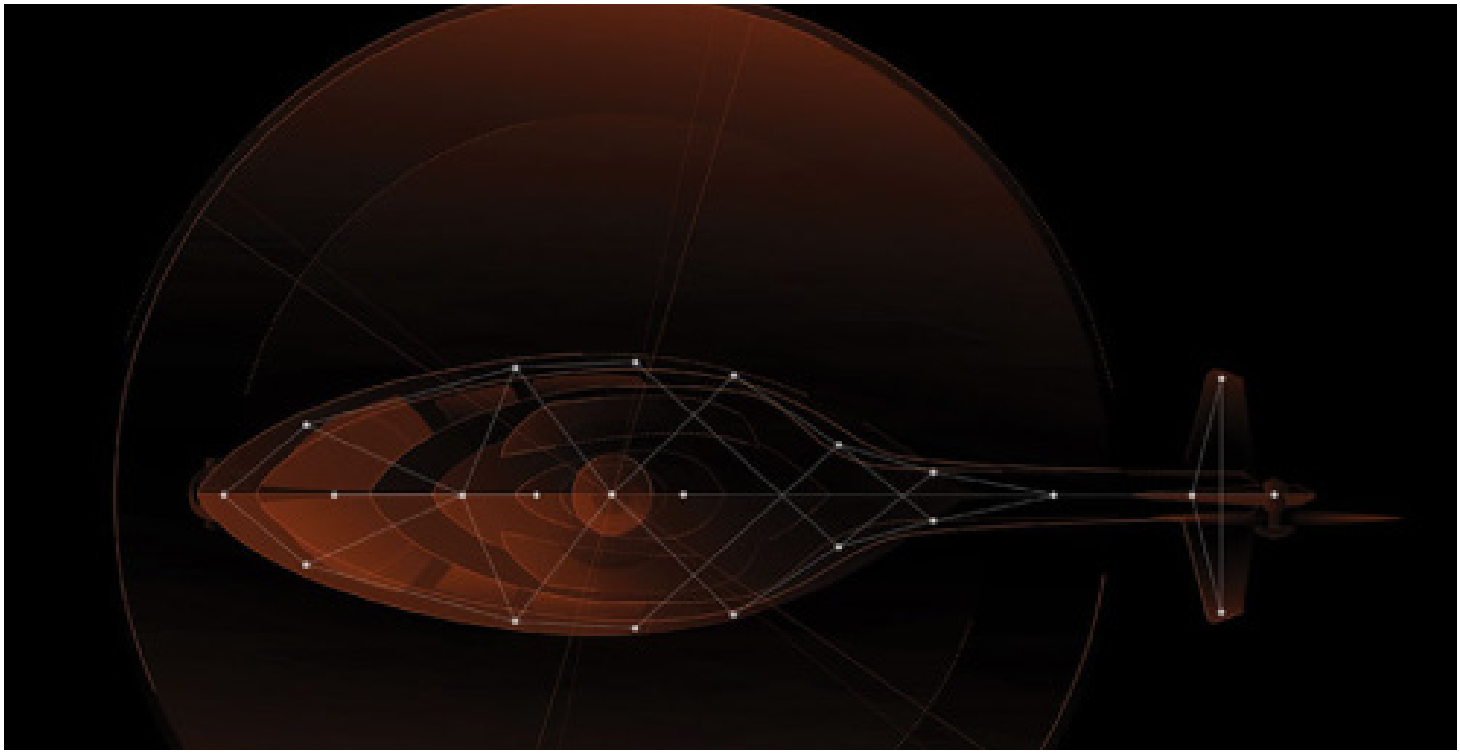


Collins Aerospace's Mosarc™ avionics solution breaks vendor lock (image courtesy of Collins Aerospace).

Innovative integration approaches and open-systems architecture can bring revolutionary improvements to the performance of FLRAA and FARA, as well as the current fleet.

With the U.S. military still flying combat helicopters designed in the 1960s and 1970s, all eyes are now on the Future Vertical Lift (FVL) program to develop new long-range assault and attack-reconnaissance aircraft. FVL is, essentially, the U.S. Department of Defense's largest military rotorcraft modernization initiative in 50 years, aiming to replace aging fleets.

In doing so, FVL seeks two new platforms with improved performance, range, speed, payload, survivability, reliability, footprint, interoperability, and supportability to enable convergence. To meet these requirements, industry has had to get creative in how systems are designed and integrated.

"The big challenge on FVL is performance," said Harold Tiedeman, technical fellow and Future Vertical Lift chief engineer responsible for technology alignment across Collins Aerospace. The two FVL aircraft under development — the Future Long Range Assault Aircraft (FLRAA) and the Future Attack Reconnaissance Aircraft (FARA) — "are being asked to do more than has ever been asked before in terms of speed, range, and capability, so we need to look at different ways of doing things."

Transforming tradition

In response, Collins Aerospace is putting a new spin on the traditional procurement model that doesn't always support integrated solutions and emphasizes standalone systems aligned with traditional OEM or DoD organizational paradigms, such as a federated flight control computer, ice protection, fire protection, or a communications system.

"We're looking at the integration of those standalone systems, each with its own tradeoffs and capabilities, from

the perspective of a system of systems, optimized for reduced weight, drag, volume, and wiring where applicable," said Luke Schmidt, director of Military Strategic Pursuits at Collins Aerospace.

Applying such a system-of-systems (SoS) approach to navigation systems, for instance, has already yielded positive results.

At one time, all navigation systems were federated, comprising a standalone Inertial Navigation System (INS) and standalone Global Positioning System (GPS) that required complex integration at the system level to create a single navigation solution, explained Tiedeman. Today, however, nearly all Army, Navy and Air Force aircraft employ, in an SoS fashion, a single embedded GPS/INS system.

"That simplifies system integration and certification and gets rid of overlapping functions like power supplies and aircraft input/output interfaces," Tiedeman added. "Now you've got a much more efficient, integrated solution that provides a better capability than those two things did when they stood alone."

Integrated and innovative

Collins Aerospace is working in a similar fashion to help the FLRAA and FARA programs meet their performance goals through the reduction of weight and drag. FARA, for example, requires that the two teams developing the aircraft fly at speeds in excess of 180 knots. For FLRAA, they're being asked to fly even faster — from 230 to 280 knots.

"Weight and drag are obviously huge elements that have to be addressed for them to be able to accomplish that," said Schmidt. "Helping with weight and drag has been a major focus of ours for FVL."

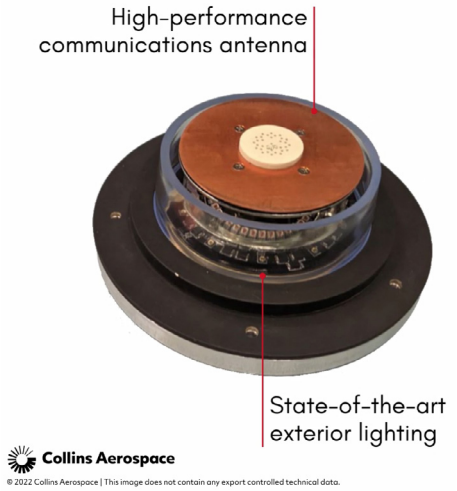
Indeed, Collins Aerospace is focused on seven key strategic areas — one of which is Integrated Solutions — to help address customer challenges. The approach empowers its product development teams to leverage technologies and capabilities across all Collins Aerospace business units and its parent company, Raytheon Technologies.

Collins and Raytheon Technologies "are working together to develop integrated offerings that incorporate the best technology from multiple product lines to deliver transformational technology and platform-wide weight and drag optimization," Tiedeman says.

One example of that is the company's successful effort to bring a light and antenna together requiring only a single aperture.

Optimizing apertures

"We've put a lot of time and energy into figuring out how we can mount an antenna on top of the light to reduce the footprint that it requires on the outside of the aircraft, while not causing interference with the antenna or the light meeting its intended objective," said Tiedeman.



In this integrated light and antenna for FVL Collins brought together an anti-collision light and a high-capacity Ku-band antenna that provides the necessary performance.

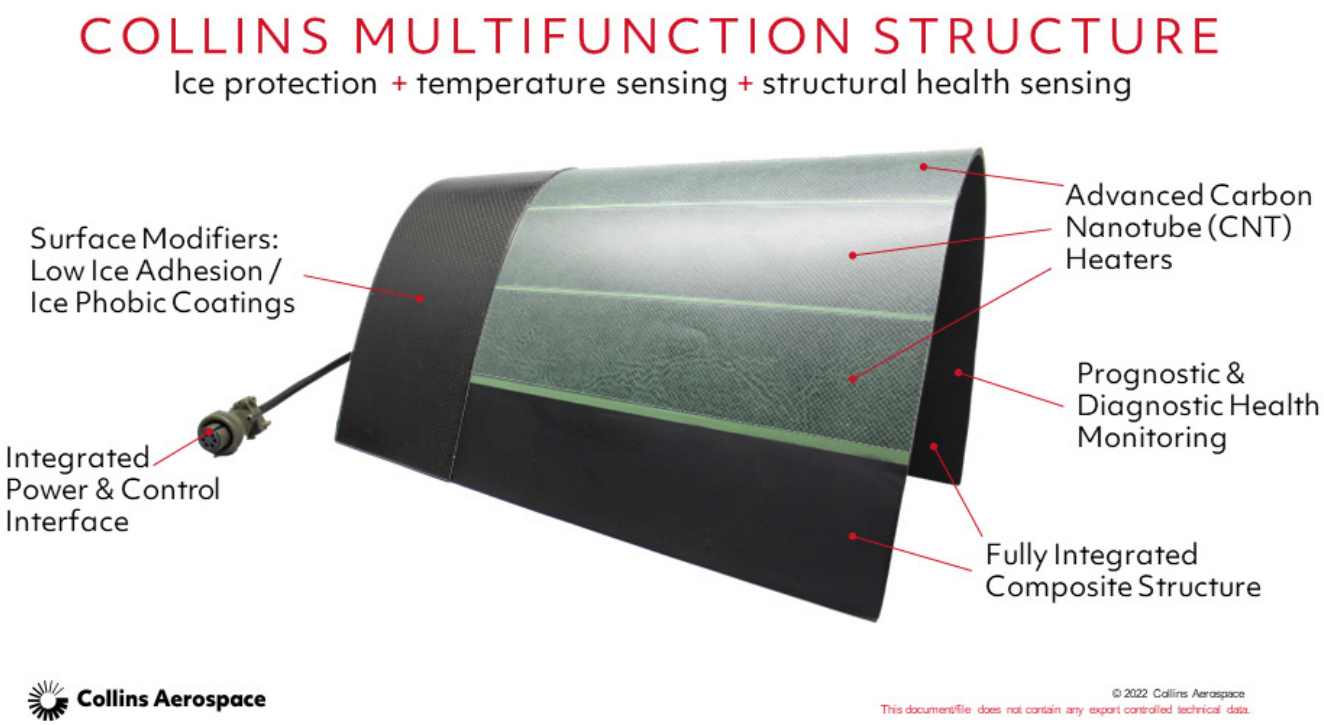
FVL's FARA, for example, sports approximately 41 different apertures just for communications and sensor applications, not including lights.

"When you look at an aircraft, it's typical that the places where lights are positioned are also strategic places for antennas," Tiedeman explains. "So, we started thinking: 'Is there a way we could bring multiple capabilities to the same space?'"

Ultimately, company engineers combined an anti-collision light and a high-capacity Ku-band antenna to deliver the performance needed in a single aperture. That, in turn, resulted in mounting one structure to the aircraft instead of two, which meant fewer attachment points. Fewer attachment points meant lower weight and fewer bumps, thus cutting down on drag.

A single innovation delivering multiple operational benefits.

"Technologies are evolving. The ability to package them together and do things in an integrated way is more possible now than it was before," Tiedeman observes. "The digital engineering infrastructure that we have and that we're constantly improving upon is an enabler for this."



The Collins Aerospace multifunction structure reduces weight by 10-15% and energy by 10-20%.

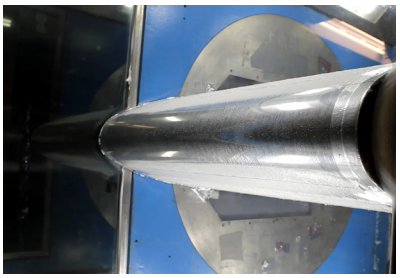
Collaborative infrastructures

The multifunction structure is another integration that Collins Aerospace developed. In this case, three different Collins businesses came together to build that structure: the aerostructures business, which has an out-of-autoclave pressurized molding capability that can form complex, composite aerostructures; the interiors business that builds carbon nanotube heaters for deicing of aircraft leading edges; and the mission systems business and its fiber-optic sensing capability for structural health monitoring and other functions.

"With a digital engineering infrastructure and the tools that we have today to develop the models, we built an integrated environment that made collaboration much easier and more powerful than it would've been 10 or 15 years ago," Tiedeman explains.

The result is a multifunction structure that combines ice protection and temperature sensing with fiber optics so that the amount of energy put into the heater can be reduced. It also doubles as a structural health sensor to monitor damage or stress on the airframe. The new structure avoids all the typical interface issues, reduces both weight and energy, and lowers cost because there are fewer parts.

"Our work here will help serve the aviation industry," Schmidt said. "That's a key part of what we do, which is to look across all our different systems and teams to help facilitate collaboration. It's transformative not only in actual systems, but also how we organize to make it happen."



The multifunction structure is seen in Collins Aerospace's ice wind tunnel de-icing the structure.

Modernizing the current fleet

Full-rate production for the first FLRAA and FARA aircraft is slated for early 2030s. With an expected production rate of 30 to 40 aircraft per year, it will take many years to establish the FVL fleet. That means FVL and current fleets will need to be interoperable for many years, and that modernization of current fleets will need to continue in parallel with FVL.

Modernizing the current fleet offers a way for the Army to test new technology for FVL and reduce risk, while also helping to ensure commonality across the Army fleet. New capabilities can be implemented in a forward-looking

manner for FVL, while upgrading current fleet capabilities and retaining the interoperability of aircraft flying for the next two to three decades, according to Ryan Bunge, vice president and general manager for Communications, Navigation, and Guidance at Collins Aerospace.

FVL will need to serve as a bridge system, interfacing with, and commanding, new systems such as Air Launched Effects while also communicating with Black Hawk helicopters and other Army systems that will persist for decades, said Christopher Bassler, senior fellow at the Center for Strategic and Budgetary Assessments (CSBA).

The ability to support both new systems and the current fleet is critical — and preferable to developing a new comms system that is not backwards compatible, he explains. It is also the fiscally responsible course of action, which helps boost affordability and reduce risk.

It is essential that the Army stay within its existing cost estimates, even as recurring supply chain challenges and high inflation erode some buying power, advises Bassler, who served as lead author of the CSBA's report, entitled *Living Within One's Means: Revisiting Defense Acquisition and Affordability, A Case Study of the Army's Future Vertical Lift Program.*

An open-architecture approach coupled with a strong plan for upgrades and enhancements later could provide an effective strategy to staying on budget. Some technologies and capabilities could be deferred for a short period of time and then incorporated as a high priority in the next recurring increments, suggests Bassler.

Open for optimization

Open systems deliver a myriad of benefits, to both new platforms and the current fleet. In fact, Army Black Hawk and Chinook helicopters employ a Collins Aerospace avionics system developed to open standards even before it became a specified customer requirement.

Today, there is a renewed focus on open systems and making sure it is done right — for the benefit of FVL and the current fleet, said Bunge.

"For FVL or any new modernization platform, it's essential to start with ensuring that you're building the platform to be appropriately open, which means that you've got to have the right digital backbone to plug into," he advised.

Collins engineers took precisely that approach with its open systems avionics offering called Mosarc™, which includes digital backbone that meets open systems standards. Mosarc ensures the separation of air vehicle and mission system equipment — and the ability to manage information exchanged between the two — to boost performance, safety, and security.

"Open systems are architected to be upgradeable and expandable right off the bat," Bunge says of Mosarc, noting Collins' 30-year legacy of pioneering open systems and involvement in standards consortiums such as OMS, OCS, FACE, SOSA, NIIA, and STANAG. Along those lines, Collins Aerospace entered into a Cooperative Research and Development Agreement (CRADA) with the U.S. Army Combat Capabilities Development Command Aviation & Missile Center in October to develop standards best practices, approaches, processes, and methods for affordable airworthiness certification of multicore processors.

Open, integrated, and innovative

The significance of the FVL modernization effort cannot be underestimated. Indeed, the CSBA report recognizes its potential to become one of the first major programs to break the trend of substantial cost growth in defense-acquisition programs, and a powerful re-envisioning of the role for rotorcraft since the last decade of the Cold War.

"If the Army can live within well-estimated means, stick to their plan, and pace advancing threats, FVL could become one of the most successful defense programs of the 21st Century," concludes the report.

Using demonstrated state-of-the-art open systems and exploring innovative system integrations — to uncover efficiencies like never before — will help the FVL program affordably develop FLRAA and FARA while meeting ambitious performance and mission goals.

Learn more: collinsaerospace.com/fvl