BIG IDEAS SMALL PACKAGES

A contract from the Rapid Innovation Fund helps eliminate tradeoffs in F-35 circuitry

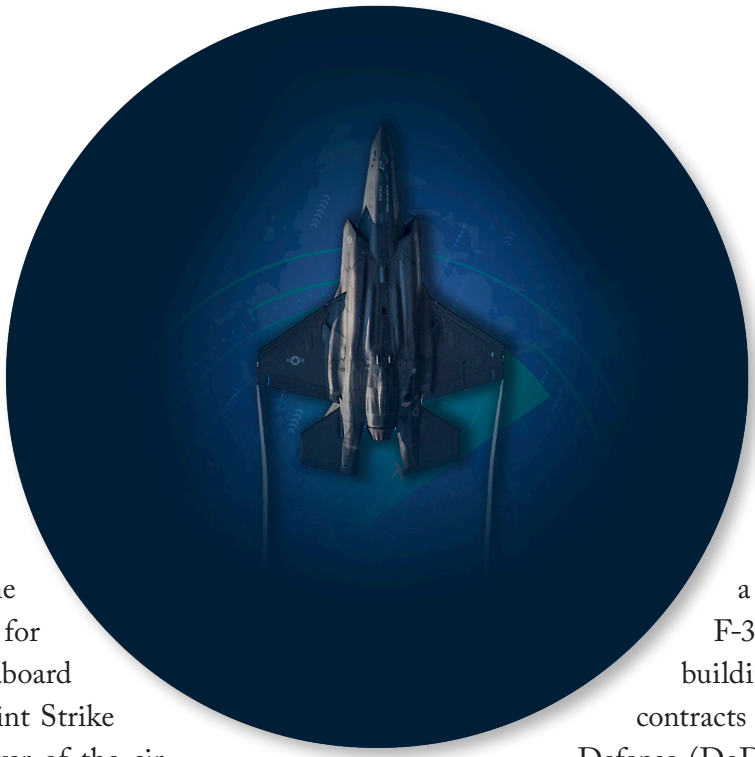


Photo of F-35 by Samuel King, 96th Test Wing Public Affairs

There are few places where space is at more of a premium than in the cramped confines of a warplane. So when the U.S. Navy began looking for ways to upgrade radar aboard the F-35 Lightning II Joint Strike Fighter, the size and power of the circuitry that powered its reconnaissance and targeting capabilities was a key consideration.

It's such a complex problem that there's a specific acronym describing the engineering trade offs involved—CSWaP, or cost, size, weight, and power. Rising to the challenge, a woman-owned small business in Colorado Springs, Colorado, took advantage of a Rapid Innovation Fund (RIF) contract to develop an integrated circuit board capable of bringing more power to a limited space aboard the F-35. In the process, and building on a lengthy history of contracts from the Department of Defense (DoD) Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs, they found other use cases as well.

"You're limited to the amount of space you have available, so maximizing the technology and the amount of compute is critical," said Greg Deemer, director of business development for Colorado Engineering, Inc.

(CEI), which received the RIF contract in 2016.

While an upgraded radar system for the F-35 was of primary concern, according to Deemer, they also "needed a node that could provide multiple types of computing solutions."

High-performance computing solutions typically involve an advanced central processor unit (CPU), a graphics processing unit (GPU), or a field programmable gate array (FPGA). CEI developed an integrated circuit that can be configured for a wide range of uses because it uses heterogeneous computing, which allows computations to be completed on a wide range of processor types.

CEI has state-of-the art design and manufacturing experience working with X86, PowerPC, ARM, GPU, and FPGA processors, and is capable of integrating these types of processors onto a single printed circuit board, or PCB. According to Michael Rodgers, business development engineer for Colorado Engineering, the challenge confronting designers had to do with the complexity of the components and the density requirements of such an airborne application. Typically, a PCB destined for a cramped space like the ones found aboard the F-35 would be able to squeeze only two or three of these components onto a single board.

Founded in 2003 by Nancy and Larry Scally, Colorado Engineering has come to have a long track record in developing cutting-edge high-performance computing solutions, including radar signal processing for both the military and commercial sectors, as well as meeting the complex networking needs of modern data centers. It has developed more than 50 unique board designs, and participated in a wide range of research funding opportunities targeted at small businesses.

Since their RIF in 2016, the company has enjoyed double-digit revenue growth and added 20 employees.

The Naval Air Warfare Center Aircraft Division, recognizing the company's capabilities, used RIF funding to award Colorado Engineering a contract to design, fabricate, and test complex boards specific to Navy needs.

Established in the 2011 National Defense Authorization Act (NDAA), the RIF program is intended to help companies, many of which had previously received SBIR/STTR awards, further mature their innovations to the point where they can be included in DoD acquisition programs. For Colorado Engineering, which had used SBIR contracts issued in 2008, 2011, and 2012 to develop technology and embedded processing solutions for military radars and unmanned aerial and ground systems, the RIF provided an entry point to the F-35 program.

Rising to the challenge presented by the Navy, CEI took state-of-the-art components and supporting architectures and managed to squeeze them onto one PCB.

"Typically, what you'd see is one or two of these processing components on a single module," Rodgers said. "We used state-of-the-art design technology and fabrication methods to fit multiple processing components onto a single PCB."

The RIF award also brought Colorado Engineering into a partnership with one of the prime contractors which plays a key technology insertion role with the F-35. The partnership helped the company "understand how our technology should be developed to integrate onto the F-35 platform," Deemer said.

Ultimately, the RIF and the resulting technology "enables the warfighter to have state-of-the-art, cutting-edge technology at their disposal," Deemer

Greg Deemer

Michael Rodgers

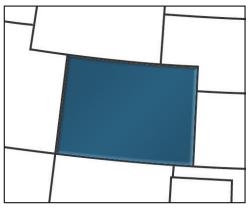
Photos this page courtesy CEI

U.S. Air Force photo/Samuel King Jr.

Space is at a premium aboard the F-35. Any change in hardware, such as the radar circuitry spearheaded by Colorado Engineering, has to take into consideration CSWaP—cost, size, weight, and power.

said. "We're going to be able to respond faster, more accurately, and better than our adversaries."

Given that the project solidified Colorado Engineering's relationship with one of the F-35's prime contractors, it further led to projects and partnerships with other divisions within the company. The complexity of the design also solidified Colorado Engineering's relationship with Tier 1 processor manufacturers. "They are now coming to us and looking for our support to develop solutions of similar complexity," Deemer said. "It really added to our credibility and our ability to develop these complex solutions and solidified our position as an industry leader in the design and development of high-performance compute."



Colorado Engineering has since been awarded a prime contract of its own for another radar technology refresh and upgrade—this one involving the Navy's SPS-49 long-range air search radar. Since their RIF in 2016, the company has enjoyed double-digit revenue growth and added 20 employees.

Deemer credits previous SBIR/STTR contracts with helping Colorado Engineering develop the capability to create high-performance embedded computing solutions which ultimately came to fruition in the F-35 through the RIF.

"You may start by developing a prototype under the SBIR channel and then leverage that technology to develop something under the RIF program," he said. "They go hand in hand, where the RIF is the next step in development. It is a great platform to help fund applications like this one."

Modernization Priority: Microelectronics
RIF Award: 2016 Air Force AFMC AFLCMC/WWB: "High Performance Embedded Graphics Processing Unit (GPU) Computing in F-35 Form Factor" (N68335-17-C-0277)
Enabling SBIRs: MDA topic MDA05-034, "Radar Advanced Receiver/Exciter (RARE)" (Phase II contract: HQ0006-08-C-7908)
Air Force topic AF093-133, "SAA Targeted Advanced Radar Technology (START)" (Phase II contract: FA8650-11-C-1070)
OSD topic OSD10-A05, "RARE with AT Systems Protector (RASP)" (Phase II contract: W31P4Q-12-C-0135)
National Defense Strategy Pillar: Force Readiness and Lethality