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Space Business

## CCDev Partners Making Progress On Commercial Crew Transport

[Aviation Week & Space Technology Sep 13, 2010](#), p. 54

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Washington

Companies bending metal with small NASA economic recovery funding  
Printed headline: Stimulating Spacecraft

Using economic stimulus funding from NASA, five U.S. aerospace companies are developing some of the technology needed for commercial human spaceflight even as they await final word from Congress and the White House on just how much support the private space transportation industry will receive.

Companies ranging from Boeing to the secretive Blue Origin startup owned by Amazon.com founder Jeff Bezos are bending metal under the U.S. space agency's Commercial Crew Development (CCDev) effort, building test hardware with a mix of their own funds and relatively modest sums of federal money made available under the American Recovery and Reinvestment Act of 2009.

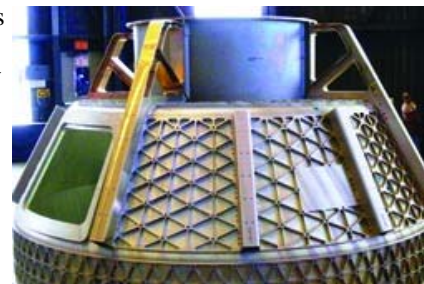
Using \$50 million in stimulus funds available in Fiscal 2010, NASA initiated the Obama administration's ambitious shift in U.S. space policy away from NASA-operated space transportation by announcing Space Act Agreements with the five companies that were designed to get the "commercial-crew" ball rolling (AW&ST Feb. 8, p. 23). Projects funded under those agreements are beginning to bear fruit, even though it appears Congress will not supply the billions originally requested in NASA's Fiscal 2011 budget to seed the new industry.

Uncertainty has been the name of the game in the U.S. space program this year, and NASA's CCDev partners are taking what they can get as a starting point for whatever comes next. "In talking to other of the CCDev contract holders, that's sort of the theme," says Taber MacCallum, CEO of Paragon Space Development Corp. "We want to stay actively engaged and keep it moving forward."

While Congress may extend the CCDev funding, MacCallum says Paragon is likely to continue its work on a plug-in air revitalization system no matter what. The Tucson, Ariz., company has the smallest CCDev agreement—only \$1.4 million—but NASA required it to add its own funding and it probably will continue to do so.

Last month, Paragon passed preliminary design review on its Commercial Crew Transport Air Revitalization System, and it is planning to finish building an engineering development unit and complete initial integrated ground tests to complete its final two CCDev milestones by the end of the year.

That sort of progress is reflected across the program, according to Valin Thorn, deputy program manager for NASA's crew and commercial cargo program at Johnson Space Center. All five companies with CCDev agreements—Boeing, Blue Origin, Paragon, Sierra Nevada Corp. and United Launch Alliance—are on track to meet most if not all of the milestones they must achieve to get paid in full. And no matter what the outcome of the broader space policy debate, Thorn and his NASA



**Boeing is using a combination of NASA CCDev funds and its own money to develop the CST-100, including this capsule engineering article. The company milled the capsule from an aluminum billet that was preformed in the proper shape. Credit: BOEING**

colleagues see the work as an important down payment on commercial crew transport.

“We fully expect that the progress made during the CCDev effort will be leveraged into the full-scale commercial crew development effort, and for many of these partners it should significantly reduce their schedule to initial operational capability,” Thorn says. “It’s going to definitely retire some key risk for them.”

The two most ambitious CCDev projects are underway at Boeing and Sierra Nevada, which both are adding what Thorn terms “significant” company money to NASA funds of \$18 million and \$20 million, respectively. Those combined funds have allowed the companies to begin work on human-rated capsules that would ride existing or planned commercial launch vehicles to the International Space Station or other destinations in low Earth orbit.

Boeing has formed a partnership with Bigelow Aerospace to develop a Crew Space Transportation capsule it calls CST-100 that would deliver crews and cargo to the ISS and Bigelow’s planned inflatable space stations (AW&ST July 26, p. 46). Under the CCDev agreement, it is building an aluminum crew compartment (photo) to validate manufacturing techniques and, after pressure testing, to anchor analytical models.

Thorn says the company adapted techniques it first developed to build Delta IV tankage, forming a billet in the shape of the capsule and then milling it into a weight-saving isogrid structure. The capsule is intended for launch on the Delta IV, Atlas V and Falcon 9 to ensure a ride will be available.

Keith Reiley, CCDev program manager at Boeing, says he is relying on his experience building commercial communications satellites for multiple launch vehicles as the company makes the human capsule workable on the different launchers. The spacecraft will be tested for the worst-case launch environments for each rocket, and fitted with adaptors designed for their specific interfaces.

Like many of the other commercial crew vehicles under development, the CST-100 will use a pusher abort system instead of a tower-mounted tractor to escape from a failing launch vehicle. Reiley says the approach is slightly heavier than a tractor, but allows the CST-100 to use its hypergolic propellants in space and is simpler and cheaper than an abort tower.

The Sierra Nevada “Dream Chaser” lifting-body vehicle also uses a pusher abort system, but it powers it with a hybrid propulsion system of nitrous oxide and a solid rubber fuel that can also be used in orbit. The company has built a composite primary structure for pressure and loads testing, and it is setting up to test its hybrid rockets at a site near San Diego “in the next few weeks,” according to Mark Sirangelo, corporate vice president for the company’s Space Systems unit.



**Sierra Nevada has built this tool to lay up the composite aerostructure for its “Dream Chaser” lifting-body vehicle by the end of the year. After that, the future of the vehicle is uncertain because the government has not decided whether it will continue the CCDEV effort. Credit: SIERRA NEVADA CORP.**

“We’re building hardware, and it’s one of those fun things after five years of working it on paper to actually be able to go out there and touch it and show some real progress,” Sirangelo says. “It’s starting to look like a real vehicle.”

Blue Origin’s work package, funded with \$3.7 million in federal stimulus money and its own investment, includes work on its own pusher abort system and a composite pressure vessel that will be based in part on similar work already done at NASA’s Langley Research Center. In addition to the stimulus money, all of the CCDev companies have received technical support and advice from experts on NASA’s payroll in what may be a harbinger for the agency’s future way of doing business in human exploration.

United Launch Alliance, a Boeing/Lockheed Martin joint venture that builds and operates the Delta IV and Atlas V, is using its \$6.7 million in CCDev funds and its own money to advance an emergency detection system that can alert a crew that its launch vehicle is failing and recommend an abort when appropriate. The software-heavy project recently used the commercial simulation facilities of the Nastar Center in Pennsylvania to measure crew reaction times to abort warnings using three test subjects and the Atlas V flight profile.

Industry lobbyists and NASA managers worry that the press of business when Congress returns later this month, combined with continued disagreements over details of a broad-brush space policy compromise between NASA’s Senate authorizers and the White House, will mean no definitive action on the future direction of NASA until sometime in the spring. Instead, the agency and its contractors would limp along under a continuing resolution that essentially maintains the status quo.

Whether that would include CCDev is unclear, although the possibility remains open. Even though Thorn and others at NASA expect this year's CCDev work to advance technology that will be needed someday, the start-stop-start nature of the government's approach to civil space development is wearing thin.

"All these people have been hired, and there's a plan in place," says Sirangelo. "It's really a shame for us to have to deal with a gap of a quarter or two where some of the companies might actually have to reverse all of the good work that's been done. Whatever the end result is, it seems like there will be some commercial program. It's just a question of how much, and when. We're really trying to encourage NASA and the government to keep these teams working and alive while they're making that decision."

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