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Commercial

NASA's choice of companies to ferry crews to the International Space Station suggests that the agency placed a premium on experience. Teal Group analyst Marco Caceres examines NASA's Commercial Crew decision in light of history and the strained U.S. relations with Russia.

ANALYSIS
BY MARCO CACERES

Looking at NASA's Commercial Crew selections, it makes sense that NASA would choose the two companies with most experience in space operations — Boeing and SpaceX — to start transporting crews to the International Space Station in 2017. Boeing stands to receive $4.2 billion from NASA to continue with development of its CST-100 capsule, while SpaceX would receive $2.6 billion to keep working on a crew version of its Dragon cargo capsule, called the Dragon V2.

NASA would have assumed unacceptable risk if it had not included Boeing, one of the U.S. government's most important legacy space launch providers. Boeing has been a major contractor on every U.S. human spaceflight program since the 1960s, namely the Saturn 5 rocket and the space shuttle program. Boeing was the prime contractor for the space station program for a quarter of a century, and it was one-half of the United Space Alliance joint venture that oversaw management and operations of the shuttle fleet for the last 15 years of that program. NASA would have had a difficult time explaining to Congress how it could have left out Boeing and all of its engineering and operational expertise.

The selection of SpaceX was also logical, given its success launching space station cargo resupply missions in recent years. Under contract with NASA as part of the Commercial Resupply Services program, SpaceX has launched five Falcon 9 rockets with its unmanned Dragon capsule to dock with the station since 2012. An obvious case could be made to support building on the track record of the Falcon 9/Dragon combination. The significant cost advantages offered by SpaceX may have given the company an additional edge. It is already well-established within the launch services industry that SpaceX is able to market its Falcon 9 at prices roughly half that of United Launch Alliance's Atlas 5 rocket.

Another indication of SpaceX's lower costs is the difference in the value of the Commercial Crew contracts. SpaceX's contract value is 38 percent lower than that of Boeing, despite the fact that the work requirements are the same. "The companies proposed the value within which they were able to do the work, and the government accepted that," Kathy Lueders, NASA's Commercial Crew program manager, said at a Sept. 16 news conference announcing the awards. The value of SpaceX's proposal was 21 percent lower than Sierra Nevada Corp.'s bid of $3.3 billion, which NASA rejected.

Quite simply, Sierra Nevada, with its winged Dream Chaser vehicle, was the odd company out. The company could not

Crew Insights

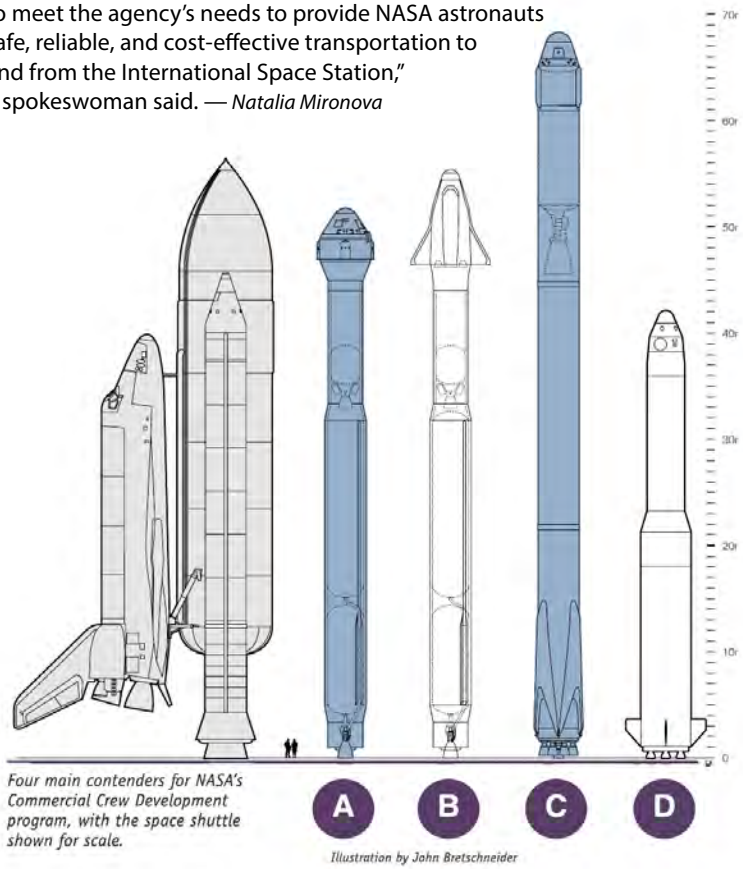
The contenders

True believers in winged space plane designs might not want to give up, despite NASA's choice to rely on capsules to carry astronauts to and from the International Space Station starting in 2017 under the Commercial Crew program. Sierra Nevada Corp. has protested that decision to the Government Accountability Office and is vowing to press ahead with its winged lifting-body Dream Chaser regardless of the outcome.

NASA expects a decision from GAO by Jan. 5, 2015. After Sierra Nevada's Sept. 26 filing, NASA told the winners — **Boeing** and **SpaceX** — to stop work on the Commercial Crew program, but retracted that order Oct. 9. NASA said it used its statutory authority to proceed with the contracts because program delays could jeopardize the International Space Station.

Sierra Nevada wants the GAO to take a fresh look at the bids, saying in a press release: "further evaluation of the proposals submitted will be that America ends up with a more capable vehicle, at a much lower cost, with a robust and sustainable future."

NASA is standing by its decision: "NASA selected the best proposals to meet the agency's needs to provide NASA astronauts safe, reliable, and cost-effective transportation to and from the International Space Station," a spokeswoman said. — *Natalia Mironova*



Four main contenders for NASA's Commercial Crew Development program, with the space shuttle shown for scale.

Illustration by John Bretschneider

A Boeing: Crew Space Transportation-100 (CST-100)

- Contract value $4.2 billion
- Weldless structure
- Reusable up to 10 times
- Up to seven crew or combination of cargo and crew
- Integrated with Atlas 5

"Boeing has been part of every American human space flight program, and we're honored that NASA has chosen us to continue that legacy," **—John Elbon, Boeing vice president and general manager for space exploration.**

B Sierra Nevada Corp.: Dream Chaser

- Winged lifting-body
- Roughly ¼ of the length of the space shuttle
- Reusable at least 25 times
- Up to seven crew
- Launches on Atlas 5 (SNC plans to partner with Stratolaunch Systems to develop a launcher for the Dream Chaser.)
- Horizontal landing on a conventional runway

C SpaceX: Dragon V2

- Contract value $2.6 billion
- Total launch payload mass 13,228 pounds
- Spacecraft payload volume 388 cubic feet
- Reusable
- Seats seven
- Three configurations: cargo, crew or DragonLab — an orbital research facility
- Integrated with the SpaceX Falcon 9 v1.1 rocket
- In 2012, Dragon became the first commercial spacecraft to deliver cargo to the space station and return to Earth

"SpaceX is deeply honored by the trust NASA has placed in us, and we welcome today's decision and the mission it advances with gratitude and seriousness of purpose." **— company statement.**

D Blue Origin space vehicle

- Biconic shape
- Reusable
- Launched with reusable first-stage booster

The company declined to provide any more information about its participation in NASA's Commercial Crew program and said it was not conducting media interviews.

Dragon V2

SpaceX

compete on experience with either Boeing or SpaceX, and it could not best SpaceX on cost. The main thing it had going for it was the unique design of its vehicle. Dream Chaser would be a reusable space plane, which although much smaller and less capable than the space shuttle orbiters, could arguably have stood the best chance of reigniting the public's fascination with human spaceflight. For all of their advantages, both the CST-100 and Dragon V2 are capsules, which gives the impression that U.S. human spaceflight has not advanced much since the Apollo era, and might even be regressing. A winged mini-shuttle with the ability to re-enter the atmosphere and glide back to earth for a horizontal landing on a runway, Dream Chaser would seem to have been the more obvious follow-on to the shuttle.

Dream Chaser

Sierra Nevada

These days, however, NASA is much more concerned about time and costs than it is about cutting-edge technology. During 1996-2001, the agency, along with Lockheed Martin Skunk Works, invested about $1.5 billion in the X-33 VentureStar technology demonstrator program to try to come up with an advanced reusable space plane to replace the space shuttle. Some industry estimates placed the cost of developing an operational VentureStar vehicle as high as $35 billion. Both the technology and cost challenges were too much for the U.S. government, and the program was canceled. NASA subsequently came up with the more modest Orbital Space Plane program, which lasted only a couple of years until it was replaced in 2004 by the Constellation program. Constellation sought to develop the Ares 1 and 5 rockets and Orion capsule, until that program was canceled by the Obama administration in 2010.

The Orbiting Space Plane was NASA's last attempt to develop a reusable space plane, and since then the agency has adopted a much more conservative and pragmatic approach to developing an American human spaceflight capability, particularly since the final mission of the space shuttle in 2011 has left NASA dependent on Russia to transport U.S. astronauts to and from the station aboard Soyuz rockets and capsules. NASA is paying about $71 million for each round trip on a Soyuz capsule. The contract extension signed by NASA with the Russians last year is worth $424 million and runs through June 2017, for a total of six round-trip flights.

The need to eliminate U.S. dependency on Russia for its human spaceflight requirements has taken on greater urgency during the past year, as political tensions between the U.S. and Russian governments have increased over the conflicts in Syria and Ukraine. The U.S.-Russian relationship, which has remained stable for more than a decade and produced a cooperative and mutually beneficial partnership in space, notably on the station, has now become unstable and unpredictable.

Economic sanctions imposed against Russia by the Obama administration over its annexation of Crimea earlier this year have led to reduced contacts between

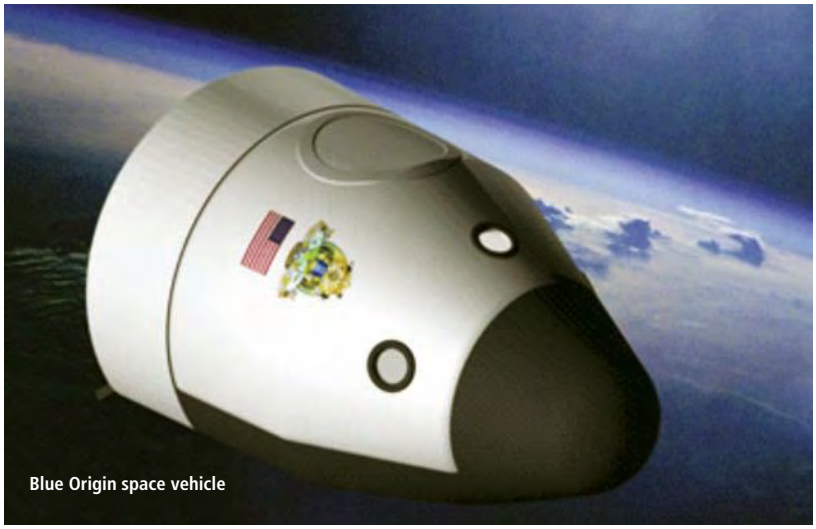
NASA and its Russian counterpart, Roscosmos. There are concerns that the government of President Vladimir Putin may block sales of critical hardware such as Russia's RD-180 liquid-fuel engine for the Atlas 5 and might even go as far as refusing to sell NASA rides to the station. Not having access to the station, while watching Russian cosmonauts travel back and forth to the $100 billion largely U.S. taxpayer-funded facility, would pose a political nightmare for the U.S. government.

It was always unlikely NASA would again invest in a reusable space plane. The existing reliance on Russia made it even more improbable. The window for having U.S. human spaceflight capability ready is too narrow now, and reusable technology is too unpredictable from both a time and cost standpoint, as well as level of difficulty.

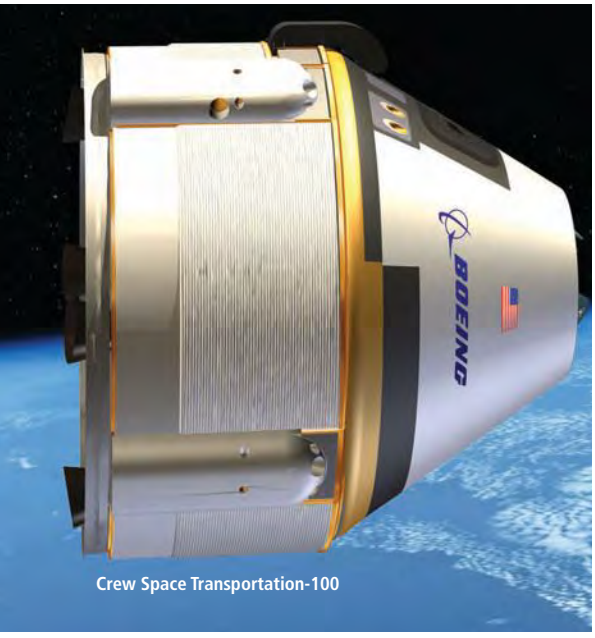
The fact that Dream Chaser, like the CST-100, was also designed to be launched by Atlas 5 rockets did not help Sierra Nevada's competitive position. If NASA was intent on picking two Commercial Crew providers, it was certainly going to go with companies that had different launch vehicles. Given that SpaceX's Dragon V2 is designed to be launched on the company's Falcon 9v1.1 rockets, the second provider had to be Boeing or Sierra Nevada. In a two-way competition against a vastly more experienced Boeing, Sierra Nevada was bound to come up short.

While NASA did state in its request for proposals that price would be the main criteria for evaluating bids (thereby making Sierra Nevada's selection protest to the U.S. Government Accountability Office reasonable), it was almost inconceivable that the agency would select two vehicles that depend on the Atlas 5. Note again that one of the primary reasons for NASA to move forward with Commercial Crew is to eliminate U.S. dependency on Russia in spaceflight. Ironically, by awarding one of the contracts to Boeing, whose vehicle uses the Atlas 5, which is powered by the RD-180 engine, a new partial dependency on the Russians is in the process of being created. Had NASA chosen the Boeing and Sierra Nevada proposals, this new dependency would be total, assuming no available replacements for the Atlas 5 or the RD-180.

Despite its perfect record of 49 successful launches since 2002, the Atlas 5 is the Achilles' heel of the Commercial Crew program, just as it is for the U.S. Air Force's Evolved Expendable Launch Vehicle rocket program. It is unclear how NASA will address this glaring problem, other than to hope that SpaceX's Falcon 9v1.1/Dragon V2 will be so superior — both in terms of performance and cost — that it will be the workhorse vehicle, while the Boeing Atlas 5/CST-100 combination will either become the backup or eventually cease to be used altogether. An alternative would be to launch the CST-100 on the Delta 4, but that would nearly triple the launch costs for NASA. Then again, NASA would have two separate and fully independent systems produced in the U.S.



Blue Origin



Boeing