



NASA's Return On Investment Report

Issue 16

July 2014



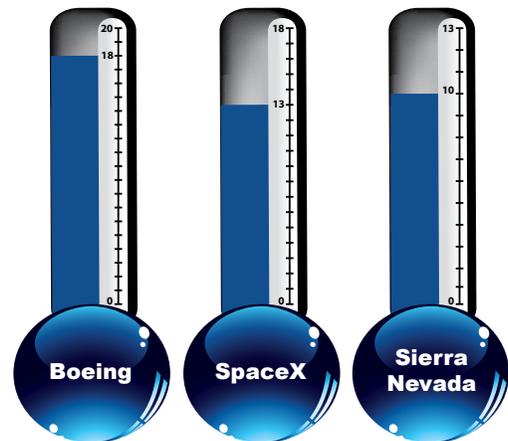
A bi-monthly newsletter of accomplishments, progress, and happenings in NASA's commercial development programs

Commercial Transportation Systems—Moving Forward

NASA's industry partners continue to move forward with their Commercial Crew integrated Capability (CCiCap) efforts, successfully completing milestones and working toward the culmination of their CCiCap Space Act Agreements. The Boeing Company is scheduled to complete its milestones later this summer. NASA has agreed to extend the terms of the Space Exploration Technologies (SpaceX) and Sierra Nevada Corporation (SNC) agreements to March 2015 allowing for completion of work associated with remaining flight testing—SpaceX an in-flight abort test and SNC a free flight test of a Dream Chaser test vehicle.

Over the past two months, several milestones are of interest:

- **Successfully Completed Milestones**
 - Boeing Software Critical Design Review
 - SNC Wind Tunnel Testing
 - SNC Main Propulsion and Reaction Control System Risk Reduction and Technology Readiness Level Advancement Testing



CCiCap milestone completion status:
Boeing, 18 of 20; SpaceX, 13 of 18;
SNC, 10 of 13.

- **Upcoming Milestones**

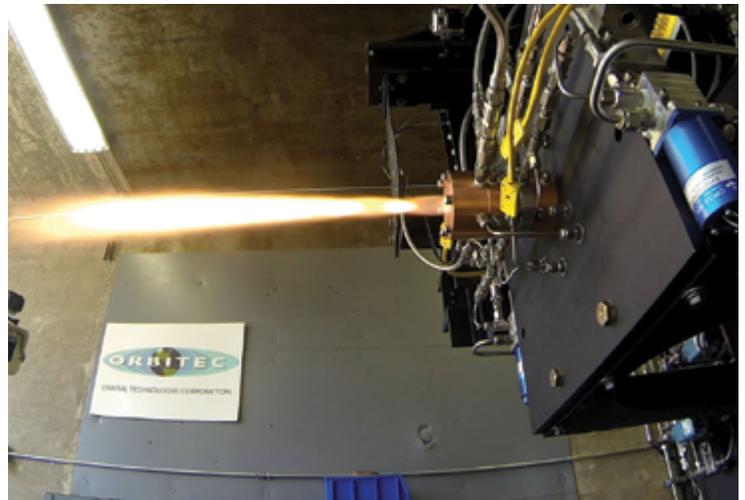
- Boeing Critical Design Review Board
- Boeing Phase 2 Spacecraft Safety Review
- SNC Risk Reduction and Technology Readiness Level Advancement Testing
- SNC Reaction Control System Testing—Incremental Test #1
- SpaceX Dragon Primary Structure Qualification

NASA's Commercial Crew Development (CCDev2) partner, Blue Origin, is working toward completing its final unfunded milestone, the Space Vehicle Subsystem Interim Design Review planned for later this summer.

NASA and industry partners also recently completed the Certification Products Contract, the first phase in the certification process that will allow U.S. commercial transportation systems to ferry astronauts to and from the International Space Station. Under the contract, Boeing, SNC and SpaceX completed reviews detailing how each company plans to meet NASA's safety and performance requirements. Later this year NASA will award the Commercial Crew Transportation Capability (CCtCap) contract(s), the second and final phase of the certification process.



In Boeing's CST-100 spacecraft mock-up, a look through the hatch shows the seat arrangement.



SNC test firing the new Reaction Control System as part of technology maturation.



SpaceX's Dragon V2 spacecraft designed to carry humans into Earth's orbit.

Conversation with Kathy Lueders, Commercial Crew Program Manager



Kathy Lueders

Q: What are your goals for the Commercial Crew Program?

A: My first goal is to help our partners safely fly crew. My second goal is to do it in the most cost-effective manner possible from an industry partner and NASA resource standpoint. My hope is that, through this, we enable a capability for others to use.

Q: How do you envision the CCtCap certification process working moving forward?

A: The CCtCap certification process is tied to the principle that we gave our partners the requirements; we will agree with them on their plans to close out our requirements; and then we need to figure out a way to have them run while we efficiently assure the requirements are met. Paper is not the product. A new certified system that will safely fly crew to the ISS is the product. We will need to work with our industry partners to find the best way to make that happen.

Q: Fifteen years from now, what do you see as the legacy of the Commercial Crew Program?

A: First, I want our legacy to be that we brought crew transportation back to the US. It will be a proud day when we launch our crews from our home and return our crews to their home. I also want us to say that Commercial Crew enabled the full usage of the ISS vehicle and, through that, amazing science. I hope to see how, by safely flying four crew and additional powered cargo to and from the ISS, we opened the doors for even further utilization of the ISS. Finally, I hope that the Commercial Crew missions will be viewed as the first small steps toward enabling commercial space to flourish and grow into areas we haven't even dreamed of yet.

Q: How do you perceive NASA's view of partnerships changing over the last several years?

A: I think we understand that this is a difficult business to be in. Spaceflight is hard and with the challenges in front of us will get harder. So we need to work together with industry to find out what partnerships, or contractual relationships, or any other new tools in our toolbox benefit both NASA and industry and ultimately move us toward our exploration and science goals.

Q: Given your experience, do you believe industry is ready to take on more exploration and utilization?

A: Smart and motivated people are everywhere—not just at NASA. We as NASA are pushing the boundaries of exploration and science; I know there are others that are out in industry pushing it, too.

Q: What attributes do you look for in commercial crew program personnel?

A: I look for people who are willing to listen and learn. I also look for people who are willing to imagine what could be but understand what needs to happen.

An Intern's View



Gautam Kanumuru

Gautam Kanumuru, a third-year computer engineering and economics student at the University of Virginia, completed a 10-week internship with the Commercial Spaceflight Development Division at NASA Headquarters. Kanumuru's primary task was to assess public-private partnerships within NASA's Human Exploration and Operations Mission Directorate (HEOMD) and provide insight on the lessons learned. During his internship, Kanumuru analyzed a half dozen HEOMD partnerships, most focused on spacecraft development. To perform the analysis, he conducted interviews with partnership managers, conducted a survey on the importance of various partnership characteristics, and developed lessons learned. The results of his survey analysis, showing the average score of "importance" for each characteristic, is shown below.

Regarding lessons learned, Kanumuru found that "Factors such as scope, goal, funding, and environment all play large roles in determining the nature of a partnership. Although there

were varying viewpoints presented throughout the interviews, the fact that all private partnerships are unique became evident. The success of any partnership is highly dependent on its ability to conform to its situation in a legal, structural, and financial way. There are no cookie-cutter solutions available for any partnership.”

In conclusion, his paper stated: “The benefits that are available from private partnerships are too large to ignore. Though there is no guarantee that every partnership will work out, it is important for the Agency to look for and foster positive characteristics in every partnership it pursues.”

According to Kanumuru, “My internship at NASA was amazing. I was lucky enough to meet some incredible people and have some very memorable experiences, all in a 10-week period. From sitting in the NASA Headquarters Control Room for a 2013 Soyuz Launch (and hearing a live feed between the Astronauts and Mission Control) to meeting former field Center directors and the Administrator of NASA, almost every day at NASA Headquarters brought something new and interesting.”

Partnership Characteristic	Average Score
One or two “champions” (forward thinkers who motivate group)	4.88
Strong leadership	4.75
Dedicated Staff (both partner and NASA)	4.63
Understanding of Objectives before start of project	4.63
Understanding who holds IP Rights	4.50
Constant Communication	4.38
Understanding of each party’s roles before start of project	4.38
Firm boundary for partnership	4.25
Known market for private companies	4.14
Proper planning for potential obstacles	4.00
Flexibility in contractual agreement	4.00
Good estimate for cost	4.00
Legal flexibility in creation of partnership	3.88
Flexible Funds	3.75
Ability to choose partners (multiple options)	3.75

Expanding Public-Private Partnerships for Space Exploration

Building on the progress of NASA’s partnerships with the U.S. commercial space industry, NASA has recently announced several new initiatives for partnerships, including: the Lunar Cargo Transportation and Landing by Soft Touchdown (Lunar CATALYST), Asteroid Redirect Mission (ARM) Broad Agency Announcement (BAA), Collaborations for Commercial Space Capabilities (CCSC), and a Request for Information (RFI) for interest in evolving ISS functions and capabilities for supply and demand in support of the development of a low-Earth orbit (LEO) commercial market. These efforts are complementary to each other and support NASA’s overall exploration implementation strategy.

NASA recently announced its selection of three U.S. companies for Lunar CATALYST Space Act Agreements (SAA): Astrobotic Technology, Masten Space Systems, and Moon Express. These partnerships will facilitate advancement of commercial lander capabilities that will enable delivery of payloads to the surface of the Moon, as well as new science and exploration missions of interest to NASA and to scientific and academic communities. There will be no exchange of funds with these agreements; however, NASA’s contributions may include technical expertise, access to Agency test facilities, equipment loans, and/or software for lander development and testing for an estimated three-year period. Additional information can be found at <http://www.nasa.gov/lunarcatalyst>.

NASA is developing concepts for the ARM, which would use a robotic spacecraft to capture a small near-Earth asteroid, or remove a boulder from the surface of a larger asteroid, and redirect the asteroid mass into a stable orbit around the Moon. To support mission formulation and reduce risk and cost, NASA selected 18 proposals for six-month studies on several topics, two of which are related to commercial spacecraft development and potential future partnerships to enable commercial activities. Study details and a full list of selected proposals can be found at <http://www.nasa.gov/content/nasa-selects-studies-for-the-asteroid-redirect-mission>.

NASA is currently also assessing proposals for CCSC partnerships, with selections to be announced later this summer. The objective of the collaborative partnerships is to advance private-sector development of integrated space capabilities so that emerging products or services could be commercially available to government and non-government customers within approximately the next five years. These no-funds exchanged SAAs will offer access to NASA’s vast spaceflight resources including technical expertise, lessons learned, and data.

Earlier this spring NASA issued a RFI to collect information on how NASA can enable greater private access, use, and applications of low-Earth orbit utilizing the ISS for commercially viable activities. The RFI provides an opportunity for NASA to learn about the interests of a range of external parties, including commercial, international, and other U.S. government sectors in the development of commercial activities and capabilities in LEO. This is a request for information only; inputs will be assessed, and NASA will determine next steps based on the best interest for the government.



The graphic above displays how these efforts fit together. The ISS RFI, Lunar CATALYST, and the ARM BAA are targeted toward more specific destinations and/or missions. The CCSC activity is broader in nature, focusing on entrepreneurial space capabilities. Taken together, these opportunities will contribute to NASA's overall exploration strategy of incremental capability development moving from low-Earth orbit to Mars.

NASA Releases Commercial Orbital Transportation Services (COTS) Final Report

The report, titled "Commercial Orbital Transportation Services, A New Era in Spaceflight," documents the work of NASA's Commercial Crew & Cargo Program Office (C3PO) between 2005 and 2013 to partner with private industry to take over more routine cargo-transportation operations in low-Earth orbit.



To download the report, please visit <http://www.nasa.gov/content/nasa-releases-cots-final-report>.

To download the latest information on the Commercial Crew Program, visit <http://go.nasa.gov/commercial-documents>

For more information on any of the articles in this report, contact Joshua Buck, Rachel Kraft, or Stephanie Schierholz in NASA's Public Affairs Office at 202-358-1100. To review NASA's other commercial space accomplishments, visit <http://www.nasa.gov/commercial/>.