Reaching New Heights and Revealing the Unknown: A Conversation with Charles F. Bolden, Jr. NASA Administrator

The United States stands at a pivotal moment in space exploration. There are plans to further extend our reach into the solar system, and the National Aeronautics and Space Administration (NASA) is leading the way. An orbiting outpost, the International Space Station (ISS), is home to a crew of astronauts from across the world that is conducting research and learning how to live and work in space. There are robotic explorers probing vast regions of the solar system, including the depths of interstellar space. NASA is also preparing for a challenging mission to capture and redirect an asteroid for human exploration—a stepping stone to the future human exploration of Mars. While NASA and its international partners strive to achieve these exploration goals, we are also witnessing the birth of a new commercial space industry.

What are NASA's key strategic goals? How is NASA expanding the boundaries of science, technology, and imagination? What is NASA doing to cultivate a risk tolerant environment? Charlie Bolden, NASA administrator, joined me on The Business of Government Hour *to explore these questions and much more. The following is an edited excerpt of our discussion, complemented with additional research.*
– Michael J. Keegan

On NASA's Evolving Mission

The United States is a world leader in the pursuit of new frontiers, discoveries, and knowledge. NASA performs a unique role in America's leadership in space. The agency has landed people on the moon, sent spacecraft to the sun and almost every planet in the solar system, and launched robotic explorers to travel beyond into [deep space].

All of the work NASA does benefits Americans and people around the world. NASA's budget is spent on Earth, supporting a strong economy and creating spinoffs that improve quality of life. Since 1958, NASA has amassed a rich history of unique scientific and technological achievements. This achievement spans into human space flight, aeronautics, science, and space applications, including the ISS, improved aircraft safety, and the launching of dozens of robotic interplanetary probes, including the first man-made object to reach interstellar space, Voyager 1.

NASA has changed significantly over time. I don't view the agency as being in competition with any other space organization. The competition today in space is among corporations and companies, so it's a commercial competition. During my five years as NASA administrator, we've tried to stoke that competition to bring the cost of launches down and enable more people to get themselves and objects into space.

The biggest hurdle for space flight is launch cost. It is what drove the market away from the United States, but with the advent of NASA'S commercial cargo program we've brought part of the market back. We now have two American companies, SpaceX and Orbital Sciences Corporation, that send

cargo to the ISS for us. That's illustrative of how NASA is evolving to meet the nation's space exploration mission.

On Strategic Vision and Key Agency Goals

We highlight three core goals outlined in our 2014–2018 NASA Strategic Plan:

- Expand the frontiers of knowledge, capability, and opportunity in space: How do we foster further exploration and development of deep space and use these discoveries to make Earth better?
- Advance understanding of Earth and develop technologies to improve the quality of life on our home planet: How do we emphasize our stewardship responsibility to this planet on which we live?
- Serve the American public and accomplish our mission by effectively managing our people, technical capabilities, and infrastructure: How do we use our people more effectively? How do we take care of them?

Our vision is: we reach for new heights to reveal the unknown so that what we do and learn makes life better for humanity.

On Challenges

NASA is a people organization. My number one challenge is to take care of our people and ensure that all NASA employees are valued, feel they're making a contribution and helping the world to become a better place. Our vision, for example, is for us to reach new heights and reveal the unknown, so that the things that we do and learn make life better for humanity. We do this every day, whether it's in aeronautics, human exploration, science, or in space technology.

The next challenge is: trying to be a mediator. I'm part of the Obama administration, but I have also chosen to be the mediator between the administration and Congress by saying,"Okay: 'we need to come together on some of these things." This role is among the most difficult for me. But if I can't bring harmony between the administration and Congress, then we won't have a robust and effective space program that remains the best in the world. To that end, I've adopted this role as one of my personal challenges.

On the ISS

The ISS is a multinational business. Our principle partners are the Russian Federal Space Agency (Roscosmos), the Japanese Aerospace Exploration Agency (JAXA), the Canadian Space Agency, and the European Space Agency, the largest partner, consisting of 22 European nations 15 to 19 of which

Photo: NASA

invest money in the operation of the ISS. Any decision about the station has to be a consensus one among these partners. The ISS, in orbit for 15 years, has been permanently occupied by humans for almost 14 years and is a model of international cooperation and collaboration.

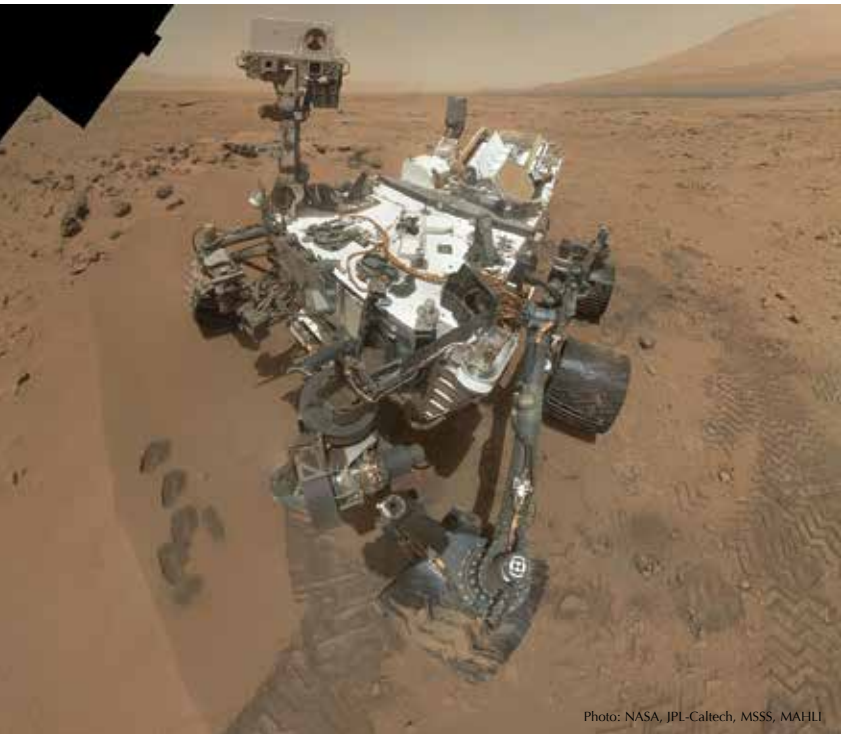
We're now using the space station to conduct testing that will enhance our understanding of the implications and challenges associated with long-term space flight on humans. We are trying to develop more robust environmental control and life support systems. Keep in mind that, a trip to Mars is an eight-month one-way trip. No supply ship will catch up with the crew with spare parts so such journeys must involve a system that's robust enough not to break or need spare parts. We're achieving this on the ISS today.

On Exploring Mars and Deep Space

We're 16 years away from putting humans on Mars. The first few missions won't land someone there, but eventually, as the president told us, he wants to see this achieved in his lifetime.

There are a number of reasons to land on Mars. The first is to understand our own planet better. The second is to see whether Mars sustains life today and if not, did it once do so and can it sustain life in the future? These are three separate but interrelated questions. If we find that the answers to all of these questions is "yes," they tell us that Mars is an alternative habitat for humanity.

When we talk about going to Mars and going to deep space, we're no longer talking merely about exploration. We're



In late October, 2012, NASA's robotic Curiosity rover stopped near a place dubbed Rocknest as it explored Gale Crater on Mars. Rocknest is the group of stones seen near the top left of the above image—just to the left of Curiosity's mast. Of particular interest was the unusually smooth patch of soil named Wind Drift seen to the left of Curiosity, which was likely created by the Martian wind blowing fine particles into Rocknest's wake.

talking about pioneering—about setting up habitats where humans can live for long periods of time. Much of this research is being conducted on the ISS.

It's worth noting that the initial habitats on Mars may not even be on the surface. Where they are to be located depends on just how harsh the radiation environment is and how much we can protect crews. We may send robotic precursors up to build subterranean habitats there. The most important priority right now is to develop the United States' capability to get our crews into space and that's the critical reason that we have a full court press on the heavy lift launch vehicle Orion.

There are also our efforts with the Mars science laboratory rover, Curiosity. It has made important discoveries. It has verified the presence of water in abundance in the form of ice. Although it hasn't found the types of organic matter or species we had hoped to detect, Curiosity has verified the presence of everything needed to create life on Mars. As it climbs Mt. Sharp, it's going to drill into the various core levels or strata where we may find a fossil or something significant. Getting it on the surface of Mars proved that the types of deceleration we used to slow down and the devices used for precision landing worked.

We have a follow-on mission that will launch in six years that we call Mars 2020. It's going to be a Curiosity-like vehicle. The science definition team of NASA and our international partners, plus members of academia and the general public, are now working to determine the scientific objectives of this mission. The number one objective will be to pull soil samples for later analysis on Earth; this has been a primary objective of the planetary science surveys for the last two decades. We have to do this to retain the support of the science community.

On the Asteroid Redirect Initiative

[As part of NASA's goal to land humans on Mars, the agency plans to test a number of new spaceflight capabilities during the next decade, in part by redirecting an asteroid's current trajectory to make it orbit the moon. The agency will then send humans to explore the asteroid.] How we'll accomplish this has not been determined. Catching it in a capture device is one potential method. An alternative approach would be to go to a big asteroid whose trajectory past earth we don't want to change and take a giant boulder from it, which we would put it into a retrograde stable orbit around the moon. NASA has identified multiple candidate asteroids and continues the search for one that could be redirected to near the moon in the 2020s. Since announcing the Asteroid Redirect Initiative in 2013, NASA's Near-Earth Object Program has catalogued more than 1,000 new near-earth asteroids discovered by various search teams. Of those identified so far, six could be good candidates for Asteroid Redirect Mission (ARM). Scientists anticipate that many more asteroids will be discovered over the next few years, and NASA will study their velocity, orbit, size and spin before deciding on the target asteroid for the ARM mission.

The ARM is one part of NASA's Asteroid Redirect Initiative. The initiative also includes an Asteroid Grand Challenge, designed to accelerate NASA's efforts to locate potentially hazardous asteroids through non-traditional collaborations and partnerships. The challenge could also help identify viable candidates for ARM.

On the Space Technology Program

We are really trying to capture a way to close the technological gap between where we are and where we want to be. NASA's ultimate goal for this nation is to put humans on Mars to conduct human space exploration. We aren't ready to achieve this yet. We face significant medical challenges,

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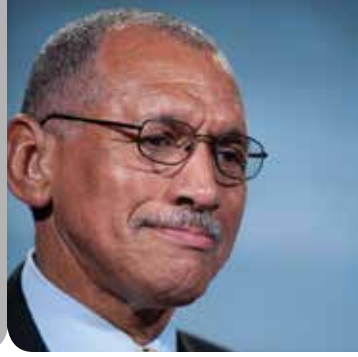


such as protecting our crews from radiation exposure. The nation's investments in space technology enable NASA to make a difference in the world around us.

NASA's Space Technology Mission Directorate (STMD) is responsible for developing the crosscutting, pioneering technologies, and capabilities the agency needs to achieve its current and future missions. The space technology program rapidly develops, demonstrates, and infuses revolutionary, high-payoff technologies through transparent, collaborative partnerships, expanding the boundaries of the aerospace enterprise. By investing in bold, broadly applicable, disruptive technology, the space technology program seeks to mature the technology required for NASA's future missions in science and exploration. It does this while also proving the capabilities and lowering the cost for other government agencies and commercial space activities.

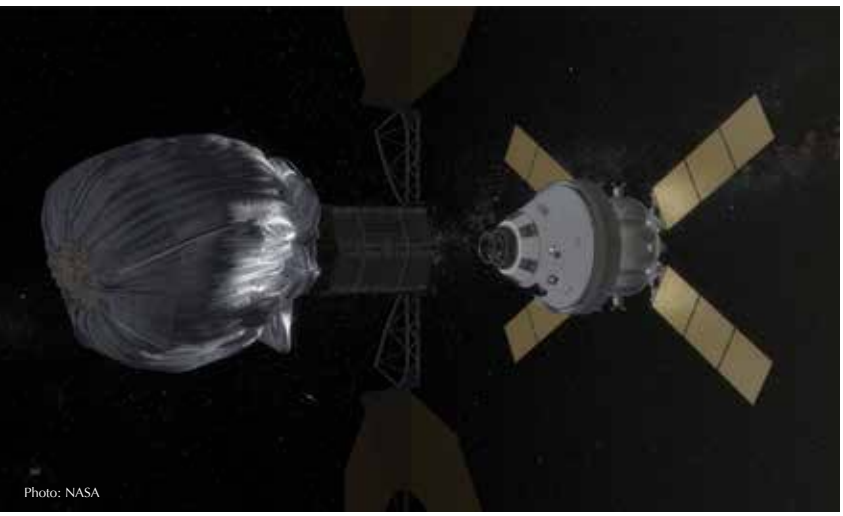


Photo: NASA

This conceptual image shows NASA's Orion spacecraft approaching the robotic asteroid capture vehicle. The trip from Earth to the captured asteroid will take Orion and its two-person crew an estimated nine days.

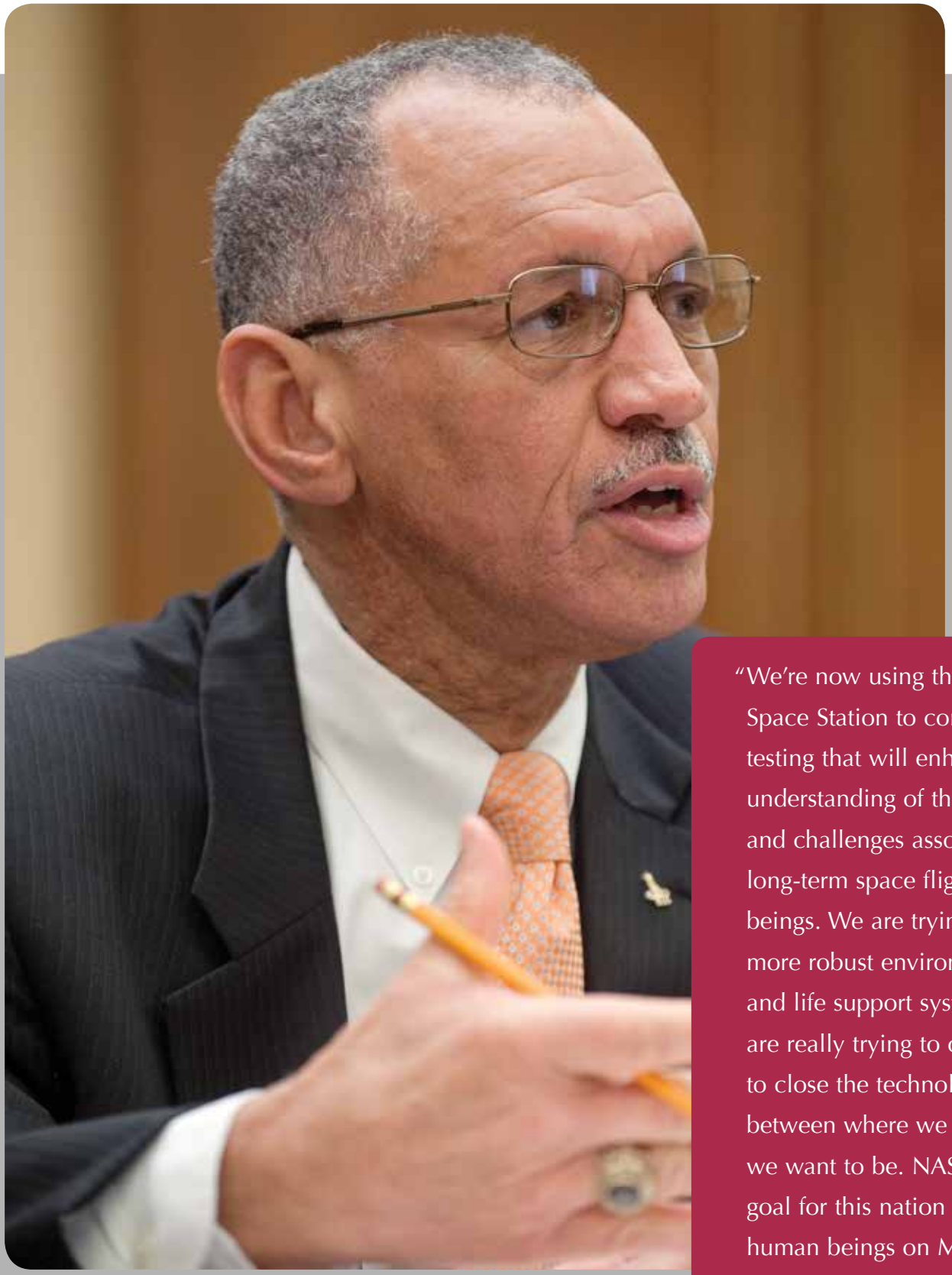
Research and technology development takes place within NASA centers, in academia and industry, and leveraging partnerships with other government agencies and international partners. The space technology program engages and inspires thousands of technologists and innovators, creating a community of our best and brightest working on the nation's toughest challenges. By pushing the boundaries of technology and innovation, it allows NASA and our nation to remain at the cutting edge. In order to stay on the cutting edge of leadership in exploration and just living here on earth, we need to be developing new technologies.

On the Commercial Space Program

Commercial space transportation is a vital component of the future of human space exploration. As NASA charts a new course to send humans deeper into space than ever before, we are stimulating efforts within the private sector to develop and operate safe, reliable, and affordable commercial space transportation systems. There are a number of changes that are already taking place and will be expanded, such as, the introduction of commercial entities in performing a critical role in space exploration. It's important for us to have a space launch system, a heavy lift launch vehicle with a crew module, along with ISS. We must also have a way to get crew and cargo to lower earth orbit because, in the future. We can't afford to come back into the gravity well of earth every time we want to go into deep space. The farther out we can establish a base from which we operate, the easier and less expensive it will be to go to deep space. We must have the infrastructure to achieve this and that's where commercial entities are going to play a key role.

On Leadership

I've led NASA as its administrator since July 2009, and no two days are alike. We have a program in which mid-and junior-level employees shadow senior leaders for a day. I've had many employees shadow me and I always tell them: "Okay you're going to get to see a totally unique day." My days are almost always very busy as you would expect leading an agency with such a significant mission. My duties



"We're now using the International Space Station to conduct testing that will enhance our understanding of the implications and challenges associated with long-term space flight on human beings. We are trying to develop more robust environmental control and life support systems…. We are really trying to capture a way to close the technological gap between where we are and where we want to be. NASA's ultimate goal for this nation is to put human beings on Mars and pursue deep space exploration."

are spelled out in our governing directives, but I consider myself to be the president's chief advisor on civil space. His chief advisor on military space is the secretary of defense, which is formally delegated to the secretary of the Air Force as the executive agent for space. The head of the National Reconnaissance Office plays a similar role within the intelligence community. The three of us form a coordinated package. We meet quarterly in what we call a summit to discuss space priorities, how we can coordinate amongst each other, and ensure that we complement our efforts.

I also view myself as the conduit for public input to the administration and Congress on the nation's space program. We pursue many activities in this area. We convene town hall meetings, hold forums, and seminars. For example, the Asteroid Redirect Initiative has been heavily influenced by public input. We put forward the basic concept and then went to the public around the world for input, which illustrates wonderfully how we are in fact a conduit for citizens' ideas to the administration and Congress.

I have my own leadership philosophy. My number one metric for success is: "If I walk away for an extended period of time will anyone know I'm gone?" If nobody knows I'm gone, then I've done a pretty good job of leadership. That's because I've built a team that knows what's expected. It knows what to do. NASA would not miss a step in my absence because I've tried my best to mold and shape it. My number one criteria for a leader is: Can you work yourself out of a job such that people are confident and knowledgeable and go forward doing the things that you would direct if you were there?

We have many managers in an organization like NASA with people who are extremely qualified and technically competent. They're among the best engineers in the world, but they may not be able to lead at all. There's a big difference between management and leadership. In fact, I changed our performance appraisal system with an emphasis on two things that are most important: leading people and influencing change. If you can't do those then, in my book, you're not a very good leader because everybody needs somebody to get behind and follow. If you don't know how to follow, you can't lead anyone because you won't know what is expected of you. Leading people and influencing change are two of the critical aspects for me as a leader. ◘

NASA Administrator Charles F. Bolden (front center) discusses the Asteroid Initiative at NASA's Jet Propulsion Laboratory, Pasadena, Calif., in one of the laboratories where engineers are testing and developing advanced spacecraft engine technology. The Asteroid Initiative is a proposal to robotically capture a small near-Earth asteroid and redirect it safely to a stable orbit in the Earth-moon system where astronauts can visit and explore it. Behind Bolden, from left to right, are JPLers Brian Muirhead, chief engineer; Firouz Naderi, director of the solar system exploration directorate; John Brophy, electric propulsion engineer; Don Yeomans, manager of the Near-Earth Object Program Office; and Paul Chodas, a scientist with the NEO office. The small circular object just to the right of Muirhead is a model of an ion engine similar to what is being developed for the Asteroid Initiative.

To learn more about NASA, go to NASA.gov.

To hear *The Business of Government Hour's* interview with Charles F. Bolden, Jr., go to the Center's website at www.businessofgovernment.org.

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