

**Moon Landing to Mars Exploration:  
The Role of Small Business in America's Space Program**

**Statement of**

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**Before the**

**U.S. Senate Committee on Small Business and Entrepreneurship**

Chairman Rubio, Ranking Member Cardin, members of the Committee on Small Business and Entrepreneurship—thank you for inviting me here today to discuss the incredible impact that American small businesses are making across the country within the space and aeronautics industries.

On March 26, 2019, the Vice President announced at a meeting of the National Space Council in Huntsville, Alabama, that, at the direction of the President of the United States, it is the stated policy of the United States of America to return American astronauts to the Moon within five years. When the first American astronauts return to the lunar surface, they will take their first steps on the Moon's South Pole. We will use what we learn on the Moon to take the next giant leap – sending astronauts to Mars.

Tomorrow we celebrate the 50<sup>th</sup> anniversary of the Apollo 11 mission landing on the Moon. At this point in 1969, astronauts Neil Armstrong and Buzz Aldrin were preparing the lunar-landing module for their historic trip to the surface. Now, we have another historic lunar landing ahead of us, in the form of Artemis 3, which will land the next man and the first woman on the surface of the Moon in 2024. This bold mission will require new, revolutionary technologies and capabilities, and NASA will look to American small businesses to create many of these. At NASA, we like to say: technology drives exploration. And as we all know, American small businesses and entrepreneurs drive innovation, transformation, and economic prosperity. Our path returning to the Moon and forward to Mars will go through literally hundreds of small businesses all across this great nation.

NASA believes the next economic revolution will happen in space, and the United States must play a leading role if we are to empower future generations and secure our nation's long-term prosperity. An emerging space economy built on scientific research, technology advancements including both low-Earth orbit and lunar commercialization, will empower countless future generations and create new jobs and industries. The investment in NASA's Moon to Mars exploration is already providing direct economic benefits and creating a variety of jobs across the country. In fact, more than 3,000 companies—many of them small businesses—in all 50 states are already doing work to support Artemis missions.

NASA's Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) programs are key components of the Agency's technology portfolio and are managed by NASA's Space Technology Mission Directorate (STMD). STMD's investments target crosscutting technologies that benefit both human and robotic exploration, actively engaging with internal NASA organizations, industry, academia, and other federal government agencies to help define investment content. Through a combination of unique in-house activities, procurements, research announcements, and public-private partnerships, STMD investments develop and test technologies that drive space exploration.

As the Program Executive for SBIR/STTR programs at NASA, I have the privilege of overseeing programs designed to encourage small businesses and research institutions to develop innovative ideas

that meet the specific research and development needs of the federal government—and have significant potential for commercialization. Since the formalization of the SBIR program in 1982, NASA’s SBIR/STTR programs have made awards to small businesses in all 50 states and Puerto Rico. And since 2011, when the SBIR/STTR Reauthorization Act increased the required funding allocation, our programs have funded an annual average of \$139 million in Phase I and Phase II contracts, making an average of 355 and 145 of these foundational awards, respectively, to deserving small businesses and entrepreneurs every year. With these awards, we fund an exciting frontier of technology interests across NASA including human exploration, space technology, science, and aeronautics related investments.

On behalf of the NASA SBIR/STTR programs, we are honored by the genuine commitment that members of this committee have shown to American small businesses. Chairman Rubio, we were especially pleased to read your June statement, applauding not only the \$45 million investment NASA will make this year through our Phase I awards, but more broadly, the critical role that the SBIR/STTR programs play in helping small businesses access federal research and development funding. As I mentioned earlier, technology drives exploration, and we are proud to be working with you and your fellow committee members to help connect the most innovative small businesses in the country with the funding and support needed to shape their technologies into those that can change the trajectory of American space exploration and boost the country’s economy.

I have personally been working on innovation-driven growth in America for over a decade, having led efforts both at NASA and the White House Office of Science and Technology Policy to involve more Americans in innovation through a number of cutting-edge business practices including grand challenges, prizes and challenges, citizen science and crowdsourcing, citizen assessments of technology, and now SBIR/STTR. And what is common to all these practices? That innovation can come from anywhere—and it is our job to shine a spotlight on and resource the best ideas so they have a chance to succeed and be the next breakthrough company or product. History has proven that many inventions revolutionary ideas have stemmed from small businesses and entrepreneurs—and our programs have found no exception.

NASA SBIR/STTR awardees have played a central role in nearly all of the agency’s programs and missions—including the International Space Station (ISS), the Mars Curiosity Rover, and Juno. For example, one of our awardees has made great use of the ISS facility in developing commercial space capabilities. Made in Space, a 24-person, California-based company that has an office in nearby Jacksonville, Florida—is partnering with NASA to bring 3-D printing to the ISS and establishing itself as the first commercially available manufacturing service in space. These efforts have the potential to help revolutionize in-space servicing, assembly, and manufacturing—and can be leveraged for NASA’s future missions. Currently, the SBIR/STTR programs are working with small businesses on their research and development to contribute to landing the first woman and next man on the Moon by 2024, followed soon thereafter by landing the first Americans on Mars. Astrobotic, a space robotics company headquartered in Pittsburgh, Pennsylvania, was one of several companies selected by NASA to deliver demonstration payloads to the Moon under the agency’s Commercial Lunar Payload Services (CLPS) contracts. Astrobotic is a successful, multiple SBIR/STTR awardee and has been expanding operations and growing its team thanks, in part, to the 16 NASA SBIR/STTR contracts it has been awarded since 2010.

As our nation reflects on the 50<sup>th</sup> anniversary of Apollo 11 and works toward a return to the Moon’s surface, we at NASA recognize that we are in a new era of space exploration, one anchored by an emerging commercial space sector that includes cutting-edge companies growing and innovating at a faster pace than ever before. This evolution presents opportunities for NASA SBIR/STTR to invest in and support this ecosystem in even more meaningful ways.

## **The Unique Impact of NASA's SBIR/STTR Programs**

U.S. small businesses working in the aerospace industry are unique in their needs, and we are constantly striving to innovate our programs to better assist the community of small businesses that we serve. We view our programs as having a dual mandate, focusing not only on advancing research relevant to NASA where NASA is the primary customer, but also acting as early stage seed funding for promising high-growth commercial space ventures where NASA is not the first—or the only—customer.

- The first objective is to further relevant research for NASA, the commercial aerospace industry, and the nation as whole. As I mentioned, SBIR/STTR awards have been key to previous space missions by providing awards to small businesses whose technologies have been used for space exploration. For example, six innovations advanced by the SBIR/STTR programs were used on the Mars Curiosity rover, including gearboxes for the robotic arm, lithium ion batteries, and software for rover operations. In addition, the SBIR/STTR programs provided awards for several technologies used on the ISS, including a universal battery charger, a deployable vegetable production system, a permanent additive manufacturing facility, and a device that can be used to recycle plastic waste and repurpose it via 3-D printing.
- The second objective is to stimulate technological innovation and increase the commercial application of research results. Each year, approximately 27% of the new technologies reported to NASA as new inventions through the technology transfer program are from SBIR/STTR, many of which go on to commercial markets. From life-saving sutures made of materials designed for Mars to spacesuit air filters that eliminate household pet odors, one of the greatest outcomes of the SBIR/STTR programs is the ingenuity that comes from small businesses that not only make it to space and back here to benefit us on Earth.

To fulfill these dual objectives, we encourage diverse participation—including first-time recipients and underrepresented communities like minority and women-owned businesses—and strive for a balanced portfolio of investments. We know the many companies that seek to work with NASA take several forms, such as those that are high-growth oriented and are seeking to capture aerospace markets outside of NASA, those that are looking to be reliable small business suppliers of innovative research and development (R&D) to NASA, and those that are hoping to become subcontractors and eventually prime contractors themselves. We've established our role in the aerospace innovation ecosystem by meaningfully interacting with each of these groups and supporting modern technologies, successful companies, and commercialized products.

This role is particularly important because the space industry can be a hard place for small businesses to work, requiring a significant investment of time, expertise, and resources to scale up. While many small businesses have achieved great success, it does not happen overnight. For example, Aurora Flight Sciences was selected for its first NASA SBIR award in 1990 and continued to work with the program for 26 years, until being acquired by Boeing in 2017. Another 26-year NASA SBIR partner and recent notable acquisition, Honeybee Robotics, became a stand-alone, wholly-owned subsidiary of Ensign-Bickford Industries in 2017. For companies such as these, we serve as an important source of R&D funds and a forward-leaning resource available to small businesses looking to launch and scale their innovative products and technologies. These companies have leveraged their SBIR/STTR success to develop breakthrough technology and become industry leaders.

While we are proud of the strong, consistent partnerships that our programs have established with innovative small business partners across the country, we know that to increase our effectiveness by an order of magnitude, we need to evolve to meet the growing needs of the new space industry, which is seeing more entrepreneurial space firms emerge than ever before. According to the fourth in a series of Bryce reports on the start-up space ecosystem: "Since 2000, more than 220 angel and venture backed space companies have been founded and funded... In the early 2000s, an average of four funded space

companies were started per year; in the last six years, the number of funded new companies have averaged 21 per year.” We believe there is a continued need in the industry for a reliable government source of non-dilutive seed funding to support companies in the space industry.

SBIR/STTR funding plays several important roles for many of these emerging space companies: providing funds to help them to get started and reduce the risk of their technologies; helping companies to attract private investment thanks to the credibility signal that NASA funding provides; and enabling small businesses to use their awards to identify customers within the aerospace industry. According to a recent Space Angels report funded by NASA, “SBIR/STTR programs awards are the most common forms of public funding for entrepreneurial space companies that are eight years and younger, accounting for 44% of all awards.” NASA’s SBIR/STTR programs are critical in seeding the growing, emerging commercial space ecosystem, while also bearing responsibility in providing the patient capital for small businesses to succeed in bringing their innovative technologies to market in a high-cost industry.

### **Importance of SBIR Program Flexibility to Establishing a Sustainable Space Economy**

One of the most beneficial features of the Small Business Act and its subsequent reauthorizations is the built-in flexibility for federal agencies to customize the design of their programs to each agency’s unique mission. As such, NASA’s SBIR/STTR programs have taken on a distinct, effective structure to accommodate the nature of the aerospace industry, while sharing objectives and best practices with other agency’s programs as applicable. Within our programs, we are conscientious about the need to strategically consider the markets we are creating to sustain our small business awardees. Given that NASA typically only needs a few units of a commercialized technology, the company often must find customers beyond NASA to survive and grow. As such, we see a benefit in developing technologies with an infusion path not only to our agency but also potential for future spinoffs with agencies or industries such as defense and energy.

Not only have NASA’s SBIR/STTR programs been able to put in place a foundational structure that works for the unique needs of small businesses in the aerospace sector, but the programs have been able to continue to evolve over the last several years because of the flexibility afforded to us through the reauthorizations. The administrative pilot program has been particularly enabling for NASA. For example, we have been able to apply needed funding to administrative enhancements, such as modernizing our IT system for the first time in nearly a decade. Through this modernization, we have effectively reduced the level of effort placed on small businesses to submit proposals by making the submission process more intuitive. As the Committee heard in May from the Small Business Administration, reducing this barrier to entry is a shared priority of all SBIR agencies.

Our goal is to not only help U.S. small businesses break into the government sphere, but to provide the individual support and guidance that they need to continue growing and innovating after our standard funding phases have concluded. To this end, for the last three years, we have utilized a portion of the administrative funding authority to offer I-Corps training to a small cohort of Phase I awardees. Participants hold the I-Corps training, offered through partnership with the National Science Foundation, in high regard for its value helping them to identify customers and develop their business strategy. According to one small business lead, “it has helped us successfully raise over \$2 million in funding, but more importantly, it helps guide us to clarify our value propositions, and gives us the confidence to keep making progress into an unknown market.”

Also, with the funding made available through the administrative pilot program, NASA also collaborates with the SBA to present and participate in its SBIR Road Tour, a national outreach effort to increase program access and awareness. This year, NASA will join SBA and other agencies at all 16 planned road

tour stops, including this November in Miami and Puerto Rico. NASA SBIR/STTR is an active collaborator with NASA's Office of Small Business Programs (OSBP) and Office of STEM Engagement (OSTEM) in presenting the NASA HBCU/MSI Technology Infusion Road Tour, which already visited Tuskegee University earlier this year and travels to New Mexico State University next month. This series of events, now in its fourth year, provides an open platform for representatives of Historically Black Colleges and Universities and Minority Serving Institutions to learn about NASA's Mentor-Protégé Program (MPP), SBIR/STTR opportunities, OSTEM's grant and cooperative agreement opportunities as well as science research opportunities, grants, fellowships and contracts.

Additionally, our annual industry day has been a highly effective use of administrative funding. Our first industry day, piloted in 2016, has evolved over the last two years into a public-private partnership focusing in large part on educating small businesses experienced with SBIR/STTR awards about various transition opportunities post Phase II within and outside the agency to advance technology, and connecting them to customers and other funding programs. The 2018 Innovation and Opportunity Conference provided significant value to participants through two days of interactive programming, including 212 one-on-one meetings between small businesses and NASA SBIR/STTR, other NASA programs, as well as DARPA, US Air Force, DoE, and USDA. Encouraged by feedback that most participants made a connection that may lead to a new business opportunity, we will be returning to Aurora, Colorado this November for a second conference, and intend to continue these events in the foreseeable future.

Finally, leveraging a different pilot program authority, the Civilian Commercialization Readiness Pilot Program (CCRPP), NASA's SBIR/STTR programs also provide additional research and development funding after Phase II to support transitions and commercialization to Phase III. By requiring matching funding for several of these opportunities, NASA's post-Phase II funding catalyzes investments by other investors and customers to commercialize research to Phase III.

## **Conclusion**

We are living in exciting time—a time that will see American astronauts return to the Moon's surface and explore farther than they ever have before. But NASA can't do this alone. Our programs will continue to look to the brightest minds and most innovative ideas in our country's small business community to bring Americans to the Moon, to Mars, and safely back home again.

We also know that we cannot do this without the support of Congressional members and committees like this one. By including qualified small businesses in the nation's R&D investments, high-tech innovation is stimulated and the U.S. economy grows as agencies meet their specific research and development needs.

Thank you for your continued support of NASA. Our programs welcome the opportunity to be a resource to the Committee on current and future matters related to the R&D being done by American small businesses in partnership with our agency, and we look forward to additional conversations around the critical role that these small businesses and entrepreneurs are playing in the nation's space exploration.