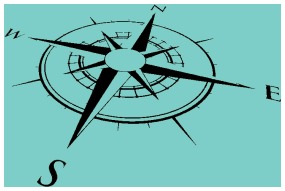
NASA 2018 Strategic Plan

NASA inspires the world with our exploration of new frontiers, our discovery of new knowledge, and our development of new technology. Our work benefits Americans and all humanity. Since NASA's inception in 1958 to present day, the Agency's history is written with each unique scientific and technological achievement. We have landed people on the Moon, visited every planet in the solar system, touched the Sun, and solved some of the core mysteries of our home planet. Today, our Nation's economic prosperity, National security, and cultural identity depend on our leadership in aeronautics, space exploration, and science. NASA accepts the challenge to continue our legacy of achievement and greatly expand the benefits we provide to mankind. Our success will be determined largely by the planning and investments we undertake today. This commitment is what drives our Vision, Mission, and overarching approach that form the core of our 2018 Strategic Plan.

We strive to accomplish our Vision and Mission with the utmost care — recognizing that we are stewards of taxpayer dollars, critical human capital, and one-of-a-kind facilities. With guidance from the White House, NASA will lead a new era of space exploration and advancements for our Nation. This plan outlines the strategic direction, goals, and priorities we will pursue to make this Vision of the future a reality. We have identified four strategic goals that will strengthen NASA's ability to accomplish its Mission and contribute to U.S. pre-eminence in space exploration, science, technology development, and aeronautics — all to the benefit of the American economy. Each strategic goal, as well as their corresponding strategic objectives, is outlined below and discussed in detail in the following section of this plan.

Contents



National Aeronautics and Space Administration (NASA)

Stakeholder(s):

Robert M. Lightfoot, Jr. :
Acting Administrator

Science Mission Directorate (SMD) :
The Science Mission Directorate (SMD) expands the frontiers of Earth science, heliophysics, planetary science, and astrophysics. Using robotic observatories, explorer craft, ground-based instruments, and a peer-reviewed portfolio of sponsored research, SMD seeks knowledge about our solar system, the farthest reaches of space and time, and our changing Earth.

Aeronautics Research Mission Directorate (ARMD) :
The Aeronautics Research Mission Directorate (ARMD) transforms aviation with research to dramatically reduce the environmental impact of flight, and improves aircraft and operations efficiency while maintaining safety in increasingly crowded skies. ARMD also generates innovative aviation concepts, tools, and technologies for development and maturation by the aviation community.

Space Technology Mission Directorate (STMD) :
The Space Technology Mission Directorate (STMD) pursues transformational technologies that have high potential for offsetting future mission risk, reducing cost, and advancing existing capabilities. STMD uses merit-based competition to conduct research and technology development, demonstration, and infusion of these technologies into NASA's missions and American industry. This mission directorate is being refocused as a new Exploration Research & Technology (ER&T) organization to support exploration as a primary customer.

Human Exploration and Operations Mission Directorate (HEOMD) :
The Human Exploration and Operations Mission Directorate (HEOMD) leads human exploration in and beyond low Earth orbit by developing new transportation systems and performing scientific research to enable sustained and affordable human life outside of Earth. HEOMD also manages space communication and navigation services for the Agency and its international partners.

Mission Support Directorate (MSD) :
The Mission Support Directorate (MSD) enables the Agency's missions by managing institutional services and capabilities. MSD is actively reducing institutional risk to NASA's current and future missions by improving processes, stimulating efficiency, and providing consistency and uniformity across institutional standards and practices.

Administrator's Staff Offices :
The Administrator's Staff Offices lead the Agency by providing guidance and direction that cuts across all of NASA's work. These offices represent the Administrator with respect to safety and mission assurance, managing the workforce and its diversity, overseeing the acquisition and use of information technology, conducting financial and procurement operations, as well as coordinating international partnerships, legislative affairs, and STEM activities.

Office of Inspector General (OIG) :
The Office of Inspector General (OIG) promotes economy, effectiveness, and efficiency within the Agency by conducting independent and objective audits, investigations, and evaluations of Agency programs and operations. The OIG safeguards taxpayer dollars and the integrity of the Agency by detecting and preventing fraud, waste, and abuse.

NASA Centers :
FIELD CENTERS AND FEDERALLY-FUNDED RESEARCH AND DEVELOPMENT CENTER STRATEGIC GOAL CONTRIBUTIONS

Armstrong Flight Research Center (AFRC)

Ames Research Center (ARC)

Glenn Research Center (GRC)

Goddard Space Flight Center (GSFC)

Jet Propulsion Laboratory (JPL)

Johnson Space Center (JSC)

Kennedy Space Center (KSC)

Langley Research Center (LaRC)

Marshall Space Flight Center (MSFC)

Stennis Space Center (SSC)

Vision

TO DISCOVER AND EXPAND KNOWLEDGE FOR THE BENEFIT OF HUMANITY.

Mission

LEAD AN INNOVATIVE AND SUSTAINABLE PROGRAM OF EXPLORATION WITH COMMERCIAL AND INTERNATIONAL PARTNERS TO ENABLE HUMAN EXPANSION ACROSS THE SOLAR SYSTEM AND BRING NEW KNOWLEDGE AND OPPORTUNITIES BACK TO EARTH. SUPPORT GROWTH OF THE NATION'S ECONOMY IN SPACE AND AERONAUTICS, INCREASE UNDERSTANDING OF THE UNIVERSE AND OUR PLACE IN IT, WORK WITH INDUSTRY TO IMPROVE AMERICA'S AEROSPACE TECHNOLOGIES, AND ADVANCE AMERICAN LEADERSHIP.

1. Discovery

EXPAND HUMAN KNOWLEDGE THROUGH NEW SCIENTIFIC DISCOVERIES.

Stakeholder(s)

NASA Programs :
Contributing Programs (or Projects)

Cosmic Origins

James Webb Space Telescope

Exoplanet Exploration

Physics of the Cosmos

Mars Exploration

Outer Planets

Astrophysics Research

Astrophysics Explorer

New Frontiers

Discovery

Planetary Defense

Planetary Research

Heliophysics Explorer

Heliophysics Research

Living With a Star

Solar Terrestrial Probes

Earth Systematic Missions

Earth System Science Pathfinder

Earth Science Research

Earth Science Multi-Mission Operations

Applied Sciences

Earth Science Technology

Planetary Technology

Suborbital Research :
[budget reported as part of other programs]

NASA's enduring purpose is scientific discovery and exploration for the benefit of the United States and humanity. For almost 60 years, NASA's discoveries have been inspiring the world, rewriting textbooks, and transforming knowledge of humanity, the planet, the solar system, and the universe. NASA's missions have not only changed what we know, but also how we think as a society — truly civilization-scale science. NASA's missions and sponsored research provide access to the farthest reaches of space and time and deliver essential information about our home planet, directly improving life here on Earth. Together, scientific discovery and human exploration improve and safeguard life on Earth. For example, Earth science research improves our weather forecasts and predictions of catastrophic events. Medical treatments have resulted from NASA studies on the effects of flight and low-gravity on

the human body. Furthermore, NASA's technology developments contribute to economic stability and growth. Scientific research is also opening the pathway for exploration and robotic-human partnerships. NASA's James Webb Space Telescope (Webb) is poised to be the premier observatory of the next decade — unlocking the mysteries of the universe for humankind. The International Space Station (ISS) is an orbital outpost for humanity. It is a blueprint for global cooperation and scientific advancement, a catalyst for growing new commercial marketplaces in space, and a test bed for demonstrating new technologies. It extends where humankind lives and is the springboard for NASA's next great leaps in human space exploration, including future missions to the Moon and beyond. Finally, NASA acts as a champion of free and open access to scientific data. The Agency's work incorporates and builds upon the work of others in a spirit of global engagement and diplomacy. As more nations seek to use space for scientific investigation, the body of knowledge grows for the benefit of all.

1.1. Sun, Earth, Solar System & Universe

Understand the Sun, Earth, Solar System, and Universe.

Conduct scientific studies of the Earth and Sun from space, return data and samples from other bodies in the solar system, peer out into the vast reaches of the universe, and play a catalyzing role in lunar robotic exploration by supporting innovative approaches to advancing science. These efforts are guided by National priorities and recommendations from the National Academies' decadal surveys and implemented through a balanced portfolio of programs. — Objective Overview: The success criteria for SMD are progress in answering fundamental science questions, implementing the decadal survey priorities, and responding to direction from the Executive Branch and Congress. The most recent versions of the decadal surveys for SMD can be found at:

- Planetary Science
- Solar and Space Physics
- Earth Science and Applications
- Astronomy and Astrophysics There are three core contexts of NASA's first strategic objective:

Stakeholder(s):

Science Mission Directorate (SMD) :
Lead Office, with support from the Human Exploration and Operations Mission Directorate (HEOMD)

Human Exploration and Operations Mission Directorate (HEOMD)

Strategy 1.1.1. Universe

Discover the Secrets of the Universe

NASA's science vision is to understand the Sun and its effects on the solar system, the Earth, other planets and solar system bodies, the interplanetary environment, the space between stars in our galaxy (the interstellar medium), and the universe beyond. NASA's journey of scientific discovery will help motivate, support, and prepare for human and robotic expansion throughout the solar system and beyond... NASA will pursue answers to important science questions to which the view from space makes a defining contribution. These science questions relate to agency priorities and guidance from National Academies' decadal research priorities. Answering these questions requires observations and measurements made from space, including direct measurements made from the surface of planets and objects in our solar system, and in some cases the analysis of returned samples in Earth-based laboratories. NASA's success in science discovery across all three core contexts is based on a balanced program that involves a number of critical and enabling elements: laying the scientific and technical foundation for spacebased missions through Research and Development (R&D); inventing and using new space-based observing and sampling capabilities; creating the context and capabilities to interpret the resulting data; and maximizing the return on investment in the acquisition of data. SMD's suborbital and ground-based programs are conducted to enable or complement space-based observations and train future mission scientists and engineers. To complete innovative space missions NASA will effectively

manage a diverse portfolio while balancing innovation with successful program execution... NASA will implement missions only after focused development has matured required technologies. A balanced science program proactively identifies potential technologies required to meet future mission requirements, conduct trade studies, assess development risks, and invest in new technologies well in advance of mission implementation. NASA is also expanding the use of lower-cost CubeSats and SmallSats to accomplish our science goals. NASA's science is uniquely positioned among Federal agencies to transfer content and expertise to an informative environment to support learning across all age groups. Data is accessible through multiple channels, which allows NASA to benefit from partners actively engaged in learning communities and emerging citizen-based science. NASA also faces challenges in carrying out this science plan. Challenges include: access to space; strategic program planning; mission cost estimation and management; maintaining measurement continuity; and balancing near-term mission and research needs against increasing longer-term technology requirements. SMD engages the science advisory committees annually to rate scientific progress. In addition, in 2005 Congress directed that the performance of each division in SMD shall be reviewed and assessed by the National Academy of Sciences at five-year intervals.

Strategy 1.1.1.1 . Metrics

Measure mission success against clearly written top-level measurement requirements

Strategy 1.1.1.2. Criteria

Develop objective criteria to enable unequivocal measurement of success or failure in meeting each requirement

Strategy 1.1.1.3. Budget

Establish a budget for each new mission that funds the mission's complete life-cycle cost, based on detailed engineering studies and independent cost estimates

Strategy 1.1.1.4. Advice

Obtain tactical-level community advice on portfolio adjustments via the NASA Advisory Council, Science Committee, and the science advisory committees

Stakeholder(s):

NASA Advisory Council

Science Committee

Science Advisory Committees

Strategy 1.1.1.5. Partnerships

Implement effective partnerships -- commercial, international, interagency, academic, and others -- that leverage NASA resources and extend scientific results

NASA will extend partnerships domestically and internationally. Science is a broad National and international enterprise and SMD partners with over a dozen U.S. Federal agencies and more than 60 nations and international research organizations to leverage ideas, capabilities, and resources. Like the ISS, NASA's constellation of Sun,

Earth, solar system, and distant universe spacecraft and observatories are models of international and interagency cooperation and serve to further common scientific interests.

Strategy 1.1.2. Life

Search for Life Elsewhere

"Are we alone?" is a central research question that involves biological research and research in the habitability of locations in the solar system such as Mars, the moons of outer planets, or thousands of potentially habitable worlds around other stars. This research supports a fundamental science topic at the interface of physics, chemistry, and biology... The search for life in the solar system and beyond is guided by the ability to understand how life originated on Earth and by the quest to find habitable environments outside of Earth. To improve the knowledge of environmental requirements for habitability, NASA will develop tools for detecting life, develop tools for determining the relative habitability of present or ancient environments, and explore analog environments on Earth. This will facilitate target selection for further robotic, and ultimately human, exploration. Observations from SMD's astrophysics missions have made it clear that habitable planets exist around stars other than the Sun and that such planets are plentiful. Improving techniques and ideas for discovering and characterizing habitable and/or inhabited environments on these planets, coupled with an understanding of the potential false positives for habitability or life, will enable prioritization of exoplanets for targeted follow-up observations. This will help to push frontiers in the coming decades of discovery and enable the search for signs of life on worlds that may be capable of harboring life, both within our own solar system and within the galaxy. NASA's strategy relies on applying the lessons learned about the origin, evolution, and distribution of life on Earth to other bodies in our solar system and beyond. There is no single measurement or experiment that will definitively reveal the presence of extant or past life on a body in our solar system or a planet around another star. NASA will utilize many measurement results in a "Ladder of Life Detection" that will inform any certainty of the discovery of past or present life elsewhere.

Strategy 1.1.3. Earth

Safeguard and Improve Life on Earth

NASA investigates the hazards to life on Earth from the solar system, the Sun, and the Earth itself. This includes understanding the Earth as a system and on all time scales. NASA also works to detect asteroids and comets, understand their composition, predict their paths, and provide timely and accurate communications about potentially hazardous objects. NASA studies the causes and effects of severe space weather events to allow for preparation and timely response. Furthermore, NASA provides data and applications for operational use by first responders to natural disasters, firefighters, farmers, fishermen, transportation and commerce focused organizations, weather forecasters, and others... NASA's Earth science activities utilize observations from space to advance our scientific understanding of the Earth in service to the United States and the world. As we pursue answers to fundamental science questions about the Earth system on all time scales, we realize they benefit humanity in many ways. NASA's ability to view the Earth from the unique vantage point of space provides a broad and integrated set of uniformly highquality data covering all parts of the planet. NASA shares this unique knowledge and data continuity with the global community, including members of the science, Government, industry, education, and policy-maker communities. For example, NASA's Earth science observations have proven helpful with crop area estimates, productivity assessments and yield models across a range of time scales, water planning and irrigation management, fisheries, and many more disciplines and industries. NASA measurements help American farmers, ranchers, agribusinesses, and local, state, and Federal agencies to improve the ability to produce food. NASA's Earth science data helps to advance U.S. National interests in agriculture by providing food security for the Nation, economic growth, products to trade internationally, and jobs here at home.

Stakeholder(s):

National Oceanic and Atmospheric Administration (NOAA) :
Through our partnerships with other agencies that maintain forecast and decision support systems, such as the National Oceanic and Atmospheric Administration (NOAA), United States Geological Survey, and Environmental Protection Agency, NASA improves National capabilities to predict climate, weather, and natural hazards, to manage resources, and to develop environmental policy.

United States Geological Survey

Environmental Protection Agency

Near-Earth Objects Observations Program :
NASA's Near-Earth Objects Observations Program funds research activities to better understand the motions, compositions, and nature of near-Earth objects. This includes using optical and radar techniques to better understand objects' orbits, shapes, sizes, and rotation states. These planetary defense activities enable the science community to understand the nature of near-objects, information that could be leveraged to mitigate a possible Earth impact.

National Science Foundation :
Space weather directly affects the safety of humans in space and on Earth by influencing the operation of electrical power grids, communications and navigation systems, gas and oil pipelines, and spacecraft electronics and orbital dynamics. NASA develops instrumentation, technology, models and research tools to understand space weather. NASA collaborates with agencies such as the National Science Foundation and NOAA to improve space weather predictive capabilities.

1.2. Spaceflight

Understand Responses of Physical and Biological Systems to Spaceflight.

Conduct a robust program of space-based research to advance technologies that enable space exploration, and to pioneer uses of the space environment to benefit life on Earth. — Objective Overview: The space flight environment stresses physical and biological systems in many ways, including microgravity and space radiation. Understanding the responses of physical and biological systems to these stressors is necessary for designing and executing longer, more distant human space flight missions. Living and working in space requires learning how living systems, from microbes and plants to complex organisms like humans, are influenced by the space environment. The same holds true for physical systems and processes such as fluid flow and combustion. These stressors can also be used as experimental tools to enable scientific discovery with applications here on Earth. The ISS, conceived and constructed to be a laboratory in space, provides opportunities to understand the role of gravity in biological and physical systems. This strategic objective reflects NASA's commitment to make full and effective use of the ISS through the end of its current phase of operations, to close key gaps in the knowledge needed to build future exploration systems, and to realize the value of the space environment as a tool for science and technology. Guidance for research includes several studies by the National Academies over the past two decades:

- Recapturing a Future for Space Exploration: Life and Physical Sciences Research for a New Era (2011)

- Review of NASA Plans for the International Space Station (2006)
- Assessment of Directions in Microgravity and Physical Sciences Research at NASA (2003)
- Microgravity Research in Support of Technologies for the Human Exploration and Development of Space and Planetary Bodies (2000)
- A Strategy for Research in Space Biology and Medicine in the New Century (1998)

Stakeholder(s):

Human Exploration and Operations Mission Directorate (HEOMD) :
Lead Office

International Space Station Research :
Contributing Programs (or Projects)

Strategy 1.2.1. Competition & Review

Openly compete and peer review research.

Exploration research is driven by well-defined NASA needs to enable long-duration crewed missions beyond low Earth orbit, while scientific discovery based research is driven by opportunities identified by external organizations. In general, this research will be openly competed and peer reviewed; the participation of the research community external to NASA will be key. Areas to be explored for scientific discovery will be those that address pressing research questions in other Government agencies, private foundations, or commercial companies.

Stakeholder(s):

National Academy of Science :
The National Academies of Science, Engineering, and Medicine, which tap the advice of experts in science and engineering, will be a major source of community input for enabling exploration and pioneering scientific discovery.

National Academy of Engineering

National Academy of Medicine

Strategy 1.2.2. Collaboration

Collaborate with external organizations.

Collaborations with external organizations will often be initiated and coordinated by the management entity for the ISS National Laboratory, the Center for the Advancement of Science in Space (CASIS), but will also result from direct agency-to-agency planning. The ultimate aim of these efforts is to make space-based research a standard component of the portfolio of traditional Federal and private R&D agencies, to the extent that other agencies are willing to take responsibility for the support of space-based capabilities.

Stakeholder(s):

ISS National Laboratory

Center for the Advancement of Science in Space (CASIS)

Strategy 1.2.3. Risks

Address the risks of exploration.

The major risks to enabling exploration through understanding the responses of biological and physical systems to space flight are continuity of exploration architecture and funding. The major risk to addressing the pressing research questions of other organizations is the ability to conduct the research within a reasonable amount of time.

Strategy 1.2.4. Metrics

Measure progress.

The first stages of progress toward achieving this strategic objective will be clearly measured by the formulation of agreements between the research programs on the one hand and the internal NASA customer (for enabling exploration) or external organizations (for scientific discovery) on the other. Such agreements will specify what research questions will be addressed by the NASA research programs and may include schedules. Subsequent progress will be measured by the accomplishment of intermediate milestones in the research program. Final accomplishment of the research objectives will be measured by showing how the research products address the original agreement's needs.

2. Exploration

EXTEND HUMAN PRESENCE DEEPER INTO SPACE AND TO THE MOON FOR SUSTAINABLE LONG-TERM EXPLORATION AND UTILIZATION.

America is a Nation of explorers. In everything we do — science, technology, commerce, the arts, sports — we strive to reach higher, farther, deeper, or faster than ever before in order to create a better future for the generations to come. NASA is pushing the same boundaries in space. Orbiting Earth aboard the International Space Station (ISS) right now, astronauts are preparing for space missions that will push the frontiers of human experience outward into the solar system. NASA is also laying the foundation for America to sustain a constant commercial, human presence in low Earth orbit. From there, we will turn our attention back toward our celestial neighbors. We will return American astronauts to cis-lunar space and the Moon to build the foundation we need to send Americans to Mars and beyond. Cislunar space will be a stepping-stone, a training ground, a venue to strengthen our commercial and international partnerships as we refocus America's space program. NASA is testing technologies and techniques needed to keep humans safe, healthy, and productive on these future deep space missions. Ranging from environmental control and life support, to advanced propulsion and automated rendezvous and docking, these capabilities will be robust, affordable, sustainable, and adaptable to a variety of destinations. NASA will pursue a sustainable cadence of compelling missions in preparation for the first crewed missions to deep space. These include the first test flight of the Space Launch System (SLS) and Orion crew vehicle near the Moon and the first crewed flight of this transportation system, designed for missions beyond low Earth orbit. At the same time, to support a broader strategy to explore and utilize the Moon and its surface, NASA is establishing a Lunar Orbital Platform - Gateway in cis-lunar space, to include a power and propulsion element by 2022, and habitation, airlock, and the required logistics capabilities soon after. In addition, to help pave the way for human exploration, NASA is planning to develop a series of robotic lunar missions to the surface of the Moon. The United States will seek international partnership on a shared exploration agenda and spearhead the next phase of human space exploration. NASA will promote permanent human presence in space in a way that enables the 21st century space economy to thrive. It will take the best of NASA, the U.S. private sector, academic talent, and the capabilities of international partners to accomplish these bold missions.

2.1. Low Earth Orbit

Lay the Foundation for America to Maintain a Constant Human Presence in Low Earth Orbit Enabled by a Commercial Market.

Enable space-based low Earth orbit economy by transitioning ISS operations and maintenance to commercial and international partners, while continuing to leverage ISS for research, technology development, and to extend human presence in space. — Objective Overview: NASA is using our resources to extend human presence in the solar system and to foster an emerging and robust commercial space market. The continuous operation of a research and technology demonstration platform in space is critical to achieving NASA's and the Nation's goals in science, technology, and human space flight. The ISS is an experimental testing ground and is currently the world's only microgravity laboratory of its kind, enabling the discovery and development of advanced robotics, materials, communications, medicine, agriculture, and environmental science. Results of research projects on the ISS will continue to yield benefits in areas such as human health, telemedicine, physical science, Earth observations, space science, and education programs that inspire future scientists, engineers, and space explorers. The Center for the Advancement of Science in Space (CASIS) is the sole manager of the ISS National Laboratory and is working to maximize use of the ISS for research in space, which by law represents 50 percent of the resources of the U.S. portion of the ISS. Furthermore, human exploration activities on ISS will leverage the station as a test bed to demonstrate key exploration capabilities and operations and enable the move to deep space. Directly supporting the ISS until 2025 allows us to maximize its potential and maintain American leadership in space, while at the same time allowing us to foster the emerging U.S. low Earth orbit commercial space industry. After 2025, the U.S. will cease directly funding the ISS, but will continue to conduct research, technology development, and other activities in low Earth orbit in conjunction with our commercial and international partners. NASA will be a reliable customer for commercial goods and services that support and enhance NASA missions and requirements both in low Earth orbit and in deep space. Critical to this objective is

the selection, training, readiness, and health of crewmembers. All aspects of astronaut crew health are managed as part of this objective, including implementation of a comprehensive health care program for astronauts, and the prevention and mitigation of negative long-term health consequences of space flight. Through these efforts NASA will maintain healthy, well-trained astronaut corps of sufficient size to meet all planned mission needs. NASA's vision for low Earth orbit in the future is a self-sustaining space-based marketplace that provides economic benefits to the Nation and societal benefits to all people. The vision is one where NASA is one of many customers of privately-owned human-tended or permanently-crewed platforms and transportation capabilities that enable a variety of activities in low Earth orbit. Those platforms and capabilities will be sustained primarily by commercial revenue rather than relying on NASA and the U.S. Government for their main source of revenue. In this vision, NASA will maximize its resources toward missions beyond low Earth orbit, while still having the ability to utilize low Earth orbit for its ongoing needs.

Stakeholder(s):

Human Exploration and Operations Mission Directorate (HEOMD) :
Lead Office

International Space Station Systems Operations and Maintenance :
Contributing Program (or Project)

Human Space Flight Operations :
Contributing Program (or Project)

Strategy 2.1.1. On-Orbit Research

Expand use of the ISS on-orbit research program.

NASA will continue to expand the use of the ISS on-orbit research program, including continuing to increase utilization of internal and external research facilities. Increasing facility occupancy is a function of the demand for the use of the ISS, which is driven by the funding of research by NASA, other Government agencies, and the private sector; and the capacity of the laboratory to support research, which is determined by the infrastructure in orbit, the transportation system, and crew availability. Beyond the current commercial crew and cargo transportation capabilities enabled by the ISS, NASA is continually exploring and implementing new partnership models to further enable commercial activities and markets in low Earth orbit.

Strategy 2.1.2. Earth-Orbit Economy

Establish a sustained low Earth orbit economy.

Following an initial request for information and stakeholder workshops in 2014 and 2017, NASA developed a plan for achieving the vision for a sustained low Earth orbit economy, and is implementing activities and initiatives to make this vision a reality. To support low Earth orbit commercialization, NASA is leveraging the ISS by maximizing utilization and throughput, demonstrating the value of ISS and low Earth orbit research, utilizing more commercial acquisition strategies, and enabling greater commercial use of ISS by offering its unique capabilities and providing Earth-similar laboratory capabilities. Additionally, NASA is addressing the policy environment and associated elimination of barriers and introduction of incentives that could enable greater commercial use of low Earth orbit. Efforts to engage our international partners in promoting commercial activities are continuing through various ISS international partner forums.

Strategy 2.1.3. Commercial Suppliers

Develop a commercial supplier base for low Earth orbit activities.

Develop a healthy commercial supplier base for low Earth orbit activities. As discussed in Strategic Objective 4. 2, the ISS is already enabling commercial cargo and crew transportation that industry is working to become more cost effective in the future. Also, through initiatives such as Research, Engineering, Mission and Integration Services, NASA is transitioning from historically NASA-provided services for tasks such as payload integration, to purchasing those services from a wide variety of commercial suppliers whose capabilities have matured through expanded ISS utilization. NASA intends to continue to expand these types of commercial partnerships.

Strategy 2.1.4. Markets & Demand

Develop commercial markets and demand for low Earth orbit activities.

NASA is working toward the development of commercial markets and demand for low Earth orbit activities beyond the more "traditional" microgravity research and applications into broad sectors of the economy. Unless this demand is expanded, future private low Earth orbit platforms will likely not be viable without significant ongoing Government support. NASA and CASIS have identified several initial potential high payoff market areas and have increased the focus and resources toward projects in these areas, including protein crystallization, organ bioengineering, and in-orbit production/manufacturing.

Strategy 2.1.5. Commercial Activities

Expand commercial activities in low Earth orbit.

To realize NASA's vision of a self-sustaining market in low Earth orbit, NASA has created the Commercial LEO Development Program to directly support efforts to expand commercial activities in low Earth orbit, with a focus on enabling, developing, and deploying commercial platforms that can be used by NASA and other customers.

Stakeholder(s):
Commercial LEO Development Program

2.2. Deep Space

Conduct Exploration in Deep Space, Including to the Surface of the Moon.

Extend human presence into cis-lunar space and the lunar surface, with capabilities that allow for sustained operations in deep space and the lunar surface. — Objective Overview: Over the next decades, NASA intends to extend U.S. leadership and to eliminate barriers of human exploration of space, and to do so in a way that enhances U.S. economic competitiveness. NASA is taking a phased approach to expanding human exploration, starting with exploration science and technology research aboard the ISS, extending to crewed missions around and eventually to the surface of the Moon, and eventually to the vicinity and surface of Mars. To support this approach, NASA is developing the capability to transport humans to and from deep space, enabling the exploration of our solar system using innovative, advanced technologies and partnerships. NASA is currently developing unique new systems for transporting people and cargo beyond low Earth orbit, including commercial cargo systems, the Orion crew capsule, the SLS heavy-lift launch vehicle, and supporting ground facilities. NASA is also defining other elements that would be needed to support missions on or around the Moon, and to Mars and beyond. Precursor robotic missions that investigate candidate destinations and provide vital information for human explorers will lay the groundwork for deep space exploration. Sending astronauts into space involves a multitude of complicated systems, but perhaps the most complex system is the human system.

The Human Research Program (HRP) is responsible for understanding and mitigating the highest risks to astronaut health and performance to ensure that crews remain healthy and productive during long-duration missions beyond low Earth orbit. HRP leverages the talents of researchers within NASA and across U.S. academia to implement a detailed plan for risk reduction, with much of this work taking place aboard the ISS. As NASA prepares to conduct crewed missions in cis-lunar space, on the Moon, and eventually at other locations including Mars, HRP biomedical research and technological development are enabling the Agency to safely send humans into deep space for longer durations. NASA is increasing its capabilities for safely surviving in deep space for long durations to enable permanent, long-term human presence throughout the solar system. This deep space exploration can generate new knowledge and other new applications by scientists and entrepreneurs here on Earth.

Stakeholder(s):

Human Exploration and Operations Mission Directorate (HEOMD) :
Lead Office

Orion :
Contributing Program (or Project)

Exploration Ground Systems :
Contributing Program (or Project)

Space Launch System :
Contributing Program (or Project)

Human Research Program :
Contributing Program (or Project)

Lunar Orbital Platform - Gateway :
Contributing Program (or Project)

Advanced Cis-lunar and Surface Capabilities :
Contributing Program (or Project)

Exploration Advanced Systems :
Contributing Program (or Project)

International Space Station :
Contributing Program (or Project)

Lunar Discovery and Exploration Program :
Contributing Program (or Project)

Strategy 2.2.1. Human Presence

Advance human presence into our solar system.

NASA's development of new capabilities such as crew transport, heavy lift, and in-space habitation provide specific functions, which in combination with other capabilities, could advance human presence into our solar system. Rather than creating specialized, destination-specific hardware, these capabilities are designed to support multiple objectives in deep space and provide flexibility to carry out increasingly complex missions to a range of destinations over time.

Strategy 2.2.2. Strategic Focus

Provide an overall strategic focus for a broad range of activities.

The larger human exploration goal provides an overall strategic focus for a broad range of activities, with the ultimate purpose of extending human presence into the solar system, from low Earth orbit to cis-lunar space, Mars, and beyond. HEOMD strategy, development, and mission planning align and are guided by these key strategic principles for enabling sustained human exploration across multiple decades:

Strategy 2.2.2.1 . Fiscal Realism

Pursue near-term implementations with the buying power of current budgets.

Fiscal Realism: Implementable in the near-term with the buying power of current budgets.

Strategy 2.2.2.2. Exploration

Leverage scientific expertise for human exploration.

Scientific Exploration: Exploration enables science and science enables exploration; leveraging scientific expertise for human exploration of the solar system

Strategy 2.2.2.3. Technologies

Apply technologies for near-term missions while sustaining investments to address the challenges of future missions.

Technology Pull and Push: Application of high technology readiness level technologies for near-term missions, while focusing sustained investments on technologies and capabilities to address the challenges of future missions

Strategy 2.2.2.4 . Capability

Incrementally build capabilities for more complex missions over time.

Gradual Build Up of Capability: Near-term mission opportunities with a defined cadence of compelling and integrated human and robotic missions, providing for an incremental build-up of capabilities for more complex missions over time.

Strategy 2.2.2.5. Economic Opportunity

Enhance the experience and business base for U.S. commercial businesses.

Economic Opportunity: Opportunities for U.S. commercial business to further enhance their experience and business base

Stakeholder(s):

U.S. Businesses

Strategy 2.2.2.6. Openness & Resilience

Develop a multi-use, evolvable space infrastructure.

Architecture Openness and Resilience: Resilient architecture featuring multi-use, evolvable space infrastructure, minimizing unique developments, with each mission leaving something behind to support subsequent missions

Strategy 2.2.2.7. Collaboration & Leadership

Leverage current ISS partnerships and building new cooperative ventures for exploration.

Global Collaboration and Leadership: Substantial new international and commercial partnerships, leveraging current ISS partnerships and building new cooperative ventures for exploration

Strategy 2.2.2.8. Continuity

Establish a regular cadence of crewed missions to cis-lunar space during ISS lifetime.

Continuity of Human Spaceflight: Uninterrupted expansion of human presence into the solar system by establishing a regular cadence of crewed missions to cis-lunar space during ISS lifetime

Strategy 2.2.3. Testing & Maturation

Test and mature selected technologies and processes.

The ISS is a cornerstone of future deep space habitation and exploration activities, and its role is described in Strategic Objective 2.1. The ISS and future low Earth orbit platforms provide outstanding opportunities to test and mature selected technologies and processes, such as environmental control, life support, communications, and navigation, power, and propulsion systems, which are required for exploration missions. Additionally, human research conducted on the ISS and future low Earth orbit platforms will help mitigate the health risks anticipated on exploration missions, such as visual impairment and intracranial pressure, pharmacology, nutrition, and muscle maintenance.

Strategy 2.2.4. Operations & Staging

Test and demonstrate flight and mission operations and staging of human-rated vehicles farther from Earth.

In the initial phase of operations around the Moon, early missions to lunar orbit will test and demonstrate flight and mission operations and staging of human-rated vehicles farther from Earth than ever before. Missions

launched on commercial vehicles and the SLS in the 2020s will operate safely and productively in deep space. Lunar science missions may acquire samples or make measurements from the surface.

Strategy 2.2.5. Safety, Reliability & Affordability

Invest in exploration Research and Development (R&D) that will make future missions safer, more reliable, and more affordable.

NASA will also continue to invest in exploration Research and Development (R&D) that will make future missions safer, more reliable, and more affordable. In parallel, NASA's science and technology organizations will continue developing research and technology to enable future human missions to the surface of Mars, and investigate approaches for reducing the costs of exploration missions to enable a more expansive and sustainable exploration program.

3. Development

ADDRESS NATIONAL CHALLENGES AND CATALYZE ECONOMIC GROWTH.

Originally tied to keeping the Nation secure and advancing U.S. leadership in aeronautics, communications satellites, and Earth remote sensing, NASA's mandate is broader today. The challenges NASA addresses relate to gathering climate change data; supplying technological solutions for terrestrial problems; advancing the state of Research and Development (R&D) in aeronautics and other fields; developing commercial and human space launch and transportation capabilities; understanding cosmic phenomena as wide-ranging as space weather, asteroids, and exoplanets; and improving the Nation's innovation capacity. NASA drives economic development and growth; the National Aeronautics and Space Act of 1958 calls out this important theme, and the Agency generally invests more than 80 percent of its funds in U.S. industry and academia to carry out its missions of scientific discovery and exploration. In doing so, NASA engages and inspires young people to become scientists, technologists, engineers, and mathematicians. This ensures that the Nation's vast intellectual and industrial base — shared by many other Government agencies, including the departments of Defense, Commerce, Transportation, and Interior — has a continuous supply of bright minds and skilled hands. NASA enhances a core strategic advantage of the United States: the ability to attract partners and work with talent globally. Because of NASA's role in the international community, the Agency can help National security leaders manage global risks. Technology drives NASA's future human and robotic exploration missions. As its technology efforts mature, NASA transfers appropriate technologies to industry and commercializes them to benefit a wide range of users. This ensures that the American people realize the full economic value and societal benefit of NASA's work. NASA also provides funding for fundamental technology research with broader benefit to the U.S. innovation system. The aerospace sector is considered to be a rough gauge of a Nation's competitiveness, and the United States leads the world in this arena. NASA aeronautics research encompasses an ever-broadening array of technologies to make airplanes safer, quieter, and friendlier to the environment, and air travel more efficient. Today, NASA technology is found aboard every U.S. aircraft and inside every air traffic control facility in the country. This infusion can be attributed to one of the most productive public-private partnerships in U.S. history, as NASA continues to team with industry, academia, and other Government agencies. Transformational demonstrations NASA plans in the next eight years will advance U.S. leadership for the next century of flight, and could bring about the return of overland supersonic flight; new airliners that consume half the fuel of today's models; safe, expanded use of unmanned aircraft systems, or drones, for economic and societal benefit; and safe, semi-autonomous small aircraft for personal "on-demand" transportation. Attracting students to enter science, technology, engineering, and mathematics (STEM) fields is vitally important, and NASA's missions help to inspire the next generation. In 2015, public interest in NASA's mission to Pluto created an internet sensation, with more than 10 million views on the mission page, and 42 percent of all U.S. Government website traffic going to NASA during the historic flyby. NASA similarly inspired millions during Scott Kelly's year-long stay aboard the International Space Station (ISS), the first flight test of the Orion spacecraft for human exploration, the Mars rover landings, and many other significant missions. One of NASA’s core missions is to ensure that our scientific and technological advances reach the widest possible audience to inspire the current and next generation of explorers.

3.1. Exploration Capabilities

Develop and Transfer Revolutionary Technologies to Enable Exploration Capabilities for NASA and the Nation.

Advance revolutionary technologies for NASA and the Nation, involving commercial space products, specifically for utilization of near-Earth space; efficient transportation through space; access to planetary surfaces; enabling human space exploration; next generation science missions; and growth and utilization of the U.S. industrial and academic base. — Objective Overview: Through the decades, NASA’s technology development and transfer have enabled important space science and exploration missions, contributed to other U.S. Government agencies’ needs, cultivated commercial aerospace enterprises, and helped foster a technology-based U.S. economy. Rising Above the Gathering Storm, Revisited, a report by the National Academies, addresses the link between technology development efforts and the economy, noting that various studies

indicate a strong link between economic growth and technological innovation in recent decades. Over the next 10 years—through investments within the Exploration Research & Technology (ER&T) funding account—the Agency will advance revolutionary capabilities for both NASA mission challenges and National needs, and also address the market challenges associated with providing state-of-the-art commercial space products and services. More specifically, technology investments within the ER&T funding account will focus on the following thrusts.

- Accelerating large-scale industrialization of space
- Enabling efficient and safe transportation into and through space
- Increasing access to planetary surfaces
- Enabling humans to live and work in space and on planetary surfaces
- Expanding capabilities through robotic exploration and discovery
- Growing and utilizing the U.S. industrial and academic base To support these strategic investment area thrusts, NASA will primarily invest in the following Exploration Campaign key focus areas: Advanced environmental control and life support systems & in-situ resource utilization; Power and propulsion technology; Advanced materials; Communications, navigation and avionics; Entry, descent, and landing; Autonomous operations; In-space manufacturing and on-orbit assembly; and Research to enable humans to safely and effectively operate in various space environments. In addition, ER&T contributes to growing the U.S. industrial and academic base to continue the Nation's economic leadership.

Stakeholder(s):

Exploration Research & Technology (ER&T) :
Lead Office

Early Stage Innovation and Partnerships :
Contributing Program (or Project)

Technology Maturation :
Contributing Program (or Project)

Technology Demonstration :
Contributing Program (or Project)

Human Research Program :
Contributing Program (or Project)

Small Business Innovation Research :
Contributing Program (or Project)

Small Business Technology Transfer :
Contributing Program (or Project)

Strategy 3.1.1. Transformational Technologies

Invest in transformational exploration technologies with high potential to offset risk, reduce cost, and advance critical capabilities.

NASA pushes boundaries and rapidly develops, demonstrates, and infuses revolutionary, high-payoff technologies. The ER&T investment portfolios span a range of discipline areas and Technology Readiness Levels to advance technologies for the benefit of NASA, industry, and other Government agencies. This research and technology development engages universities, business, and all NASA Centers for widespread benefits. Through the ER&T account, NASA invests in transformational exploration technologies with high potential to offset risk, reduce cost, and advance critical capabilities for future NASA exploration missions and broader National needs.

Strategy 3.1.2. Collaboration

Collaborate with other Government agencies and commercial partners.

Collaboration is key to NASA's strategy for achieving this objective.

Stakeholder(s):

Government Agencies :
NASA collaborates with many other Government agencies on approximately 40 activities as of early 2018. These relationships allow NASA to utilize investments made by other agencies to meet NASA challenges, while contributing to other National needs.

Commercial Partners :
NASA also uses commercial partnerships with mutual benefit, addressing both NASA mission needs and the market challenges of providing state-of-the-art commercial space products and services. These investments in commercial space span the ER&T technology programs in addition to targeted activities through the NASA Technology Transfer Program and other partnerships.

U.S. Aerospace Industry :
For example, NASA established public-private partnerships with the U.S. aerospace industry through the Tipping Point and Announcement of Collaborative Opportunity solicitations.

Private Sector :
NASA plans to continue such partnerships that leverage significant private sector capabilities and funds for the development of key technologies needed by both the Agency and the greater commercial sector.

Commercial Sector

Strategy 3.1.3. Progress Evaluation

Evaluate progress through transition and infusion of technologies in addition to varied assessments.

NASA will evaluate progress toward this objective through transition and infusion of technologies in addition to varied assessments. The latter include annual strategic objective assessments; assessment of multi-year performance goals and annual performance indicators; annual Program Performance Reviews; Agency Baseline Performance Reviews; guidance from external committees and advisory groups; and external audits.

Strategy 3.1.4. Risks

Address external risks, including programmatic risk of access to space.

Key external risks to this objective include programmatic risk of access to space. To demonstrate new technology capabilities in space, NASA ER&T relies on rideshare and hosted payloads. Increasing costs and limited availability are also challenges. The latter is of particular concern, as NASA's technology demonstrations do not typically represent primary payloads for commercial launches.

3.2. Aviation

Transform Aviation Through Revolutionary Technology Research, Development, and Transfer.

Maintain and advance U.S. global leadership in aviation through application of new concepts and technologies pioneered by NASA and developed in partnership with U.S. industry that lead to transformative improvements in mobility, efficiency, and safety. — Objective Overview: As a primary mechanism for physically connecting cities and countries across the world, air transportation is an integral part of today's U.S. and global economies. Aviation enables U.S. enterprises to operate on a global scale, providing safe and high-speed transport of people and goods. It accounts for more than $1.6 trillion of U.S. economic activity each year and generates a positive trade balance — $82.5 billion in 2015. The aviation industry also supports more than 11.8 million direct and indirect jobs in the United States, including more than one million high-quality manufacturing jobs. Aviation comprises more than five percent of the total U.S. gross domestic product. Nearly every product created and purchased today has been touched by aviation in some way. Globally, the aviation system is growing rapidly with the potential for more than five times as many passengers and 10 times the cargo in 2050 as today. Since its establishment, NASA has continually advanced America's aviation system to improve humanity's quality of life and productivity on Earth. NASA contributes unique innovations to aviation through research activities. These innovations serve as key enablers for the role of U.S. commercial aviation in sustaining American commerce and safe, environmentally sustainable mobility, and hence the Nation's economic well-being. NASA's role is to explore early stage concepts and ideas, develop new technologies and operational procedures through foundational research, and demonstrate the potential of promising new vehicles, operations, and safety technology in relevant environments. The Agency is focused on appropriate cutting-edge research and technologies to overcome a wide range of aeronautics technical challenges for the Nation's and the world's current and future air transportation systems.

Stakeholder(s):

Aeronautics Research Mission Directorate (ARMD) :
Lead Office

Transformative Aero Concepts :
Contributing Program (or Project)

Integrated Aviation Systems :
Contributing Program (or Project)

Airspace Operations and Safety :
Contributing Program (or Project)

Advanced Air Vehicles :
Contributing Program (or Project)

Strategy 3.2.1. Aviation

Focus major research areas for the long-term future of aviation.

To continue NASA's leadership in aviation innovation and enable a revolutionary transformation of the aviation system, NASA is focused on six major research areas, or ARMD Thrusts, for the long-term future of aviation. These research Thrusts utilize the full capability of NASA's in-house aeronautics expertise. Through high-risk, high-reward research and technology development, NASA seeks to:

Strategy 3.2.1.1. Global Operations

Enable safe and efficient growth in global operations

Strategy 3.2.1.2. Supersonic Aircraft

Enable innovation in commercial supersonic aircraft

Strategy 3.2.1.3. Commercial Vehicles

Enable ultra-efficient commercial vehicles

Strategy 3.2.1.4 . Propulsion & Energy

Enable transition to alternative propulsion and energy

Strategy 3.2.1.5 . Safety

Enable real-time system-wide safety assurance

Strategy 3.2.1.6. Automony

Enable assured autonomy for aviation transformation

Strategy 3.2.2. Research & Technology Development

Address important areas of research and technology development tol further U.S. leadership in the aviation industry and enhance global mobility.

Each Thrust is designed to address an important area of research and technology development that will further U.S. leadership in the aviation industry and enhance global mobility. This research is performed with an emphasis on multi-disciplinary collaboration focused on the critical, integrated challenges aligned to the six research Thrusts — what NASA refers to as convergent research. Together, these research Thrusts combine to enable safe, sustainable growth in the overall global aviation system, while pioneering transformative capabilities that will create revolutionary opportunities.

Strategy 3.2.3. Partnerships

Work with partners to achieve our missions.

In pursuit of this objective, NASA encounters and manages several challenges and opportunities, including:

Stakeholder(s):

Government Agencies :
NASA works with partners in other Government agencies, aligned with the principles, goals, and objectives of the National Aeronautics Research and Development Policy and its related National Aeronautics Research and Development Plan, to achieve its missions.

Industry :
NASA also partners with industry and academia to support innovative concepts and technologies, and with international counterparts to leverage complementary investments.

Academia

Strategy 3.2.3.1. Risks

Accept inherently high-risks in pursuit of challenging, cutting-edge technology advances and aeronautics research goals.

Inherent Risk — NASA pursues challenging, cutting-edge technology advances and aeronautics research goals that are inherently high-risk. In accepting this risk, NASA gains valuable knowledge and advances the capabilities of the Agency, even when results fall short of expectations. By increasing its knowledge base and developing potential new solutions, NASA makes better-informed decisions regarding committing future research resources and pursuing promising high-return investments.

Strategy 3.2.3.2. Influences

Mitigate risks and challenges faced by partners.

Domestic Partnership Influences — NASA's domestic aeronautics partnerships enable leveraging investments in support of mutual objectives and avoiding duplication of effort. They ensure NASA is moving forward on the right challenges and improve the transition of research results to users. Through continual coordination with our partners, NASA mitigates risks and challenges faced by partners which may negatively influence schedules and research outputs.

Strategy 3.2.3.3. Demands

Reach for more transformational concepts.

Growing System Demands — As demand for greater global mobility increases, so does the pressure for the current aviation system to accommodate demand, reduce environmental impacts, and improve safety. Because the rate of system change may be greater than that achievable through incremental change, NASA may need to reach for more transformational concepts.

Strategy 3.2.3.4. International Partnerships

Foster international partnerships in pre-competitive areas.

Strategic Global Partnerships — Many emerging economies are rapidly developing infrastructure and embracing next generation technologies, and partners around the world have increasingly advanced technical capabilities which complement NASA's own. By carefully fostering international partnerships in pre-competitive areas, NASA supports the safe and efficient growth in global aviation important to the United States. In turn, this improves the potential for leveraging partnership investments, reducing duplication, and acquiring knowledge for NASA's research programs and capabilities.

Stakeholder(s):

Emerging Economies

Strategy 3.2.4. Reviews & Outcomes

Conduct reviews and determine outcomes.

For each one of NASAs six research ARMD Thrusts, near-term (2015 to 2025), mid-term (2025 to 2035), and long-term (>2035) community outcomes are determined. Reviews are conducted several times a year, to evaluate progress toward all such community outcomes using criteria such as NASA performance, partnership performance, and stakeholder buy-in.

3.3. Inspiration & Engagement

Inspire and Engage the Public in Aeronautics, Space, and Science.

Inspire, engage, educate, and employ the next generation of explorers through NASA-unique Science, Technology, Engineering and Mathematics learning opportunities. — Objective Overview: NASA has a long history of engaging the public and students in its mission through educational and outreach activities and programs. NASA's endeavors in education and public outreach began early on, driven by the language in Section 203 (a) (3) of the Space Act, "to provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof, and to enhance public understanding of, and participation in, the Nation's space program in accordance with the NASA Strategic Plan." NASA's education and outreach functions aim to inspire and engage the public and students, each playing a critical role in increasing public knowledge of NASA's work and fostering an understanding and appreciation of the value of STEM, and enhancing opportunities to teach and learn. By augmenting NASA's public engagement and communicating NASA's work and value, the Agency contributes to our Nation's science literacy. NASA is committed to inspiring an informed society; enabling the public to embrace and understand NASA's work and value, today and tomorrow; engaging the public in science, technology, discovery, and exploration; equipping our employees to serve as ambassadors to the public, and providing unique STEM opportunities for diverse stakeholders. This strategic objective includes proactive efforts to diversify the STEM pipeline to NASA internships and employment. NASA works to ensure grant recipient institutions are in compliance with civil rights/equal opportunity laws in accordance with criteria from NASA Form 1206, Assurance of Civil Rights Compliance. Equal opportunity compliance and technical assistance can help to identify and report diversity and inclusion best practices among institutions receiving NASA funds that can, in turn, help increase the number of underrepresented and underserved groups in STEM fields available to apply for NASA opportunities.

Stakeholder(s):

The Public

Mission Support Directorate :
Lead Office

Office of Communications (OCOM) :
Lead Office

Office of the Chief Scientist :
Contributing Program (or Project)

Office of Diversity and Equal Opportunity

4. Enablement

OPTIMIZE CAPABILITIES AND OPERATIONS.

NASA is proud to be the U.S. agency charged with exploring the unknown in space and driving new advances in aerospace science and technology on behalf of the American public. Reaching for the stars requires dedicated, knowledgeable people and cutting-edge facilities and capabilities to provide the tools and support necessary to carry out our ambitious tasks. NASA strives to accomplish our mission with the utmost care — recognizing that we are stewards of taxpayer dollars, critical human capital, and one-of-a-kind facilities. NASA maintains a large and diverse set of technical capabilities and assets to support our missions, other Federal agencies' work, and the private sector to test, validate, and optimize innovations. The Agency understands that a skilled, valued, and diverse workforce is central to creating and maintaining the capabilities to explore the solar system and beyond and for understanding our home planet. NASA will continue to maintain and ensure the availability and safety of critical capabilities and facilities necessary for advancing our space-, air-, and Earth-based activities. This hybrid goal includes both strategic objectives and management focused objectives. NASA has a renewed focus on its essential and distinctive technical capabilities. As a result, the Agency has adopted a new operating model that strengthens its management of the engineering and systems capabilities that are fundamental to every mission and strategic goal. This model provides for proactive, strategic management of these capabilities and allows NASA to optimize the allocation of technical specialties to its Centers, to select key areas for future investments, and to identify and transition those capabilities that are no longer needed or are better obtained from emerging National commercial sources. Recognizing the growth of technologies and innovations increasing outside the Agency, NASA is instituting a robust partnership and acquisition strategy focused on leveraging and collaborating with the private sector and academia in order to benefit from their innovations. NASA's role in global engagement extends directly from the Space Act in areas such as data-sharing agreements and joint science and technology flight projects. More than two-thirds of NASA's science missions have foreign partners. NASA's domestic and international collaborations are often pathfinders for other forms of cooperation, in part by demonstrating standards of best practices for civil and commercial space activities such as orbital debris mitigation, data sharing, openness, operational coordination, and flight safety. NASA plays a key role in setting global polices for aviation safety and access and specific standards and norms for space operations. NASA is most successful when it leads through example and practice, attracting partners who realize the benefits of shared values. Such principles include a shared understanding of the responsible use of space, free and open data policies, and the broad benefits of fundamental public Research and Development (R&D). U.S. leadership in space is due in part to NASA's ability to inspire and create access to complex challenges. The Agency continues to retain and serve as a unique National resource of engineers, scientists, business and international specialists, and technologies. NASA provides the Nation with tools for leadership and inspiration in aerospace science and technology. This goal enables all of NASA's space-, air-, and Earth-based research and innovation activities, producing the best return on the Nation's investment.

4.1. Partnerships

Engage in Partnership Strategies.

Support cooperative, reimbursable, and funded initiatives through domestic and international partnerships. — Objective Overview: NASA identifies, establishes, and maintains a diverse set of domestic and international partnerships to enable collaborations of mutual benefit to NASA and other Government agencies, U.S. industry, academia, nonprofit organizations, state and local governments, and international entities that contribute to the Agency's strategic objectives and develop capabilities to achieve NASA's Mission. NASA partners with other Federal departments and agencies, the U.S. private sector, non-profit organizations, universities, and foreign space agencies to coordinate, develop, and implement mutually beneficial cooperative space working groups, programs, projects, missions, and ground-based research activities that support NASA's 2018 Strategic Plan. NASA also engages with Executive Branch offices on space policy and other interagency matters to ensure that the U.S. civil space program supports and enhances the broader policies and priorities of the U.S. Government and the Administration. These partnerships are instrumental in supporting the strategic goals and strategic

objectives in NASA's 2018 Strategic Plan. Such partnerships provide access to unique capabilities and expertise, increase mission flight opportunities, and enhance the scientific return of the Agency's missions.

Stakeholder(s):

Mission Support Directorate (MSD) :
Lead Office

Office of Procurement :
Contributing Program (or Project)

Partnerships Office :
Contributing Program (or Project)

Office of International and Interagency Relations :
Contributing Program (or Project)

Office of Small Business Programs :
Contributing Program (or Project)

Strategy 4.1.1. International & Interagency Partnerships

Use international and interagency partnerships.

NASA uses international and interagency partnerships to advance National priorities in global engagement and diplomacy, foster new discoveries and expand human knowledge, strengthen interactions with the Nation's security and industrial base, promote economic development and growth, address National challenges, and provide global leadership and inspiration. These partnerships strongly support NASA's Mission, U.S. foreign policy objectives, and Administration initiatives.

Strategy 4.1.1.1. Global engagement & Diplomacy

Advance National priorities in global engagement and diplomacy.

Strategy 4.1.1.2. Discoveries & Knowledge

Foster new discoveries and expand human knowledge.

Strategy 4.1.1.3. Interactions

Strengthen interactions with the Nation's security and industrial base.

Strategy 4.1.1.4 . Economic Development & Growth

Promote economic development and growth.

Strategy 4.1.1.5. Challenges

Address national challenges.

Strategy 4.1.1.6. Leadership & Inspiration

Provide global leadership and inspiration.

Strategy 4.1.2. Domestic Agreements

Enter into agreements with U.S. industry and other private sector entities.

NASA has more than 1,200 domestic agreements with U.S. industry and other private sector entities in support of NASA's mission directorates and Centers. Such partnerships strengthen U.S. industry and are instrumental in supporting NASA's 2018 Strategic Plan.

Stakeholder(s):

U.S. Industry

Private Sector Entities

Commercial Space Providers :
For example, NASA is incorporating commercial space providers into its core missions because these companies represent a source of capability the Agency needs and an opportunity to support a new area for U.S. economic growth and competitiveness.

Strategy 4.1.3. International Agreements

Enter into international agreements in support of a wide variety of programs, projects, and activities.

Currently, NASA has over 800 active international agreements with more than 120 countries in a wide variety of programs, projects, and activities.

Stakeholder(s):

European Space Agency :
While over half of these agreements are with the European Space Agency and partners in five countries (France, Germany, Japan, Canada and the United Kingdom), a large number are with partners around the world.

France

Germany

Japan

Canada

United Kingdom

International Space Station (ISS) :
The largest and most complex of all these partnerships is the International Space Station (ISS).

Strategy 4.1.4. Interagency Agreements

Enter into agreements with U.S. Government departments and agencies.

Currently, NASA has over 900 active interagency agreements with U.S. Government departments and agencies. NASA's scientific collaborations lend credibility and merit to projects, and expand the scientific prestige of the Nation.

Stakeholder(s):

U.S. Government Departments

U.S. Government Agencies :
For example, NASA currently has partnerships with the National Science Foundation, the Department of Energy, and the Federal Emergency Management Agency.

National Science Foundation

Department of Energy

Federal Emergency Management Agency

Strategy 4.1.5. Missions & Programs

Use partnerships in support of the Agency's missions and programs of record.

NASA utilizes partnerships in support of the Agency's missions and programs of record. NASA implements its strategic plan to align resources to accomplish our goals in the most efficient and effective way possible... Finally, exchanging mutually beneficial knowledge and information to spur innovation and incentivize the creation of new markets supports NASA's goals.

Stakeholder(s):

U.S. Commercial Space Sector :
One such example includes encouraging a robust commercial space industry. NASA is leveraging its partnerships with the U.S. commercial space sector to lower launch costs and create more opportunities for commercial space flight.

U.S. Federal Aviation Administration :
Another example is addressing critical problems such as air traffic capacity and the environmental effects of air traffic to safely enable the next generation of air transportation. NASA is working closely with the U.S. Federal Aviation Administration and other partners in several areas toward this end.

U.S. Industry :
The Agency also partners with U.S. industry to test experimental materials and share the resulting data.

Strategy 4.1.6. Value & Alignment

Ensure NASA receives value and alignment from its partnership activities.

Management tools ensure that NASA receives value and alignment from its partnership activities, including comprehensive training and guidance that are available on an on-going basis. Potential partnerships are evaluated at the Centers, by mission directorates, and by other key stakeholders in advance of establishing final agreements to ensure alignment with NASA's Mission. In addition, once completed, the Agency requires an assessment of partnerships that utilize NASA resources (activities performed on a "no exchange of funds" basis) to determine how beneficial the agreement was to furthering the Agency's objectives.

Strategy 4.1.7. External Factors

Take into account key external factors for partnerships.

Key external factors for partnerships include: export control considerations; U.S. foreign policy; U.S. National security policy; U.S. National space policy; and changes in Government leadership or objectives in the U.S. and abroad.

Strategy 4.1.8. Evidence & Evaluation

Use evidence and evaluate progress.

Evidence and evaluation of progress in this area include: NASA internal and external reviews and audits; studies by the National Academies of Science, Engineering, and Medicine; audits by the Government Accountability Office; and other opportunities for assessment.

Stakeholder(s):

National Academies of Science, Engineering, and Medicine

Government Accountability Office

Strategy 4.1.9. Acquisitions

Create integrated acquisitions.

NASA's acquisition process, from strategy development through contract management and contract closeout, helps the agency achieve its various missions through development and implementation of domestic and international partnerships. The coordination and collaboration among these many strategic alliances creates integrated acquisitions that involve all interested parties early and throughout the process. From a management perspective, the objective is to avoid unnecessary expenses, delays, and disruptions.

4.2. Space Access & Services

Enable Space Access and Services.

Support the communication, launch service, rocket propulsion testing, and strategic capabilities needs of NASA's programs. — Objective Overview: NASA uses private and government capabilities to deliver people, payloads, and data to and from space. Two examples of such capabilities are the Commercial Crew Program (CCP) and the Launch Services Program (LSP). These programs implement strategic investment decisions to sustain and enable U.S. commercial industry and to provide transportation of crew, cargo, and key scientific payloads to their destinations in space. The Space Communications and Navigation (SCaN) program manages and directs the ground-based facilities and services provided by the Deep Space Network (DSN), Near Earth Network, and Space Network. SCaN supports three reliable communications networks with data transmissions between space missions and Earth and provides navigation services to spacecraft in orbit. NASA's other technical capabilities in the Rocket Propulsion Testing (RPT) Program, Strategic Capabilities Assets Program (SCAP), and Space Environments Testing Management Office (SETMO) support commercial industries by providing specialized facilities to test and evaluate items to mitigate risk and optimize engineering designs. All of these capabilities are critical to enabling space missions that allow NASA and its partners to discover new science, explore the solar system, and develop transformative technologies and research that will drive the National economy.

Stakeholder(s):

Human Exploration and Operations Mission Directorate (HEOMD) :
Lead Office

Launch Services :
Contributing Program (or Project)

Crew and Cargo :
Contributing Program (or Project)

Commercial Crew :
Contributing Program (or Project)

Rocket Propulsion Test :
Contributing Program (or Project)

Space Communications and Navigation :
Contributing Program (or Project)

Strategic Capabilities Asset Program :
(and Space Environments Testing Management Office) Contributing Program (or Project)

Strategy 4.2.1. Human Exploration & Robotic Missions

Manage the infrastructure and efforts that provide access to space for human exploration and robotic missions.

Several programs manage the infrastructure and efforts that provide access to space for human exploration and robotic missions. Each of these programs and offices develop strategies to overcome challenges, manage risks, and contribute to the strategic objectives. These strategies complement NASA's overarching efforts to keep critical capabilities available that enable the mission success of NASA and other customers. Some of NASA's key strategies for Strategic Objective 4.2 are to:

Strategy 4.2.1.1. Satellite & Robotic Planetary Missions

Provide access to space for the Nation's civil sector satellite and robotic planetary missions.

The civil sector has multiple space-based missions. In addition to NASA's science and discovery missions, there are civil communications, geographic survey, and civil weather missions that provide key services for our Nation and the world. The National Space Transportation Policy identifies the NASA Administrator as the launch agent for the Nation's civil sector. LSP enables the Administrator to execute this role by acquiring and managing domestic commercial launch services for assigned missions; certifying new commercial launch vehicles for readiness to fly "high value" spacecraft; performing mission design and launch integration activities; and directing launch mission assurance efforts to ensure the greatest probability of launch mission success. While no space mission is "routine," whether going to low Earth orbit or some other Earth-centric orbit, what makes LSP a critical National capability is its unique launch system expertise involving payloads containing nuclear power sources, and for launching "one-of-a-kind" science exploration missions sent to other planets, the sun, or other locations in space. NASA relies on LSP to provide robust, reliable, commercial, and cost-effective launch services. NASA achieves assured access to space through a competitive "mixed fleet" approach utilizing the breadth of U.S. industry's capabilities. In addition, LSP provides launch related expertise to other NASA programs, such as Commercial Resupply Services and CCP, along with "launch advisory" support to NASA payload missions using launch services contributed by a foreign partner, to other government agencies, and to the launch industry as a whole.

Stakeholder(s):

Civil Satellite Sector

Civil Robotic Sector

Strategy 4.2.1.2. Access to Space

Provide access to space for human exploration and cargo to and from the ISS and low Earth orbit from America

NASA's CCP facilitates the development of the U.S. commercial crew space transportation capability with the goal of achieving safe, reliable, and cost-effective access to and from low Earth orbit and the ISS. By supporting the development of human space flight capabilities, NASA is laying the foundation for future commercial transportation capabilities. Commercial transportation to and from the ISS will provide expanded utility, additional research time, and broader opportunities of discovery on the orbiting laboratory. The station is critical for NASA to understand and overcome the challenges of long-duration space flight necessary for journeys to deep space. By encouraging industry to provide human transportation services to and from low Earth orbit, NASA can expand its focus on building spacecraft and rockets for deep space missions. Ultimately, the goal is to establish safe, reliable, and cost-effective access to space. Once a transportation capability is certified to meet NASA requirements, the Agency will fly missions to meet its space station crew rotation and emergency return obligations.

Strategy 4.2.1.3. Communication & Tracking Services

Ensure responsive and reliable space communication and tracking services for NASA's missions

NASA's SCaN Network provides mission-critical communications services, and consists of a constellation of geosynchronous relay satellites, ground tracking stations for near-Earth and deep space missions, and their associated ground elements. The SCaN Network also enables missions from commercial space, other Government agencies, and collaborating international partners. SCaN provides these critical services by operating Government owned facilities, procuring commercial communication services, and utilizing capabilities of interoperable National and international partners. Recognizing the significant capabilities developed by the commercial communications satellite sector, SCaN is taking steps to reduce its reliance on Government systems and increase its usage of commercial services. Planned communications development of new

technologies, such as optical communications, will enable new mission concepts, assist in maintaining safe operations for crew and vehicles, and bring the public along for the adventure as astronauts travel into deep space.

Strategy 4.2.1.4. Capabilities

Manage capabilities effectively

NASA's RPT program is responsible for managing and sustaining the Agency's expertise and facilities for ground testing of rocket engines. It works both to advance new test technologies and to reduce propulsion test costs. The RPT program prioritizes its limited resources to sustain its core test capabilities and meet customer test requirements. In addition, the RPT program is NASA's representative on the interagency National Rocket Propulsion Test Alliance, which was established between NASA and the Department of Defense in 1998.

Stakeholder(s):

SETMO :
NASA's SETMO and SCAP manage functionally similar mission-critical capabilities ("capability portfolio") — a combination of workforce, competencies, assets, equipment, processes, and technologies — to meet NASA's needs. SETMO/SCAP capabilities include space environments testing, motion based simulation, and highenthalpy materials testing (required for spacecraft that re-enter the Earth's and other planet's atmospheres). SETMO/SCAP's purpose is to sustain and ensure effective capabilities through centralized integrated management that includes a strategy aligned with requirements aggregated across multiple mission directorates, Centers, programs, and projects.

Government Agencies :
SETMO/SCAP collaborates with other Government agencies, academia, and industry to ensure NASA's current and future missions have access to needed capabilities and assets that are owned and operated by NASA and outside organizations. In support of NASA's Mission, SETMO/SCAP provide the vision and leadership for these Nationally important capabilities (that include unique National facilities). By staying up-to-date on technological advances, industry demand, and issues that concern the public, NASA is able to make decisions on facility and capability investments and divestments.

Academia

Industry

Strategy 4.2.1.4.1. Portfolios

Evaluate, prioritize, and optimize components within capability portfolios.

Strategy 4.2.1.4.2. Capabilities, Capacities & Quality

Identify and achieve needed Agency capability, capacity, and quality for the capability portfolios.

Strategy 4.2.1.4.3. Needs, Requirements & Priorities

Allocate resources based on customer needs and requirements while maintaining alignment with Agency priorities.

Strategy 4.2.1.4.4. Effectiveness & Efficiency

Continuously improve effectiveness and efficiency.

4.3. Safety & Success

Assure Safety and Mission Success.

Assure effective management of NASA programs and operations to complete the mission safely and successfully. — Objective Overview: Safety and Mission Success (SMS) programs include programs that provide technical excellence, mission assurance, and technical authority. The elements of SMS reflect the recommendations outlined in many studies and by advisory boards and panels. These programs directly support NASA’s core values and serve to improve the likelihood for NASA's programs, projects, and operations to achieve mission success while protecting the health and safety of NASA's workforce. SMS programs protect the health and safety of the NASA workforce and improve the likelihood that NASA's programs, projects, and operations are completed safely and successfully. They contribute to the Agency's SMS by establishing applicable safety, engineering, and health policy directives and procedural requirements. Furthermore, SMS programs assure that directives and requirements are appropriately implemented, and perform independent technical analysis of safety and mission critical software products. SMS programs develop policy and procedural requirements and provide assessments and recommendations to the Administrator, mission directorates, Center directors, and program managers who are ultimately responsible for the SMS of all NASA activities. SMS resources provide the foundation for NASA's system of checks and balances, enabling the effective application of the strategic management framework and the technical authorities defined in NASA's Governance and Strategic Management Handbook. SMS programs enable risk-informed decision making by providing independent assessments of the technical challenges, independent technical analysis of safety and mission critical software products, and risks encountered by programs and projects. SMS practices verify that all pertinent policy and procedures have been followed or appropriate waivers have been obtained. The programs also participate in key decision point milestones and the Agency's Baseline Performance Reviews.

Stakeholder(s):

Office of the Chief Engineer (OCE) :
Lead Office / Technical Authority

Office of the Chief Health and Medical Officer (OCHMO) :
Lead Office / Technical Authority

Office of Safety and Mission Assurance (OSMA) :
Lead Office / Technical Authority

NASA Safety Center :
Contributing Program (or Project)

Independent Verification and Validation Program (IV&V) :
Contributing Program (or Project)

NASA Engineering and Safety Center :
Contributing Program (or Project)

Strategy 4.3.1. Risk Acceptability

Analyze the criticality of technical, safety, and health risks and evaluate risk acceptability.

Discipline experts analyze the criticality of technical, safety, and health risks and evaluate risk acceptability through an established process of independent reviews, assessments, and technical analysis. The information and advice from these experts provide critical data and knowledge used by the Technical Authorities to develop authoritative decisions related to application of requirements within programs and projects.

Stakeholder(s):

Discipline Experts

Strategy 4.3.2. Key Indicators

Address key indicators to support SMS strategies for success.

Key indications to support SMS strategies for success include:

Strategy 4.3.2.1. Independence

Independently assess the appropriate implementation of Agency safety, engineering, and health policies and procedures.

The ability to independently assess the appropriate implementation of Agency safety, engineering, and health policies and procedures to a level of penetration required as determined by the risk assessed within programs and projects.

Strategy 4.3.2.2. Modeling

Create and refine high fidelity safety, engineering, and health models.

The ability to create and refine high fidelity safety, engineering, and health models to better enable risk informed decision making.

Strategy 4.3.2.3. Access

Provide independent Technical Authorities with direct access to Agency decision makers.

Continued implementation of the Agency's governance model that provides the independent Technical Authorities with direct access to Agency decision makers.

Stakeholder(s):

Technical Authorities

NASA Decision Makers

Strategy 4.3.2.4. Safety

Assure human space programs meet or exceed safety threshold and goals for exploration missions.

The ability to have reliability/risk data to inform hardware development, mission planning, and mission execution to assure Agency human space programs meet or exceed Agency safety threshold and goals for exploration missions during the next five to ten years.

Strategy 4.3.2.5. Verification & Validation

Independently verify and validate critical software safety and mission assurance capabilities.

The ability to independently verify and validate critical software safety and mission assurance capabilities.

Strategy 4.3.3. Trilateral Summit

Share best practices, lessons learned, and current concerns relative to completing missions safely and successfully.

The annual Trilateral Summit (NASA, European Space Agency, and Japan Aerospace Exploration Agency) provides the opportunity for leading spacefaring nations to share best practices, lessons learned, and current concerns relative to completing missions safely and successfully.

Stakeholder(s):

European Space Agency

Japan Aerospace Exploration Agency

Strategy 4.3.4. Risk Mitigation

Understand and assure the Agency mitigates safety, health, and technical risks.

SMS programs are charged with understanding and assuring that the Agency mitigates, to an acceptable level, all safety, health, and technical risks to NASA missions. NASA accomplishes this by evaluating hardware, software, environmental, and human performance aspects to identify hazards, including the impacts of new requirements and departures from existing requirements. Limited resources could impact NASA's ability to adequately implement an SMS program.

4.4. Human Capital

Manage Human Capital.

Cultivate a diverse and innovative workforce with the right balance of skills and experience to provide an inclusive work environment in which employees that possess varying perspectives, education levels, life experiences, and backgrounds can work together and remain fully engaged in our mission. — Objective Overview: Mission success is highly dependent on a skilled, technical workforce. Through this management objective, NASA will attract, select, develop, deploy and retain competitive talent. NASA will enhance the efficiency and effectiveness of human capital service delivery in order to operate more like a business, taking on leaner postures through identification of efficiencies. As one of the leading employers of science, technology, engineering, and mathematics (STEM) professionals, NASA seeks to optimize the Agency's technical solutions through a workforce reflective of diverse ideas, life experiences, and backgrounds. Complementary to a diverse workforce is a work environment characterized by the key principles of equal opportunity: equity, fairness, and career advancement (e.g., access to growth opportunities and mentoring).

Stakeholder(s):

Mission Support Directorate (MSD) :
Lead Office

Office of Human Capital Management (OHCM) :
Lead Office

Office of Human Capital Management :
Contributing Program (or Project)

Office of Diversity and Equal Opportunity :
Contributing Program (or Project)

Center Management and Operations :
Contributing Program (or Project)

Strategy 4.4.1. Management

Design and implement a new functionally-aligned architecture for human capital management.

NASA will design and implement a new functionally-aligned architecture for human capital management with the goal of delivering consistent and effective human capital programs and services across NASA, while improving efficiency and reducing duplication. Progress will be initially assessed by maintaining or exceeding existing customer service standards. Long-term progress will be measured by resource savings.

Strategy 4.4.2. Talent

Attract, select, develop, deploy, and retain competitive talent.

In order for NASA to attract, select, develop, deploy, and retain competitive talent, within and external to the Government, NASA continues to implement state-of-the art and modern human capital programs including broad professional development for the workforce and leveraging opportunities to collaborate with other agencies on hiring flexibilities, especially for STEM skills.

Strategy 4.4.3. Opportunity, Diversity & Inclusion

Ensure equal employment opportunity, diversity, and inclusion.

Strategies relating to equal employment opportunity, diversity, and inclusion for the NASA workforce include, but are not limited to:

Strategy 4.4.3.1 . Employment Opportunity & Discrimination

Ensure Equal Employment Opportunity and prevent discrimination.

Proactive efforts to ensure Equal Employment Opportunity and prevent discrimination in the workplace, such as the Agency's Anti-Harassment Program and the Reasonable Accommodations Program.

Strategy 4.4.3.2. Employee Viewpoints

Assess employee viewpoints.

Regular assessment of the Federal Employee Viewpoint Survey's Inclusion Index.

Strategy 4.4.3.3. Diversity

Measure diversity increases.

Measurement of diversity increases through annual comparison with the U.S. relevant civilian labor workforce.

Strategy 4.4.3.4. Internships, Fellowships & Hiring

Increase the diversity of the Agency's internship, fellowship, and early career hiring programs

Targeted outreach and recruitment efforts to increase the diversity of the Agency’s internship, fellowship, and early career hiring programs

Strategy 4.4.3.5. Career Opportunities

Provide greater access to career opportunity.

Greater access to career opportunity through mentoring and other forms of formal and informal education and awareness (networking and shadowing) for both managers and employees.

Strategy 4.4.4. External Factors

Consider external factors of relevance.

External factors of relevance include the U.S. Census Bureau population projection, which indicates that by 2050 the current minority population will be 50 percent of the overall U.S. population.

Stakeholder(s):

U.S. Census Bureau

Strategy 4.4.5. Evidence & Evaluation

Provide evidence and evaluation to assess program success.

Evidence and evaluation to assess program success are provided through the Agency's Model Equal Employment Opportunity (EEO) Agency Plan, Diversity and Inclusion Strategic Plan, and Promising Practices for Diversity and EO guidebook, which serve as the blueprint for its efforts in these areas.

4.5. Enterprise Protection

Ensure Enterprise Protection.

Increase the resiliency of NASA's enterprise systems by assessing risks and implementing comprehensive, economical, and actionable solutions. — Objective Overview: Enterprise systems include NASA's mission programs and projects, information systems, and supporting institutional infrastructure. These systems are at risk of having disrupted, degraded, or denied environments due to natural, accidental, and malicious threats. This threat climate prompts the need for comprehensive risk assessments and risk-based safeguards for NASA's capabilities, technologies, and intellectual property. Insight, coordination, and action across the Agency will reduce the likelihood and consequences of enterprise protection risk. NASA shares responsibility across its missions and mission support organizations to safeguard against these threats by operationalizing effective, innovative, and economical protections. The Agency's protection approach focuses on understanding, communicating, controlling, and, as appropriate, accepting these risks to the achievement of the Agency's objectives. This approach aligns with and supports the Agency's overarching enterprise risk management framework as well as Federal laws and policies for requirements such as cybersecurity. The Agency will balance its protections with appropriate openness and transparency to promote accessibility and citizen engagement in NASA's missions.

Stakeholder(s):

Principal Advisor for Enterprise Protection :
Lead Office

Office of the Chief Information Officer (OCIO) :
Lead Office

Enterprise Protection Program :
Contributing Program (or Project)

Agency Information Technology Services :
Contributing Program (or Project)

Office of Protective Services :
Contributing Program (or Project)

Office of Strategic Infrastructure :
Contributing Program (or Project)

Strategy 4.5.1 . safeguards

Coordinate safeguards to increase protection effectiveness, mature protection capabilities to reduce risks in NASA's complex ecosystem.

The Agency will coordinate safeguards to increase protection effectiveness, mature protection capabilities to reduce risks in NASA's complex ecosystem, and optimize protections in an economical manner. NASA will coordinate protection horizontally and vertically, across and within programs, projects, and institutions. NASA's technologies and systems must be trusted, resilient, and consistent with the Agency's requirements.

Stakeholder(s):

Enterprise Protection Program :
This approach will require collaboration among the mission directorates, the Enterprise Protection Program, the OCIO, the Office of Protective Services, the Office of Strategic Infrastructure, the OCE, the OSMA, and NASA's Federal and commercial partners.

OCIO

Office of Protective Services

Office of Strategic Infrastructure

OCE

OSMA

NASA's Federal Partners

NASA's Commercial Partners

Strategy 4.5.2. Vulnerability, Susceptibility & Mitigation

Conduct vulnerability, susceptibility, and mitigation assessments of existing and planned architectures, requirements, technology, systems, workforce, and other relevant factors.

Enterprise-wide visibility is necessary to provide mission and mission support programs with optimal insight into the risks associated with threats. The Agency will conduct comprehensive vulnerability, susceptibility, and mitigation assessments of existing and planned architectures, requirements, technology, systems, workforce, and other relevant factors. Analysis of these assessments will result in strategic, actionable recommendations to reduce protection risk. Coordination across the Agency will ensure that enterprise protection requirements, restrictions, and safeguards are addressed throughout the life cycle of NASA's programs, projects, and activities.

Strategy 4.5.3. Data & IT Assets

Ensure the confidentiality, integrity, and availability of data and IT assets.

Cybersecurity threats can exploit the increasing complexity and connectedness of critical systems, placing NASA's missions and objectives at risk. The Agency must ensure the confidentiality, integrity, and availability of its data and IT assets to enable trust and resilience. NASA will increase the robustness of its cybersecurity capabilities to responsively identify and reduce vulnerabilities. This strategy depends on full adoption of the National Institute of Standards and Technology cybersecurity framework to enable NASA to identify, protect, detect, respond, and recover from cyberattacks. NASA is partnering with the Department of Homeland Security to modernize, and consolidate where appropriate, the Agency's IT infrastructure in alignment with the cybersecurity framework. NASA's personnel must be informed, trained, and vigilant to maximize the effectiveness of this comprehensive cybersecurity modernization.

Strategy 4.5.4. Investment

Invest in affordable protection.

As a steward of American taxpayer dollars, NASA must invest in affordable protection for its mission, corporate, and physical domains. Enterprise-wide visibility and coordination will strengthen NASA's ability to strategically and economically plan for and acquire safeguards. Data-driven operating model choices and acquisitions will reduce redundant contract vehicles, increase transparency, and drive down costs while optimizing protection effectiveness.

Strategy 4.5.5. Laws & Policies

Evolve out ability to protect the Agency in alignment with Federal laws and policy related to enterprise protection.

As threats evolve globally, NASA will evolve its ability to protect the Agency in alignment with Federal laws and policy related to enterprise protection. New mission and commercial capabilities will also introduce mission complexity and new risks. Success will depend on NASA’s cooperation and partnerships with other U.S agencies, academia, and the commercial sector for the exchange of knowledge, technologies, tools, and techniques for enterprise protection. NASA’s missions and operations will be more resilient and accessible in a manner that protects the Agency’s people, assets, and work. Coordinated policies, risk assessments, and actions coupled with mature, adaptive protection capabilities will underlie NASA's increased resilience and accessibility.

4.6. Infrastructure

Sustain Infrastructure Capabilities and Operations.

Enable NASA's Mission by providing the facilities, tools, and services required to efficiently manage, operate and sustain the infrastructure necessary to meet mission objectives. — Objective Overview: Through this management objective, NASA is integrating and optimizing operations across Centers and Mission Support areas to reduce costs and revitalize the capabilities required to enable NASA's portfolio of missions. To address challenges associated with aging infrastructure, NASA is aggressively managing its facility portfolio to consolidate and modernize into fewer, more efficient, and sustainable facilities. Through a systematic assessment of service areas, NASA is consolidating and improving operations to balance risks across services and activities to provide a safe and reliable infrastructure.

Stakeholder(s):

Mission Support Directorate (MSD) :
Lead Office

Center Management and Operations :
Contributing Program (or Project)

Office of Strategic Infrastructure :
Contributing Program (or Project)

Strategy 4.6.1. Stewardship

Reduce costs, revitalize and integrate capabilities, and optimize operations.

NASA's mission support strategy is to steward resources by reducing costs, revitalizing capabilities, integrating capabilities across NASA Centers and Mission Support areas, and optimizing operations. To move toward a model of interdependence, NASA implements Business Services Assessment decisions. Our workforce depends

on the availability of unique facilities, tools, capabilities, and services to successfully conduct our mission. Planning, operating, and sustaining this infrastructure and our essential services requires a number of critical institutional capabilities including management of finance, real property, and other support functions. To operate as efficiently as possible, NASA relies on its Shared Services Center to provide timely, accurate, and high quality business support services in a consolidated fashion to all NASA Centers.

Strategy 4.6.2. Sustainability

Increase our inventory of sustainable buildings and award more energy savings performance contracts and utility energy service contracts.

Sustainable management of NASA's infrastructure ensures that our assets support our workforce in meeting mission requirements and schedules. NASA is increasing its inventory of sustainable buildings and awarding more energy savings performance contracts and utility energy service contracts, which enable energy service companies and utility companies to finance energy projects that NASA repays over time from avoided utility costs. In 2016, NASA added two Leadership in Energy & Environmental Design (LEED)-certified buildings to its portfolio, with a combined area of more than 21,000 gross square feet. It should be noted that a LEEDcertified building from the previous year obtained a “2 Green Globes” certification from the Green Building Initiative last year. This 153,000 gross square feet building is the first NASA building to attain multiple sustainable facility systems ratings. To support our mission, NASA has adopted a facilities maintenance and operation philosophy by proactively pursuing and adopting the safest, most cost-effective blend of reliability centered maintenance techniques, sustainability practices, and safety procedures. Other best practices conducted by NASA include providing safe, sustainable, efficient, and reliable facilities. Funding for reliabilitycentered maintenance and condition-based maintenance is set aside within the maintenance funding for Centers to invest in technology advancements, allowing Centers to better manage maintenance resources.

Strategy 4.6.3. Business Services

Implement business service recommendations and decisions.

NASA is implementing the following recommendations and decisions from its Business Services Assessment that identified areas for improved management of the Agency's portfolio.

Strategy 4.6.3.1. Master Plan

Develop an agency master plan.

A key recommendation is the development of an Agency Master Plan that identifies Agency facility priorities over a 20-year timeframe to assist the development of Center master plans in meeting Agency goals, missions, sustainment, and demolition activities.

Strategy 4.6.3.2. Facility Capability Leadership

Appoint a Facility Capability Leader.

Another key decision is the appointment of a Facility Capability Leader to manage and implement the Agency Master Plan in the most effective and cost-efficient manner possible.

Stakeholder(s):
Facility Capability Leader

Strategy 4.6.3.3. Additional Decisions

Additional decisions include the implementation of improved processes to facilitate divestment, limitations for in-grant investments, and a revised methodology for prioritizing capital investments and repairs across the Agency.

Strategy 4.6.3.3.1. Divestment

Implement improved processes to facilitate divestment.

Strategy 4.6.3.3.2. In-Grant Investment

Limit in-grant investment.

Strategy 4.6.3.3.3. Capital Investments & Repairs

Revise methodology for prioritizing capital investments and repairs.

Strategy 4.6.3.4. Maintenance

Improve standards for levels of maintenance and focused investment on condition-based maintenance and reliability-centered maintenance.

Improvements in operations and maintenance call for improving standards for levels of maintenance and more focused investment on condition-based maintenance and reliability-centered maintenance. This will maximize maintenance investments and optimize maintenance cycles for core critical assets.

Strategy 4.6.4. Capability Leadership

Institute Capability Leadership.

NASA has instituted Capability Leadership as part of the Agency Operating Model. The model will advance and optimize deployment of resources and divestment of technical capabilities that are no longer needed. NASA is developing policies and processes for Capability Portfolio Management related to facilities and technical capabilities that will:

Strategy 4.6.4.1 . Advice & Alignment

Advise the Agency and ensure proper alignment across Missions and Centers

Strategy 4.6.4.2. Technical Guidance Plans

Establish plans based on strategic needs to provide technical guidance to the Agency

Strategy 4.6.4.3. Gaps

Determine gap areas for advancement and strategic investment

Strategy 4.6.4.4. Investments & Divestments

Assess opportunities for investments and divestments

Strategy 4.6.4.5. Standards & Specifications

Establish standards and specifications

Administrative Information

Start Date: 2018-02-02
End Date: 2022-09-30

Publication Date: 2018-03-12
Source: https://www.nasa.gov/sites/default/files/atoms/files/nasa_2018_strategic_plan.pdf

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