



NASA Information Technology Strategic Plan (Fiscal Years 2018-2021)

Office of the Chief Information Officer





NASA VISION

To discover and expand knowledge
for the benefit of humanity.

Table of Contents

- 2 Introductory Message
- 3 Purpose
- 4 NASA's Information Consumers & Stakeholders
- 5 Strategic Management Model for NASA IT
- 6 IT Vision, Mission, Values, and Principles
- 8 NASA IT Strategic Plan Summary
- 9 Strategic IT Roadmap
- 10 Strategic Goals and Objectives
 - GOAL 1 Partner with customers to consistently deliver excellence and enable mission success.
 - GOAL 2 Capitalize on data management, access, and innovation.
 - GOAL 3 Safeguard NASA's data and IT assets.
 - GOAL 4 Maximize business value by optimizing IT.
 - GOAL 5 Care for our people today and prepare them for tomorrow.
- 24 Alignment With NASA's Strategic Plan
- 25 NASA CIO Authorities, Strategic Sourcing, and Accessibility
- 26 IT Governance Model
- 28 IT Investment Management
- 29 Visual Representation of this Strategic Plan
- 30 List of Acronyms

Introductory Message

NASA's Mission is to 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, and to 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. To accomplish this, NASA will depend heavily on many things – key among them is information technology (IT). IT enables us to operate the International Space Station and prepare for human exploration beyond low-Earth orbit. IT also helps us to explore our solar system and the universe. And, IT enables us to create safer, faster, and more efficient air transportation systems.

NASA leads the scientific community in the amount of research data collected and shared. From views of distant places captured by observatories, to analyzing other bodies in the solar system, to satellites observing Earth, these research data teach us more about our home planet. Here on Earth, NASA is testing improvements to air travel for the benefit of the American public.

It is critical that our IT vision, policies, services, cybersecurity, and people support the successful execution of these multi-faceted missions.

Part of our job is to deliver data and IT systems easily, efficiently, and securely to NASA's Federal and contractor employees to enable NASA's Mission. We also make NASA's data and data analytics tools available to the public, industry, and other Government agencies through our websites, data repositories, and information and technology transfer programs. Since the Agency exists in a climate of persistent threats against our networks and IT systems, securing our information and technology is a critical responsibility that we all share.

NASA's IT Business Services Assessment (BSA) is transforming the way the Agency does business. Our implementation of this transformation is helping us to identify opportunities for efficiencies, to facilitate collaboration, and to minimize redundancies, while enabling our implementation of the Federal Information Technology Acquisition Reform Act (FITARA).

We continue to improve NASA's IT environment:

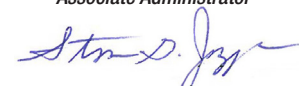
- New network and web services architectures are increasing our cost-effectiveness.
- Our progress in implementing the use of personal identity verification (PIV) smart cards to authenticate network users is protecting our missions and information.
- We have closed 59 of our 79 data centers and we are shifting major customer segments to the cloud.

NASA's human exploration, science, aeronautics, technology, and mission support endeavors are intertwined to accomplish NASA's Mission. IT helps drive discovery and share NASA's results, so the information systems our customers depend on must work effectively. Achieving NASA's Mission by sharing data easily and collaborating efficiently to reveal the unknown is within our reach. NASA IT is there when you need it, delivering our missions safely and securely.

Renee P. Wynn
Chief Information Officer



Stephen G. Jurczyk
Associate Administrator

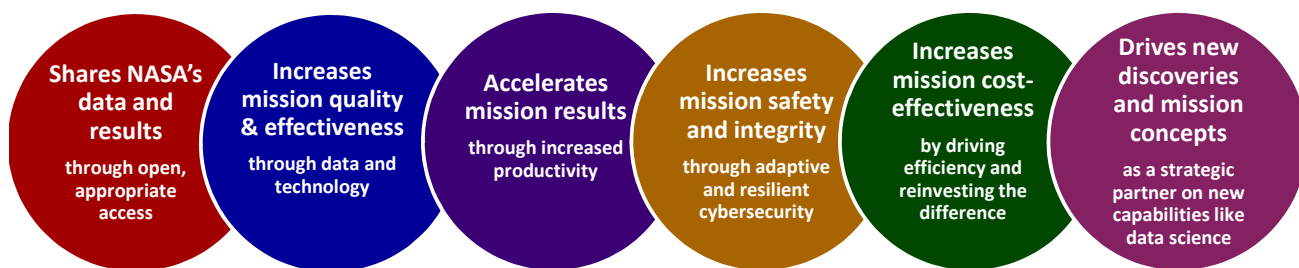


Purpose

As part of section 3506(b)(2) of Title 44 of the United States Code and the Clinger-Cohen Act of 1996, the Office of the Chief Information Officer (OCIO) is required to develop and maintain an information resources management strategic plan. NASA uses its Information Technology (IT) Strategic Plan to guide the direction, mission alignment, investments, and accountability of NASA's IT community in supporting the achievement of the NASA Strategic Plan. The outcome of this plan over the next four years (Fiscal

Years 2018-2021) is to maximize the value of our IT contribution to NASA's missions, partners, and the American public. NASA's IT community will accomplish this outcome by sharing NASA's results and partnering on new strategic capabilities to drive discovery while increasing quality, productivity, mission safety, and cost optimization. These mission-oriented strategic outcomes are described below and are referenced throughout this plan.

The strategic use of IT contributes to NASA's missions in several ways



NASA reviews progress annually toward its IT Strategic Plan and publishes an updated plan as appropriate. This plan includes minor updates from late 2018 to clarify performance metrics, address stakeholder feedback from the last publishing cycle, and clarify alignment with NASA's 2018 Strategic Plan. The plan identifies IT goals and objectives that ensure close alignment with the NASA

Strategic Plan and Federal laws and policies. These goals establish investment priorities to guide the allocation of IT resources to help accomplish the Agency's Vision and Mission. The release of this NASA IT Strategic Plan addresses the main drivers for change listed below as well as several additional drivers.

NASA Drivers	Federal Drivers
<p>NASA's 2018 Strategic Plan and stakeholder priorities and feedback. NASA's Chief Information Officer (CIO) engaged with leaders and representatives spanning the Agency's mission directorates, mission support organizations, and Center communities.</p> <p>Findings and strategies identified during NASA's IT Business Services Assessment (BSA) and the Mission Support Future Architecture Program (MAP). The BSA is NASA's disciplined approach to strategically assess the health of its mission support services, including IT, and identify opportunities for service optimization. The goal of MAP is to further optimize NASA's mission support services by moving toward an enterprise operating model.</p>	<p>The Federal Information Security Modernization Act (FISMA). FISMA requirements include a comprehensive framework for ensuring the effectiveness of cybersecurity controls over information resources that support Federal operations and assets, and effective management and oversight of cybersecurity risks and Agency cybersecurity programs.</p> <p>The Federal Information Technology Acquisition Reform Act (FITARA). Requirements include the following areas: 1) Agency CIO Authority Enhancements, 2) Enhanced Transparency and Improved Risk Management in IT Investments, 3) Portfolio Review, 4) Federal Data Center Consolidation Initiative, 5) Expansion of Training and Use of IT Cadres, 6) Maximizing the Benefit of the Federal Strategic Sourcing Initiative, and 7) Government-wide Software Purchasing Program.</p> <p>The President's Management Agenda (PMA). The PMA lays out a long-term vision for modernizing the Federal Government in key areas, such as information technology, that will improve the ability of agencies to deliver mission outcomes, provide excellent service, and effectively steward taxpayer dollars on behalf of the American people.</p>

NASA's Information Consumers and Stakeholders

Per the National Aeronautics and Space Act of 1958, NASA is accountable to “provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof.” To achieve this requirement, the Agency collaborates with and supports a diverse set of internal and external information consumers, as well as numerous external stakeholders, with varying needs, responsibilities, and uses for NASA’s information. The public is our largest information consumer, sharing in the results of our missions and using our growing number of open datasets available on <https://data.nasa.gov/>. This plan identifies several NASA information consumers below. NASA conducts its work in four principal organizations, called

mission directorates, and the mission support directorate. NASA Headquarters, nine field centers, and a federally funded research and development center, the Jet Propulsion Laboratory (JPL), conduct the work that supports these directorates. The Agency maintains a global presence that extends beyond the summary below. An example of this presence is the Deep Space Network, which is directed and managed for NASA by JPL, with locations in Australia, Spain and the United States. NASA also coordinates with Federal Government entities that issue laws and mandates, policy decisions, and standards that influence the direction and operation of NASA’s information resources management.

Mission Directorates

Aeronautics Research Mission Directorate (ARMD): ARMD’s four research programs develop advanced technologies to reduce aviation’s environmental impact & transform the way we fly.

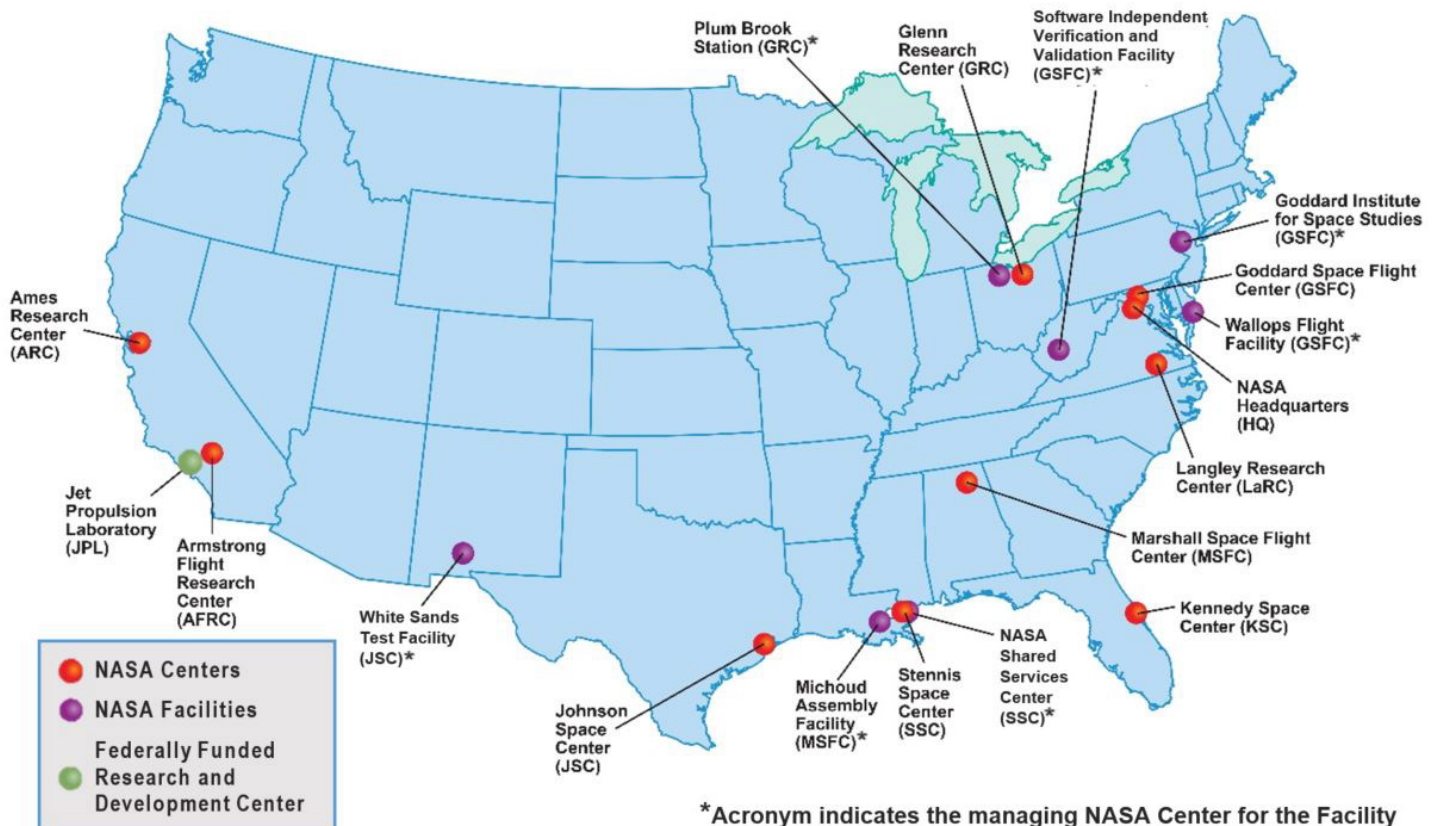
Human Exploration and Operations (HEO): HEO provides the agency with leadership and management of NASA space operations related to human exploration in and beyond low-Earth orbit.

Mission Support Directorate (MSD): MSD provides effective and efficient institutional support to enable successful accomplishment of NASA mission objectives.

Science Mission Directorate (SMD): SMD uses space observatories to conduct scientific studies of the Earth from space to visit and return samples from other bodies in the solar system and to peer out into our galaxy and beyond.

Space Technology Mission Directorate (STMD): STMD rapidly develops, demonstrates, and infuses revolutionary, high-payoff technologies through transparent, collaborative partnerships, expanding the boundaries of the aerospace enterprise.

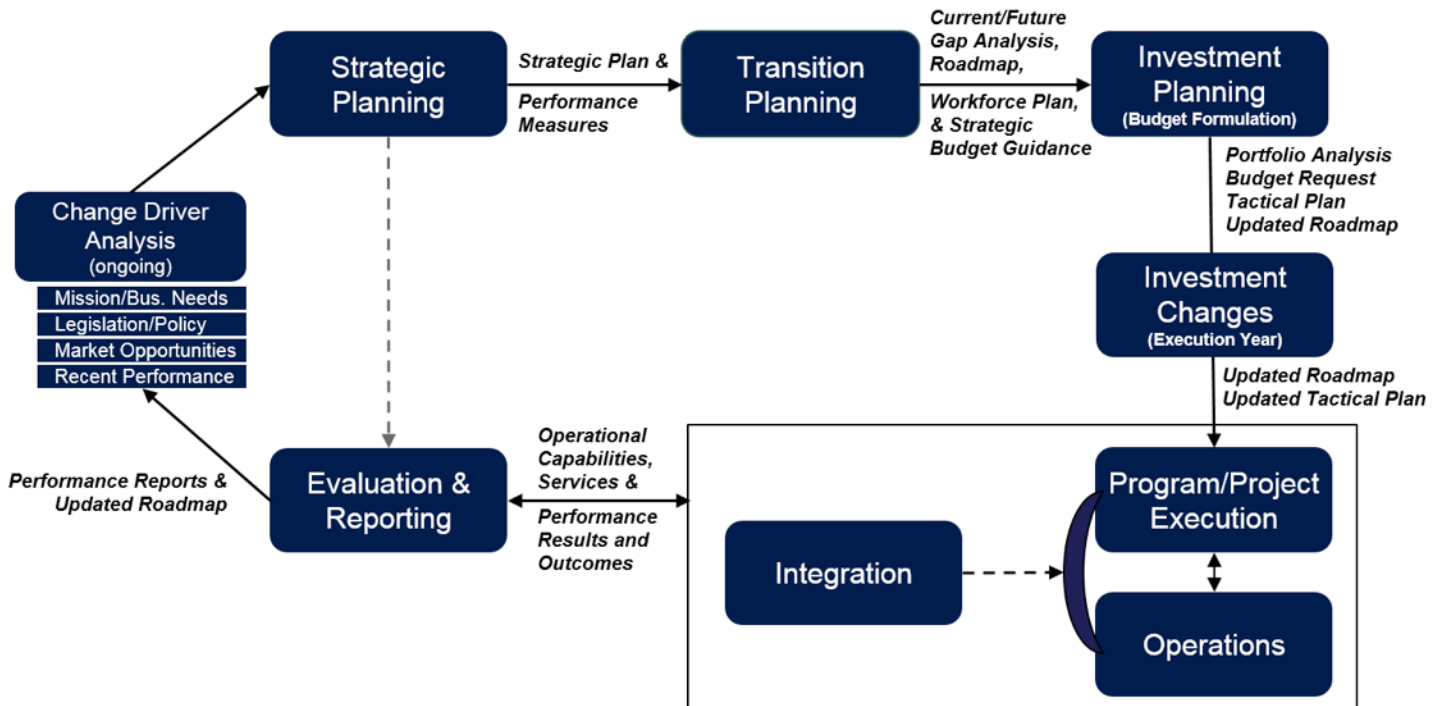
NASA Centers and Facilities



Strategic Management Model For NASA IT

This model represents our approach to responsively plan, execute, and evaluate changes to NASA's IT environment needed to achieve NASA's Vision and Mission. The model facilitates repeatable near- and long-term planning by helping identify needs, forecast

capability and technology changes, inform resource planning, and align program/project management to implement and sustain the changes. The summary below provides context for the role of this strategic plan for NASA's customers and IT community.



Analysis of drivers for change, including Agency needs, NASA's Strategic Plan, and Federal laws and policies, inform the formulation of NASA's IT Strategic Plan. The resulting plan sets the vision, mission, goals, and outcomes for NASA's IT environment for the next four years in alignment with the Agency's direction. Next, we perform a gap analysis between our current environment and the future environment identified in the strategic plan. The resulting gap analysis informs development of our transition plan, or roadmap, which translates these IT strategies into actionable plans for our IT community to meet our customers' needs. Through our participation in development of the Agency's broad NASA Technology Roadmap, we provide input regarding information technology such as physics modeling, simulation tools, and spacecraft IT. We also participate in the Agency technology prioritization, ensuring that decisions are consistent with NASA's IT infrastructure requirements and capabilities.

Our roadmap guides our annual budget formulation priorities and execution focus. We optimize our annual budget request in alignment with mission needs and strategic priorities by performing IT portfolio analysis. Then, we assess our recent performance and develop tactical plans and performance criteria for major initiatives to guide execution for the upcoming year. Our IT programs and projects execute these plans in an integrated manner to ensure the effectiveness and quality of our IT capabilities and services.

NASA uses these plans and performance criteria to evaluate and report on our program and project execution through periodic IT program reviews. We also perform periodic functional reviews across NASA's Centers to ensure policy compliance and operational effectiveness. The results of these program and functional reviews support internal management processes and decision-making. Collectively, these results provide critical information on performance toward our near-term and long-term objectives, as well as influence changes to our IT strategy and roadmap.

IT Vision, Mission, Values, and Principles

NASA's IT vision and mission statements remind us of our purpose and our path to support achievement of NASA's Vision and Mission. Our vision leads to a future state for the use of NASA's data and IT that directly supports achievement of NASA's Vision. Our mission statement outlines our fundamental purpose and role in bringing NASA's Vision to life through the strategic use of data and IT. Our IT vision and mission statements directly support NASA's Vision and Mission statements.

Vision: Our IT vision is to manage IT as a strategic resource to securely unleash the power of data.

Mission: Our IT mission is to enable the secure use of data to accomplish NASA's Mission.

Values: Values: The IT values (at right) supplement the core values in NASA's Governance and Strategic Management Handbook and guide our behavior in achieving NASA's Vision and Mission.



Guiding Principles

NASA's Governance and Strategic Management Handbook relays overarching principles that govern NASA's activities. The seven IT principles below further articulate how our IT community will make decisions to support achievement of NASA's Vision and Mission.

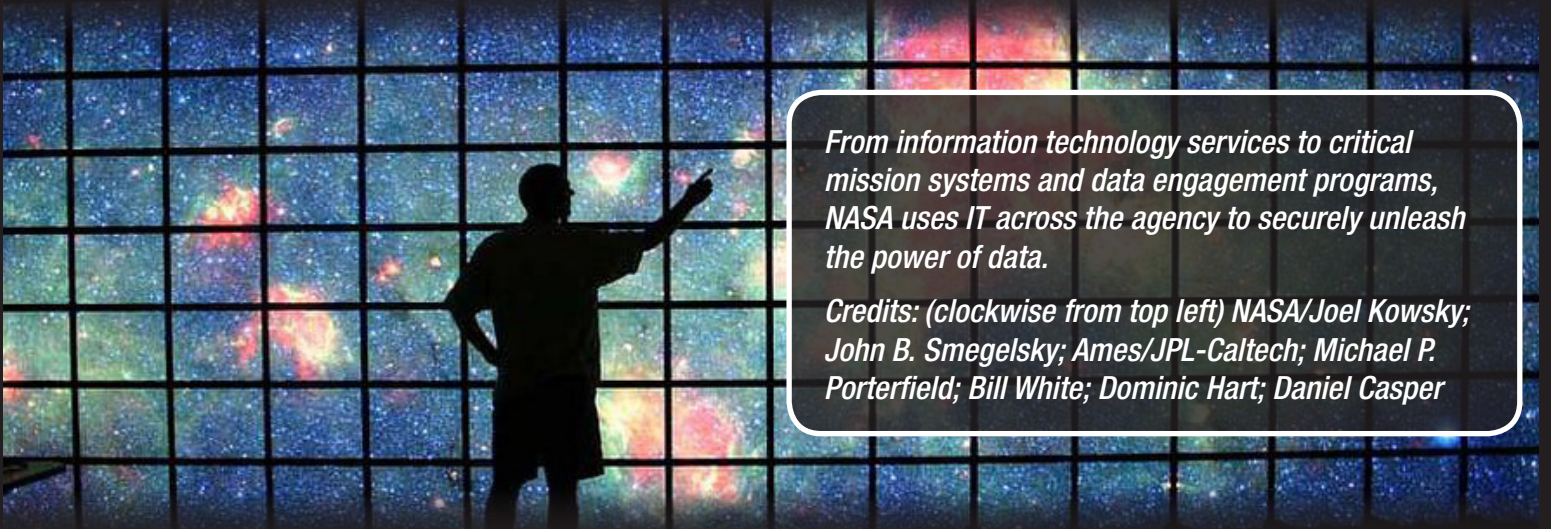
- Engage with our missions and customers to understand their requirements and what they value.
- Facilitate integration across our mission directorates and Centers.
- Manage IT as a crosscutting NASA capability and use standard criteria to assess value and risk to inform our decisions.
- Design cybersecurity into our programs, services, and systems.
- Assess emerging IT, leverage Government and private sector innovation, and focus on advancing Agency priorities.
- Source common IT products and services strategically to drive cost-effective purchasing and partnerships.

- Utilize the most effective IT operating model for each capability and service using the criteria below:
 - Enterprise model: Achieve economies of scale and simplify architecture and cybersecurity in order to maximize agency-wide integration and collaboration when requirements are common and not tightly coupled to unique missions.
 - Federated model: Allow local management and operations control and standardize products and tools in order to improve integration and simplify cybersecurity.
 - Diversified model: Understand that when requirements are tightly coupled to unique missions and Center/project needs for agility and speed, these needs outweigh potential economies of scale and the risk of increased integration and cybersecurity complexity.

Our IT Strategic Plan and Priorities

The remainder of this plan outlines the strategic IT direction, goals, priorities, and future environment that we will pursue to make our vision of the future a reality. We iteratively formulated this plan with stakeholders across the Agency. To provide focus, we identified five strategic goals for the next four years. After clarifying these initial goals, we engaged NASA's mission directorates and Centers through Agency-wide stakeholder reviews on the goals and objectives. After we updated the plan based on stakeholder feedback, NASA's IT governing councils reviewed and approved this plan, which is published on NASA's public website.

The next section of the plan discusses each strategic goal, supporting strategic objectives, and performance measures in detail. Our goals focus on partnering with our customers to deliver excellence, capitalizing on data and innovation, safeguarding our National data and assets, maximizing business value through optimization, and caring for our people and preparing them to securely unleash the power of NASA's data.



From information technology services to critical mission systems and data engagement programs, NASA uses IT across the agency to securely unleash the power of data.

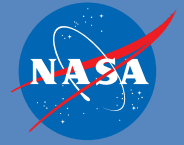
Credits: (clockwise from top left) NASA/Joel Kowsky; John B. Smegelsky; Ames/JPL-Caltech; Michael P. Porterfield; Bill White; Dominic Hart; Daniel Casper



NASA IT Strategic Plan Summary

NASA's Mission Directorates

- Aeronautics Research
- Human Exploration and Operations
- Science
- Space Technology
- Mission Support



IT Vision

Manage IT as a strategic resource to securely unleash the power of data.

IT Mission

Enable the secure use of data to accomplish NASA's Mission.

IT Values

Customer Driven (Responsive, Make IT Easy!) ❖ Continuously Learning (Insight Driven)
Accountable (Transparent) ❖ Trusted Partner

Mission-Oriented Strategic Outcomes



Goal 1: Excellence
Partner with customers to consistently deliver excellence and enable mission success.

R Q A S

Goal 2: Data
Capitalize on data management, access, and innovation.

R Q A S C D

Goal 3: Cybersecurity
Safeguard NASA's data and IT assets.

R Q S

Goal 4: Value
Maximize business value by optimizing IT.

Q S C

Goal 5: People
Care for our people today and prepare them for tomorrow.

R Q A S C D

Objectives

1.1 Increase customer satisfaction.

- ❑ Implement a Customer Experience Index (FY 2018)
- ❑ Baseline customer experience (FY 2019)
- ❑ Incrementally increase customer experience (FY 2021)

1.2 Increase end-to-end usability and effectiveness.

- ❑ Develop a transition plan to a device-agnostic architecture (CY 2018)
- ❑ Design NASA's network strategy (FY 2019)

1.3 Enable responsive, actionable service performance improvement.

- ❑ Establish service reliability, availability, and resiliency metrics (CY 2018)
- ❑ Improve customer experience through voice of the customer and automated system feedback (FY 2020)

Objectives

2.1 Enable transformation of NASA's data into insights.

- ❑ Analyze enterprise-wide data tools (FY 2018)
- ❑ 70% of catalogued data in NASA Data Centers searchable (FY 2020)
- ❑ 35% of catalogued data in NASA Data Centers securely accessible by enterprise analytical suite (FY 2021)

2.2 Increase secure data accessibility and data management through innovation to address capability gaps and improve operations.

- ❑ Test and operationalize six IT/process data innovations in a phased approach in alignment with Agency needs and priorities (FY 2021)

Objectives

3.1 Reduce the risk to data and information systems.

- ❑ 95% HW/SW asset mgmt (FY 2018)
- ❑ 85% multi-factor authentication to network (FY 2018)
- ❑ Implement Agency-wide continuous monitoring (FY 2019)
- ❑ Only authorized devices and software access NASA's data & networks (FY 2019)
- ❑ Mission and business owners have cyber risk profile for their assets (FY 2020)
- ❑ Strategically manage highest priority cyber risks (FY 2021)

3.2 Prioritize and mitigate cybersecurity risks based on a framework.

- ❑ COOP/DR plans for high-risk cybersecurity systems (FY 2019)

3.3 Improve cybersecurity education and practices.

- ❑ Innovate on cyber training (FY 2019)
- ❑ 50% of applicable employees complete role-based training (FY 2021)

Objectives

4.1 Empower data-driven decisions and operating model choices.

- ❑ Enterprise vendor mgmt capability (FY 2020)
- ❑ Enterprise software life cycle mgmt capability (FY 2021)

4.2 Increase effectiveness of investment analysis and prioritization.

- ❑ \$50M of NASA cost avoidance/savings (FY 2017-18)
- ❑ Business cases have measurable outcomes for all new major IT investments (FY 2019) and for 35% of NASA's IT investment budget (FY 2020)
- ❑ Benchmark NASA's spending on IT capabilities (FY 2019)
- ❑ Execute IT investment mgmt process for 20% of NASA's IT portfolio (FY 2022)

4.3 Increase effectiveness of IT strategy execution.

- ❑ 85% of projects execute in conformance with approved project plans (annual)

Objectives

5.1 Care for our people and encourage mission-oriented performance.

- ❑ List critical positions within IT functional areas (FY 2018)
- ❑ Define IT operating model (FY 2019)
- ❑ Complete NASA's IT workforce strategy (FY 2019)
- ❑ Reorient IT budget year 2022 request to align to NASA's enterprise mission support operating model (FY 2020)
- ❑ Execute transition of NASA IT to Agency's enterprise mission support operating model (FY 2022)

5.2 Attract & retain diverse, high-quality people.






- ❑ Enhance diversity and inclusion (FY 2018)
- ❑ Develop market-informed pay for mission critical IT positions (FY 2021)

5.3 Prepare our people to achieve NASA's vision.

- ❑ Implement IT workforce strategy (FY 2021)

Strategic IT Roadmap

NASA's strategic IT roadmap is a time-based visual representation of key NASA leadership and personnel to ensure alignment of existing and new IT elements of this strategic plan. This roadmap presents an overarching view of investments to support mission and business priorities. critical IT activities over the next four years and enables collaboration across

	FY 2018	FY 2019	FY 2020	FY 2021	Future
Excellence  Decentralized and inconsistent IT capabilities with aging hardware and software	Create customer experience index	Expand customer engagement Design NASA's network strategy	Improve IT service and help desk quality to incrementally increase base line customer experience Implement NASA's network strategy		Proactive customer engagement and excellence through modern, reliable, and secure IT services
Data  Fragmented data constrains timely research and decision making	Analyze customers' data and analytics requirements	Increase enterprise-wide ability to securely search, analyze, and interpret data in NASA Data Centers	Complete six phased data/process innovations in alignment with Agency needs and priorities		Catalogued data and analytical tools accelerate research and decision making
Cybersecurity  Reactive cybersecurity and incomplete visibility across assets and risks	Increase Agency-wide visibility into cybersecurity risks by implementing continuous monitoring	Mission/business owners have cyber risk profiles for their assets	Strategically manage NASA's highest priority cyber risks		Reduced risk through modern cybersecurity capabilities and training
Value  Decentralized accountability and unintentional redundancies; unifying oversight of IT portfolio	Increase the resiliency of high-risk enterprise cybersecurity systems	Expand NASA's role-based cybersecurity training	Standardize collection of IT portfolio data Benchmark spending on IT capabilities Link IT capabilities to NASA's needs Expand use of measurable outcomes in IT business cases to guide investment prioritization	Implement new investment process for 20% of NASA IT portfolio	Increased value through economies of scale and use of intentional IT operating models
People  Clarified lines of authority and accountability for IT between the Agency and Centers	Create software management plan	Complete phased implementation of NASA's vendor management and software life-cycle management capabilities	Establish list of critical IT positions	Refine NASA's IT operating model and develop IT workforce strategy Implement IT workforce strategy	People have shared goals for IT, diversity, skills, and motivation to achieve NASA's vision

Strategic Goals and Objectives

Strategic Goal 1: Partner with customers to consistently deliver excellence and enable mission success.

NASA's missions require excellent performance and successful service delivery. Investment in IT must meet these requirements by providing the consistent quality, effectiveness, and productivity needed to deliver value. We must partner with our customers to understand and advocate for their requirements and excel during planning, delivery, and use of data and IT systems. This approach demands an ability to set and manage expectations that are informed by financial and cybersecurity realities. To ensure that NASA's IT portfolio is balanced, we must target excellence in areas in which IT provides a strategic asset for the Agency's missions. This focus will prevent us from over-committing to excellence for less critical IT services that compete for resources with critical priorities.

We will strengthen our relationships with our customers to better understand their mission priorities and IT requirements. Our intent is to increase customer engagement during planning and delivery to drive timely, effective, mission-enabling IT products and services. Our approach will be informed by our customers' experience with the products and services we deliver and with our delivery process. Customer feedback will help us identify which products and services to continue and where improvements need to be made.

To ensure mission quality, we will hold ourselves accountable for delivering IT that is reliable, available, and secure, while modernizing technologies in the process. NASA needs to be

strategic when selecting the operating model for each IT service; the Agency must analyze the tradeoffs between offering an IT product or service at the enterprise level or, as appropriate, addressing specific requirements to meet the tailored needs of a Center or mission. Appropriate training and user preparedness will be critical to realize the potential value of each of these IT services. We must also provide our customers with feedback mechanisms to report whether or not their needs are being met. In addition to this customer-driven feedback, our digital services need to capture performance information to enable responsive, actionable service improvement. Our intent is to detect and resolve service performance issues before our customers must report an issue manually.

We strive to implement IT products and services that can be leveraged to support mission and Center-unique requirements. Because our customers include NASA employees and contractors, as well as partners with whom we do business, including universities, international partners, corporations, and the public, our ability to provision or broker IT services reaches beyond the NASA enterprise. A key challenge is to ensure that our services provide the extended reach necessary so that missions and Centers do not need to duplicate infrastructure or functionality for basic IT infrastructure services. We recognize that there will be a natural progression along this path over time due to NASA's mission diversity and highly complex IT ecosystem.

Objective 1.1: Increase customer satisfaction with our business relationships and service delivery.

To develop business relationships that exceed expectations, NASA's IT community must understand the current and anticipated needs of the customers we serve. We will engage with NASA's missions and Centers to understand their needs and desired outcomes and we will accommodate these needs within the budget and product life cycle. By focusing on delivering reliable, available, and resilient IT, our enterprise service delivery model will provide the level of performance that NASA customers need. These enterprise services will serve as the foundation upon which the IT needs of NASA's customers can be built.

We will simplify the catalog of enterprise IT capabilities in order to satisfy the needs of most customers. NASA's IT community will collaborate with our mission and Center customers to configure

these services in order to accommodate unique requirements that can be plugged into a solid foundation. The result will be an interoperable environment with increased reliability and resiliency that provides secure availability of data and services.

We will evolve relationships with our customers in order to exceed expectations and achieve mission success through periodic forums and surveys assessing the usefulness and effectiveness of IT services. This approach will ensure that the IT community works in tandem to deliver quality services, enabling scientists and engineers to invest their resources efficiently and advance NASA's Mission. We will analyze performance metrics to identify opportunities for service improvements and to help identify services that are needed but unavailable, or services that are no longer needed, providing data-driven reasons to adjust NASA's IT

environment to meet customer needs. We will perform continuity of operations planning, based on service priority, to ensure that our capabilities are resilient.

NASA will convene functional communities of interest for the purpose of ongoing engagement to discuss service performance and to collaborate on service planning and delivery. We will include activities associated with the IT life cycle within this scope, including requirements analysis, selecting, acquiring, developing, implementing, operating, and maintaining our services. By establishing these communities of interest, we will increase mission alignment by providing the opportunity for our customers to collaborate in service planning, development, and enhancement.

Objective 1.2: Increase end-to-end usability and effectiveness by creating an agile and responsive approach to IT investments.

The required agility, elasticity, and timeliness to deliver in NASA's IT environment dictates a shift to a much more responsive model and operating environment. We will engage with our customers to help us identify which business and technology trends are appropriate for NASA to pursue. By responsively identifying needs and technology options, we can prototype and pilot options and incrementally adopt solutions that provide the best value to the NASA community. This approach allows a broad customer base to participate in service selection, design, and testing, providing ample opportunity to make adjustments along the way.

We must align NASA's IT infrastructure and services with an enterprise architecture and data architectures that incorporate evolving customer needs as well as advances in IT products and service delivery capabilities. Our plan is to drive complexity out of the IT ecosystem while providing elastic and scalable capacity for our services. A key driver of complexity in NASA's IT ecosystem is the current requirement for device access to networks. NASA must shift from a device approach to a data access approach. The resulting goal is to migrate to a device-agnostic environment where NASA customers with authorized access can get to the data they need, regardless of which device they use to obtain that access.

In order to deliver and manage these capabilities effectively, we will implement infrastructure and cybersecurity rulesets that enable NASA to migrate to a highly virtualized environment. Once implemented, these capabilities will allow us to develop an easy-to-use IT services catalog, a suite of tools that allows flexibility of use across NASA's diverse IT ecosystem, and a robust IT sourcing strategy that accommodates most customer requirements and complies with cybersecurity policies and procedures.

Performance Measures

- Implement a Customer Experience Index by the end of fiscal year (FY) 2018 to measure customer experience with elements like IT capabilities, the IT product life cycle, service delivery, and interactions and relationships with OCIO. This measure will include all customers of OCIO services, including mission and engineering personnel.
- Target future improvements to customer experience with NASA IT service and delivery by baselining the current customer experience profile by the end of FY 2019.
- By the end of FY 2021, incrementally increase IT customer satisfaction above the customer experience baseline.

Over the long term, we will collaborate with NASA's mission directorates and field Centers to enlist an enterprise first approach to provide services where requirements are shared across multiple communities of interest. NASA can only realize this future state by intentionally making strategic investments and financial decisions, which will rely on collaboration between mission directorates, field Centers, and enterprise IT service providers. The likelihood of success for this approach increases as the Agency pools its fragmented resources to achieve a common IT operating environment upon which NASA can build mission-unique requirements.

We will provide innovative, sustainable, and transparent mission support of foundational IT services that enable NASA's missions to focus on science and engineering requirements. We will centralize asset management to enable more robust configuration management. Finally, we will increase insight into the quantity, cost, cybersecurity, and management of the enterprise infrastructure, across contract vehicles, to enable NASA to create more effective performance metrics as well as identify opportunities to consolidate duplicative services.

Performance Measures

- Document a transition plan by the end of calendar year (CY) 2018 that articulates how NASA will move enterprise IT services from a device-laden to device-agnostic architecture.
- By the end of FY 2019, design NASA's network strategy that addresses automation and support for the Agency's enterprise mission support model.

Objective 1.3: Enable responsive, actionable service performance improvement.

NASA's delivery and operations of foundational IT services must be reliable, resilient, and available. We must be able to measure service performance effectively and ensure our customers agree that the service metrics sufficiently meet their requirements. Then, we will begin to optimize performance and develop a continuous service improvement model. To support achievement of this objective, we must use an analytics-driven approach that enables us to capture the appropriate data for decision making. We will structure the data to inform us regarding how systems are operating behind the scenes, so that we can provide timely notification of outages to our community and responsively identify which enhancements, upgrades, or infrastructure replacements are needed.

Attaining the full potential of continuous service improvement requires incorporating customer needs into the conversation. Knowing what our customers expect, combined with relevant performance data, enables analytics and optimization efforts, which inform decision making regarding where NASA should sustain, enhance, or divest current IT services. This analysis will allow us to design and adjust our infrastructure and service delivery baseline intentionally to keep up with customer expectations and technology trends, without compromising service delivery. To responsively address delivery issues, we will use capabilities such as predictive analytics and artificial intelligence over time to continually assess service performance, and we will establish event tracking monitors that enable us to proactively engage and inform the NASA community regarding service delivery and outages.



*Astronaut Chris Cassidy, Expedition 36 on the International Space Station (ISS).
Credit: Karen Nyberg*

Performance Measures

- Collaboratively develop service reliability, availability, and resiliency measures with our customers by the end of CY 2018, in order to quantitatively measure, communicate, and manage the performance of enterprise services delivered to our customers. NASA will publish key metrics once formulated.
- Proactively drive improvements to customer experience through voice of the customer and automated system feedback by the end of FY 2020.

Strategic Goal 2: Capitalize on data management, access, and innovation.

Effective data management, data access, and innovation are critical to achieving NASA's Vision and Mission due to the increasing capability requirements of our scientific, engineering, and business communities. Used strategically, IT can dramatically amplify the effectiveness of NASA's stewardship and missions through robust capabilities to search, analyze, and interpret the Agency's data. As an example, NASA recently solved a complex data management problem that increased the safety of the extra-vehicular activity (EVA) spacesuits. Effective use of data and innovation can come from anywhere but must be fostered from potential to operational reality. NASA needs to provide enterprise-wide data tools to increase decision-making effectiveness and must drive information technology and process innovation to increase the Agency's productivity.

An example of capitalizing on data and innovation is our focus on mobile access and data-centric architecture. These shifts have the potential to securely increase the availability of Agency capabilities to our mobile workforce. Becoming data-centric means that data will be permanent, shared assets, and applications that use this data can change over time depending on mission and business needs. The Agency is also exploring capabilities such as the Internet of Things (IoT), a capability of connecting devices and sensors that collect and exchange data, with a dedicated lab to provide needed functionality while ensuring that NASA's data are protected.

NASA is a leader in Federal efforts such as Open Government, Open Data, and Open Innovation, and has published popular Web sites such as <https://open.nasa.gov/> and <https://api.nasa.gov/>. However, we still need to increase information sharing and the alignment of NASA's data, process, and IT innovation with the Agency's needs. At the same time, we also must decrease the time and effort required to introduce, adopt, and operationalize new data initiatives and innovations. To support these efforts,

the Agency needs to establish enterprise-wide data standards to enable a data analytics capability, which in turn will accelerate and increase program and business insights and improve the quality of NASA's decision making.

NASA is working on a multitude of prototypes for data analytics and deep learning functions, search analytics, data tagging, financial analytics, a data management model, application programming interfaces, and data integration. The Agency places special emphasis on creating smaller, independent services that the mission directorates and mission support organizations can use to achieve NASA's Mission. For example, NASA's Data Management Team completed a series of visualizations of financial data in collaboration with the Office of the Chief Financial Officer (OCFO). NASA also invested in two prototypes to help solve data tagging and network logging needs with the Agency's Security Operations Center (SOC). As the Agency's data management capabilities mature, NASA and the public will benefit through accessibility to historic scientific and engineering data.

We will achieve this goal by using an intentional investment process that closely aligns data and innovation with mission needs and by transitioning promising innovations into operations in a timely, effective manner. Successful, mission-oriented data use, and innovation require broad engagement across NASA's diverse communities. We will establish a central collection point for innovative ideas that will enable us to develop a common understanding of customer needs and challenges. Our effective use of internal and external partnerships will foster diversity and creativity during the innovation cycle, and we will take advantage of existing capabilities when practical. Success will be measured by our delivery and operations of cost-effective innovative products that serve customers' needs, increased satisfaction with IT capabilities and services, improved protection of NASA's data, and increased availability of IT services.

Objective 2.1: Enable the transformation of NASA's data into insights.

NASA requires the ability to transform data and information into actionable insights and knowledge to accomplish its vision and mission. This capability impacts our Federal workforce, contractors, partners, and academia, as well as the public, who engage with our missions and results. Data provide NASA leadership and senior managers with clarity regarding the performance and effectiveness of Agency plans, policies, and projects. Current data management processes are often very time and resource intensive, and the processes scale poorly with the ever-increasing supply of fragmented data to be considered.

As an example, NASA missions are increasingly complex. This complexity necessitates that models, simulations, big data analytics, machine learning, and high performance computing assets work collectively across multiple research, engineering, and scientific domains. Currently, data are stored in different locations and are difficult to integrate across domains. As a result, the Agency experiences difficulty in finding relevant information, achieving a technical understanding, and merging these data for use in decision making. All of these activities are labor-intensive. Since the current infrastructure does not support this sort of

critical Agency-wide analytics activity, NASA is assessing various business analytics capabilities. The Agency needs standards and an enterprise-level capability to drive the transformation of NASA's valuable mission and operational information to effectively achieve its Vision and Mission.

We will facilitate the identification, implementation, and use of powerful and more efficient Agency-wide data analytics to improve NASA's mission capabilities. NASA must develop new governance models and processes to effectively manage, use, and share its data. This governance requires the development of policies to validate and enforce the ability of authorized users to quickly and easily find and access relevant data. The Agency also needs to establish the infrastructure to facilitate access to, sharing of, and collaboration with the data. The infrastructure must support human-to-human, human-to-machine, and machine-to-machine scenarios. An Agency-wide publication mechanism for these analyses will help normalize the approaches to common analytics problems. To complement this approach and drive usability, an Agency-wide capability is needed to define the execution environment, access status, and owner of the analytics.

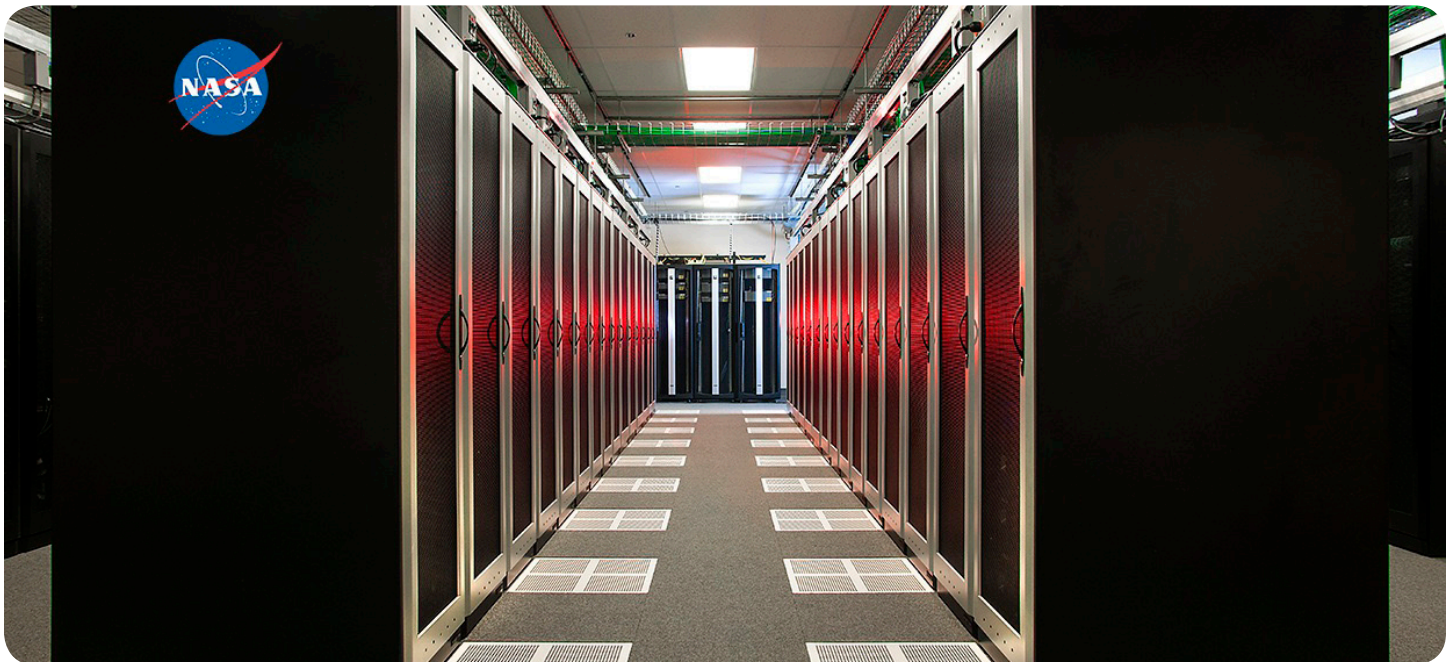
NASA must also inventory its current data systems and establish a means to register the authoritative source for the data. This inventory will include information about the nature of the data content, the system location, the owner, how the system is accessed, and who is authorized for access. A common understanding of the mapping between the metadata standards for each of these data sources and a means to translate data between authoritative sources will be critical to drive an efficient

data management capability. Furthermore, NASA must better enable its programs and projects to share the insights from their analyses in a safe and appropriate manner. Sharing methods among internal, partner, and public stakeholders may include dashboards and shared visual analytics tools.

NASA has begun work in data management (architecture, acquisition, analysis, and archive), governance, data systems inventory, analytics tools and infrastructure, and collaboration environments. The risk of not continuing to implement a strategic, data-driven analytics capability for the Agency is significant. Conducting missions and business of NASA's scale, complexity, and data intensity is becoming increasingly difficult. Our activities are becoming more resource intensive as the number of data and sources of data, such as IoT, increase. To help drive down this risk, NASA must consider ways to introduce and strengthen data science as a critical competency for the Agency.

Performance Measures

- Provide analysis of needed enterprise-wide data tools by the end of FY 2018.
- Make 70 percent of catalogued data within NASA Data Centers searchable within the Agency by the end of FY 2020.
- Make 35 percent of catalogued data within NASA Data Centers securely accessible by an enterprise analytical suite by the end of FY 2021.



Consolidated Information Technology Center, Armstrong Flight Research Center (AFRC). Credit: Tom Tschida

Objective 2.2: Increase secure data accessibility and data management through innovation to address capability gaps and improve operations.

Our approach to foster data management and innovation will be driven by the common framework to identify and prioritize capability gaps that will be developed as part of Objective 4.1 in this plan. The Agency will develop architectures, standards, policies, and products that support data management and accessibility for our Federal and contractor workforce, as well as for the public. NASA will continue its implementation of a data-centric architecture. We will review the enterprise roadmap, domain roadmaps, and prototypes to ensure every practical effort is made to align with the data-centric model.

NASA will investigate new technologies that contribute to data accessibility and investments required to address out-of-date legacy systems. Our intent is to address gaps and leverage opportunities where existing technical capabilities and competencies cannot resolve the gap. Innovative ideas to address these gaps identified in the Agency's enterprise roadmap will be analyzed and vetted through the IT governance process for funding and implementation. Funding considerations should leverage existing technological investments, whenever practical, from our Government, academic, industry, and international sources. The Federal Government has been following industry's trend towards being more mobile to increase service accessibility and employee efficiency, while reducing costs.

NASA will collaborate across IT programs to identify solutions to share information easily and securely. Additional promising focus areas include support for system interoperability, digital services, and applications strategy. Other approaches to drive

accessibility include increasing NASA's open data inventory and providing secure mobile access. To ensure strategic alignment, NASA will invest in prototypes that originate from business needs with clearly articulated goals, in collaboration with our programs.

As the Agency fosters its culture of IT data and innovation in a collaborative, intentional, repeatable, and measurable manner, we must be willing to take risks and introduce disruptive technologies and ideas when appropriate. Data use and innovation will occur in a manner that enables new and enhanced technologies and processes to be introduced into operations with the intent of improving the data and services we provide to NASA.

The outcome of this objective is to increase employee engagement in the data management and innovation processes, generate an ongoing stream of ideas and operational changes that provide measurable benefit for NASA's missions, and positively impact our organizational culture. Besides increasing the number of new ideas, our approach will increase the quality of ideas and enable more efficient implementation of those quality ideas within NASA's missions and support functions.

Performance Measures

- Test and operationalize six IT/process data innovations in a phased approach by the end of FY 2021 in alignment with Agency needs and priorities.

Strategic Goal 3: Safeguard NASA's data and IT assets.

The cybersecurity threat environment is ever changing. The Federal Government, and NASA in particular, must be prepared to defend against these dynamic threats by understanding the risks and adapting its cybersecurity posture to protect Federal information. Cybersecurity continues to be a National priority and agencies are required to report on their investments in cybersecurity and compliance at the level that the investments are managed and executed. In the spirit of and alignment with the FISMA and FITARA laws, Federal organizations that manage a cybersecurity program must report a business case that provides cost transparency and outcomes for cybersecurity activities.

We must ensure the confidentiality, integrity, and availability of NASA's data and IT assets to support the quality, safety, and effectiveness of the Agency's planning and missions. The Agency has made significant progress in adapting to complexities in the cybersecurity landscape in order to protect and defend our National assets and information. Efforts to strengthen the Agency's cybersecurity posture are driven by guidance from internal risk analysis, the Office of Management and Budget (OMB), Congress, NASA's Office of the Inspector General, the Department of Homeland Security (DHS), and other key stakeholders. Additionally, the NASA BSA for IT identified key actions to improve the Agency's cybersecurity posture. While the

Agency has made great progress in cybersecurity by mitigating previously defined gaps, our work is not complete.

NASA recognizes that an effective cybersecurity program must continually evolve. The Agency will discover, evaluate, and strategically manage its cybersecurity risks and implement appropriate cybersecurity safeguards across its mission, corporate, and physical domains. A key element of NASA's ongoing evolution is the adoption of the National Institute of Standards and Technology (NIST) cybersecurity framework to adaptively identify, protect, detect, respond, and recover from dynamic threats, risk, and incidents.

We will strengthen NASA's safeguards while we modernize, optimize, and operate our IT capabilities. Efficient and effective safeguarding of NASA's data and assets poses a significant challenge due to the breadth, fragmentation, and complexity of the Agency's data and infrastructure. To address this challenge, NASA identified three strategic objectives to identify, understand, act upon, and reduce cyber risk. Achievement of these objectives will significantly improve the Agency's cybersecurity risk posture and help ensure mission safety and integrity. NASA will accomplish this goal by implementing IT investment and portfolio decisions that achieve a risk-based balance between mission needs and Agency cybersecurity priorities.

Objective 3.1: Reduce the risk of loss, unauthorized disclosure, and unauthorized modification of data and information systems, while strengthening IT asset identification and vulnerability mitigation.

Cybersecurity is a critical NASA priority due to the dynamic and persistent threats against its users and systems. NASA has the responsibility to protect and defend its IT users and assets. Since safeguarding NASA's data is vital to the Nation, the Agency must identify and prioritize which data are most sensitive. NASA is implementing a variety of cybersecurity tools to identify and protect IT assets and respond in the event of an incident. The Agency promotes awareness regarding the classification of certain data types for storage and transmission. NASA is investing in projects to improve encryption capabilities across the Agency, including mobile devices and desktops, to increase privacy and reduce the risk of data loss. The Agency also is implementing personal identity verification (PIV) strong authentication on user workstations and servers to protect NASA's data and user accessible services. NASA is identifying any installation of unapproved software or configurations that introduce cybersecurity risk to the Agency's missions and operations.

NASA is partnering with the DHS Continuous Diagnostics & Mitigation (CDM) program to upgrade existing cybersecurity capabilities with modern solutions to strengthen NASA's ability to monitor, detect, and respond to cybersecurity incidents and events. These solutions include improved hardware and software asset management, configuration settings management, and vulnerability management. This ongoing modernization also provides opportunities for NASA to consolidate existing cybersecurity tools and shift toward a centrally managed cybersecurity infrastructure. Insights from these new capabilities will enable NASA to determine the strategy and policies for access to the Agency's network and how to manage and audit cybersecurity events. To complement this approach, NASA will examine continuity of operations requirements to ensure critical mission and infrastructure systems have proper cybersecurity, back-up, and disaster recovery procedures.

The Agency will enhance its policies and procedures to adapt to the changing threat environment and leverage industry standards and best practices. NASA is updating and enhancing its data classification to move to the Government-wide Controlled Unclassified Information (CUI). Enhancing data classification is a key step to ensure that only authorized personnel and systems have access to specific data and control types. To reduce the risk of data loss, NASA must strengthen its mobile device management (MDM) capability since NASA's workforce is increasingly reliant on mobile technology to support the missions. Furthermore, the Agency is planning to provide effective, efficient, and reciprocal authentication and vetting processes to support an entrusted Federal workforce in accordance with the Suitability and Security Clearance Performance Accountability Council.

Performance Measures

- Attain hardware and software asset management of 95 percent for the corporate environment by the end of FY 2018.
- By the end of FY 2018, attain 85 percent authentication of unprivileged user accounts and 100 percent authentication of privileged user accounts to the NASA network through the machine-based or user-based enforcement of a two-factor Personal Identity Verification (PIV) credential or other Identity Assurance Level (IAL) 3/ Authenticator Assurance Level (AAL) 3 credential.
- Improve visibility into NASA's cybersecurity risk by implementing continuous monitoring agency-wide across all applicable mission and corporate hardware assets by the end of FY 2019.
- Ensure that only authorized devices and software access NASA's data and networks by the end of FY 2019.
- Provide mission and business owners with the cybersecurity risk profile for their assets by the end of FY 2020.
- Strategically manage the highest priority and unacceptable cybersecurity risks to mission and business assets by the end of FY 2021.

Objective 3.2: Prioritize and mitigate cybersecurity risks based on a cybersecurity risk framework and architecture.

Safeguarding NASA's mission and mission support assets cannot be achieved without proper risk identification, analysis, and mitigation. NASA's IT BSA identified a critical need for an Agency-wide integrated cybersecurity risk management framework to prioritize and reduce cybersecurity risk. This cybersecurity-focused risk management effort will align with the Agency's overarching enterprise risk management (ERM) approach.

NASA is addressing IT BSA findings by implementing risk management tools to inform decision making that communicate cybersecurity risk from the system owner at a field Center through to the executive level. The Agency currently manages Plans of Action and Milestones (POAMs) to address mitigation of individual risks across the Center. A key focus is to realize risk management from the Center-level, to Center leadership, and, as necessary, to the NASA CIO and Agency leadership. The

Agency will implement a capability to visualize cybersecurity risk in order to strengthen investment decision making. Over the upcoming years, NASA will implement several risk management capabilities to address specific Agency needs. The overarching risk management program, once implemented, will enable NASA to allocate resources to cybersecurity using risk-based priorities to maximize risk reduction and enable mission safety, integrity, and success.

Performance Measures

- Develop disaster recovery and continuity of operations plans for all high-risk enterprise cybersecurity systems by the end of FY 2019.

Objective 3.3: Reduce cybersecurity risk by improving user education and promoting cybersecurity awareness and best practices.

Cybersecurity usually depends, in part, on personnel, such as end-users and IT professionals. NASA has capabilities for role-based cybersecurity training and for promoting cybersecurity awareness across the Agency. Providing educational opportunities and training for NASA's entire workforce, including civil servants and contractors, will be an iterative undertaking. For instance, personally identifiable information must always be marked as Sensitive But Unclassified, and NASA educates its workforce on procedures to report potential and realized data spillage and unauthorized disclosures. The Agency also prioritized phishing awareness and training capabilities that included Agency-wide anti-phishing exercises to address the current threat environment. To supplement this training, NASA implemented tools that identify and protect users against many phishing e-mails before they are presented to an end user.

Training and awareness must evolve with the changing threat environment to be effective. Our intent is to identify and use training formats and content that are the most effective in improving the Agency's cybersecurity risk posture. NASA will improve its policies and processes to ensure user awareness, training, and protection of the Agency's information and assets.

This effort will evolve to include communications of best practices and policies to address phishing attacks, secure coding, controlled unclassified information, and reporting cybersecurity incidents. Additionally, the Agency plans to use a variety of data and training metrics to identify additional training topics. For example, a potential training topic could require users who repeatedly fail anti-phishing exercises to participate in enhanced training to improve learning outcomes. The focus of Agency-wide and cybersecurity workforce training must align with evolving critical Agency risks to achieve the outcome of reduced cybersecurity risk and increased protection of NASA's data and assets.

Performance Measures

- Use innovative methods to engage and educate employees during the FY 2019 annual cybersecurity training.
- 50 percent of NASA civil servant and contractor employees with significant security responsibilities complete role-based training by the end of FY 2021.

GOAL 3



Rachel Power (left), Bethanne Hull, and Krista Schaffer in Kennedy's Vehicle Assembly Building (VAB) on Introduce a Girl to Engineering Day. Credit: Glenn Benson

Strategic Goal 4: Maximize business value by optimizing IT.

We are stewards of taxpayer dollars, and we must invest wisely in IT to support NASA's missions through business and technical capabilities. NASA has made significant progress in transforming the Agency's IT operating model to become more effective and efficient. These optimization efforts align with, and are driven in part by, NASA's internal IT BSA transformation effort and FITARA. NASA connected and streamlined its previously fragmented IT governance and chartered its IT Council (ITC) with executive members from each of NASA's mission directorates and Centers to ensure diversity during strategic IT decision making. To strengthen decision making through data and analysis, NASA held its first annual IT capital investment review and IT portfolio assessment in 2016. The Agency continues to encourage adoption of enterprise IT contracts to achieve benefits arising from economies of scale and increased cybersecurity for standard IT products and services. However, NASA still has opportunities to optimize its IT investments to meet NASA's diverse mission needs.

We will build on this foundation to address key challenges in NASA's complex IT ecosystem. IT inefficiencies and obsolescence absorb resources from mission programs and NASA will need to make strategic investments to overcome these inefficiencies. Incomplete insight into the Agency's IT portfolio also constrains

adequate identification, mitigation planning, and risk reduction of potential cybersecurity vulnerabilities. To address these challenges, NASA identified the strategic objectives below to categorize high-quality IT portfolio data and capability assessments, which will in turn inform strategic IT decision making and execution to more effectively support the Agency's Mission. Together, these strategies will guide our IT operating model choices, strategic sourcing, and enterprise roadmap. Critical to this work will be a fundamental change in how NASA evaluates the health of its IT capabilities, performs business case analysis, and manages its IT investments in alignment with the Agency's ERM approach.

NASA's optimized IT ecosystem will result in capabilities that align with NASA's mission and business needs as well as increased cost savings, cost avoidance, and reinvestment opportunities. Success indicators include alignment between Agency and Center IT strategies and plans and the use of a common investment terminology to connect these processes. Additional indicators include standardized acquisition practices, effective adoption strategies for enterprise contracts, and a reinvestment model to allocate savings into Agency priorities. It is important to note that cost savings from optimization will generally lag behind the up-front investments required for implementation of optimization initiatives.

Objective 4.1: Empower data-driven strategic decisions and intentional IT operating model choices.

The effective use of recent improvements in NASA's IT governance model depends on increased insight into the Agency's needs and IT investments to drive strategic decision making. This insight and informed decision making are critical for NASA to use information more effectively to advance the Agency's Vision and Mission. NASA currently does not have complete insight into the Agency's IT capabilities and investments as a connected portfolio. Inconsistent terminology across the Agency is a leading cause of difficulty with identifying and strategically coordinating IT capabilities and investments across units. These issues constrain the effective selection of operating models for IT services, use of strategic sourcing and shared services, and elimination of unintended redundancies.

NASA will develop a common framework and taxonomy to facilitate effective analysis and drive strategic investment in IT. The Agency must improve how it identifies capability gaps and investigates business opportunities, such as IT modernization, reduced spending on legacy IT, planned obsolescence, and use of shared services and functional transfers. The Agency will perform capability assessments to identify gaps between the current and target states and to create gap closure strategies. NASA will

operationalize its Agency-wide IT investment portfolio analysis to inform these capability assessments. NASA's IT governing entities will assess options and recommendations for optimization discovered during portfolio analysis, guided by the principles described earlier in this plan. By using capability assessments and portfolio data, NASA will make better-informed decisions on the scope and operating model for each of its IT services.

NASA will use the results of this analysis and the priorities decided through governance to develop a strategically aligned roadmap to guide IT implementation. This roadmap will inform IT investment decisions by aligning changes to IT capabilities with actionable achievement of the Agency's Vision and Mission. Through governance oversight, NASA will evaluate adherence to the IT roadmap to ensure that IT investments, spending, and outcomes are aligned with NASA's mission needs. NASA will also strengthen its ability to acquire common IT products and services in order to reduce redundant contract vehicles, improve transparency, and drive down costs. A critical step will be to establish an enterprise-wide software life-cycle management capability to administer software, hardware, and support over the life of a system. This capability will enable NASA to optimize software licensing and

configurations and rationalize its applications, especially as software providers change their business models during the shift to cloud and/or the software-as-a-service model.

As our enterprise, federated, and diversified operating models mature, NASA will evolve its IT governance to better connect decision making across organizations. In addition, as NASA increases its understanding of the entire IT portfolio and mission needs, the Agency will be better informed to develop specific strategies to use the diversified operating model. Our data-driven, connected governance will drive more effective use of IT resources and increased transparency, strengthened planning and execution oversight, and accountability and shared ownership for the results.

Performance Measures

- By the end of FY 2020, complete the phased implementation of a comprehensive enterprise vendor management capability and expand the use of enterprise acquisition and strategic sourcing vehicles in alignment with FITARA.
- By the end of FY 2021, complete the phased implementation of a software life-cycle management capability for all software used in support of NASA's missions and mission support functions.

Objective 4.2: Increase the effectiveness of investment analysis and prioritization.

Investment in an IT portfolio management capability will be critical to effectively scale IT investment analysis and management across the Agency and inform prudent reallocation of resources as business needs change. IT investment portfolio management currently differs across the fragmented segments (e.g., mission directorates, field Centers, and IT programs) of NASA's IT portfolio. Some segments do not use portfolio management, while other segments use differing implementations of portfolio management practices.

NASA will implement an end-to-end IT investment management process, with some variation as needed across portfolio segments, to supplement the Agency's existing planning, programming, budgeting, and execution (PPBE) process. This approach will increase the consistency and quality of NASA's IT investment analysis, proposals, decision making, acquisition, benefits verification, and reporting. Specific elements of this approach include development of new IT investment criteria, discovering currently unreported IT investments, development of an investment review process, and implementation of a NASA IT investment dashboard and reporting tool. IT investment analysis must consider all benefits, costs, risks, and opportunities, including mission and engineering impacts related to changes in IT infrastructure, processes, and procedures. NASA will implement an IT financial management process that integrates OCIO, field Center, and mission directorate IT spending. This process will map IT investments to NASA's Vision and strategy, as well as enable high-quality internal and external investment insight and reporting.

The Agency will require new and changing workforce competencies to strengthen business case analysis, drive

NASA's IT optimization, and expand the use of business analytics tools and data visualizations. NASA will also need to formalize a process and criteria for prioritizing the reinvestment of funding made available through cost-saving IT activities in alignment with the Agency's reinvestment strategy. We will continue to increase the quality of our portfolio analysis and assess our optimization progress using performance metrics designed to measure investment schedule and budget variance, innovation, and protection of Federal data and IT assets.

Performance Measures

- Identify and implement \$50 million of NASA-wide cost avoidance/cost savings by the end of FY 2018. This is a two-year effort with a \$50 million cumulative target across FY 2017 and FY 2018.
- Business cases for all new major IT investments submitted in FY 2019 have measurable outcomes identified by mission/business owners that are approved through IT governance.
- Benchmark NASA's spending on all IT capabilities with Federal and industry spending to determine NASA's relative spend posture and identify opportunities for optimization by the end of FY 2019.
- Business cases for 35 percent of NASA's IT investment budget have measurable outcomes identified by mission/business owners by the end of FY 2020.
- Execute the IT investment and business case prioritization and selection process for 20 percent of the Agency's IT portfolio by the end of FY 2022.

Objective 4.3: Increase the effectiveness of our IT strategy execution through disciplined program and project management.

In order to maximize the value of this strategic plan, we must strengthen our ability to plan and execute at the tactical level. Disciplined program and project management will enable us to execute more effectively in alignment with the direction set by NASA's governing entities. Program and project managers will also inform governing decisions using performance data, risks, and opportunities identified during execution. Effective execution begins with clear requirements and expectations and necessitates transparency, accountability, and efficient oversight to enable mission success. NASA will set these expectations by establishing and communicating the scope, expectations, and outcomes for each IT program to facilitate execution of this IT strategic plan.

Today, core execution functions, such as scheduling, performance management, and resource management, are not standardized, are supported by several independent tools, and often require manual data entry and integration. These challenges may lead to inefficiency and quality issues during execution. To drive effective, transparent, and efficient execution across the Agency's IT portfolio, we will establish and evolve an enterprise approach for integrated program and project management. A key component will be a scheduling capability to perform capacity planning, manage required resource staffing levels, and perform scenario analysis to optimize resource usage across the IT portfolio. To complement this scheduling capability, we will provide a consistent, transparent view

into investment performance data to enable efficient performance oversight of NASA's IT Portfolio. Performance oversight will extend across our IT programs, Centers, projects, initiatives, and activities and will align with NASA's ERM framework and process. These capabilities will be supported by staffing and budget resource data at each schedule level to inform resource prioritization and allocation investment decisions.

We will adjust our policies and procedures as necessary to enable these activities and accommodate multiple execution methodologies, including incremental development, through process tailoring. These policies and procedures must facilitate a common understanding of NASA's IT authorities—and the delegation of these authorities—to empower program and project managers and ensure accountability for results. NASA will establish and use common terminology and best practices for IT programs and project management to enable effective execution using these strengthened capabilities.

Performance Measures

- 85 percent of enterprise and Center IT projects are executing in conformance with their approved project plans (annually).



David L. Iverson, Ames Research Center (ARC), monitoring ISS gyroscopes. Credit: Dominic Hart

GOAL 4

Strategic Goal 5: Care for our people today and prepare them for tomorrow.

NASA's greatest asset is its people. The Agency's dedicated, skilled, and diverse workforce helps achieve NASA's Mission through the efficient, secure, and innovative use of data and IT. NASA's IT workforce consists of those individuals who directly support and provide IT services, and those individuals who are users of IT in support of NASA's missions. The IT workforce includes Federal civil service employees, contractors, university researchers, students, and many others. To deliver on the direction set forth in this IT strategic plan, we must invest in our human capital as a strategic asset and driver to effect the organizational changes required to successfully achieve our strategic goals and objectives. We will partner with NASA's Office of Human Capital Management (OHCM) to accomplish these

changes, including the transition of the Agency's IT resources to an enterprise operating model in alignment with the Mission Support Future Architecture Program (MAP).

We will define clear lines of authority and accountability for IT between the Agency and NASA's Centers. This transparency will ensure that employees understand their role in supporting NASA's IT in each level of service planning and delivery. Additionally, we will manage our evolving workforce requirements by creating a comprehensive view of critical IT positions and those positions that may become vacant in the next three to five years. We will use this information to prepare actionable steps to fill each critical IT position to keep pace with NASA's mission needs.

Objective 5.1: Care for our people and encourage mission-oriented performance.

We will pursue several activities to accomplish this objective. We must ensure that each employee understands NASA's Vision and Mission as well as the direction in which NASA is headed through its programs. We will motivate our employees by clearly articulating the link between our IT community's efforts and achievement of NASA's Vision and Mission. Our organization must provide opportunities for employees to identify and assess emerging information technology and best practices to meet mission goals. We will establish a diverse set of skills and competencies that can adapt to the changing business and technical environments.

committed to achieving efficiencies across the Agency and will recognize and reward employees who identify and reduce IT inefficiencies such as duplication or drive new efficient and effective ways of doing business. We will embrace a culture of inclusive decision making and empower our employees to take calculated risks.

We will define clear lines of authority and accountability for IT between the Agency and NASA's Centers. This transparency will ensure that employees understand their role in supporting NASA's IT in each level of service planning and delivery. Additionally, we will manage our evolving workforce requirements by creating a comprehensive view of critical IT positions and those positions that may become vacant in the next three to five years. We will use this information to prepare actionable steps to fill each critical IT position to keep pace with NASA's mission needs.

We will encourage and reward employees for stewardship and innovation that supports NASA's direction and values. We are

Performance Measures

- Establish a list of critical positions within IT functional areas and initiate standard qualifications, classifications, and certifications for those positions by the end of FY 2018.
- By the end of FY 2019, define NASA's IT operating model that aligns to the Agency's enterprise mission support model.
- By the end of FY 2020, complete the Agency's IT workforce strategy to meet NASA's future mission and business needs.
- By the end of FY 2020, reorient NASA's IT budget and resources request for budget year 2022 to align with the Agency's enterprise mission support operating model.
- Execute the transition of NASA IT to the Agency's enterprise mission support operating model by the end of FY 2022.

Objective 5.2: Attract and retain diverse, high-quality people.

NASA will provide a work environment that attracts IT talent from top universities and market-leading corporations by keeping pace with current technologies and management practices, and by preparing for evolutions in these dynamic areas. We will ensure that highly-qualified leaders are in place to provide leadership, coaching, and mentoring so employees can help accomplish the Agency's goals.

Additionally, NASA's IT community will seek creative ways to recruit and hire the most qualified and competitive IT talent and expand upon programs that increase diversity. Our hiring practices will have a strong focus on recruiting IT professionals with relevant technical credentials, business acumen, and a passion for and commitment to NASA's Vision and Mission. NASA

will leverage all available hiring authorities to increase the quality of Government applicants and reduce the overall time to hire an employee. Through the identification of challenging assignments and opportunities and by ensuring that employees understand how they contribute to achieving NASA's Vision and Mission, the Agency will be better positioned to attract and retain a workforce that is committed to NASA's success. Through partnerships with industry, we will establish employee programs to foster cooperation and understanding between the private sector and Government IT organizations. Furthermore, we will build a cadre of digital service experts with industry experience in design, engineering, and product management to transform key services.

NASA will develop IT career tracks that encourage our workforce to sharpen their skills continuously through participation in mentoring programs, job sharing and exchange programs, and professional certifications. We will build effective mechanisms for knowledge

sharing and mentoring across the Agency. We will encourage and support employees who want to take on leadership roles within the organization and ensure that these employees have the appropriate skills to succeed. To foster cooperation and share talent, we will develop an internal employee exchange program.

Performance Measures

- Collaborate with NASA's Centers and NASA's Diversity and Equal Opportunity Office to identify ways to enhance current diversity and inclusion efforts by the end of FY 2018.
- By the end of FY 2021, develop a market-informed pay and compensation strategy for cybersecurity and other mission critical IT positions to improve recruitment and retention.

Objective 5.3: Prepare our people to achieve NASA's IT vision.

We are creating a work environment that offers IT employees a greater opportunity for career development and cross-training. We will strengthen professional development opportunities in coordination with NASA'S OHCM. By establishing transparent and clearly defined IT career paths with criteria for progression to the next level in both technical and leadership positions, we will more effectively enable IT staff to identify and manage their careers. We will implement a consistent approach to meeting IT career development, training, and certification needs across the organization to enable workforce flexibility for critical enterprise, local, and mission-focused assignments.

We are also developing and retaining effective, skilled IT leadership that fosters an inclusive environment where employees feel engaged, productive, and valued. Through IT leadership and supervisors, employees will establish a development plan that is consistent with the Agency IT Professionals Career Tracks. These

career tracks will include training, education, and experiential qualifications, and will ensure that employees understand and are prepared to accomplish NASA's Vision and Mission. As NASA's IT needs evolve, the knowledge, skills, and competencies of our people in the IT community must evolve as well. NASA will provide training and professional development opportunities for its IT workforce to facilitate this evolution. NASA will strengthen the ability for its people to execute their responsibilities through supporting information technology and processes.

Performance Measures

- By the end of FY 2021, implement the IT workforce strategy to close skill gaps in alignment with NASA's needs.



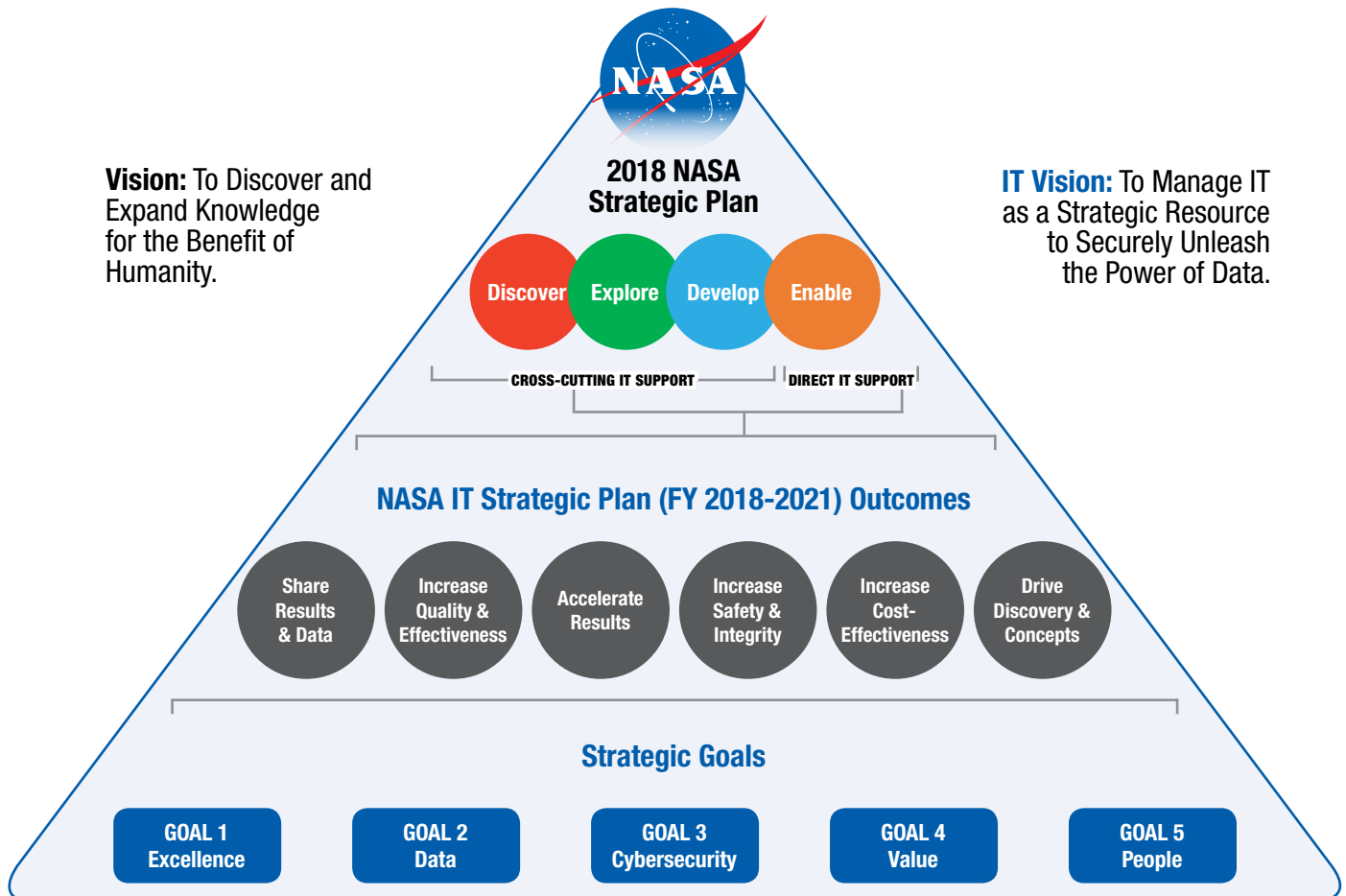
STS-130/20A flight controllers on console, Johnson Space Center (JSC). Credits: James Blair & Regan Geeseman

Alignment With NASA’s Strategic Plan

NASA’s enduring purpose is aligned to four strategic themes, to Discover, Explore, Develop, and Enable. These themes correspond to the Agency’s missions of scientific discovery of the Earth, of other worlds, and of the cosmos as a whole; missions of exploration in our solar system with humans and robotic probes that expand the frontiers of human experience; missions of development that advance new aeronautics technologies to support continued global competitiveness of the national aerospace industry and new technologies that allow American industry to create and expand a nascent space marketplace; and critical mission support activities, including IT, that enable these missions. These four themes are reflected in the four strategic goals that frame NASA’s 2018 Strategic Plan, which outlines the Agency’s goals and objectives and describes how the Agency will accomplish these goals over the next decade or more. NASA’s 2018 Strategic Plan can be found at https://www.nasa.gov/sites/default/files/atoms/files/nasa_2018_strategic_plan.pdf.

NASA’s IT strategic goals provide direct or cross-cutting support to achieving the Agency’s goals. Direct support is established when there is a specific linkage between the execution of an IT goal and achieving an Agency goal. Cross-cutting support is established when execution of the IT goal supports the broader environment in which an Agency goal will be achieved.

The Agency’s goals cover more than flagship missions and cutting-edge technology development. These goals reinforce NASA’s commitment to working smarter, doing business more effectively and efficiently, and being transparent in its operations. NASA’s IT community will be transparent and accountable while continuously improving to enable mission success. We will adhere to NASA’s core values while fostering the pioneering, innovative, and partnering spirit that drives the Agency. We will collaborate within the Federal Government and with international partners, educators, industry, the public, and other stakeholders to drive success.



NASA CIO Authorities

Per NASA policy, the OCIO provides leadership, planning, policy direction, and oversight for the management of NASA information and all NASA IT in accordance with the responsibilities required by the Clinger-Cohen Act of 1996, the FITARA law of 2014, the Paperwork Reduction Act of 1995, the E-Government Act of

2002, the FISMA law of 2014, and the Privacy Act of 1974. The NASA CIO's authorities are described in NASA Policy Directive (NPD) 2800.1B, Managing Information Technology, within the Agency's policy management system (<https://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPD&c=2800&s=1B>).

Strategic Sourcing

The goal of NASA's Strategic Sourcing Plan is to identify and pursue opportunities to increase savings and enhance mission performance through strategic sourcing initiatives. Strategic sourcing is a collaborative and structured process of analyzing an organization's spending and using the information to make business decisions about acquiring commodities and services more effectively and efficiently. NASA's Strategic Sourcing Plan formalizes the process for Agency-wide Strategic Sourcing Initiatives and provides maximum value to the taxpayer. The OCIO plays a key role in the Strategic Sourcing Plan and has representation on the Agency Strategic Sourcing Team and relevant working groups. NASA's approach balances the goals of strategic sourcing, value to the Government, optimization of Agency resources, and customer experience to align the sourcing effort with the best procurement vehicle to support NASA's requirements. IT products and services are subsets of NASA's acquisition portfolio and strategic sourcing effort. Agency-level strategic sourcing guidance is available at <https://www.nssc.nasa.gov/strategicsourcing> and the NASA Federal Acquisition Regulation Supplement is available at <https://www.hq.nasa.gov/office/procurement/regs/NFS.pdf>.

area of application portfolio rationalization. The NASA CIO works closely with the Agency Software Manager and the Enterprise License Management Team (ELMT) on licensing and contract consolidation initiatives. These initiatives drive economy of scale pricing and cost savings by leveraging the pooled purchasing power of the agency. The Agency Software Manager and the ELMT also work across NASA's field centers to manage licenses and eliminate duplication within the license portfolio. NASA continues to leverage Agency-wide and Federal enterprise IT contracts for the procurement of hardware, software, and services.

In addition, NASA's strategic sourcing approach aligns with our transition from acting predominately as a service-provider to being a hybrid of service provider and service broker. We will procure services in addition to managing systems, broker IT services for our NASA customers, and invest in owned infrastructure when commercial services that meet the Agency's specific requirements do not exist or cannot be acquired effectively. NASA also participates in other innovative sourcing approaches as represented by NASA's Agency-wide Open Source Initiative, which focuses on centralizing NASA's open source software efforts for use by developers inside and outside of our Agency.

One of our greatest opportunities for IT cost optimization is in the

Accessibility

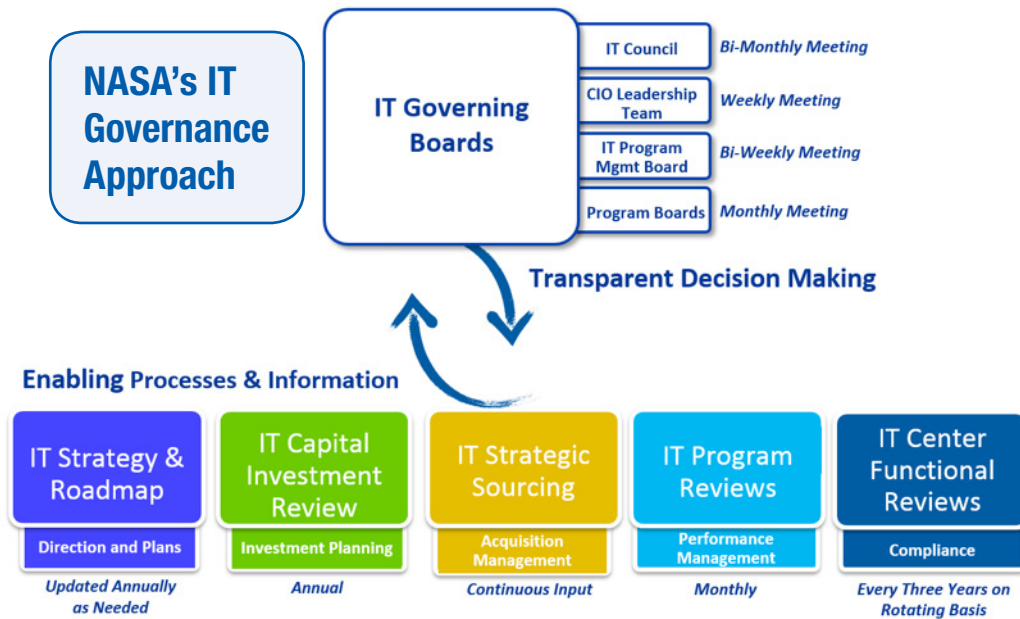
In alignment with our workforce diversity strategy and to ensure that NASA's electronic and information technology are accessible to individuals with disabilities, the Agency developed NPR 2800.2: Electronic and Information Technology Accessibility. This guidance from OCIO aids our workforce with understanding accessibility legislation and assigns responsibility to key stakeholders in order to achieve and maintain compliance. The scope of these requirements includes the procurement of goods and services, as well as any electronic and IT development

by NASA or its contractors for the use of NASA employees, employees of other Federal agencies, and the public. To facilitate ongoing awareness and implementation of these accessibility requirements, NASA maintains the online resource center that includes contact information for Agency and Center accessibility coordinators, an accessibility checklist, tools, and links to the United States Access Board website. Furthermore, accessibility compliance is validated as a standard part of our implementation processes.

IT Governance Model

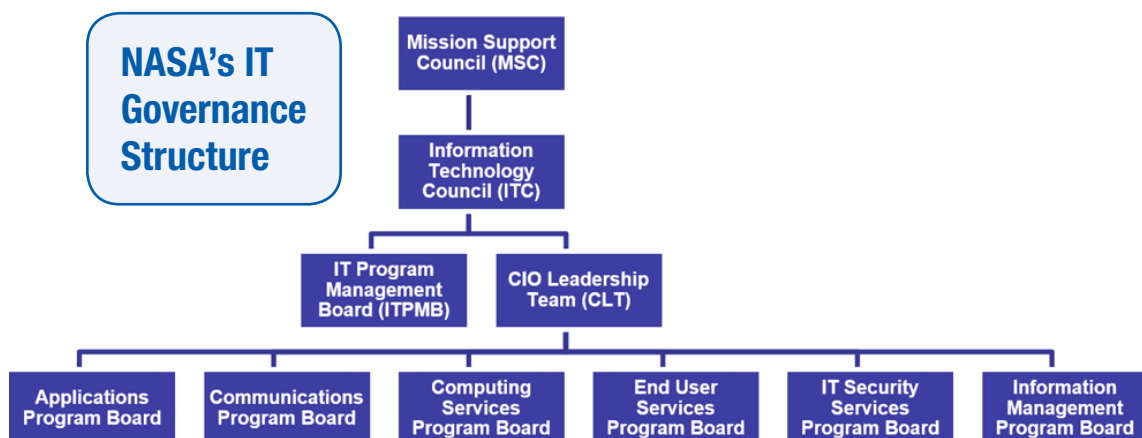
NASA's IT governance model is consistent with the Agency's overall approach to governance. Adoption of this structured and holistic approach to IT governance enables NASA's Mission by:

- Establishing ongoing alignment of NASA's IT investments and management practices with the Agency's business requirements and strategic initiatives;
- Integrating mission and business processes and information across organizational boundaries;
- Leveraging data and information technology to achieve greater efficiencies and cybersecurity; and
- Ensuring that NASA's IT is implemented efficiently and effectively.



NASA's IT governance structure facilitates the overarching direction and oversight for the Agency's IT. Governance is engaged during the life cycle of an IT investment, from the initial decision to fund a proposed investment, to oversight of its implementation and operations, and its eventual decommissioning. Each of these phases includes milestones and metrics that require different ac-

tivities and, therefore, differing governing structures. The Agency established its IT governance by chartering councils and boards with diverse stakeholder representation as depicted in NASA's IT Governance Structure below. NASA maintains specific decision criteria and thresholds for each governing entity in the entity's charter.



Mission Support Council (MSC)

The MSC serves as the Agency's senior decision-making body regarding the integrated Agency mission support portfolio, including facilities, workforce, infrastructure, technical capabilities, and associated investments and divestments. Council members are advisors to the Deputy Associate Administrator, who serves as the MSC Chair and decision authority. The MSC determines and assesses mission support requirements to enable the accomplishment of the Agency's mission.

- Scope: Encompasses the portfolio of all mission support activities conducted by NASA.
- Membership: Deputy Associate Administrator, Associate Administrator, Associate Administrator for Mission Support, Chief Financial Officer, Chief Information Officer, Chief of Safety and Mission Assurance.

Information Technology Council (ITC)

The ITC serves as the Agency's senior IT decision-making body. Council members are advisors to the NASA CIO, who serves as the ITC Chair and decision authority. The ITC assesses and approves strategic IT requirements and oversees implementation of approved requirements in order to enable the accomplishment of the Agency's mission.

- Scope: Encompasses the portfolio of all IT activities conducted by NASA, including all current and future investments, both developmental and operational, regardless of funding source.
- Membership: Senior executive leadership from mission directorates, Centers, and institutional offices.

Agency IT Program Management Board (IT PMB)

The IT PMB serves as the governing body for Agency-wide IT programs and projects within the scope of NASA Procedural Requirements (NPR) 7120.7: NASA Information Technology and Institutional Infrastructure Program and Project Management Requirements. The IT PMB provides a forum for high-level

Agency participation in the oversight and evaluation of IT investment execution. The board is chaired by NASA's Deputy CIO with decision authority delegated from the NASA CIO. The IT PMB oversees approved projects from development through operational readiness in order to evaluate execution effectiveness.

- Scope: IT programs and projects that are in scope of NPR 7120.7. IT PMB has two tiers: an Agency IT PMB and Center IT PMBs. Center IT PMBs perform comparable functions of Agency IT PMB at the Center level.
- Membership: Representatives from missions, centers, and institutional offices that independently evaluate and provide advice to the Agency's IT programs and projects.

CIO Leadership Team (CLT)

The CLT serves the NASA CIO as an advisory body focused on IT services, technologies, operations, and management decisions. CLT members are advisors to the CIO, who serves as the CLT Chair and decision authority. The CLT provides visibility into field center and mission directorate IT requirements, operations, performance, risk management strategies, and stakeholder issues. The CLT serves as a change agent and sounding board for Center and mission directorate stakeholders.

- Scope: Encompasses Agency-level and Center-level IT services, cross-cutting IT policies and processes, cybersecurity risk management, and investments and issues that significantly impact IT architectures, compliance, or portfolio strategies that are escalated by an IT Program Executive or Center CIO.
- Membership: The NASA CIO's direct reports and representatives from NASA's mission directorates.

Program Boards

Functional governance boards exist for each IT program. Each of these boards ensures that a consistent approach is used for planning, delivery, and operational performance within each program. Governance across these functional programs is integrated through an enterprise change control board.

List of Acronyms

AFRC	Armstrong Flight Research Center
ARC	Ames Research Center
ARMD	Aeronautics Research Mission Directorate
BSA	Business Service Assessment
CDM	Continuous Diagnostics & Mitigation
CIO	Chief Information Officer
CLT	CIO Leadership Team
COOP	Continuity of Operations
CUI	Controlled Unclassified Information
CY	Calendar Year
DHS	Department of Homeland Security
DME	Development, Modernization, and Enhancement
DR	Disaster Recovery
ELMT	Enterprise License Management Team
ERM	Enterprise Risk Management
EVA	Extra-Vehicular Activity
FISMA	Federal Information Security Modernization Act
FITARA	Federal Information Technology Acquisition Reform Act
FY	Fiscal Year
GRC	Glenn Research Center
GSFC	Goddard Space Flight Center
HEO	Human Exploration and Operations
HQ	Headquarters
HW	Hardware
IOT	Internet of Things
ISS	International Space Station
IT	Information Technology
ITC	IT Council

JPL	Jet Proportion Laboratory
JSC	Johnson Space Center
KSC	Kennedy Space Center
LaRC	Langley Research Center
MAP	Mission Support Future Architecture Program
MDM	Mobile Device Management
MSC	Mission Support Council
MSD	Mission Support Directorate
MSFC	Marshall Space Flight Center
NIST	National Institute of Standards and Technology
NPR	NASA Procedural Requirements
O&M	Operations and Maintenance
OCFO	Office of the Chief Financial Officer
OCIO	Office of the Chief Information Officer
OHCM	Office of Human Capital Management
OMB	Office of Management and Budget
PIV	Personal Identity Verification
PMA	President's Management Agenda
PMB	Program Management Board
POAM	Plan of Action and Milestones
PPBE	Planning, Programming, Budgeting, and Execution
SMD	Space Mission Directorate
SOC	Security Operations Center
SSC	Stennis Space Center
STMD	Space Technology Mission Directorate
STS	Space Transportation System
SW	Software
WSTF	White Sands Test Facility

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