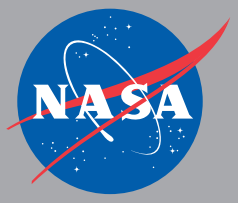
National Aeronautics and Space Administration



IT Talk

July - September 2018 Volume 8 • Issue 3

The Big Data Wave

IT Talk

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Message from the NASA CIO

Every hour, day, and year, NASA gathers millions of data-points (a.k.a Big Data) from our active missions. The collection rate is growing by leaps and bounds, handling, storing, and managing these data is a massive challenge. Our proprietary data is among our most valuable assets, and its strategic importance in our research and science is enormous. NASA is committed to making our data as accessible as possible, both for the benefit of our work and for the betterment of humankind. In this issue, we'll explore why it matters how the Agency uses big data.

NASA also relies heavily on big data to help the Agency with artificial intelligence (AI). By applying AI and machine learning, satellites control these systems seamlessly, making real-time decisions without awaiting instruction. We'll take a look at how AI is helping NASA engineers to develop software and algorithms to meet the specific requirements of missions.

And soon, NASA will be migrating to Microsoft Office 365, offering a breadth of capability to our users. The suite allows employees access to e-mail, calendar, contacts, and tasks through a Web browser on any authorized NASA computer with a PIV badge or Agency Smart Badge. I'm excited about this initiative because this technology is industry-leading for our workforce. This cloud-based e-mail, calendaring, and collaboration service supports NASA's plans to enhance our Agency's security posture.

Finally, this quarter, we are pleased to highlight some prestigious industry honors earned at the Centers. I'm so proud of all the hard work happening right now. We are making a difference in leading the transformation of IT at NASA! So I hope you enjoy reading this issue!

~Renee

CIO Center Visits. Clockwise from top: CIO Face-to-Face at Stennis Space Center, April 10-12; with Langley Research Center's Acting CIO Catherine Prohaska and NASA SAISO Mike Witt; and with Federal CIO Suzette Kent and NASA Shared Services Center CIO Danny Harvill.

NASA Ames CIO Coauthors Award-Winning Paper

By Penny Hubbard, Communication Specialist, Ames Research Center

Ames Research Center (ARC) CIO Jerry Davis, with Krishna Sampigethaya of United Technologies Research Center and NASA's Parimal Kopardekar, took first place in the "Best of Track" category, and second place overall, at April's Integrated Communications Navigation and Surveillance (ICNS) Conference. The conference focuses on providing an understanding of domestic and international programs, implementation strategies, standards development, research, and ICNS technologies.

Their paper, "Cyber Security of Unmanned Aircraft System Traffic Management (UTM)," provides a comprehensive glimpse into Small Unmanned Aircraft Systems (sUAS) and the compelling impacts to society as they become mainstream. Simply put, the millions of small Unmanned Aircraft Systems, along with other aircraft of various shapes and capabilities, will soon be flying at low altitudes in urban environments—and it is critical to ensure that they fly safely, predictably, and efficiently.

While research into the challenges, inherent to UAS Traffic Management (UTM), are being explored, cybersecurity considerations have been largely missing. This paper bridges this gap and addresses UTM cybersecurity needs and issues. It contributes a comprehensive framework to understand, identify, classify, and assess security threats to UTM. Promising threat mitigations, major challenges, and research directions are discussed to secure UTM today and into the future.

Congratulations to Krishna, Parimal, and Jerry! They have coauthored an award-winning paper and established significant research, policies, and processes to secure UTM and sUAS for the benefit of society.

Read the award-winning paper:
https://intranet.share.nasa.gov/arc/it/Documents/2018-04-ICNS/Cyber-security_of_UTM_Paper.pdf

View their Integrated Communications Navigation and Surveillance (ICNS) presentation:
https://intranet.share.nasa.gov/arc/it/Documents/2018-04-ICNS/Cyber-sec_UTM_ICNS_2018_Presentation.pdf

NASA Headquarters' Information Technology and Communications Division (ITCD) held "A Day with ITCD" on Wednesday, June 20. They shared IT and communications products and services, with on-the-spot consultations, demos, and workshops. Photo Credit: NASA/Garrett Shea

JPL IT Directorate Recognized with CIO 100, Computerworld Best Places To Work in IT Honors

By Whitney Haggins, IT Communication Strategist, Jet Propulsion Laboratory, California Institute of Technology

NASA's Jet Propulsion Laboratory's (JPL's) IT Directorate was recently recognized with two industry honors.

On May 1, JPL was named a 2018 CIO 100 Honoree by CIO magazine. The CIO 100, now in its 31st year, honors 100 organizations that have distinguished themselves through their innovative use of technology to create business value. This is JPL's seventh consecutive appearance on the CIO 100. The honorees will be celebrated at a gala during the CIO 100 Symposium in Palos Verdes, CA, August 13–15, and they will be profiled in the August issue of CIO magazine.

On June 18, JPL was named one of the 100 Best Places to Work in IT by IDG's Computerworld magazine and ranked number 19 among large companies. This is JPL's sixth consecutive appearance on the prestigious list, a ranking of the top 100 work environments for information technology professionals by Computerworld magazine, now in its 25th year. The list is compiled based on a comprehensive questionnaire regarding company offerings in categories such as benefits, career development, training, and retention. In addition, Computerworld conducts extensive surveys of IT workers, and their responses factor heavily in determining the rankings.

Jim Rinaldi, JPL CIO, said: "We are excited and honored to again be recipients of these industry honors. We strive to provide IT that matters and appreciate that we can present some of the exciting things we are doing and receive recognition. It's truly gratifying to know that we have a work environment where our people enjoy what they are doing."

An Agency-Wide Approach to Software Asset Management

By Kellie White, Communications Specialist, Marshall Space Flight Center

The Office of the Chief Information Officer (OCIO) is taking a proactive approach to the challenge of software asset management.

NASA needs a comprehensive strategy and approach to address the full software life cycle for both new and existing software licenses for cloud and non-cloud platforms, including non-licensed or free software. The foundation for this approach was established with the NASA Interim Directive (NID) 7150.113, Software License Management, issued in 2017. The Enterprise License Management Team (ELMT), established in 2008, provides another key component of the overall strategy. Now, we are prepared to build on the foundation by establishing, regularly tracking, and maintaining a comprehensive inventory of NASA software licenses.

Who is responsible for managing software at NASA? Everyone who uses software at NASA has a responsibility to ensure that the software they use or purchase is

1. approved for use by NASA,
2. secure, and
3. being used in accordance with the terms and conditions of the license agreement.

What software does NASA need to track?

1. Commercial-off-the-shelf (COTS) software and software license types (e.g., perpetual licenses, software maintenance, term licenses, subscriptions, shareware, software as a service [SaaS], open source, freeware, and demonstration/trial software that is intended to be deployed within NASA that may not have an initial acquisition cost) and
2. Modified commercial-off-the-shelf software (MOTS).

The Agency Software Manager (ASM) role recently transitioned from the NASA Shared Services Center (NSSC) to the Applications Program (AP) Office. The AP was assigned the task to implement an effective Agency-wide Software Asset Management process and appointed Jane Maples to lead the effort. While the concept of software management is not new to any enterprise, it is a difficult undertaking for an agency the size of NASA, with numerous geographical locations and process owners across multiple directorates.

Fundamental to beginning the process and achieving success, is understanding the problem. Currently, any software deployed within the Agency, regardless of its function, injects risk into NASA's infrastructure from a cybersecurity and software compliance perspective, which has the potential to cost NASA millions per year in waste, inefficiency, and noncompliance fees. To decrease this risk, NASA must deploy an Agency-wide approach to software management that provides visibility and efficiency throughout the software life cycle, beginning with planning and continuing through retirement and disposition. Knowing the Agency's inventory of software provides multiple benefits, some of which are listed below.

Cost avoidance/savings

- Increased opportunity to reduce software cost and avoid paying significantly higher prices
- Maximization of software investments without purchasing new products and support
- Decreased costs for new projects and maintaining existing systems
- Cost avoidance on audits and cyber threats

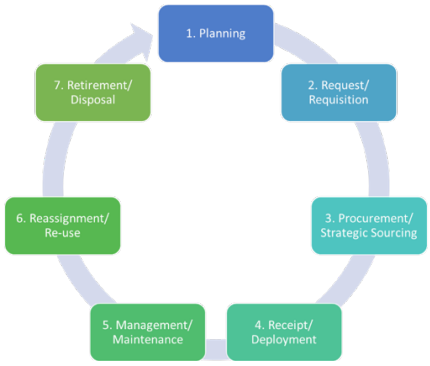
Cyber threat detection

- Increased awareness of cyber threats to NASA's data (i.e., mission and personnel)
- Quick removal of legacy IT hardware/software, which decreases threat possibility
- Identification and mitigation of outdated/unsupported software

Audit prevention

- Reduced frequency of audits, or of negative outcomes from audits
- Compliance with Government Accountability Office (GAO) and Office of Management and Budget (OMB) guidance on software license management

Most everyone would agree that the benefits to be gained are significant, but realizing those benefits will take substantial work. How do we get to the benefits? The seven steps in the software license life cycle are depicted in the picture below.



Utilizing a stakeholder-inclusive approach with representation from multiple Centers and disciplines, the resulting two-year implementation of this strategy will provide the Agency with a centralized, standardized, streamlined lifecycle process for managing software that delivers service to the customer in a timely manner and that is automated to the greatest extent possible. We will have greater insight into the software entering and existing in NASA's environment; a comprehensive software inventory; the ability to track and maintain software licenses, maintenance, and cost; an improved NASA security posture; and the elimination of unnecessary costs, duplication, and waste.

If you have questions related to the Agency Software Lifecycle Management approach developed by the AP, please contact the Agency Software Manager (ASM), Jane Maples, via e-mail at jane.maples@nasa.gov.

Using Advanced Data Analytics To Maximize the Value of NASA's Voice and Text Data

By Justin Gosses, Data Scientist, Johnson Space Center; Anthony Buonomo, Data Scientist; Andrew Adrian, PhD, Data Scientist; Brian Thomas, PhD, Data Scientist, NASA Headquarters

NASA has vast amounts of data stored as text or audio. Oftentimes, gaining insight into these data requires humans to read or listen to many files and summarize the results. This process is expensive and, therefore, precludes many potentially useful types of analyses simply because these analyses are too costly, too boring, or too time-consuming. Considering that we will never be able to hire enough folks to handle the avalanche of data that already exists, let alone the new data that are coming in year after year, we need to find a better solution.

Fortunately, recent advances in natural-language processing (NLP) and machine learning (ML) are helping to meet this need, and we are now poised to unlock the value of NASA's vast amounts data. NLP, a subfield of machine learning, is concerned with how to program computers to analyze large amounts of natural-language data, including both human speech and written text. If you have ever used Google Translate, created a reminder with Siri, or used grammar checking in Microsoft Word, you have interfaced with an NLP program.

The amount of data that NLP will make available is daunting, but ML provides us with the means to understand all of this new information. ML allows us to teach or program the computer using the data itself. The resulting model can approximate complex behavior that would, using traditional approaches, be very difficult and expensive to model. ML can be applied to data of many types, including raw text, text extracted via speech-to-text, or a subset of the whole text extracted via NLP. There are many different ML algorithms that one might choose to apply to solve a given problem, and it is not always clear which of the possible choices will be the best solution.

When applying both NLP and ML, a trained data scientist can help. Our team of data scientists has been working with partners here at the

Agency to apply these technologies to help solve NASA mission problems. We have identified avenues for speeding up analyses and improving the accuracy of business processes, and we have pointed out ways to reduce costs while enabling our workforce to focus on higher-order tasks. In this article, we highlight a few of our projects.

Speech-To-Text

Speech recognition has a long history. Although people have sometimes been disappointed when the technology fails to live up to human-level expectations, we have found that building good speech-to-text projects is often an exercise in matching each speech-to-text technology's strengths and weaknesses to the requirements of the use case. We have found that key criteria when picking a speech-to-text engine include whether computation occurs in the cloud, on an intranet, or on a local machine; whether the tool is geared for keyword tagging, command and control, or transcription tasks; accuracy during the use case; and how important is it that we are able to update the speech model with specific background noise or NASA-specific words.

Proof-of-concept applications we have developed include adding voice control to a Web site with a real-time map of the International Space Station's (ISS's) current position. Speech-to-text on a Web page represents a new user interface that might be useful when hands are busy or using a mouse and keyboard is inconvenient. WebAssembly, a way to convert C code to JavaScript, was used to create a system where all speech-to-text computation happened inside the local browser. This approach paves the way for building small speech-to-text applications without requiring lengthy security reviews, elevated privileges to install software, or the security implications of sending data between computers or outside the network. The data do not move outside the control of the user, and no software is installed.

Another proof-of-concept in this area involved writing code to scan through spacewalk training videos from the Neutral Buoyancy Laboratory and create data visualizations of tagged keywords. Having a visual representation of the clustering of key terms linked back to their place in the video sped up searching in what would normally be a human-intensive task of listening to the videos and taking notes.

Research Access

One of our text-based natural-language processing projects is building a service to automatically recommend keywords in NASA Scientific and Technical Information (STI) documents.

The STI program would derive great value out of a good keyword recommendation system. Why? Because they are tasked to organize and make accessible a wealth of NASA research. The standard mechanism for doing so is by tagging keywords to papers. There are upwards of 25,000 official STI NASA concepts, many of which only apply to small/niche areas of the overall collected work. Moreover, this official set only scratches the surface of the NASA concept space. A few individuals cannot possibly understand and summon to mind all of the keywords that apply to the broad wealth of knowledge being produced at NASA.

By providing an ML model to automatically recommend tags, we can (at least) provide an initial filter so that the folks who are assigning tags have some help. For clarity, this system (or one like it) is not set to replace people; it is only set to augment their workflow. It is an assistant—a "bionic arm," if you will, for the stewards of STI.

This work is poised to free up time for these stewards and allow them to direct their mental energy toward tasks that only they can do—the careful curation of a great source of information in order to educate, spread knowledge, and reduce duplication of research.

E-mail Records Classification

Since 2008, NASA has collected and archived over 11 million e-mails from certain "Capstone" officials. These e-mails contain a mix of Federal records and non-records that must be sorted before these e-mails can become part of the public record. For example, the subject "Booster Thrust Test Results" would likely be a record, whereas "Late to work" would likely not be a record. The manual reading and sorting of these 11 million messages is estimated to take some 23 years of human effort—and by the end of that time, we would have many more e-mails to sort! Therefore, we require an automated, "smart" solution for this problem.

Our team has developed a smart solution that reads and sorts NASA business e-mails "automagically," with up to a 96 percent accuracy rate. This outstanding accuracy rate is a result of ML—the process of teaching a computer to find statistical patterns in data without being explicitly programmed to do so. By utilizing ML in our development, this solution will enable us to save thousands of dollars in storage and transfer costs as we switch to preserving an increasing amount of sent and received e-mail.

Moving Forward

When domain experts and data scientists work together to tackle a problem, we can create solutions that free up time and mental energy, enabling our workforce to focus on higher-impact tasks. Looking forward, many of the projects in this space have applications wider than the teams and use cases they were originally built for. If NASA could enable more sharing of the labeled training datasets, methods, code, and IT infrastructure for executing these types of projects, it would pay back many times over. Toward this end, our Agency Data Analytics Team has been working to understand the needs for advanced data analytics at the Agency and to present the case for the adoption of needed techniques (such as ML and NLP) and the development of the requisite strategy, policy, and technical infrastructure that will help drive us toward a vision of a future NASA where workers can all leverage these benefits in a cost-effective manner.

Currently at NASA and want to get involved?

Check out these working groups:

Science Mission Directorate and OCIO's Big Data Working Group: contact John Sprague (*john.sprague@nasa.gov*)

Artificial Intelligence Community of Interest: contact James McClellan (*james.b.mcclellan@nasa.gov*)

Aeronautics Research Mission Directorate's Data Analytics Community of Interest: contact Yuri Gawdiak (*yuri.o.gawdiak@nasa.gov*)

Capitalize On Data Management, Access, And Innovation

NASA's IT Strategic Plan – Goal 2

By Jonathan Walsh, IT Strategic Planner, and Meredith Isaacs, Communications Specialist, NASA Headquarters

Data and information are cornerstones of NASA's past, present, and future missions and discoveries. The Agency's 2018 Strategic Plan depends on a robust capability to conduct research and interpret data in order to accelerate decision making and discoveries. NASA's IT Strategic Plan for Fiscal Years 2018-2021 provides the focus needed for the Agency to manage IT as a strategic resource to securely unleash the power of data. The use of data to amplify the benefits of NASA's missions and stewardship requires the ability to transform NASA's data into insights and increase secure data accessibility through innovation.

To achieve this strategic goal, NASA will establish Agency-wide data standards supported by secure, integrated data search and analytics capabilities to accelerate insights and improve the quality of decision making across NASA's complex data-rich environment. We will also investigate new technologies, take risks on disruptive ideas, and invest in operationalizing prototypes aligned with mission needs to increase secure data access and usability.

Through data management, the use of analytics, modernized infrastructures, and collaboration, NASA will remain a leader in Federal data sharing (*open.nasa.gov*; *data.nasa.gov*), increase data availability and mobility, and innovate with projects such as financial data visualizations, extravehicular activity (EVA) suit data management, and scientific research.

NASA's IT Strategic Plan outlines the Agency's IT goals, objectives, strategies, and metrics for Fiscal Years 2018 – 2021. The plan focuses NASA's IT community on strategic IT priorities, such as data management, accessibility, and innovation, that support achievement of NASA's 2018 Strategic Plan and its missions. The Agency uses IT to share NASA's results and deliver strategic IT capabilities that drive discovery while increasing quality, productivity, mission safety, and cost optimization.

Check out NASA's IT Strategic Plan here: *https://www.nasa.gov/ocio/itsp*
Questions? - *agency-itsp@mail.nasa.gov*

This visualization of NASA's IT Strategic Plan highlights how the plan emphasizes data and information. The more a word was used, the larger and bolder it is seen here.

Automated Data Tagging Project

By David Kelldorf, JSC Chief Technology Officer, and Truong Le, Data Architect, Johnson Space Center

Last year, Johnson Space Center (JSC) developed the first Center-wide IT planning activity and created the JSC Master IT Plan (available at *https://inside.nasa.gov/ocio/ocio-news/what-will-it-jsc-look-2037*), which aligns with the 20-year JSC Center Plan. From this planning vision, three planning goals emerged to guide the development process: a collaborative and evolving IT environment, secure and accessible data, and a flexible workforce.

To support the first two goals, the Information Resources Directorate (IRD) at JSC initiated the Automated Data Tagging Project in June 2018. In this project, a prototype is underway to investigate mechanisms to automatically identify and categorize unstructured data. This initiative is designed to make unstructured data discoverable and accessible and to identify high-value assets (HVA).

The current state of NASA data presents challenges in securing data, engineering security controls, and managing data overall. The strategic goals of the Automated Data Tagging Project that address these challenges include simplifying discovery and use for authorized users while providing the appropriate degree of security and control relevant to data categories, empowering data-driven strategic decisions and intentional IT operating model choices, right-sizing storage costs while enhancing monitoring and management, and developing data categories that align with Agency and network data loss prevention tools.

The Automated Data Tagging Project will develop data models and connectors for file shares and SharePoint storage. Testing will focus on IRD-owned data shares and SharePoint repositories as a microcosm of the JSC data challenges. The goal is to discover and unify the view of unstructured data and develop strategies to store, share, and tag the information.

Partnering with the Agency team that has been developing tools for the Extravehicular Activity (EVA) Office, IRD will test developed tools for applicability on corporate unstructured data.

The Automated Data Tagging Project will investigate mechanisms for HVA and provide recommendations for JSC and Agency architectures. The outcome of this project has the potential to scale to other NASA Field Centers, making NASA data more discoverable and accessible while driving space exploration.

Big Data Big Think @GRC

By Terry Jackson, Associate CIO for Technology, Data & Innovation Division, NASA Headquarters

NASA held a Big Data Big Think at Glenn Research Center (GRC) from May 22 through 24. A very diverse group of subject matter experts (SMEs)—including members of the Aeronautics Research Mission Directorate (ARMD), Human Exploration and Operations Mission Directorate (HEOMD), Space Technology Mission Directorate (STMD), Office of the Chief Engineer (OCE), Centers, and many others from across NASA—were in attendance at this joint meeting sponsored by the Office of the Chief Information Officer (OCIO) and the Science Mission Directorate (SMD). This was the sixth gathering since the first one held at Langley Research Center (LaRC) in October 2014. The Big Data Big Think meetings provide a forum where SMEs share what they have been working on and collaborate on solutions to NASA's data challenges.

The meeting was opened by GRC Deputy Director Dr. Marla E. Pérez-Davis, followed by GRC Chief Information Officer (CIO) Sean Gallagher and other GRC representatives. Experts from around the Agency discussed science and engineering projects, high-performance computing and analytics, IBM Watson projects, Internet of Management Things (IoMT), scientific workflows, secure code sharing, and NASA WorldWind. Special Lightning Talks were conducted, giving programs and Centers ten minutes to share best practices; OCE also helped lead a data roadmap discussion. The keynote address was given by Ted Friedman, a Gartner data expert. During the conference, participants were treated to a visit to the Cleveland Museum of Art innovation event, hosted by the museum's CIO, Jane Alexander. The team also toured the GRC Simulated Lunar Operations (SLOPE) Lab to see the latest in rover technology.

Many thanks to the GRC CIO and staff for hosting this event!

Attendees at NASA's Big Data Big Think meeting in Cleveland, OH. Photo by Herb Schilling, GRC

Visitors tour the Cleveland Museum of Art event. At center, using the interactive touch display, is NASA data scientist Dr. Brian Thomas. Photo by Herb Schilling, GRC

Comprehensive Digital Transformation Initiative Ignites Data Science Adoption at NASA's Langley Research Center

By Jeremy Yagle, Technical Lead, LaRC Data Science Team; Corey Portalatin-Berrien, LaRC Data Science Team; and Ed McLarney, Strategic Lead, LaRC Data Science Team—Langley Research Center

Data science is the convergence of statistics, social sciences, and computer sciences. The discipline aims to discover the underlying value in data, from identifying trends to analyzing massive datasets for anomalies. Data science includes the subdomains of machine learning, big data analytics, and artificial intelligence (AI). Speech-to-text on smartphones, online shopping recommendation systems, and smartwatch fitness analysis are just a small sampling of technologies that have rapidly become an integral part of daily life.

Significant advances in data science methods have demonstrated the potential to transform the disciplines of science and engineering. Novel approaches, paired with rapidly evolving computational capabilities, create an environment where cross-fertilization and unique collaborations achieve previously unattainable outcomes.

Data Science at Langley

Four years ago, NASA's Langley Research Center (LaRC) recognized the technology changes referenced above and created the Comprehensive Digital Transformation (CDT) initiative. The primary goal of CDT is to catalyze the application of cutting-edge capabilities to enable innovative concepts, reduce design cycle time, improve affordability, and increase confidence.

In 2014, LaRC's Big Data Analytics and Machine Intelligence Strategy and Roadmap outlined a long-term vision for an AI-driven "Virtual Research and Design Partner" to enable NASA to achieve greater scientific discoveries. A key component was the creation of LaRC's Office of the Chief Information Officer (OCIO) Data Science team. Since its inception, the LaRC Data Science team has made significant progress with the implementation of more than two dozen pilot projects and use cases across multiple domains. Projects include the exploration of applications of machine learning on images, the analysis of sensor data for humans and materials, the development of computational models, and the analysis of mission support datasets. These projects have allowed the team to assess potential value for NASA researchers.

Project success is dependent upon collaboration between LaRC's OCIO Data Science team, mission organizations, and external partners from academia and industry. This convergence of skills provides a comprehensive view of the problem while encouraging collaboration, buy-in, and continued learning.

Since there are few off-the-shelf solutions for applying these techniques to physics-based datasets at NASA, our challenges must be researched and solutions developed by enhancing current methods and providing regular outreach. The OCIO Data Science team is working to build a robust data architecture and infrastructure that will be used by multiple disciplines to gain new insights into heterogeneous technical data.

The LaRC OCIO Data Science Team is an enthusiastic member of the Agency big data community and enjoys partnering with other Centers to benefit the NASA mission.

NASA/GSFC ... Home of Big Data

By Myra Bambacus, Program Manager, Program Formulation & Development Office, GSFC POC for Big Data, and Chair of the National Science Foundation Spatiotemporal Center Industry Advisory Board, and Daniel Duffy, Chief of the Computational and Information Sciences and Technology Office, Goddard Space Flight Center

To the scientists and engineers at NASA's Goddard Space Flight Center (GSFC), it seems unnecessary to point out that Goddard is a big data hub for Earth science, planetary, heliophysics, astrophysics, and engineering data. Over the past 60 years, Goddard has lead and been a part of numerous missions studying the Earth, sun, planets, and the universe, all of which have generated big data. While missions come and go, the data that NASA generates lives on.

In addition to generating volumes of data, major NASA programs are at the forefront of managing access to data in new and innovative ways. The Earth Observing System Data and Information System (EOSDIS) program manages NASA's Earth science data from remote sensing instruments, and beyond. EOSDIS curates a multi-petabyte archive distributed across multiple data centers that provide search, order, data distribution, and analytics services. Future missions will require more data storage so EODIS is looking to the cloud as a solution.

At the NASA Center for Climate Simulation (NCCS), scientists are increasing our understanding of the processes that govern the Earth's environment in order to design the next generation satellites and remote sensing platforms. Starting from observation data, computer models (see Figure 2) simulate complex processes in the Earth system and are used for data assimilation, research weather forecasts, decadal studies, retrospective analysis, and climate studies. It is not unusual for applications to generate petabytes of data.

Within the Earth Science Technology Office (ESTO), the Advanced Information Systems Technology (AIST) Program develops and advances Information Technologies (IT) needed for NASA Earth Science programs in the 5 to 25-year timeframe, providing tools, technologies, and virtual environments in which big data science is accomplished.

NASA cannot do all of this alone and is constantly looking for external partnerships to help accelerate our mission. One such partnership which is leveraging millions of dollars of investments across academia, industry, and the government is the National Science Foundation's (NSF's) Industry–University Cooperative Research Centers Program (I/UCRC) Spatiotemporal Center (STC). Lead by George Mason University with co-leads at University of California, Santa Barbara, and Harvard University, the STC supports Goddard initiatives in cloud computing infrastructure, planetary defense mitigation gateway, and climate data analytics.

Given the size and complexity of the data, downloading data is no longer an option. Co-locating data, either physically or virtually, with compute capabilities is a requirement. By combining large-scale data volumes with elastic compute capabilities, researchers can scale from small to large problems efficiently.

NASA is only beginning to understand the applications of big data. Artificial Intelligence (AI) has created new areas of research that require access to large disparate data sets to train models to answer a variety of scientific questions. Goddard is rapidly moving into the next phase of big data technologies using models and algorithms to harness the potential of AI. By both using existing technologies and NASA innovations, Goddard is enabling new ways big data can change how people act, play, and thrive on Earth and among the stars.

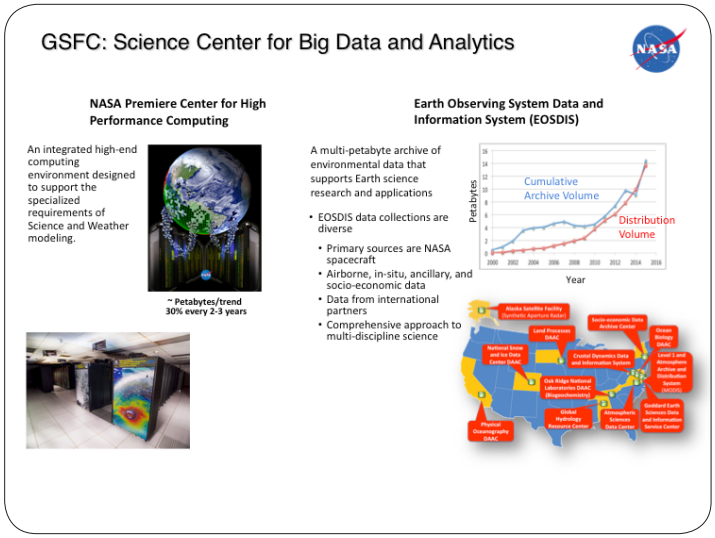


Figure 1: Two programs containing 100's of petabytes that represent the Big Data Challenges in NASA.

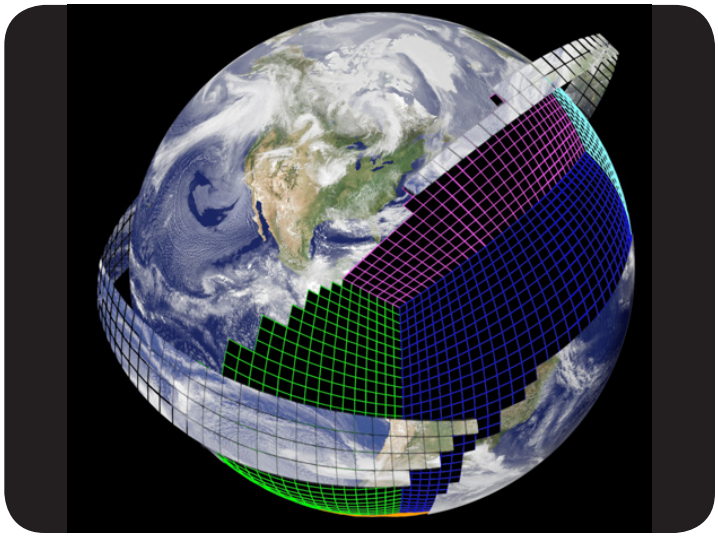


Figure 2: Goddard Earth Observing System (GEOS) global atmospheric model. Image courtesy of the GMAO.

BSA Corner

By Meredith Isaacs, Communications Specialist, NASA Headquarters

NASA began implementing its IT Business Services Assessment (BSA) decisions in March 2016. The Mission Support Council (MSC) approved IT transformation decisions for Roles and Responsibilities, Governance, Computing Services, Communications, Workstations, Collaboration, and IT Security.

During this implementation period, IT at NASA has journeyed from limited investment insight, duplicative services, and minimal stakeholder engagement. While still transforming in a number of ways, IT at NASA is identifiable by greater CIO insight and oversight, more efficient operations, formal assessments, and the implementation of new tools. Each IT BSA decision area has made great progress and four have completed implementation.

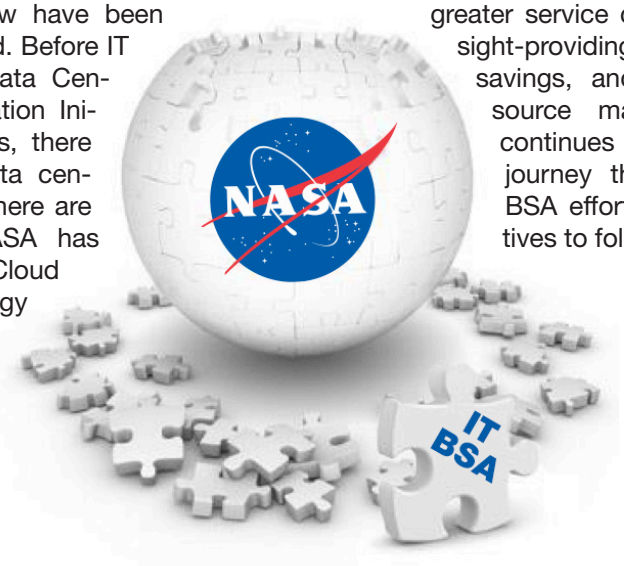
For Roles and Responsibilities, there was limited insight into IT spending and an operating model that didn't reflect all program areas. Now, there are six IT programs (Applications, Communications, Computing Services, End User Services, Information Management, and Cybersecurity Services) and greater CIO oversight and authority, following Federal Information Technology Acquisition Reform Act (FITARA) guidelines.

In Governance, boards were ineffective and IT lacked insight mechanisms. Now, governance boards are streamlined and thriving, and the IT Capital Investment Review and Center Functional Review have been implemented. Before IT BSA and Data Center Optimization Initiative efforts, there were 79 data centers. Now, there are 24 and NASA has adopted a Cloud First strategy and implemented a data center architecture.

Prior to IT BSA, some Communications services were transforming to enterprise services. IT BSA efforts address transformation risk and reinvestments of savings. Center End User Services procurement was varied and did not always take advantage of enterprise services. Today, nearly all Centers procure at least 80% of their workstations from the enterprise contract and the program continues further contract consolidation.

Like other IT services, many of NASA's collaboration tools were duplicated at each Center, raising costs. By defining a Core Suite of Collaboration Tools to meet most needs and filling the Core Suite with Cisco capabilities and Office 365 (coming Fall 2018), we will reduce duplicative services and save Agency resources. Cybersecurity teams addressed potential gaps in coverage by adopting a risk management framework and deploying continuous monitoring tools.

Through IT BSA activities, NASA's IT has evolved into a state of greater CIO oversight, more enterprise services, greater service consistency, insight-providing assessments, savings, and strategic resource management. IT continues transformation journey through final IT BSA efforts and in initiatives to follow.



Office 365

Office 365 Coming to NASA

By Emily Townsend, EUSO Communications Lead, Marshall Space Flight Center

Office 365 will allow NASA employees to work in the cloud AND on the ground. The Agency's migration to Office 365's cloud-based service starts this month with a limited pilot and will continue throughout the summer and into the Fall. Initially, NASA will implement Online Email, Skype, and OneDrive (which includes personal storage and file sync and share within NASA). In the meantime, Microsoft Office (i.e., Word, Excel, Access, and PowerPoint) will continue to function as they do today. Other O365 features, including additional collaboration capabilities, roll out in Spring 2019.

All NASA email-enabled customers will receive an Office 365 account. Because securing our devices, networks, and data are top priorities for NASA, Office 365 will be configured as an internal service and will require an approved NASA device and PIV card or Agency Smart Badge to gain access. Customers will be migrated in a phased approach beginning late summer and will receive targeted communication, instructions, and training close to their migration date.

Office 365 is a smart decision for NASA. It provides the agency with modern, innovative, and collaborative technology and gives our customers increased mailbox sizes, online storage capabilities with OneDrive, and larger attendance per Skype meeting.

For more information, FAQs, O365 training videos, and a list of Center POCs, visit: https://inside.nasa.gov/office-365.

Center Functional Review

By Saurabh Baveja, CFR Lead, NASA Headquarters

Over the past few years, the Business Services Assessment (BSA) efforts have spanned the Agency, including how information technology (IT) at NASA works and how best to optimize IT to execute projects that benefit and provide added value to our customers, providers, and the Agency.

Based on this effort, the Mission Support Council (MSC) developed a BSA IT Implementation Plan with the goal of creating a Level 0 through Level 3 management structure to enable a strategic path forward while clearly defining responsibilities and authorities for each level. As a result, the Implementation Plan approach established six IT programs, with each being spearheaded by a Program Executive (at Level 2) and their respective Program Offices operating at Level 3. The plan further laid out key decisions in the area of Governance including the requirement that the CIO shall conduct Center Functional Reviews (CFR). These reviews, per the Business Services Steering Committee (BSSC) recommendation, were put in place to ensure Center compliance with Agency IT policy and standards and serve as a "means to assess the effectiveness, efficiency, and compliance of the IT work performed across Centers…through Agency Program Executives."

Over the course of FY 2017 and FY 2018, multiple successful CFRs have taken place to ensure alignment with these BSA-prescribed guidelines. These reviews have come to span six IT programs and six crosscutting areas (see list) and have resulted in collaborative dialogue and improvements by the Centers, as well as programs and crosscutting areas, helping ensure alignment and compliance with the requirements levied per the BSA, as well as from the strategic direction of the OCIO.

IT Program Areas:	Crosscutting Areas:
Applications	Collaboration
Communications	Enterprise Architecture
Computing	Governance
End User	IT Contracts
Information Management	IT Investments
IT Security	Project Management

The next CFR is scheduled at Johnson Space Center (JSC) in July 2018, and it will mark the midpoint milestone of this activity. Per the Implementation Plan, these reviews will rotate on a 3-year cycle. Past CFRs have been successfully held at Langley Research Center (LaRC), Kennedy Space Center (KSC), Headquarters (HQ), and Ames Research Center (ARC).

CFRs continue to serve a pivotal role in helping enable the BSA Implementation and Governance Plan requirements. These CFRs, in partnership with the Center CIOs and Center leadership, have come to serve not only as a means to assess and look closer at compliance with existing NASA IT policies and standards, but also as an opportunity to improve communications. This partnership helps identify additional enterprise adoption opportunities while increasing awareness and understanding of the Centers we (in IT) serve to help better meet current and future mission needs.

NASA Cloud Team Member Wins FedRAMP Award!

By Penny Hubbard, Communications Specialist, Ames Research Center

The Federal Risk and Authorization Management Program (FedRAMP) of the General Services Administration (GSA) announced the winners of the inaugural FedRAMP Five Awards in Washington, DC, on June 13, 2018, during the Advanced Technology Academic Research Center's (ATARC) Cloud and Data Center Summit. The FedRAMP Five is FedRAMP's first-ever awards program and honors the agencies and people that are doing the most to shape program progress to enable cloud providers to work with the Federal Government and provide approved and secure cloud services. NASA's Computing Services Program Office (CSPO) is pleased to congratulate Steven Hunt, who was selected to receive FedRAMP's Large Agency Tech Lead award. This award is especially significant because it is given to only a single individual across the entire Federal Government.

The full details are posted on the FedRAMP site here: *https://www.fedramp.gov/congratulations-to-the-2018-fedramp-five-award-winners/*.

Congratulations, Steven!

Ames Research Center's Steven Hunt, winner of the FedRAMP Five Large Agency Tech Lead award.

Cleveland Data Meetup

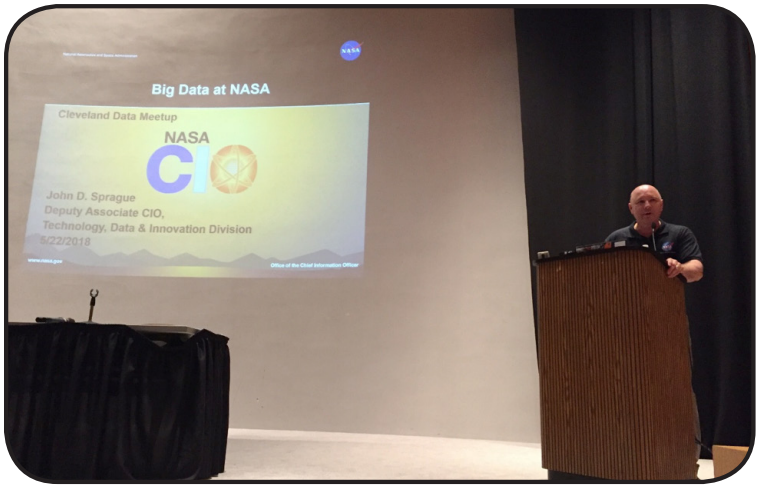
By John Sprague, Deputy Associate CIO for Technology, Data & Innovation Division, NASA Headquarters

Data meetups are held all over the United States and the world. Cleveland, OH, holds some of the largest meetups in the country. Attendees to these monthly and quarterly meetups are from the public and private sectors from the surrounding area, and Cleveland is home to a number of businesses with a focus on data management and analytics, such as Progressive Insurance, Key Bank, Pandata, and IBM Watson Health. While in town for NASA's Big Data Big Think conference at Glenn Research Center (GRC), a number of NASA personnel were able to attend Cleveland's Big Data Meetup; I served as the keynote speaker for this particular meetup.

Topics ran the gamut from NASA's Pleiades Supercomputer to the Lunar Laser Communication Demonstration and Quantum Artificial Intelligence Laboratory located at Ames Research Center (ARC). I shared use cases like the Hubble Space Telescope, the James Webb Space Telescope, and extravehicular activity (EVA), as well as unique challenges from astronaut data.

We discussed new space research, like the romaine lettuce grown and eaten by astronauts (including Scott Kelly) on the International Space Station, as well as the anticipated wave of data expected from the slew of missions scheduled over the next year. Meetup participants were also interested in NASA's Distributed Active Archive Centers (DAACs), scattered across the United States and storing large amounts of data. It was a great, free flow of information as we fielded numerous questions and held a dialogue.

Cleveland's data meetup was an excellent opportunity for NASA to talk about its data management challenges, initiatives, and accomplishments. After all of the discussions, I was reminded of one of my favorite sayings: Data becomes Information, becomes Knowledge, which becomes Wisdom.



NASA's John Sprague presents at the meetup.

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