

National Aeronautics and Space Administration

Goddard Space Flight Center
Flight Projects Directorate



Performance Management Should We Manage to a Single Data Point? A NASA/Goddard Space Flight Center Perspective

Dr. Wanda Peters

Deputy Director for Planning and Business Management

2019 Project Management Symposium
Turning Knowledge into Practice
University of Maryland
May 10, 2019



- Goddard Overview
- Project Management at Goddard
- Business Change Initiative Optimization
- State of Business
- Why is this Important?

Best Place to Work in the Federal Government 2018





Goddard Overview

Goddard Space Flight Center



ONE World-Class Science and Engineering Organization

SIX Distinctive Facilities & Installations

**Greenbelt
Main Campus
1,270 Acres**

**Wallops Flight
Facility
6,188 Acres**

**Goddard Institute
for Space Studies**

**Independent
Validation &
Verification
Facility**

**White Sands Test
Facility Ground
Stations**

**Columbia
Balloon
Facility**

Executing NASA's most complex science missions
Est. 1959



MARYLAND

Launching Payloads for NASA & the Nation
Est. 1945



VIRGINIA

Understanding our Planet
Est. 1961



NEW YORK

Providing Software Assurance
Est. 1993



WEST VIRGINIA

Communicating with Assets in Earth's Orbit
Est. 1963

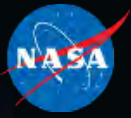


NEW MEXICO

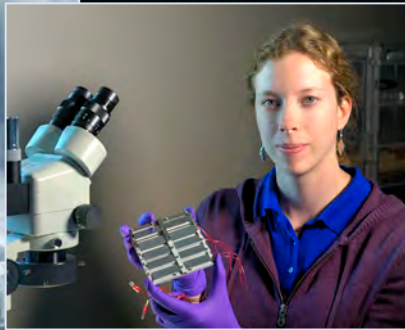
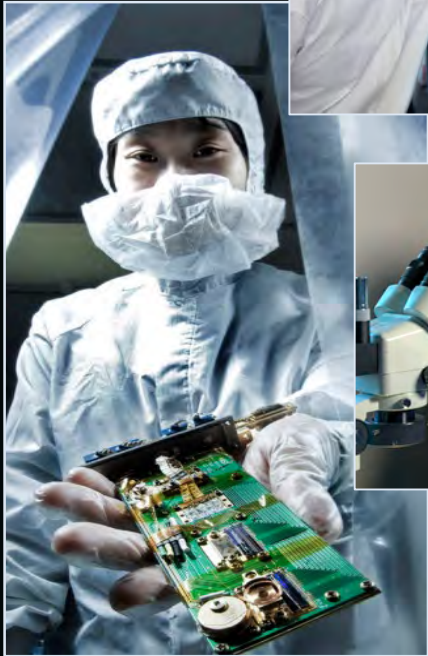
Directing High Altitude Investigations
Est. 1982



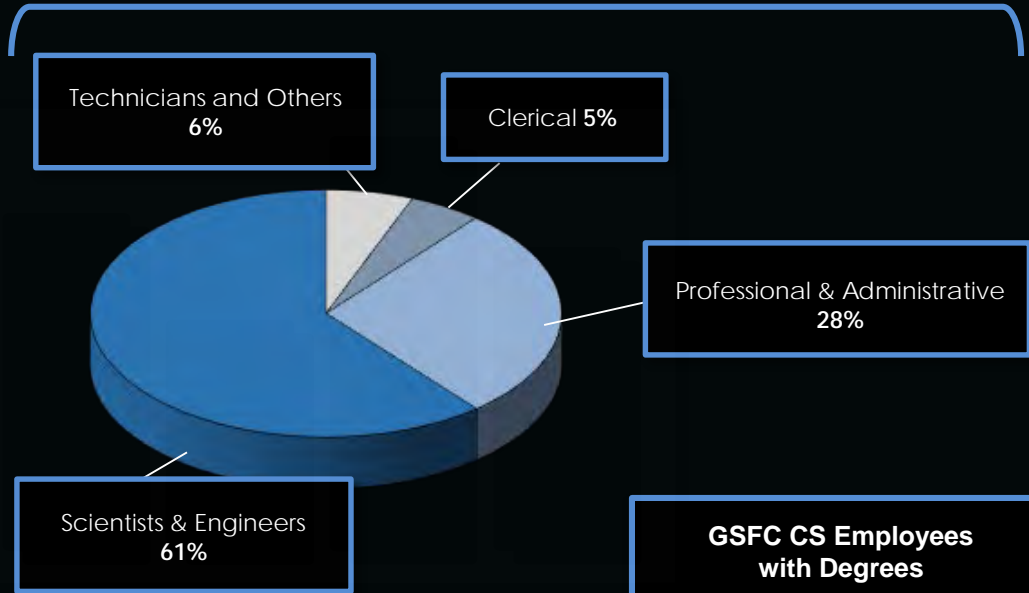
TEXAS



Who We Are



THE GODDARD COMMUNITY



GSFC CS Employees with Degrees

- Bachelors – 37%
- Advanced Degrees – 48%
- Associate/Technical – 2%
- High School – 13%

Number of Employees

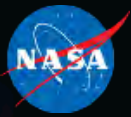
- ~3,000 Civil Service
- ~6,000 Contractor
- ~1,000 Other*
- Total - ~10,000**

A diverse community of scientists, engineers, technologists, and administrative personnel dedicated to the exploration of space

**Including off-site contractors, interns, and Emeritus*

The Nation's largest community of scientists, engineers, and technologists

Goddard Space Flight Center



Employees Receive Worldwide Accolades for Their Work

Dr. Piers Sellers
Most Excellent Order of
the British Empire
2011



Dr. John Mather
Nobel Prize in Physics – 2006
Rumford Prize – 1996
Franklin Medal – 1999



Dr. Mather is the recipient of more than 30 honors in the physical sciences.

Dr. Compton Tucker
Galathea Medal – Denmark 2004
Vega Medal – Sweden 2014
In Physical Geography



The Intergovernmental Panel on Climate Change (IPCC) was awarded the Nobel Peace Prize in 2007 for its work on climate change, together with former US Vice-President Al Gore. Over 50 scientists from the Goddard Space Flight Center contributed to the IPCC Assessments that formed the basis for the award.



Key Science Themes

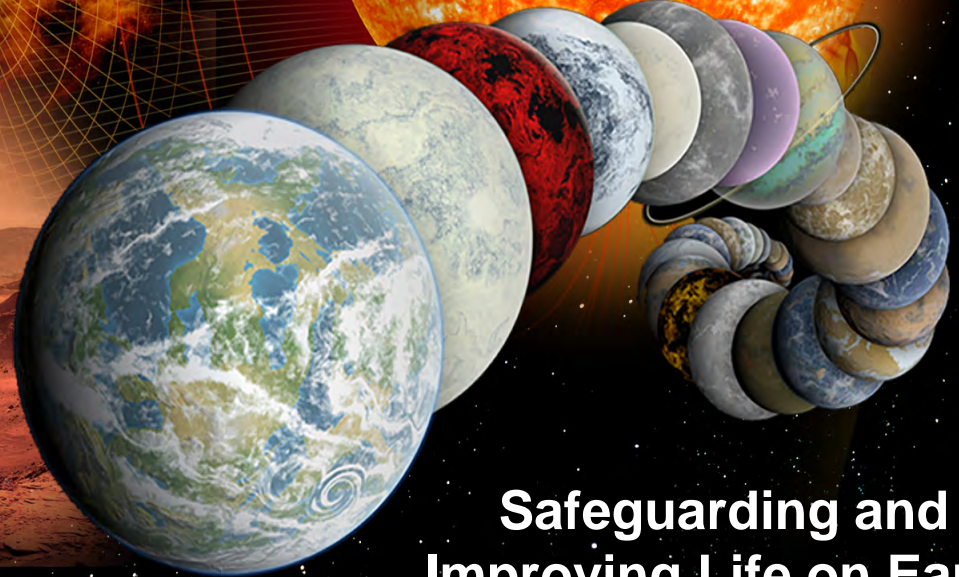


**Discovering the Secrets of
the Universe**

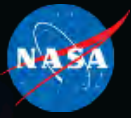
**Translate the knowledge and technologies derived from these
areas of exploration to practical applications today.**

**Searching for Life
Elsewhere**

**Safeguarding and
Improving Life on Earth**



What We Strive to Do



Lead in Science and Technology

Goddard's end-to-end capabilities, world-class scientific expertise, top-tier engineering talent, and facilities enable it to develop & manage NASA's most complex science missions



Enable Exploration

Goddard's science missions, launch facilities, and space communications/navigation capabilities help us understand the universe and explore deeper within it



Improve Lives & Protect the Nation

Goddard enables improvements in our understanding and forecasting of extreme weather, the spread of water-borne diseases, crop yields, etc. to inform national security objectives



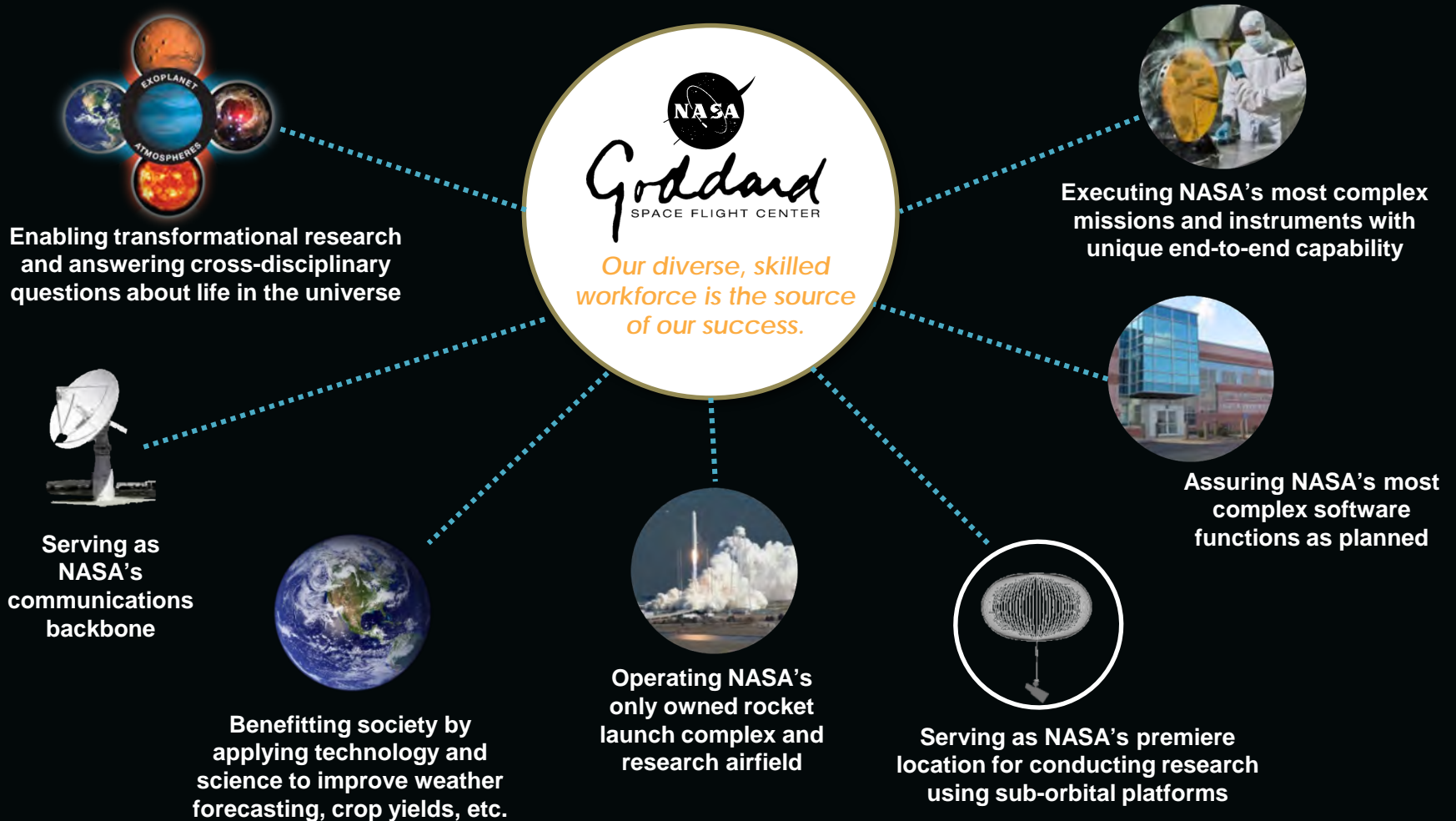
Invest in America

Goddard is committed to strengthening the US economy by seeding new technologies, creating business opportunities, and inspiring young innovators and engineers

One World-Class Organization



What makes Goddard NASA's preeminent science center?



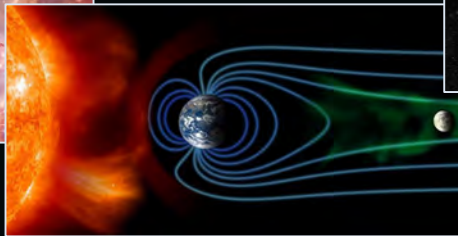
Goddard's Lines of Business



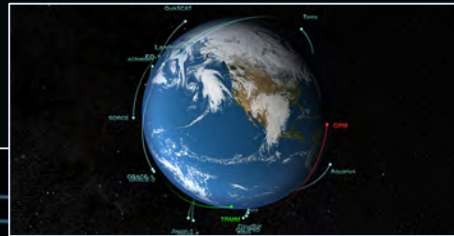
Astrophysics



Heliophysics



Earth Science



Planetary & Lunar Science



Human Exploration & Operations



Suborbital Platforms



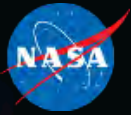
Cross Cutting Technology And Capabilities



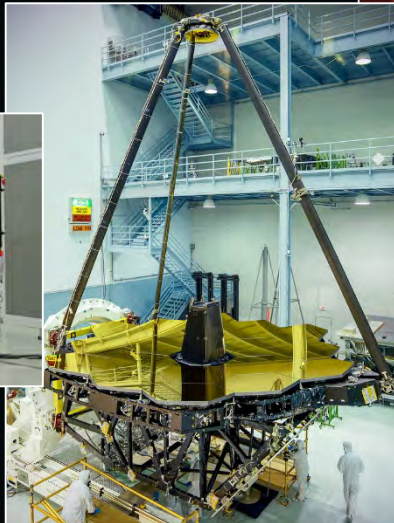
Communications & Navigation



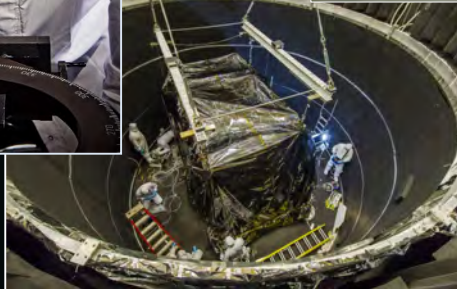
Our Capabilities



World Class Facilities



Engineering and Technology Development



End-to-End Capabilities from Concept through End of Mission Life



Exceptional Human Capital



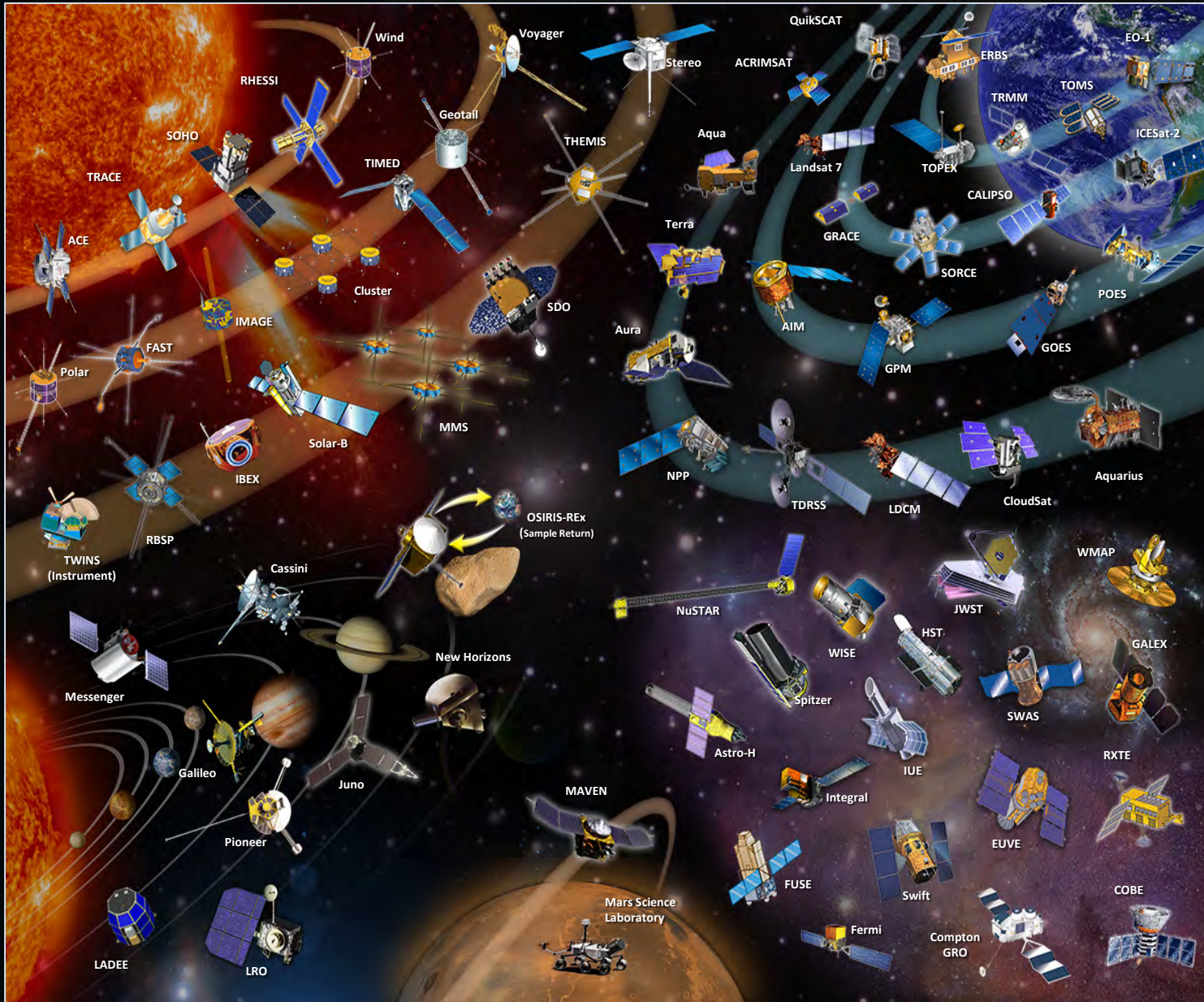
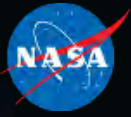
Expertise in Core Science and Cross-Cutting Disciplines



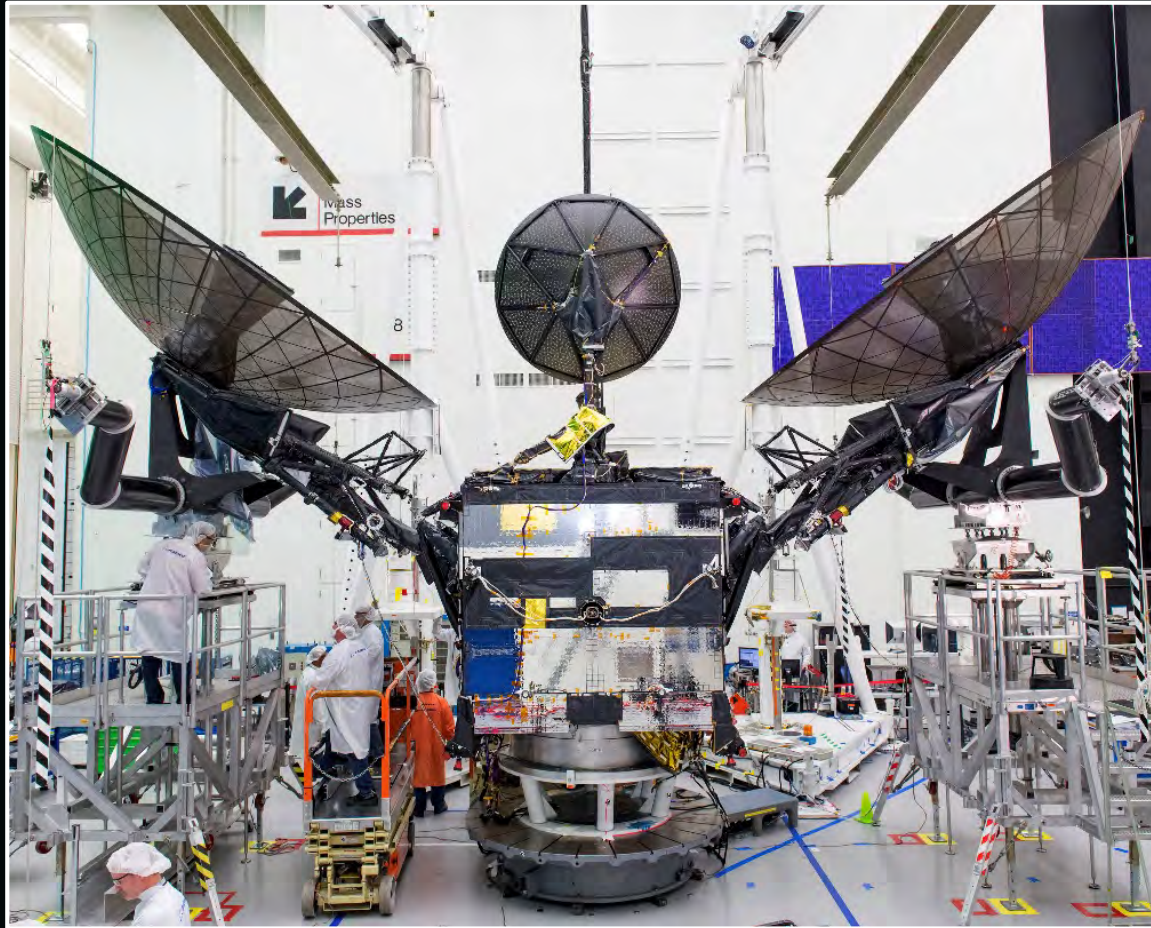
Diverse Partnerships



GSFC: A Diverse Mission Portfolio



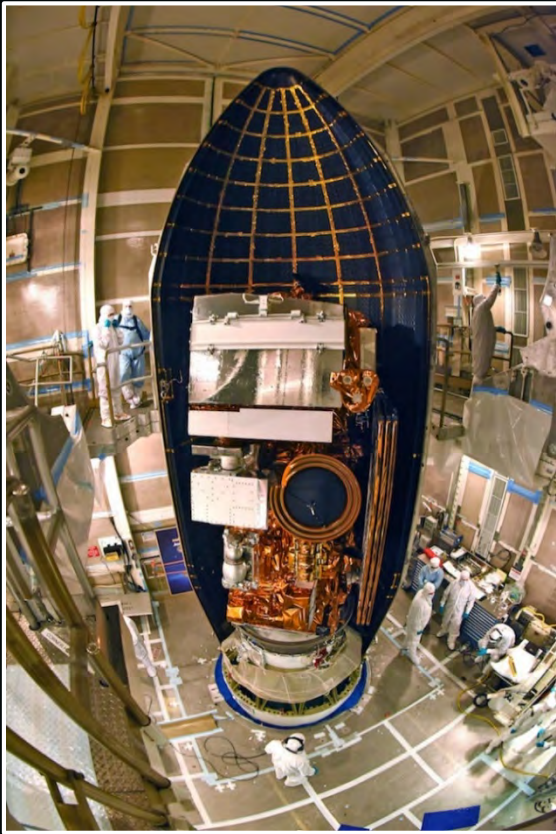
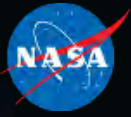
Recent Launches: Communications



Tracking and Data Relay Satellite (TDRS) M is third satellite in a series that will ensure the Space Network's continuation of around-the-clock, high throughput communications services to NASA's missions.

Launched **August 18, 2017**

Recent Launches: Weather Satellites



Joint Polar Satellite System 1 (JPSS 1) spacecraft will sustain continuity of and enhance NOAA's Earth observation analysis and forecasting capabilities from global polar-orbiting observations.
Launched **November 18, 2017**



Geostationary Operational Environmental Satellite R (GOES-S) is a collaborative program between NOAA & NASA to develop the next generation GOES environmental satellites.
Launched **March 1, 2018**

Meteorological Operational Satellite-C (MetOp-C) is the next (and last) in a series of three weather satellites from the ESA and EUMETSAT. Under Interagency agreements with NOAA, NASA (GSFC) is providing four POES heritage instruments AMSU-1, AMSU-2, AVHRR/3, and SEM.
Launched: **November 7, 2018**



Recent Launches: Astrophysics & Heliophysics



Parker Solar Probe (PSP) will determine the structure and dynamics of the Sun's coronal magnetic field, understand how the solar corona and wind are heated and accelerated, and determine what mechanisms accelerate and transport energetic particles.

Launched **August 12, 2018**

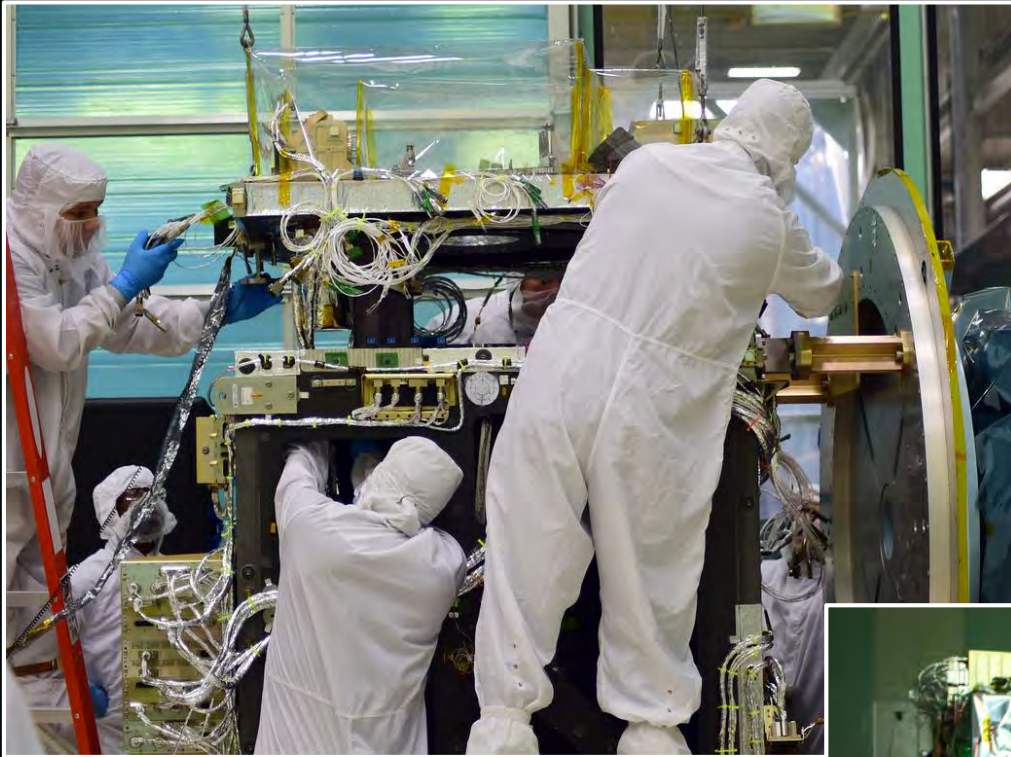
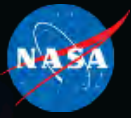
Transiting Exoplanet Survey Satellite (TESS)

will discover Transiting Exoplanets around the brightest stars and search for Earth like planets.

Launched **April 18, 2018**



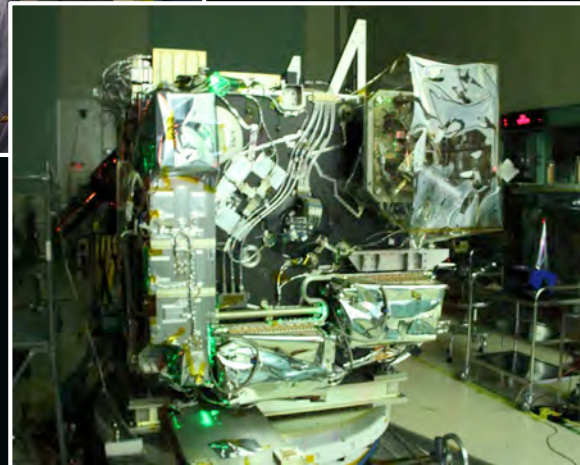
Recent Launches: Earth Sciences



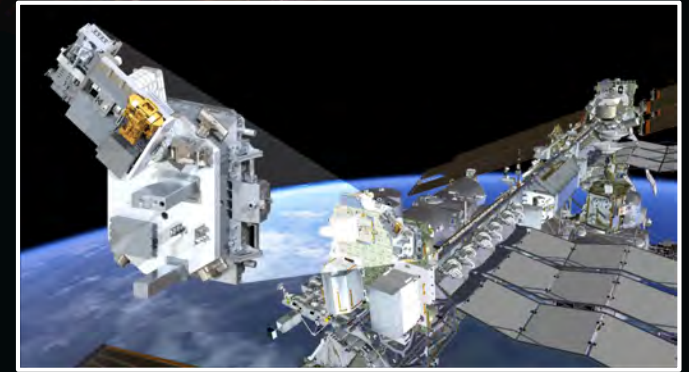
Ice, Cloud, and Land Elevation Satellite (ICESat-2)

ICESat-2 is designed to collect altimetric measurements of the Earth's surface, optimized to measure the heights and freeboard of polar ice and global vegetation canopy.

Launched **September 15, 2018**



Advanced Topographic Laser Altimeter System (ATLAS) Instrument on ICESat-2



Total and Spectral Solar Irradiance Sensor (TSIS-1)

mission will provide absolute measurements of the total solar irradiance (TSI) and spectral solar irradiance (SSI), important for accurate scientific models of climate change and solar variability.

Launched **December 15, 2017**

Recent Launches to Space Station



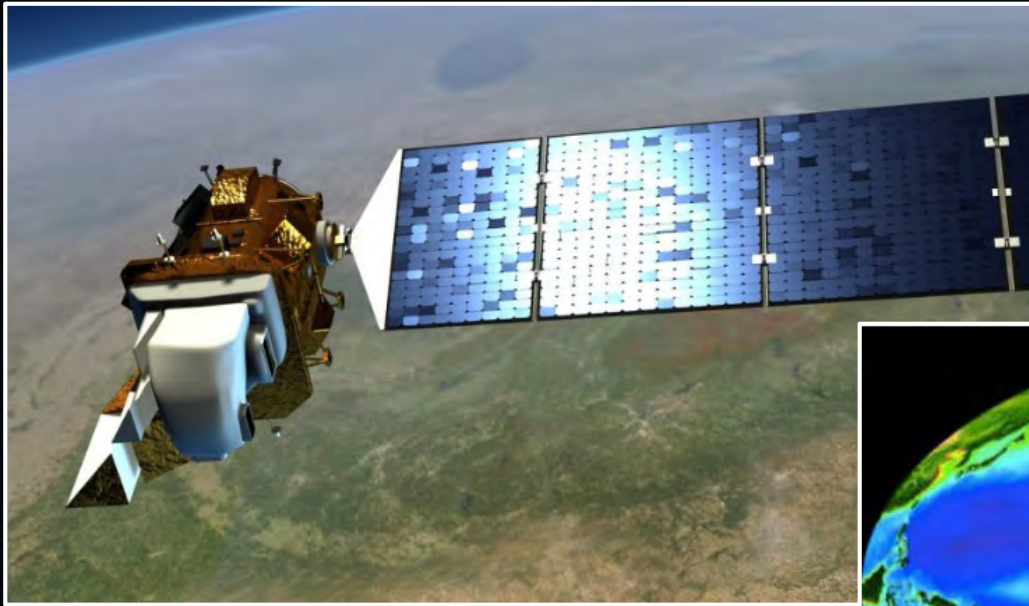
Global Ecosystem Dynamics Investigation Lidar (GEDI) will characterize the effects of changing climate and land use on ecosystem structure and dynamics to enable radically improved quantification and understanding of the Earth's carbon cycle and biodiversity.
Launched **December 5, 2018**



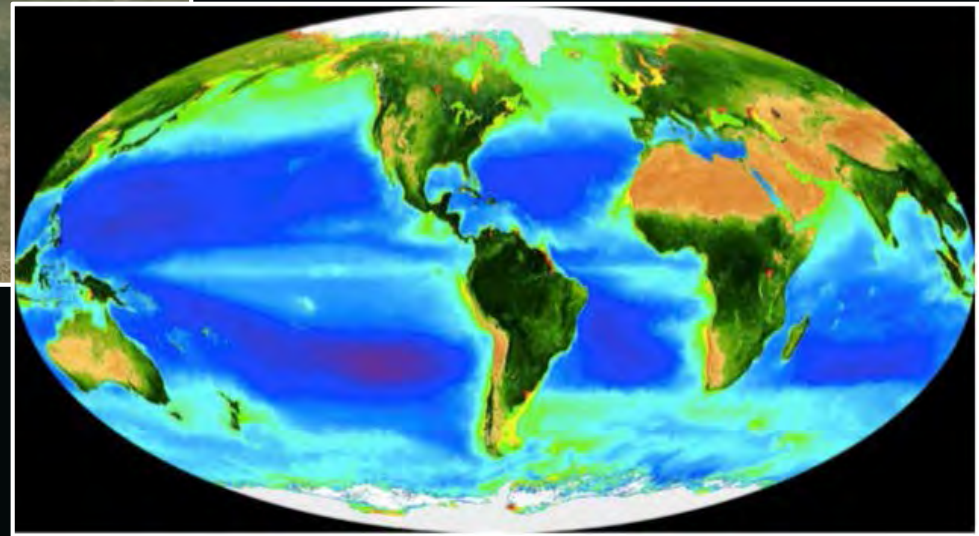
Robotic Refueling Mission (RRM) Phase 3 is a multi-phased International Space Station technology demonstration that is testing tools, technologies and techniques to refuel and repair satellites in orbit - especially satellites not designed to be serviced. Phase 3 demonstrates final tasks required to replenish cryogens in existing satellites not designed for servicing.
Launched **December 5, 2018**



Earth Science Missions



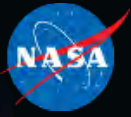
Landsat 9 is designed to provide continuity in the multi-decadal land surface observations to study, predict, and understand the consequences of land surface dynamics. This mission is a NASA and USGS partnership.



Pre-Aerosol, Clouds, and Ocean Ecosystem (PACE)

will make global ocean color measurements to provide extended data records on ocean ecology and global biogeochemistry (e.g., carbon cycle) along with polarimetry measurements to provide extended data records on clouds and aerosols.

Astrophysics Missions



James Webb Space Telescope (JWST) is a deployable infrared telescope, passively cooled, with 6.5 meter diameter segmented adjustable primary mirror designed to study the origin and evolution of galaxies, stars, and planetary systems.



Wide Field Infrared Survey Telescope (WFIRST)

is a NASA observatory designed to settle essential questions in the areas of dark energy, exoplanets, and infrared astrophysics.

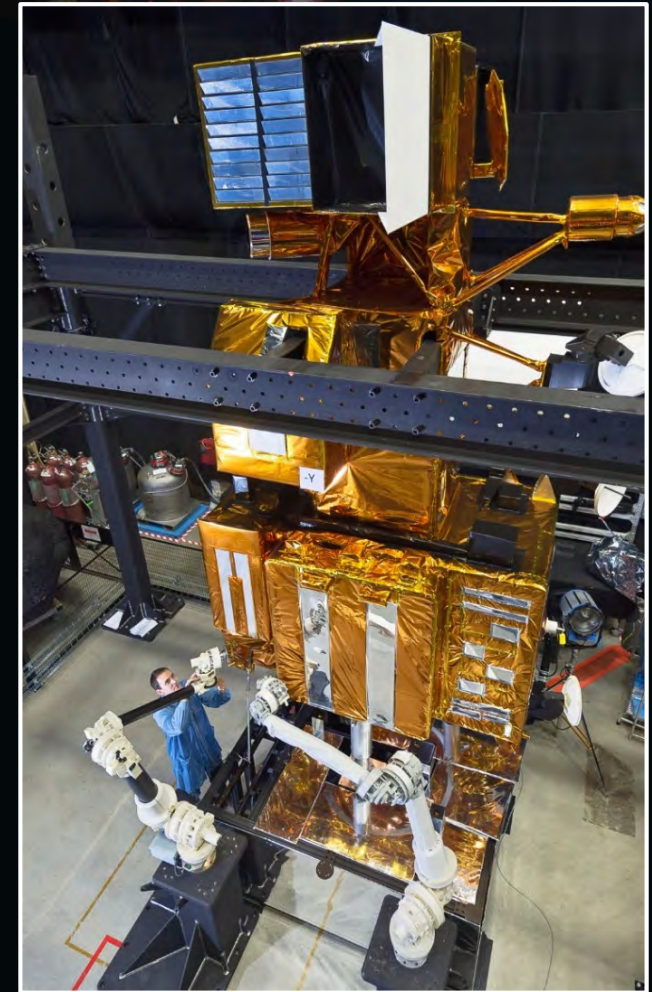


Space Technology Missions



Laser Communications Relay Demonstration (LCRD)

will demonstrate advanced bidirectional optical communications between geosynchronous Earth orbit (GEO) and Earth.



Restore-L will robotically refuel a Government-owned satellite in low Earth orbit (LEO). Shown here with Landsat 7 mock-up.

Space Communications at GSFC



Space Network (SN) is an operational project that provides near-continuous space-ground communications through the Tracking and Data Relay Satellite (TDRS) system supporting Human Spaceflight, Commercial, NASA, and Other Government Agency (OGAs) platforms with a extremely high level of proficiency. Ground Stations are located at White Sands (Primary), Guam, Blossom Point, and Australia.



Near Earth Communications Network (NEN) provides telemetry, commanding, ground-based tracking, data and communications services to a wide range of customers with satellites in low Earth orbit (LEO), geosynchronous orbit (GEO) highly elliptical orbit, Lunar orbit and missions with multiple frequency bands.



The **SN Ground Segment Sustainment (SGSS)** project will implement a modern ground segment that will enable the Space Network to continue to deliver high quality services to the SN community, meet stakeholder requirements, and significantly reduce required operations and maintenance resources.

Other Capabilities



Sounding Rocket Program



CubeSats and SmallSats



Antares Launch Vehicle



Aircraft



Balloon Program



Space and Near Earth Communications Networks



Laser Communications Relay Demonstration



Project Management at Goddard Space Flight Center

GSFC Mission Portfolio



Formulation	Implementation		Primary Operations	Extended Operations		Communications & Ground Systems
LISA Athena HIRMES WFIRST XARM PACE TSIS-2 GUSTO JPSS-3 JPSS-4 Restore-L PACE OCI Lucy L-Ralph Lemnos O2O Lemnos ILLUMA-T LOCNESS	JWST XRISM Landsat 9 ICON SET-1 SOC JPSS-2 GOES-T GOES-U LUCY	MOMA (ExoMars) LCRD NIRSpec LCRD TIRS II XRISM - Resolve	TESS NICER (ISS) ICESat-2 GEDI (ISS) GPM Landsat 8 TSIS-1 SMAP MMS DSCOVR POES/Met- Op-C OSIRIS-Rex RAVEN (ISS) RMM-3 ATLAS	Fermi HST Swift XMM-Newton AQUA AURA LAGEOS (2) Landsat 7 S-NPP SORCE Terra TCTE ACE AIM Geotail IBEX	IRIS RHESSI SDO SOHO STEREO (2) THEMIS (5) TIMED TWINS (2) Van Allen (2) Wind LRO MAVEN	SSMO HST Ops ESDIS ESMO JPSS Ground GOES Ground NIMO TEMPO Search and Rescue Space Network Near Earth Network SGSS TDRS

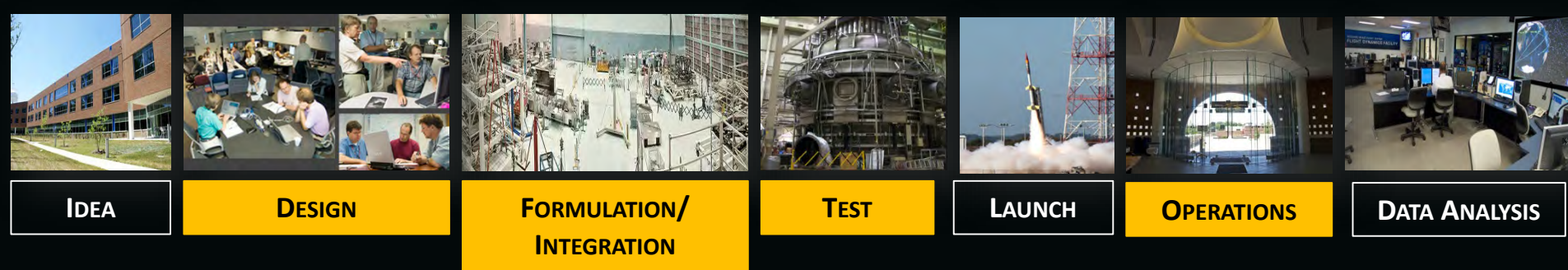
Astrophysics
 Earth Science
 Heliophysics
 Joint Agency Satellite Division

Planetary
 Satellite Servicing
 Space Communications
 Instruments

The Flight Projects Directorate



... is responsible for overall management and implementation of flight, ground, and instrument projects at Goddard Space Flight Center



FUNCTION	DESCRIPTION OF SERVICES
Leadership	Deliver vision, context and enable performance to achieve customer needs
Technical Expertise	Direct and train team of technical experts through formulation and implementation
Mission Development	Manage mission formulation, implementation and operations for in- and out-of-house missions
Project Control	Provide planning, resource management, and the latest methods, tools, and practices
Monitoring & Guidance	Assess performance; guide consistency, effectiveness, timeliness, and accountability
Advocacy	Liaise with external stakeholders on behalf of flight projects
Compliance & Control	Execute project activities in accordance with Center, Agency, and Federal standards
Mission Support	Offer mission support services for Space and Earth Science flight projects/missions
Knowledge Management	Recognize, collect, represent, and enable the delivery of and adoption of insights and experiences that will improve performance

Project Management at GFSC

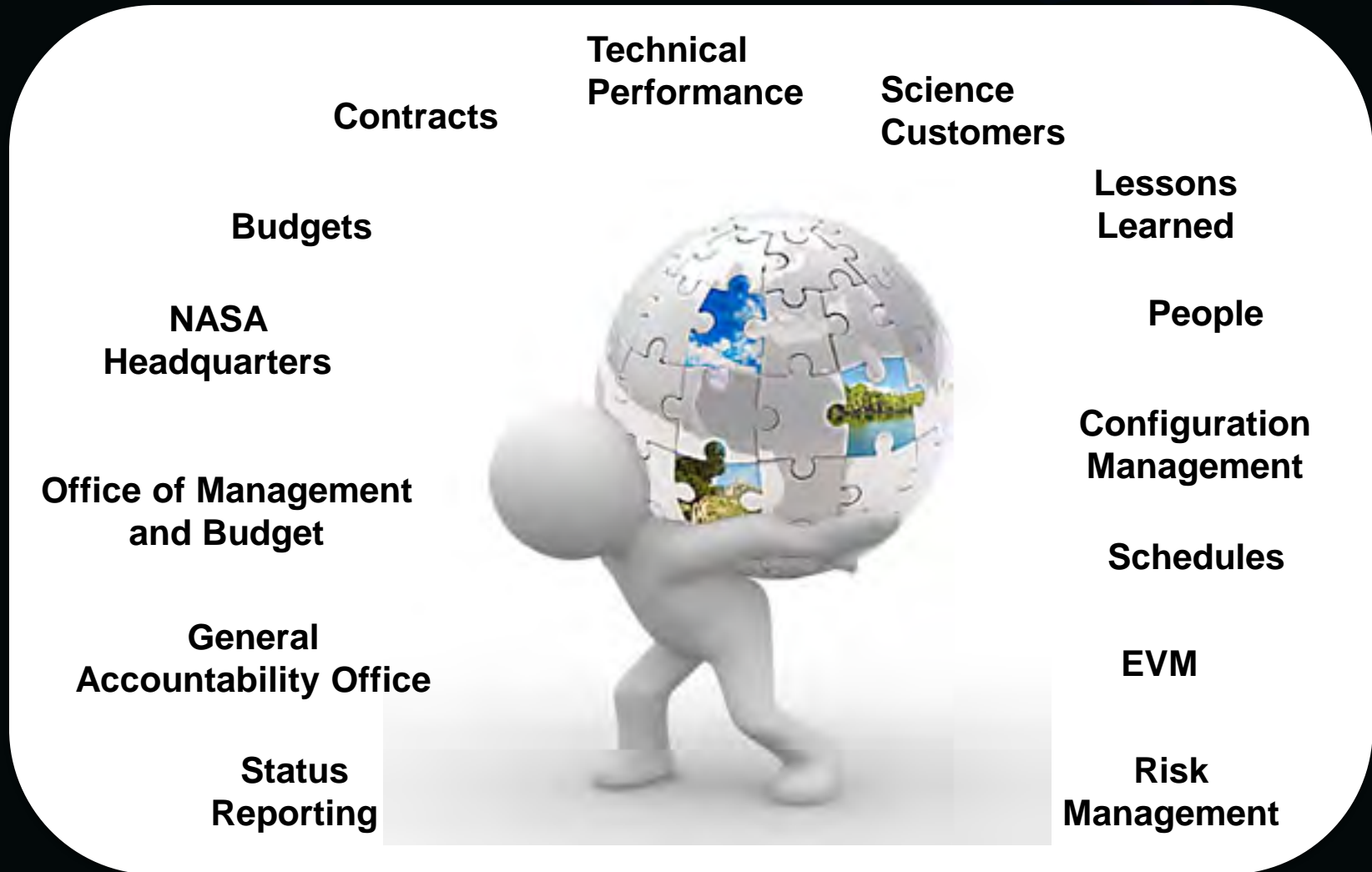


- The Flight Projects Directorate assigns program managers and project managers to provide the following functions, enabling the vision of the customers and stakeholders:
 - Leadership and advocacy
 - Forming and directing the team of technical experts (project workforce)
 - Managing the development of mission critical technologies
 - Initiating in-house studies or contractual solicitations
 - Controlling and managing available resources (cost and schedule)
 - Managing project risk
 - Reporting status and progress to program and GSFC management
 - Executing project activities in accordance with the GSFC Quality Management System, ISO 9001 standards and NPR 7120.5E

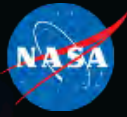
What does a Project Manager Do?



Planning, Organization, Implementation, and Control

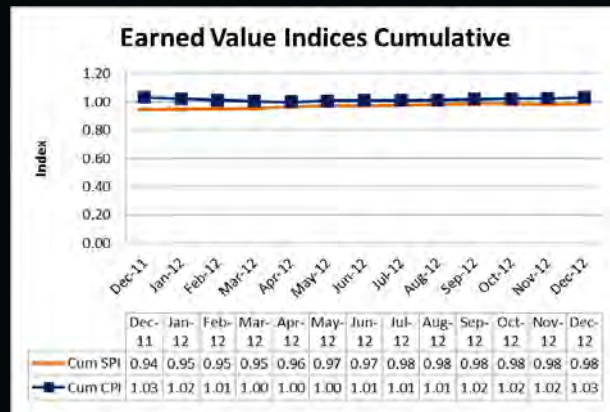
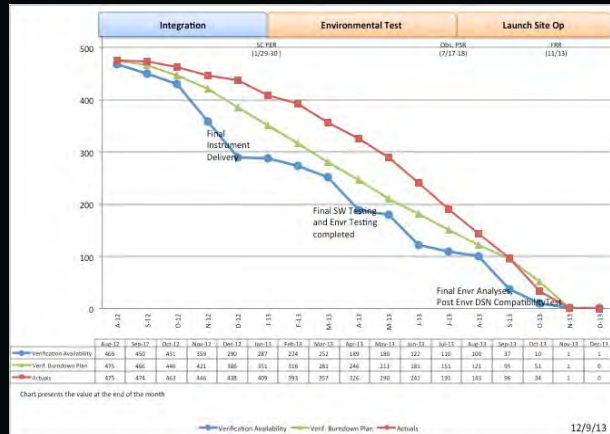


Lessons Learned from Flight Projects



Rigorous tracking of metrics (cost, schedule, technical) is critical to keeping leadership aware of negative trends to react early

Verification Status (L1 & 2 Burndown)



MAVEN Critical Milestones		Need Date	2012		2013						
			Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1	NGIMS FM ready for Environmental Testing (GSFC)	1/7/13			17						
2	NGIMS Vibration Test Complete (GSFC)	2/7/13			105	108					
3	Delivery of SWEA Payload to LM (SSL)	3/21/13				225					
4	Deliver NGIMS Payload to LM (GSFC)	3/25/13					305				
5	Flight TAME Controller Available to ATLO	2/1/13									
6	C&DH #1 DTCL-U Flight Spare available to ATLO (LM)	2/3/13									
7	Magnetics Swing Test (ATLO)	1/10/13									
8	Begin S/C Modal Survey Test (ATLO)	2/4/13									
9	Re-Install TAME (ATLO)	2/5/13									
10	FSW Build 5.0 Available (LM)	3/18/13									
11	Begin S/C Acoustics Test (ATLO)	2/8/13									
12	Begin S/C Sine Vibe Test (ATLO)	2/27/13									
13	Install SWEA to Spacecraft (ATLO)	3/28/13									
14	Install NGIMS to Spacecraft (ATLO)	4/1/13									
15	Begin ORT 1 Test (GDS)	4/17/13									
16	Begin S/C EMI/EMC Test (ATLO)	4/19/13									
17	S/C Self Test #7	4/25/13									
18	Begin SVT/MOI (Off-Nominal) Tests (ATLO)	5/1/13									
19	Lost in Time Test (LM)	5/3/13									
20	Begin Thermal Vac Test (ATLO)	5/22/13									
21	Power Performance Test (ATLO)	6/11/13									
22	Begin ORT 2 Launch Nominal Test (GDS)	6/12/13									
23	Payload Final Performance Test (ATLO)	6/21/13									
24	Dry Spin Balance Test Complete (ATLO)	7/9/13									

Review	Review Held / Scheduled	Actions	Submitted	% Submitted	Closed	% Closed
RSS PER	4/10/12	5	5	100%	5	100%
PFP PER	5/22/12	7	7	100%	7	100%
NGIMS PER	10/15/12	2	2	100%	2	100%
Spacecraft PER	1/29/13	5	3	60%	3	60%
SIR	6/25/12	4	4	100%	4	100%
Electra HRCR (JPL Internal)	6/21/12	0	n/a	n/a	n/a	n/a
RSS PSR	10/24/12	1	1	100%	1	100%
PFP PSR	10/30/12	1	1	100%	1	100%
NGIMS PSR	TBD	TBD	-	-	-	-
Observatory PSR	7/16/13	TBD	-	-	-	-
MOS/GDS Peer Review	6/5/12	0	n/a	n/a	n/a	n/a
MOR	11/13/12	14	8	57%	6	43%
ORR/FOR	8/13/13	TBD	-	-	-	-
Totals		39	31	79%	29	74%

Project Planning and Control



Project Planning

Stakeholder Expectation

1. PP&C Stakeholder Expectation Definition
2. PP&C Planning

Resource Definition

3. WBS Development
4. Cost Estimation
5. Schedule Definition & Estimation
6. Acquisition Management

Project Control

Resources

7. Contracts Management
8. Resource Management
9. Schedule Management

Performance Management

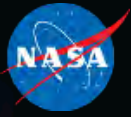
10. Tracking/Trending and Forecasting
11. PP&C Control

PP&C Integration

12. Earned Value Management
13. Risk Management
14. Configuration Management
15. Data Management

PP&C Assessments

16. Project Review and Evaluation
17. Decision Analysis



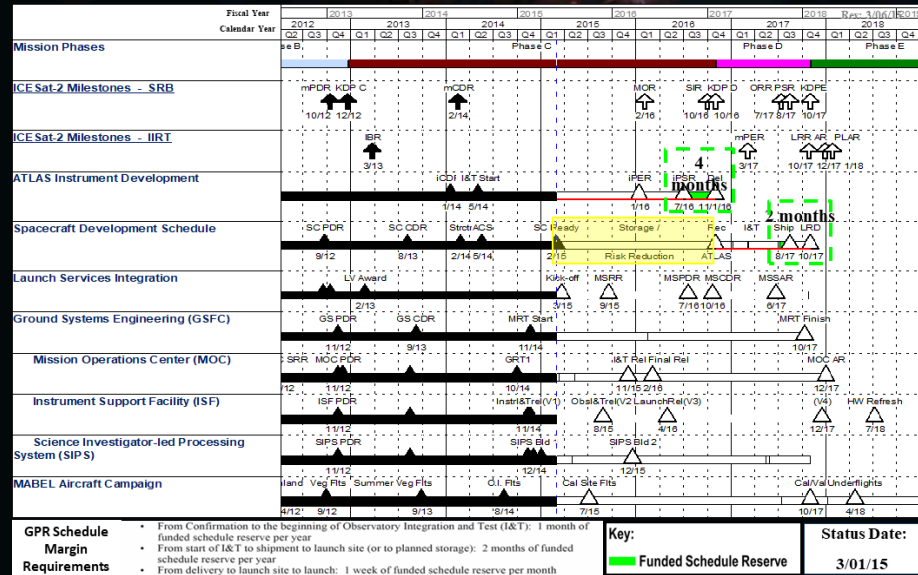
Project Management

- Cost Management
- Schedule Management
- Performance Management
- Risk Management
- Challenges

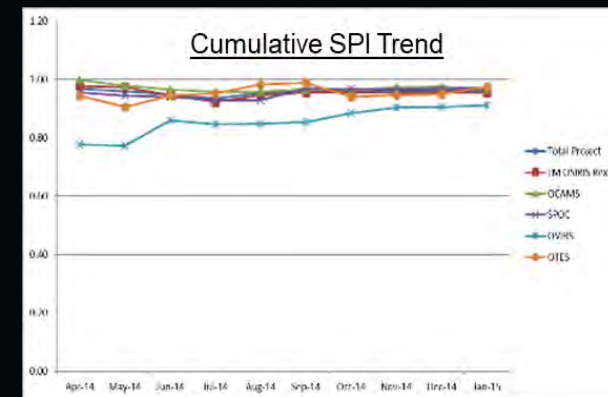
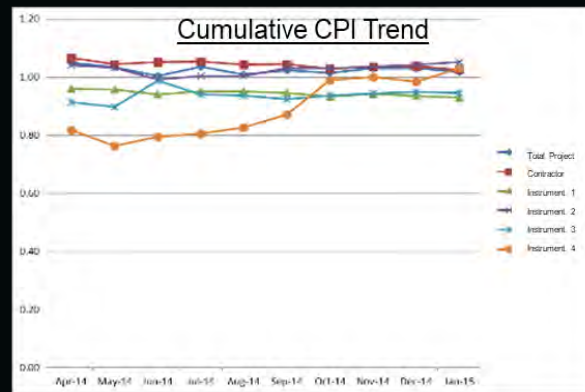
Life cycle cost (LCC) is the total cost of a program or project, developed to establish commitment between stakeholders and the project

The LCC and schedule commitments are formalized in management agreements

Guiding principles: design to minimize total LCC, spend only what is needed, and maintain adequate margin



Performance is tracked through an Earned Value Management System (EVM)



Earned Value Management Focus



Objective: Increase EVM use and consistency for better tracking through improvements in various elements (tools, process, policy, training, and reporting)

POLICY

- Interpret NASA Headquarters requirements
- Develop and implement Center responses
- Provide internal guidance for projects to navigate policy and approach

COMPLIANCE

- Integrated Baseline Reviews/ Surveillance Reviews
- Key Decision Point reviews
- Contractor reviews

TOOLS

- Generate requirements for tools based on policy, compliance, reporting, and training needs
- Identify, develop, and integrate tools for projects use
- Evaluate if implemented tools are adequate for project needs

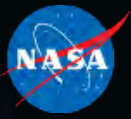
Earned Value Management System

REPORTING

- Issue reporting requirements
- Monthly status reviews
- Create and maintain reporting users guidelines for uniformity across projects

TRAINING

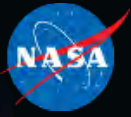
- Identify available training
- Identify training needs of workforce
- Develop and implement tools training
- Tailor EVM training to projects life cycle and workforce



Risk Management

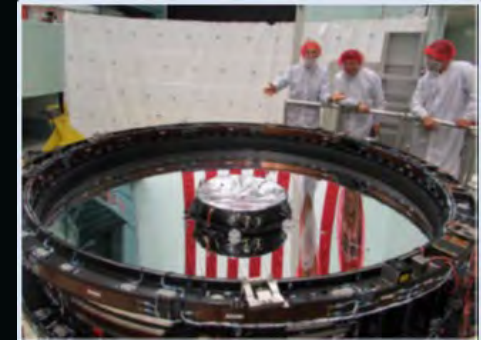
- **Proactive communication of risks is vital** to maintain an accurate accounting of risks - maintain a rigorous risk process
- Develop risk mitigation plans for risks with high likelihoods or consequences
- Need to ensure sufficient cost reserves at the outset of the mission
 - May be able to “buy down” risk in some cases with some cost reserves
- Do not convert perceived “excess” margins into additional requirements
- Risk impacts objectives, financial management, and schedule management
- **Risk will always be present in programs and projects**
- Not all risk can be avoided
- Management, project team, customers and stakeholders must be active participants in the mission risk acceptance process
- Risks are different from problems/issues
 - Risks are tracked separately from problems/issues
 - Problems/issues may be realized risks

Challenges

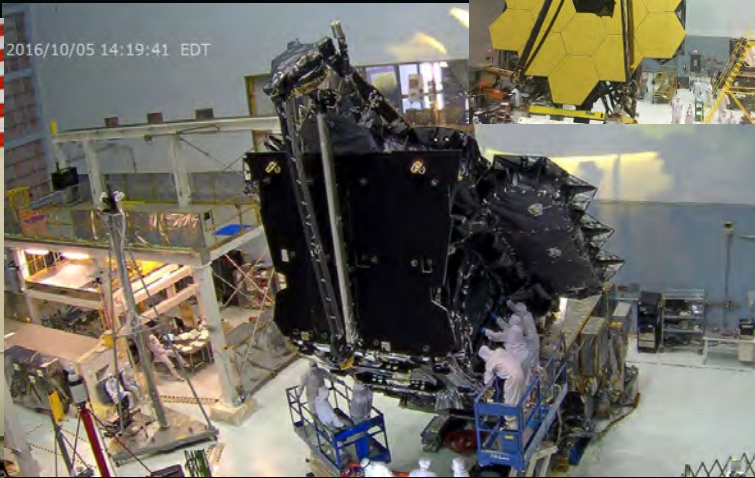


- Problems and challenges can arise on the most well planned projects
- Schedule and budget reserves are needed to address unknown unknowns, manage issues/concerns, and mitigate risks
- Technical reserves and design margins need to be managed
- Common challenges:
 - Budgets
 - Schedule (meeting planetary windows)
 - Changing requirements
 - Heritage hardware, systems designs, and people
 - Complex design (flight, ground, hardware, and software)

Heritage H/W



OSIRIS-REx completing environmental testing –
Launch window: September 3 – October 12, 2016

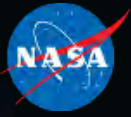


James Webb Space Telescope (JWST)

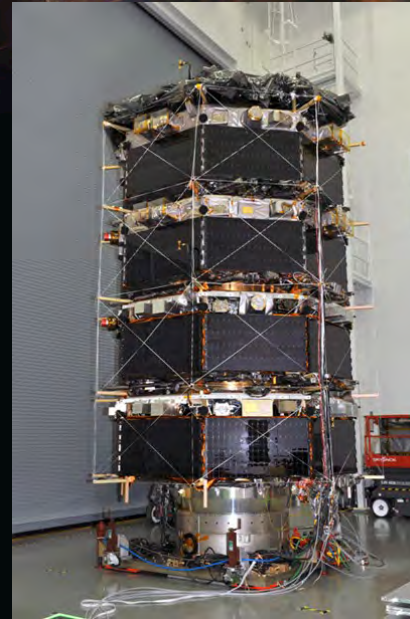


Thermal Infrared Sensor (TIRS)
instrument drove schedule

Challenges

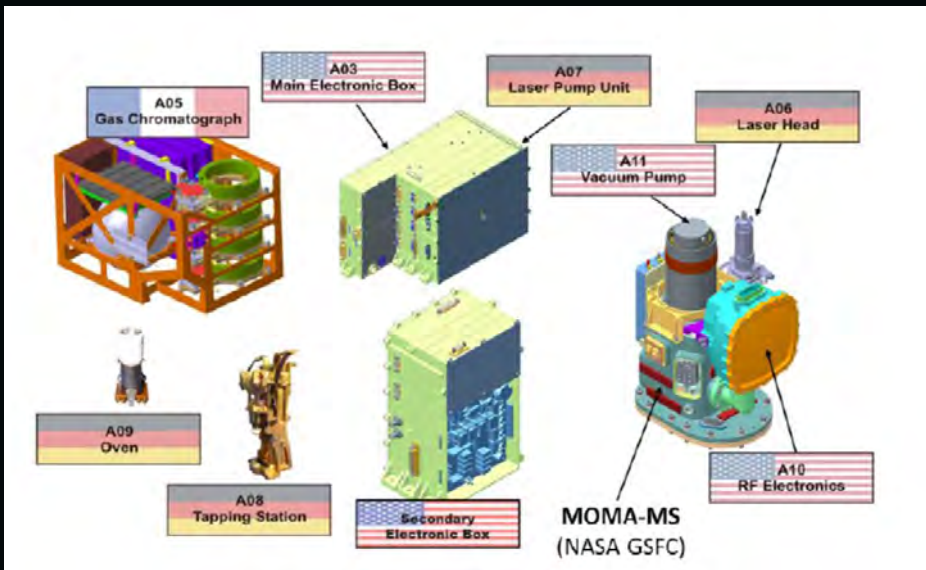


- Common challenges (continued):
 - Unique facilities and facility conflicts
 - Technical and hardware issues
 - Procurement delays
 - Stakeholders
 - Outside partnerships
 - Launch vehicle schedule
 - Mishaps and on-orbit events

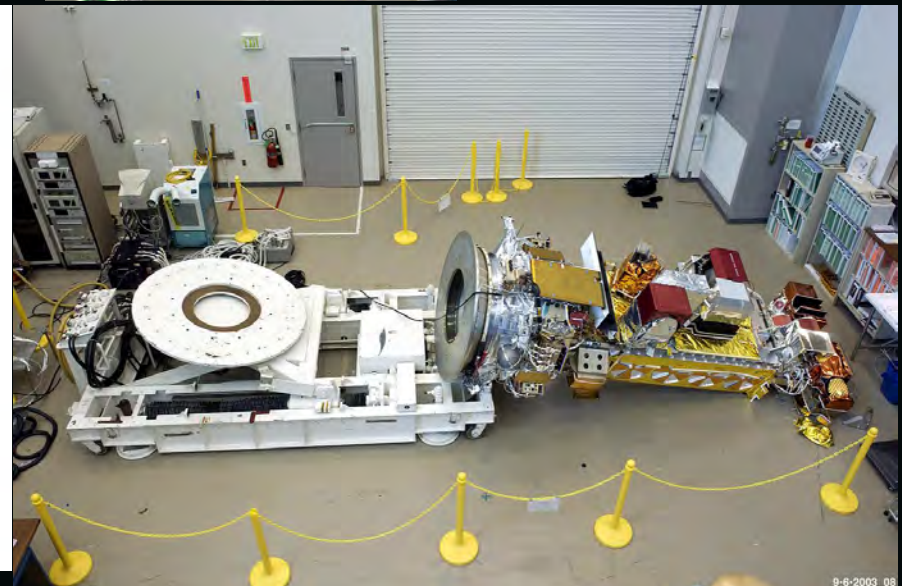


The environmental test schedule of the Magnetospheric Multiscale (MMS) conflicted with JWST, requiring MMS to go to Naval Research Laboratory for thermal vacuum testing

Facility conflicts also drove MMS to build their own cleanroom facility



GSFC contribution to European ExoMars mission:
Mars Organic Molecule Analyzer Mass Spectrometer (MOMA-MS)



Spacecraft mishap during integration

9-6-2003_08



Business Change Initiative Optimization

Leveraging Our Project Management Skills

Changing the Project Planning & Control Environment

Prior State



Current/Future State



A disparate community with pockets of project planning & control (PP&C) expertise, which is not well known, and where programs/projects often create their own unique solutions to solve problems

An integrated community of practitioners, educating, openly sharing, and instilling best practices across organizations and within programs/projects

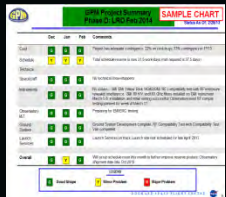
Increased collaboration with and among programs/projects, consistently applying best practices and methodologies to foster cost-effective processes and on-time delivery for meeting missions' commitments

BCI Accomplishments



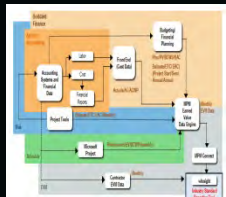
SCHEDULING – CONSISTENTLY DEVELOP, ANALYZE, AND EVALUATE PROJECT PROGRESS

- ✓ Developed and deployed principle guidelines on Schedule Management
- ✓ Identified and created 30+ planning and scheduling best practice instructions
- ✓ Built a Planning and Scheduling Knowledge Network (via SharePoint)
- ✓ Coordinated collection for development of a project portfolio integrated management system



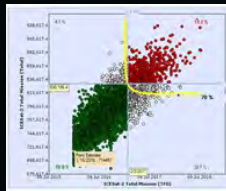
MANAGEMENT REPORTING – REFINE REPORTING TO MINIMIZE REDUNDANCY AND ADD TRANSPARENCY

- ✓ Revised monthly status review guidance
- ✓ Streamlined the collection and reporting of top 10 issues report for programs/projects



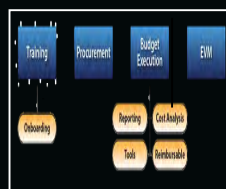
EVM – ADVANCE PERFORMANCE MANAGEMENT ANALYSIS AND EXECUTION

- ✓ Assessed and defined As-Is EVM System Architecture
- ✓ Designed an EVM Training Curriculum Concept Document
- ✓ Coordinated and distributed EVM templates for project performance reporting
- ✓ Streamlined the acquisition process for EVM software



COST ESTIMATING – STANDARDIZE AND IMPROVE TECHNIQUES AND COST ESTIMATING PROCESSES DOCUMENTATION

- ✓ Employed a reliable framework for conducting Joint Confidence Level model assessments
- ✓ Wrote and released a parametric cost estimation handbook/guide



KNOWLEDGE MANAGEMENT – IMPROVE KNOWLEDGE AND TRAINING AND AID IN TRANSFER OF DEPLOYMENTS

- ✓ Re-constituted a forum to share learning, knowledge among community
- ✓ Designed curriculum and helped train to assist in successful execution of EVM
- ✓ Developed a tool kit and assessment tool for PP&C practitioners to develop skills
- ✓ Extended training on Budget Execution, Planning and Scheduling

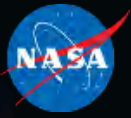


Should We Manage to a Single Data Point? "The State of Business"



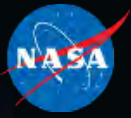
State of Business

- State of Business is one of by-products of the Business Change Initiative
- State of Business is an internal independent assessments of projects for senior leadership in the Flight Projects Directorate to provide them with additional insight through:
 - Objective, data performance-based indicators collected by an independent team of project management subject matter experts assessing and advising whether projects based on that data can reasonably meet their schedule and budget commitments.
 - Discussing the significance and implications of performance metrics, trends and forecasts in a monthly meeting with FPD management
 - Providing an integrated view of schedule, cost, EVM and risk data across the entire FPD project portfolio
 - Focusing on projects in need of additional management attention due to unfavorable schedule and cost trends and variances.
 - Assisting leadership in making informed decisions for mission success.



State of Business Process

- Monthly inputs are derived from Projects data (via monthly status reporting, tag-ups, emails, Empower, etc.) from each discipline area
- Assessment team members running their own independent analysis and generate their respective reports using the input data
- Independent analysis is performed in the following areas:
 - Schedule Performance
 - Cost Performance
 - Earned Value Metrics
 - Look Ahead/Early Warning Metrics
 - Risks and Issues
- The team meets internally to collaborate and integrate the collected data
- A monthly brief is given to the Flight Projects Directorate leadership



Projects Inputs

- Includes, but not limited to:
 - Critical paths
 - Current period performance metrics
 - Cumulative performance metrics
 - Historic performance trends
 - Budget and schedule margins
 - Threats, liens and encumbrances
 - Risks and Issues



Schedule Analysis and Assessment

- Examine project schedule performance trends, variances, margin adequacy, critical path, risks and issues
- Follow-up with project planners on specific schedule questions and concerns
- Generate performance-based “best case” and “worst case” schedule estimates for launch, delivery, or ground system readiness using BEI and CEI
- Conduct “deep dive” analyses and assessments of projects as needed (usually in concert with cost, risk, EVM, and early warning metrics)
- Prepare State of Business Monthly Summary Schedule Assessment Report (partial example on next page)

Project + PM's Schedule Assessment	State of the Business Schedule Assessment	Funded Schedule Margin	SP	BEI	HMM	CEI	Cumulative Milestone Actual vs. Plan Ratio	Top Schedule Issue Risk	Primary Critical Path Driver	Planned (RD), Instrument Delivery or Ground Milestone	Best Case Completion Forecast (BEI-based)	Worst Case Completion Forecast (CEI-based)
Project 1												
Project 2												
Project 3												
Project 4												
Project 5												
Project 6												
Project 7												
Project 8												
Project 9												
Project 10												
Project 11												
Project 12												
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Project 26												
Project 27												
Project 28												
Project 29												
Project 30												

Schedule Report

State of Business Monthly Summary Schedule Assessment Report



Project + PM's Schedule Assessment	State of the Business Schedule Assessment	Funded Schedule Margin	SPI (monthly)	BEI	HMI	CEI	Cumulative Milestone Actual vs. Plan Ratio	Top Schedule Issue / Risk (as reported by project)	Primary Critical Path Driver	Planned LRD, Instrument Delivery or Ground Milestone	Best Case Completion Forecast (BEI-based)	Worst Case Completion Forecast (CEI-based)
COF	OVERALL TREND: STABLE - The AOB procurement has slipped one week to 12/26/2019 and now drives the COF critical path - BEI was unchanged, while HMI and CEI declined from the previous month and have fallen below FPD goals	147 days	-	0.87	0.30	0.51	0.76	Risk: Optical design closure	AOB procurement	COF Delivery 7/23/2021	04/2021	Awaiting 4 months CEI data
GPAR	OVERALL TREND: DETERIORATING - SAA-2 now driving the critical path, but since there is more project-controlled schedule margin along the SAA-2-driven path it increased to 73 days - CEI increased to .57, reversing a multi-month downward trend - BEI has been trending downward, but is still above the FPD goal of .80 - At .24 HMI remains below the FPD goal of .50 - Significant LRD delay possible based on worst case CEI-based forecast	73 days	0.78	0.86	0.25	0.57	0.88	Issue: Spacecraft schedule erosion	SAA-2 Instrument	Launch 12/15/2020	09/2020	06/2021
RTS2	OVERALL TREND: Stable - TVAX testing completed, MEB FM-1 now driving the critical path - No change in 50 days of schedule margin - Detector current characterization risk could threaten 9/8/2019 RTS2 delivery if redesign/rework is required - SRA results indicate an improvement to .62 from .50 confidence in 8/8/2019 RTS2 delivery	50 days	0.63	0.96	0.46	0.65	0.94	Risk: Flight and Spare Detector Current Characterization	MEB FM-1	Delivery 08/8/2019	06/2019	11/2019



PM's
Schedule
Assessment

State of Business
Schedule
Assessment

Is the
margin
adequate?

How efficiently
is work
getting done?

What is
the top
schedule
concern?

Did the
critical
path
change?

When is
the
planned
launch or
delivery?

How could
the launch or
delivery be
impacted by
performance
trends?

Internal Cost Analysis and Assessment



- Examine project cost performance trends; commitment, obligation, and cost variances; budget margin/UFE adequacy; liens, threats, and encumbrances; risks and issues
- Follow-up with financial/business managers on specific cost questions and concerns
- Conduct “deep dive” analyses and assessments of projects as needed (usually in concert with schedule, risk, and EVM data)
- Prepare State of Business Monthly Summary Cost Assessment Report (partial example on next page)

Project # Overall Assessment	State of the Business Cost Assessment	Summary per the Project and Project Cost Assessment	Phase	\$ Reserve Guidance	\$ Reserve thru Liens and Encumbrances	Percent Difference between Columns E and F	\$ Reserve thru Threats	Percent Difference between Columns F and H	Cost To Go [G]	UFE thru Liens [H]	Reserve for Change in \$ Reserve Since Last Month	Funded Schedule Margin (Time)	Funded Schedule Margin (Funds)	Top Cost Issue/Risk	Com Old Variances [M]	Percent Com Old Variances	Com Cost Variances [M]	Percent Com Cost Variances	Project Obligation Explanation	Project Cost Variance Explanation
Project 1																				
Project 2																				
Project 3																				
Project 4																				
Project 5																				
Project 6																				
Project 7																				
Project 8																				
Project 9																				
Project 10																				
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Cost Report

State of Business Monthly Summary Cost Assessment Report



A	B	C	D	E	F	G	H	I	J	K
Project + PM's Overall Assessment	State of the Business Cost Assessment	Summary per the Project and Project Cost Assessment	Phase	\$ Reserve Guideline	\$ Reserve thru Liens and Encumbrances	Percent Difference between Columns E and F	\$ Reserve thru Threats	Percent Difference between Columns F and H	Cost To Go (K)	UFE Thru Liens (\$K)
Project A	- OVERALL TREND: STABLE	Adequate cost reserves	C	25%	32.9%	31.6%	27.4%	-16.7%	517,500	170,200
Project B	- OVERALL TREND: STABLE - Large obligation ahead of plan- no explanation	Adequate cost reserves	B	25%	31.0%	24.0%	30.4%	-1.9%	1,847,100	572,700
Project C	-OVERALL TREND: STABLE	No Issues	C	NR	11.3%	N/A	11.3%	0.0%	310,700	35,200
Project D	- OVERALL TREND: STABLE - Almost a full year of uncosted carryover -New PPBE reflects \$XXXM payback to program	Funding sufficient to cover plans and expected contingencies	C/D	20%	11.0%	-45.0%	4.0%	-63.6%	NR	114,783



PM's evaluation of Cost

State of Business average of all column assessments

Based on project cost assessment

Based on project assessment

Yellow is less than 20% below guideline

Red is more than 20% below guideline

Yellow is none

Red is less than 10%

Yellow if Column G between 25% and 50% less than column E

Red if column G more than 50% less than column E

State of Business Monthly Summary Cost Assessment Report (continued)



L	M	N	O	P	Q	R	S	T	U
Reasons for Change in \$ Reserve Since Last Month	Funded Schedule Margin (Time)	Funded Schedule Margin (Funds)	Top Cost Issue / Risk	Cum Obl Variances (M)	Percent Cum Obl Variances	Cum Cost Variances (M)	Percent Cum Cost Variances	Project Obligation Variance Explanation	Project Cost Variance Explanation
no change	9.6 mos	NR	Issue: Bus Late completion	-\$69.5	-27.7%	-\$49.2	-27.2%	NR	NR
PPBE increase	NR	NR	Risk: Instrument ...	\$62.0	41.0%	-\$20.3	-12.2%	NR	NR
PPBE increase	NR	NR	Risk: Spacecraft ...	-\$63.5	-33.8%	-\$15.1	-12.9%	NR	NR
\$XXM of additional liens and threats to fund impacts of xxx anomalies	207	NR	Issue: Leaky ...	\$30.8	53.6%	-\$10.7	-4.4%	no specific reason	accrual problem due to contractor overstating their plan



Yellow if between \$10M & \$20M reduction in reserves

Based on project assessment

Based on project assessment

Yellow if between 10% & 20% ahead or behind plan

Yellow if between 10% & 20% ahead or behind plan

Yellow if vague or inadequate explanation provided

Yellow if vague or inadequate explanation provided

Red if greater than \$20M reduction in reserves

Red if greater than 20% ahead or behind plan

Red if greater than 20% ahead or behind plan

Red if no explanation provided

Red if no explanation provided

Internal EVM Analysis and Assessment

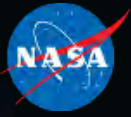


- Examine project performance trends for cumulative to date and short term performance (CPI3, CPI6)
- Compare cumulative performance trends to IEAC projections
- Compare tag up presentations to EVM evaluations for factors in evaluating if aligned and if not, why
- Evaluate SPI along with schedule data to evaluate if driving costs
- Evaluate Percent Complete and Percent Spent in evaluating assumptions

PROJECTS	SoB Assessment	SPIcum	CPI3	CPIcum	CPI_BAC	CPI IEAC	FundBAA or Contract Value	% Complete	% Spent	SoB Assessment Change Month to Month
Project 1	Green									No Change Green
Project 2	Yellow									Green to Yellow
Project 3	Green									Yellow to Green
Project 4	Yellow									No Change Yellow
Project 5	Green									No Change Green
Project 6	Yellow									No Change Yellow
Project 8	Green									No change Green
Project 9	Yellow									No Change Yellow
Project 10	Yellow									Yellow
Project 14	Yellow									No Change Yellow
Project 22	Green									No Change Green
Project 35	Green									No Change Green
Project 36	White									
Project 37	Green									No Change Green

EVM Report

EVM Examples



PROJECTS EVM Assessment	SoB Assessment (EVM) (Bold latest assessment and <i>Italic previous assessment</i>)	SPICum	CPI3	CPI6	CPIcum
Project A (Ph C) Contractor 85%	PM assessment continues for EVM as Green with SPI and CPI holding steady, but cost trends for EVM continue well below thresholds. CPI3, CPI6 and CPIcum all exceed thresholds. Also with 90.00 % of work done, 110,38% was spent./ EAC trending from Red to Yellow with latest EAC. TCPI with latest EAC went to Green. PM assessment continues for EVM as Green with SPI and CPI holding steady, but cost trends continue well below thresholds. 88% work completed against 105% spent. EVM still continues on a	0.92	0.80	0.79	0.85
Project B (Ph D) Contractor Only	Timeline for remaining work understood but NASA Project B Management assessing the vendor estimate for future costs. Majority of work remaining related to Interface Data. EAC continues to be somewhat overly optimistic when compared to the CPIcum/ EAC went from Yellow to Red this month and CPI3 went from Green to Yellow. Will need to watch EAC estimates compared to CPIcum and how they are running over the next couple months as well as CPI3 and CPI6 trending. TCPI_MA is in good shape though.	1.00	0.96	0.99	0.97



PM's evaluation of Earned Value

State of Business brief summary of overall status and any concerns for current month for EVM / *below that is the previous month data in italics for*

SPICum Index used with schedule data to help understand cost drivers

CPI3/CPI6 derives shorter trends

CPIcum derives past cumulative trend data

Program name colors represent Tag Up EVM rating by PM	SoB EVM Assessment	SPIC/CPIc/CPI3 Thresholds	TCPIBAC/TCPIEAC TCPIMA/TCPIABC Thresholds
	No EVM trend concerns	>.95	Greater than -.05
	EVM Trends to be watched	.90 to .95	Less than -.05 to -.10
White = No tag up rating by PM	EVM Trend Concerns	< .90	Less than -.10

* For contractors, Fund MA is total contract value

EVM Examples



PROJECTS EVM Assessment	CPIcum	TCPI_EAC	TCPI FundMA or Contract Value	% Complete	% Spent	SoB Assessment Change Month to Month
Project A (Ph C) Contractor 85%	0.85	0.85	0.81	90.00	110.38	No Change Yellow
Project B (Ph D) Contractor Only	0.97	1.10	0.65	75.00	77.00	No Change Green



CPIcum derives past cumulative trend data. Reference thresholds above

TCPI calculations. Assessed against CPIcum to derive colors. Reference thresholds above

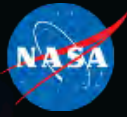
Dollars spent for work completed comparison

Color change from last month to new month

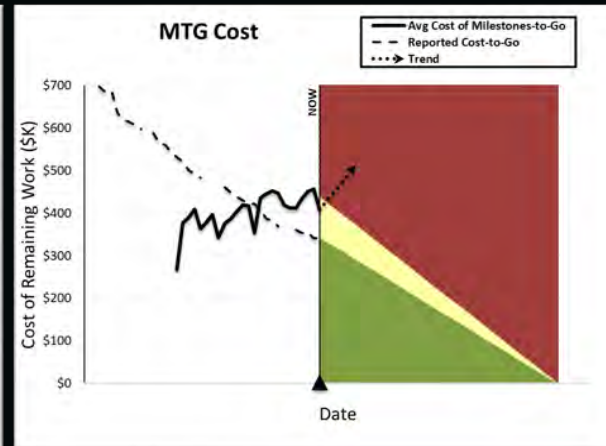
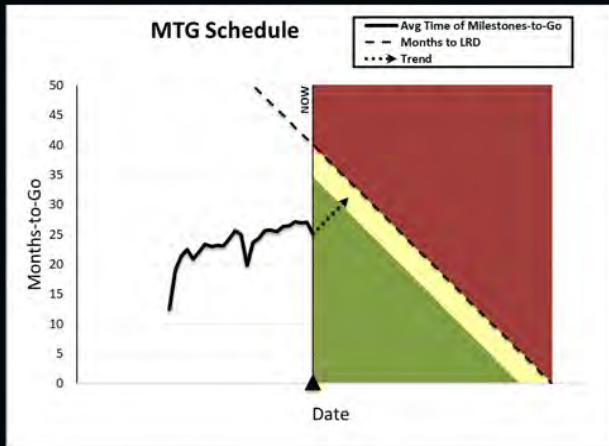
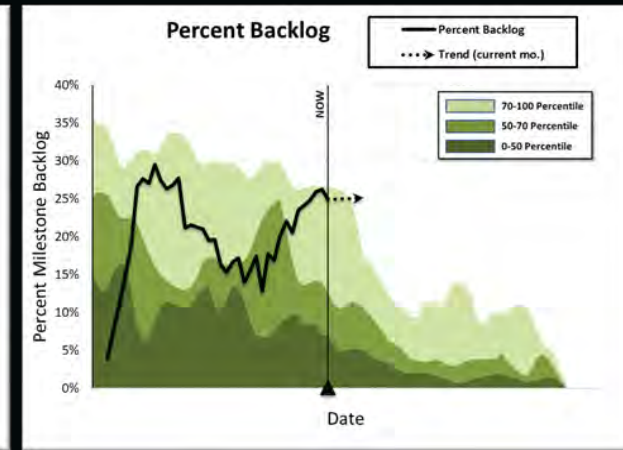
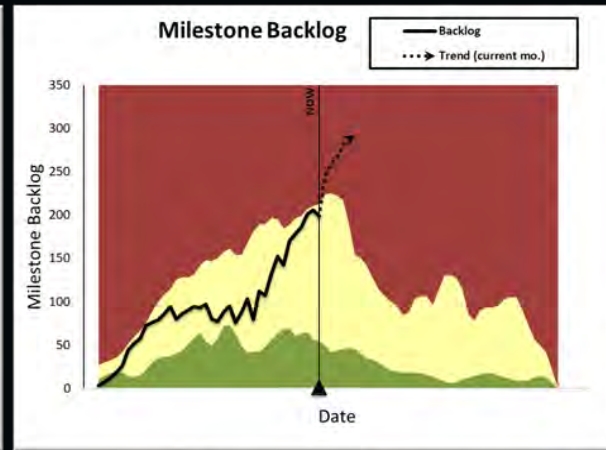
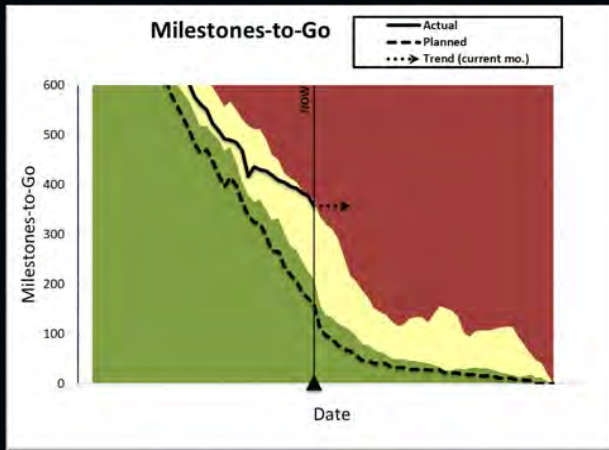
Program name colors represent Tag Up EVM rating by PM	SoB EVM Assessment	SPIC/CPIc/CPI3 Thresholds	TCPIBAC/TCPIEAC TCPIMA/TCPIABC Thresholds
	No EVM trend concerns	>.95	Greater than -.05
White = No tag up rating by PM	EVM Trends to be watched	.90 to .95	Less than -.05 to -.10
	EVM Trend Concerns	< .90	Less than -.10

* For contractors, Fund MA is total contract value

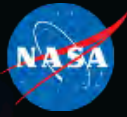
Early Warning (Look Ahead) Metrics



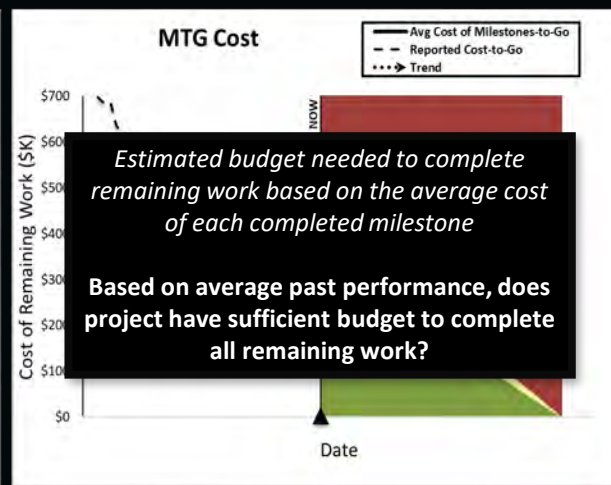
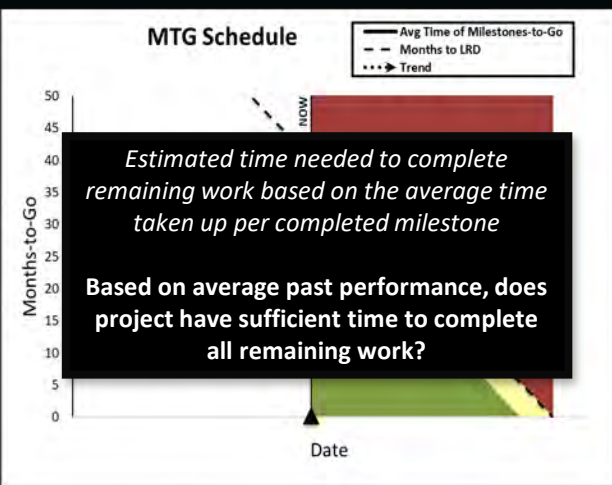
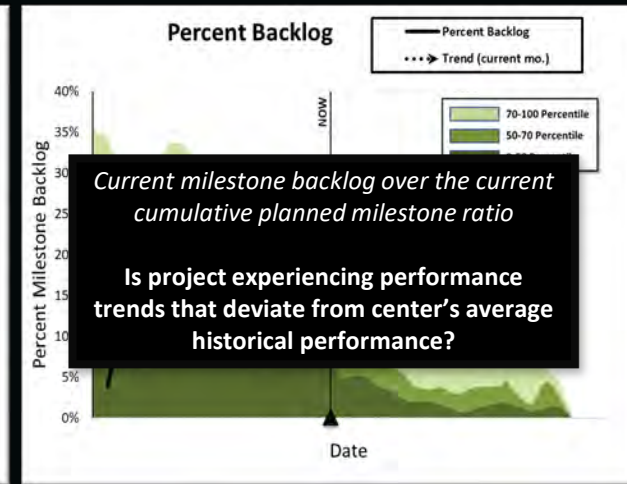
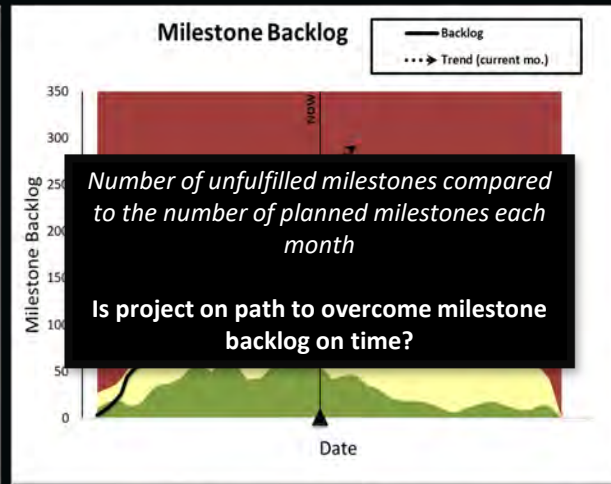
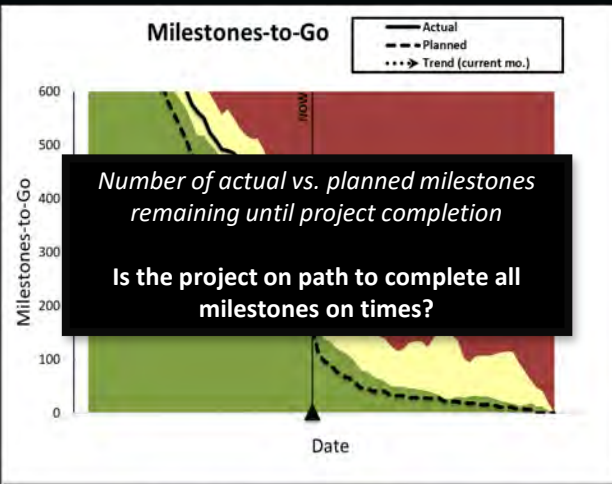
- Provides at-a-glance view of the past, present, and future state of the project relative to its planned and actual milestones



Early Warning (Look Ahead) Metrics



- Provides at-a-glance view of the past, present, and future state of the project relative to its planned and actual milestones



- In comparison to previous projects' historical data at a similar given time in the life cycle

Early Warning Metrics Performance Thresholds



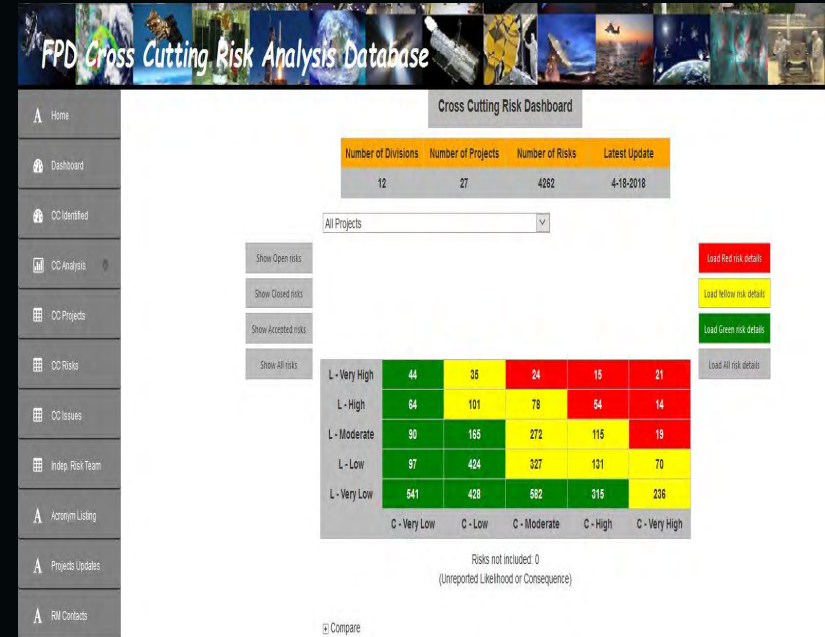
The Early Warning Metrics have the following performance thresholds:

	Green Performance Threshold	Yellow Performance Threshold	Red Performance Threshold
<p>Milestones-to-Go (MTG), Milestone Backlog, & Pct. Milestone Backlog</p> <p><i>Performance thresholds formulated from historical project performances</i></p>	<p>Backlog \leq 50th Percentile of historical GSFC missions at this time in its schedule</p> <p>Backlog is in-family or better than previous, healthy GSFC projects</p>	<p>Backlog \leq 70th Percentile of historical GSFC missions at this time in its schedule</p> <p>Backlog is within the typical performance range of historical GSFC projects but may require attention</p>	<p>Backlog $>$ 70th Percentile of historical GSFC missions at this time in its schedule</p> <p>Backlog is equal to or worse than unhealthy historical GSFC projects and requires attention as it may threaten the baseline plan</p>
<p>MTG Schedule</p> <p><i>Performance compared to remaining schedule and schedule reserves</i></p>	<p>MTG Schedule \leq (Months to LRD/Delivery – GPR 7120.7)</p> <p>Program is completing milestones at a fast pace and may complete the remaining work well within the GPR 7120.7 FSR</p>	<p>MTG Schedule \leq Months to LRD</p> <p>Program is completing milestones at a typical pace to meet LRD on time but may exceed the GPR 7120.7 FSR</p>	<p>MTG Schedule $>$ Months to LRD</p> <p>Program is achieving milestones at a slower than planned pace, and if maintained, this performance has the potential delaying the schedule</p>
<p>MTG Cost</p> <p><i>Performance compared to remaining cost-to-go and cost reserves</i></p>	<p>MTG Cost \leq Reported Cost-to-Go</p> <p>Cost per milestone to date is cheaper than the planned and may complete the remaining work well within the reported budget without using reserves</p>	<p>MTG Cost \leq Reported Cost-to-Go + Contingency thru Liens</p> <p>Cost per milestone to date is typical and the program is on track to completing the remaining work within the reported budget and reserves</p>	<p>MTG Cost $>$ Reported Cost-to-Go + Contingency thru Liens</p> <p>Cost per milestone is more expensive than planned and there is a potential budget overrun</p>

Risks Management Projects Portfolio Review



- FPD Risk Manager participates in monthly Tag Up review of Center-level Monthly Status Review (MSR) presentations from each Program and Project
- Independent Risk Assessment is provided at the conclusion of each review in the form of observations and recommendations
- Assessment of FPD Project Portfolio is ongoing, feeding into the Directorate-level RM process



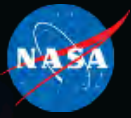
Risks/Issues Report

Risks vs. Issues



- A healthy Concern-Risk-Issue-Risk-Concern process should anticipate the majority of Issues before they occur
 - Are project Issues being anticipated/preceded by a project Risk(s)?
 - Data is assembled from various sources
 - Incomplete Source: Monthly delivery of project Risk and Issue databases
 - Complete Source: MSR Presentation Risk and Issue charts
- Key metric: Were new red Issues preceded by risks?

Integrated Assessment



- Tie the performance stories together. To help management understand:
 - State of Business Monthly Meeting/Discussion
 - SoB assessments in agreement with PM assessments as reported in tag up? Why different?
 - Based upon current performance, will projects meet schedule commitments? Cost commitments? Then are budget/schedule margin adequate (given risks, threats, upcoming funding gaps)?
 - Additional insight to management on performance not reported to management
 - Identify projects that may require further analysis
 - Provide observations, insights, recommendations and follow-up questions to support managerial oversight and decision making

State of the Business Briefing



- **Agenda**

1. Performance Overview

- *Elevated Concerns*
- *Assessment Comparison*
- *Watch List*
- *GPR 7120.7A Guideline Adherence*

2. Red Issue Summary

3. Assessment Comparison

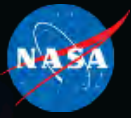
4. Back-up

SoB Assessment Color Key
RED – Launch/delivery slip and/or budget overrun has been realized or appears highly likely; Course correction is needed
YELLOW – Launch/delivery slip and/or budget overrun is likely; Project appears to be equipped to implement course correction
GREEN – Project is on plan (on schedule and/or on budget) with no significant issues.

G	Good Shape	Y	Minor Problem	R	Major Problem
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NOTE: Assessments are based on Project Reporting (Tag-ups, MSRs, dialogue)

State of the Business Briefing



STATE OF THE BUSINESS – ELEVATED CONCERNS BASED ON MONTH 2018 PROJECT REPORTING

Denotes changes from last month

Prog. A – Proj. Cost ■ Proj. Sch ■ SoB Cost ■ SoB Sch ■

Key Question/Comments: (Conducted meeting with program on December 30th)

Supporting Data:

In this example, Program evaluates Schedule as Green, but State of Business evaluates it as Yellow. Each area has a list of key questions and comments about the teams observation and supporting data that goes along with it.

Prog. B – Proj. Cost ■ Proj. Sch ■ SoB Cost ■ SoB Sch ■

Key Questions/Comments:

Supporting Data:

In this example, Program evaluates Cost as Yellow, but State of Business evaluates it as Red. Each area has a list of key questions and comments about the teams observation and supporting data that goes along with it.

This can be one program, two or as many as there are elevated concerns about that are different from the program managers evaluation

State of the Business Briefing



State of the Business: Assessment Comparison

Project		SoB	
C	S	C	S
Green	Yellow	Yellow	Yellow
Red	Yellow	Red	Yellow
Red	Red	Red	Red

- Project X has reported schedule issues; however, sufficient reserves for completion
- Project Y will require additional UFE.
- Project Z's budget beyond current FY is uncertain

C=Cost, S=Schedule

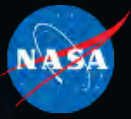
Should We Manage to a Single Data Point?



- The State of Business assessment provides an integrated look at technical, cost, and schedule performance of projects
- This monthly integrated look provides leadership with unique and objective insight into the projects' performance of cost and schedule
- The integrated look indicates areas that are in need of more in-depth monitoring and identifies areas requiring further inquiry
- The assessment highlights areas in need of assistance, enabling leadership to assist projects with meeting their commitments to achieve mission success



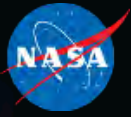
Why is this important?



The Science - GEDI

A large graphic with a bright yellow background. At the top, there is a silhouette of a forest of evergreen trees. Below this, the text "MAY THE FOREST BE WITH YOU" is written in a bold, sans-serif font. The letters are filled with various forest scenes, including trees, a path, and a close-up of a tree trunk. The text is arranged in four lines: "MAY THE", "FOREST", "BE WITH", and "YOU".

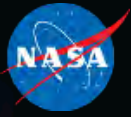
MAY THE
FOREST
BE WITH
YOU



The Science....

View Delta II ICESat-2 Launch Highlights on
YouTube

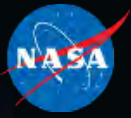
<https://www.youtube.com/watch?v=jalAqj-Rell>



It is difficult to say what is
impossible...
for the *dream of yesterday*
is the *hope of today*
And the *reality of Tomorrow.*

- *Robert H. Goddard (1882 - 1945)*

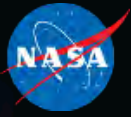




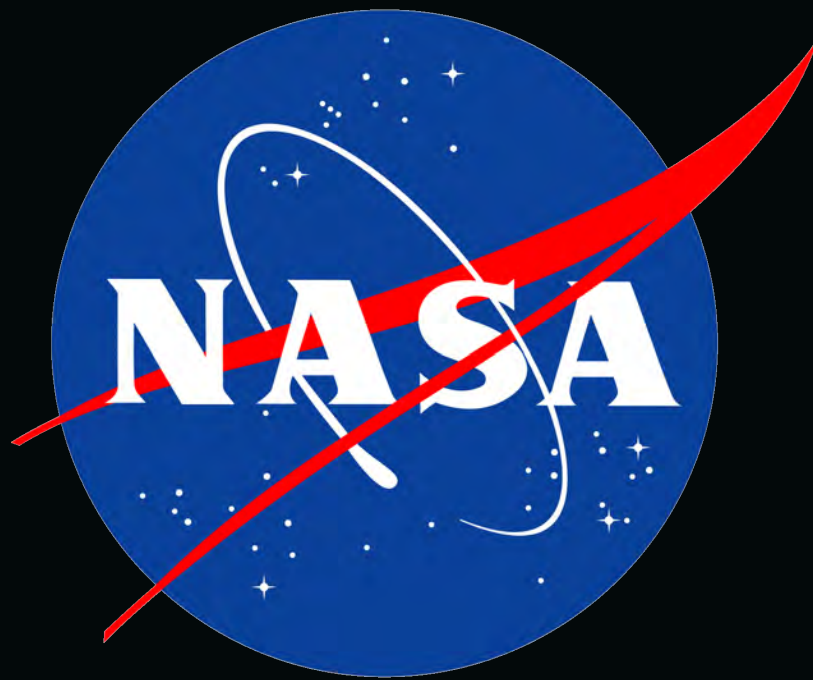
Acknowledgements

State of Business Assessment Team

- Dr. Sherrica Holloman, Team Lead
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 - PAAC IV
- Jerry Klein and Jennifer Poston, Risks and Issues
 - PAAC IV



Thank You!



For more information, please visit our web site:
www.nasa.gov/goddard