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

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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
One World-Class Science and Engineering Organization

Six Distinctive Facilities & Installations

- **Greenbelt Main Campus**
  - 1,270 Acres
  - Executing NASA’s most complex science missions
  - Est. 1959

- **Wallops Flight Facility**
  - 6,188 Acres
  - Launching Payloads for NASA & the Nation
  - Est. 1945

- **Goddard Institute for Space Studies**
  - Understanding our Planet
  - Est. 1961

- **Independent Validation & Verification Facility**
  - Providing Software Assurance
  - Est. 1993

- **White Sands Test Facility Ground Stations**
  - Communicating with Assets in Earth’s Orbit
  - Est. 1963

- **Columbia Balloon Facility**
  - Directing High Altitude Investigations
  - Est. 1982
Who We Are

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

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

Scientists & Engineers 61%

Technicians and Others 6%

Clerical 5%

Professional & Administrative 28%
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. Compton Tucker
Galathea Medal – Denmark 2004
Vega Medal – Sweden 2014
In Physical Geography

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

- Enabling transformational research and answering cross-disciplinary questions about life in the universe
- Serving as NASA’s communications backbone
- Benefitting society by applying technology and science to improve weather forecasting, crop yields, etc.
- Operating NASA’s only owned rocket launch complex and research airfield
- Executing NASA’s most complex missions and instruments with unique end-to-end capability
- Serving as NASA’s premiere location for conducting research using sub-orbital platforms
- Assuring NASA’s most complex software functions as planned

Our diverse, skilled workforce is the source of our success.
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

Expertise in Core Science and Cross-Cutting Disciplines

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

Exceptional Human Capital

Engineering and Technology Development

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
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

Transiting Exoplanet Survey Satellite (TESS) will discover Transiting Exoplanets around the brightest stars and search for Earth like planets. 
Launched April 18, 2018

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
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

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

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

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.

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.
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.
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.

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.

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

Aircraft

Balloon Program

Space and Near Earth Communications Networks

Antares Launch Vehicle

Laser Communications Relay Demonstration
Project Management at Goddard Space Flight Center
## GSFC Mission Portfolio

<table>
<thead>
<tr>
<th>Formulation</th>
<th>Implementation</th>
<th>Primary Operations</th>
<th>Extended Operations</th>
<th>Communications &amp; Ground Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>LISA</td>
<td>JWST XRISM</td>
<td>MOMA (ExoMars)</td>
<td>Fermi</td>
<td>SSMO HST Ops ESDIS ESMO NIMO TEMPO Search and Rescue Space Network Near Earth Network SGSS TDRS</td>
</tr>
<tr>
<td>Athena</td>
<td>Landsat 9 ICON</td>
<td>LCRD NIRSpec LCRD</td>
<td>HST Swift XMM-Newton</td>
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<tr>
<td>HIRMES</td>
<td>SET-1 SOC</td>
<td>TIRS II XRISM - Resolve</td>
<td>AURA LAGEOS (2) Landsat 7 S-NPP SORCE Terra TCTE ACE AIM Geotail IBEX</td>
<td></td>
</tr>
<tr>
<td>WFIRST</td>
<td>JPSS-2 GOES-T</td>
<td>TESS Nicer (ISS) ICESat-2 GEDI (ISS) GPM Landsat 8 TSIS-1 SMAP MMS DSCOVR POES/Met-Op-C OSIRIS-Rex RAVEN (ISS) RMM-3-3 ATLAS</td>
<td>IRIS RHESSI SDO SOHO STEREO (2) THEMIS (5) TIMED TWINS (2) Van Allen (2) Wind LRO MAVEN</td>
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<td>XARM</td>
<td>GOES-U U</td>
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<tr>
<td>PACE</td>
<td>LUCY</td>
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<td>TSIS-2</td>
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<td>GUSTO</td>
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<tr>
<td>JPSS-3</td>
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<td>JPSS-4</td>
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<tr>
<td>Restore-L</td>
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<td>PACE OCI</td>
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<tr>
<td>Lucy L-Ralph</td>
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<td>Lemnos 020</td>
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<td>Lemnos ILLUMA-T LOCNESS</td>
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**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

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

- Contracts
- Technical Performance
- Science
- Customers

- Budgets
- Lessons Learned
- People
- Configuration Management
- Schedules
- EVM
- Risk Management

- NASA Headquarters
- Office of Management and Budget
- General Accountability Office
- Status Reporting
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)

<table>
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<tr>
<th>Review</th>
<th>Review Held / Scheduled</th>
<th>Actions</th>
<th>Submitted</th>
<th>% Submitted</th>
<th>Closed</th>
<th>% Closed</th>
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<tr>
<td>RSS PER</td>
<td>4/10/12</td>
<td>5</td>
<td>5</td>
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<td>0</td>
<td>100%</td>
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<tr>
<td>PFP PER</td>
<td>5/20/12</td>
<td>7</td>
<td>7</td>
<td>100%</td>
<td>7</td>
<td>100%</td>
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<tr>
<td>NGIMS PER</td>
<td>10/15/12</td>
<td>2</td>
<td>2</td>
<td>100%</td>
<td>2</td>
<td>100%</td>
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<tr>
<td>Spacecraft PER</td>
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<td>3</td>
<td>60%</td>
<td>3</td>
<td>60%</td>
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<tr>
<td>SIR</td>
<td>6/25/12</td>
<td>4</td>
<td>4</td>
<td>100%</td>
<td>4</td>
<td>100%</td>
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<tr>
<td>Electric HPCR (JPL Internal)</td>
<td>6/21/12</td>
<td>0</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>RSS PIR</td>
<td>10/24/12</td>
<td>1</td>
<td>1</td>
<td>100%</td>
<td>1</td>
<td>100%</td>
</tr>
<tr>
<td>PFP PIR</td>
<td>10/30/12</td>
<td>1</td>
<td>1</td>
<td>100%</td>
<td>1</td>
<td>100%</td>
</tr>
<tr>
<td>NGIMS PIR</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
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<tr>
<td>Observatory PIR</td>
<td>7/16/13</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
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<tr>
<td>MOS/GIMS Peer Review</td>
<td>6/5/12</td>
<td>0</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
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<tr>
<td>ORR FOR</td>
<td>1/13/12</td>
<td>14</td>
<td>8</td>
<td>57%</td>
<td>6</td>
<td>43%</td>
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<tr>
<td>Totals</td>
<td></td>
<td>39</td>
<td>31</td>
<td>79%</td>
<td>29</td>
<td>74%</td>
</tr>
</tbody>
</table>
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

**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 Control**

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

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

**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)

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
Business Change Initiative Optimization
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
### Monthly State of Business Reports

**Output/ Value Added:**
- Performance Trends and Projections
- Performance and Risk Management Recommendations

### Integrated Monthly Report

**Early Warning**

**EVM Report**

**Schedule Report**

**Cost Report**

**Risks/Issues Report**
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)
## State of Business Monthly Summary Schedule Assessment Report

<table>
<thead>
<tr>
<th>Project + PM’s Schedule Assessment</th>
<th>State of the Business Schedule Assessment</th>
<th>Funded Schedule Margin</th>
<th>SPI (monthly)</th>
<th>BEI</th>
<th>HMI</th>
<th>CEI</th>
<th>Cumulative Milestone Actual vs. Plan Ratio</th>
<th>Top Schedule Issue / Risk (as reported by project)</th>
<th>Primary Critical Path Driver</th>
<th>Planned LRD, Instrument Delivery or Ground Milestone</th>
<th>Best Case Completion Forecast (BEI-based)</th>
<th>Worst Case Completion Forecast (CEI-based)</th>
</tr>
</thead>
<tbody>
<tr>
<td>COF OVERALL TREND: STABLE</td>
<td></td>
<td>147 days</td>
<td></td>
<td>0.87</td>
<td>0.39</td>
<td>0.51</td>
<td>0.76</td>
<td>Risk: Optical design closure</td>
<td>AOB procurement</td>
<td>COF Delivery 7/23/2021</td>
<td>04/2021</td>
<td>Awaiting 4 months CEI data</td>
</tr>
<tr>
<td></td>
<td>- The AOB procurement has slipped one week to 12/26/2019 and now drives the COF critical path</td>
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<tr>
<td></td>
<td>- BEI was unchanged, while HMI and CEI declined from the previous month and have fallen below FPD goals</td>
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<tr>
<td>GPAR OVERALL TREND: DETERIORATING</td>
<td></td>
<td>73 days</td>
<td>0.78</td>
<td>0.86</td>
<td>0.25</td>
<td>0.57</td>
<td>0.88</td>
<td>Issue: Spacecraft schedule erosion</td>
<td>SAA-2 Instrument</td>
<td>Launch 12/15/2020</td>
<td>09/2020</td>
<td>06/2021</td>
</tr>
<tr>
<td></td>
<td>- 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</td>
<td></td>
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<tr>
<td></td>
<td>- CEI increased to .57, reversing a multi-month downward trend</td>
<td></td>
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<tr>
<td></td>
<td>- BEI has been trending downward, but is still above the FPD goal of .80</td>
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<tr>
<td></td>
<td>- At .24 HMI remains below the FPD goal of .50</td>
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<tr>
<td></td>
<td>- Significant LRD delay possible based on worst case CEI-based forecast</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>RTS2 OVERALL TREND: Stable</td>
<td></td>
<td>50 days</td>
<td>0.63</td>
<td>0.96</td>
<td>0.46</td>
<td>0.65</td>
<td>0.94</td>
<td>Risk: Flight and Spare Detector Current Characterization</td>
<td>MEB FM-1</td>
<td>Delivery 08/8/2019</td>
<td>06/2019</td>
<td>11/2019</td>
</tr>
<tr>
<td></td>
<td>- TVAX testing completed, MEB FM-1 now driving the critical path</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>- No change in 50 days of schedule margin</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>- Detector current characterization risk could threaten 9/8/2019 RTS2 delivery if redesign/rework is required</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td>- SRA results indicate an improvement to .62 from .50 confidence in 8/8/2019 RTS2 delivery</td>
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</tbody>
</table>

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)
## State of Business Monthly Summary Cost Assessment Report

<table>
<thead>
<tr>
<th>Project + PM's Overall Assessment</th>
<th>State of the Business Cost Assessment</th>
<th>Summary per the Project and Project Cost Assessment</th>
<th>Phase</th>
<th>$ Reserve Guideline</th>
<th>$ Reserve thru Liens and Encumbrances</th>
<th>Percent Difference between Columns E and F</th>
<th>Percent Difference between Columns F and H</th>
<th>Cost To Go (K)</th>
<th>UFE Thru Liens ($K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project A</td>
<td>- OVERALL TREND: STABLE</td>
<td>Adequate cost reserves</td>
<td>C</td>
<td>25%</td>
<td>32.9%</td>
<td>31.6%</td>
<td>27.4%</td>
<td>-16.7%</td>
<td>517,500</td>
</tr>
<tr>
<td>Project B</td>
<td>- OVERALL TREND: STABLE</td>
<td>Adequate cost reserves</td>
<td>B</td>
<td>25%</td>
<td>31.0%</td>
<td>24.0%</td>
<td>30.4%</td>
<td>-1.9%</td>
<td>1,847,100</td>
</tr>
<tr>
<td>Project C</td>
<td>- OVERALL TREND: STABLE</td>
<td>No Issues</td>
<td>C</td>
<td>NR</td>
<td>11.3%</td>
<td>N/A</td>
<td>11.3%</td>
<td>0.0%</td>
<td>310,700</td>
</tr>
<tr>
<td>Project D</td>
<td>- OVERALL TREND: STABLE</td>
<td>Funding sufficient to cover plans and expected contingencies</td>
<td>C/D</td>
<td>20%</td>
<td>11.0%</td>
<td>-45.0%</td>
<td>4.0%</td>
<td>-83.6%</td>
<td>NR</td>
</tr>
</tbody>
</table>

- **PM's evaluation of Cost**: Based on project cost assessment.
- **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**: Yellow if Column G between 25% and 50% less than column E. Red if column G more than 50% less than column E.
<table>
<thead>
<tr>
<th>L</th>
<th>M</th>
<th>N</th>
<th>O</th>
<th>P</th>
<th>Q</th>
<th>R</th>
<th>S</th>
<th>T</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reasons for Change in $ Reserve Since Last Month</td>
<td>Funded Schedule Margin (Time)</td>
<td>Funded Schedule Margin (Funds)</td>
<td>Top Cost Issue / Risk</td>
<td>Cum Obl Variances (M)</td>
<td>Percent Cum Obl Variances</td>
<td>Cum Cost Variances (M)</td>
<td>Percent Cum Cost Variances</td>
<td>Project Obligation Variance Explanation</td>
<td>Project Cost Variance Explanation</td>
</tr>
<tr>
<td>no change</td>
<td>9.6 mos</td>
<td>NR</td>
<td>Issue: Bus Late completion</td>
<td>-$69.5</td>
<td>-27.7%</td>
<td>-$49.2</td>
<td>-27.2%</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>PPBE increase</td>
<td>NR</td>
<td>NR</td>
<td>Risk: Instrument ...</td>
<td>$62.0</td>
<td>41.0%</td>
<td>-$20.3</td>
<td>-12.2%</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>PPBE increase</td>
<td>NR</td>
<td>NR</td>
<td>Risk: Spacecraft ...</td>
<td>-$63.5</td>
<td>-33.8%</td>
<td>-$15.1</td>
<td>-12.9%</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>SXXM of additional liens and threats to fund impacts of xxx anomalies</td>
<td>207</td>
<td>NR</td>
<td>Issue: Leaky ...</td>
<td>$30.8</td>
<td>53.6%</td>
<td>-$10.7</td>
<td>-4.4%</td>
<td>no specific reason</td>
<td>accrual problem due to contractor overstating their plan</td>
</tr>
</tbody>
</table>

Yellow if between $10M & $20M reduction in reserves
Red if greater than $20M reduction in reserves

Based on project assessment

Based on project assessment

Yellow if between 10% & 20% ahead or behind plan
Red if greater than 20% ahead or behind plan

Yellow if between 10% & 20% ahead or behind plan
Red if greater than 20% ahead or behind plan

Yellow if vague or inadequate explanation provided
Red if no explanation provided

Yellow if vague or inadequate 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
## EVM Examples

### 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**

<table>
<thead>
<tr>
<th>SPIcum</th>
<th>CPI3</th>
<th>CPI6</th>
<th>CPIcum</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.92</td>
<td>0.80</td>
<td>0.79</td>
<td>0.85</td>
</tr>
</tbody>
</table>

### 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.**

<table>
<thead>
<tr>
<th>SPIcum</th>
<th>CPI3</th>
<th>CPI6</th>
<th>CPIcum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>0.96</td>
<td>0.99</td>
<td>0.97</td>
</tr>
</tbody>
</table>

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

### Program name colors represent Tag Up EVM rating by PM
- **White = No tag up rating by PM**
- **Black = Tag up EVM rating by PM**

### SPIc/CPIc/CPI3 Thresholds
- ** SPIc > .95**  
  - Greater than -.05
- ** SPIc between .90 to .95**  
  - Less than -.05 to -.10
- ** SPIc < .90**  
  - Less than -.10

### TCPIM/TCPI/TCPIA/TCPIABC Thresholds

*For contractors, Fund MA is total contract value*
## EVM Examples

<table>
<thead>
<tr>
<th>PROJECTS EVM Assessment</th>
<th>CPIcum</th>
<th>TCPI_EAC</th>
<th>TCPI FundMA or Contract Value</th>
<th>% Complete</th>
<th>% Spent</th>
<th>SoB Assessment Change Month to Month</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project A (Ph C)</strong> Contractor 85%</td>
<td><img src="green.png" alt="" /> 0.85</td>
<td><img src="green.png" alt="" /> 0.85</td>
<td><img src="green.png" alt="" /> 0.81</td>
<td>90.00</td>
<td>110.38</td>
<td>No Change Yellow</td>
</tr>
<tr>
<td><strong>Project B (Ph D)</strong> Contractor Only</td>
<td><img src="green.png" alt="" /> 0.97</td>
<td><img src="red.png" alt="" /> 1.10</td>
<td><img src="green.png" alt="" /> 0.65</td>
<td>75.00</td>
<td>77.00</td>
<td>No Change Green</td>
</tr>
</tbody>
</table>

### 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

<table>
<thead>
<tr>
<th>No EVM trend concerns</th>
<th>Greater than .95</th>
</tr>
</thead>
</table>

### SPIc/CPIc/CPI3 Thresholds

<table>
<thead>
<tr>
<th>EVM Trends to be watched</th>
<th>Less than .05 to .10</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>EVM Trend Concerns</th>
<th>Less than -.10</th>
</tr>
</thead>
</table>

### TCPIBAC/TCPIEAC TCPIMA/TCPIABC Thresholds

* 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:

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

NOTE: Assessments are based on Project Reporting (Tag-ups, MSRs, dialogue)
### STATE OF THE BUSINESS – ELEVATED CONCERNS BASED ON MONTH 2018 PROJECT REPORTING

<table>
<thead>
<tr>
<th>Program</th>
<th>Project Cost</th>
<th>Project Sch</th>
<th>SoB Cost</th>
<th>SoB Sch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prog. A</td>
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</tr>
<tr>
<td><strong>Key Question/Comments:</strong></td>
<td>(Conducted meeting with program on December 30th)</td>
<td></td>
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<tr>
<td>Supporting Data:</td>
<td></td>
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</tbody>
</table>

*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.*

<table>
<thead>
<tr>
<th>Program</th>
<th>Project Cost</th>
<th>Project Sch</th>
<th>SoB Cost</th>
<th>SoB Sch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prog. B</td>
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<td></td>
</tr>
<tr>
<td><strong>Key Questions/Comments:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supporting Data:</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

*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: Assessment Comparison

<table>
<thead>
<tr>
<th>Project</th>
<th>SoB</th>
<th>C</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>C</td>
<td>S</td>
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</tr>
</tbody>
</table>

- 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
The Science....

View Delta II ICESat-2 Launch Highlights on YouTube

https://www.youtube.com/watch?v=jalAqj-ReII
Looking to the Future.....
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
  – The Aerospace Corporation
• Nikka Pelayo, Early Warning Metrics
  – The Aerospace Corporation
• Walt Majerowicz, Schedule/Cost Performance
  – PAAC IV
• Howard Leibowitz, Earned Value Metrics
  – 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