



2022 HIGH RISK CORRECTIVE ACTION PLAN

In Response to Recent Programmatic Performance and
NASA's Designation on GAO's High Risk List

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Change Log

Date	Change	Justification	Requester
1/26/2023	Correct NASA Procedural Directive (NPD) 1000.5D to NPD 1000.5C – found on document page 8	Updates described did not constitute a new version of NPD 1000.5. A change log for NPD 1000.5C from March 2022 accounts for the updates. NPD 1000.5C remains the current version of the policy.	L. Guerra, Office of the Administrator

Purpose

This Corrective Action Plan (hereinafter referred to as the “Plan,” or the “CAP”) encompasses a collection of initiatives and areas of emphasis that the National Aeronautics and Space Administration (the “Agency,” or “NASA”) commits to pursuing as it matures Agency acquisition management, program and project management, and related surveillance of contractors. The Plan is developed in support of the Agency’s steadfast commitment to good governance and effective stewardship of the resources entrusted to it. The Plan is prepared and pursued in recognition of the Government Accountability Office’s designation of NASA’s Acquisition Management practices as high risk for waste, fraud, abuse, mismanagement, or otherwise needing transformation. The Government Accountability Office (GAO) High Risk report interprets Acquisition Management broadly, including program and project management concerns as well as the strategy and decision-making around Make/Buy/Partner considerations prior to procurement.

Background

In 1990, the Government Accountability Office listed NASA’s contract management on its inaugural High Risk List, a report that identified areas of the federal government at high risk for waste, fraud, abuse, mismanagement, or otherwise needing transformation. In 2009, GAO broadened its High Risk designation from contract management to acquisition management to encompass the full scope of issues that needed to be resolved – including persistent cost growth and schedule delays, antiquated financial management systems, poor cost estimating, and undefinitized contracts. During the 32 years that GAO has identified NASA’s contract or acquisition management as High Risk, NASA has invested a tremendous amount of effort to significantly advance its programmatic controls, analytical capabilities, contract management, acquisition strategies, reporting transparency, and cost and schedule performance. In direct response to its High Risk designation, NASA has implemented a series of Corrective Action Plans (described in this document’s [Appendix](#)) with specific initiatives that address GAO concerns, while also putting forth significant effort in related areas that have advanced NASA toward a more trusted, transparent steward of taxpayer dollars in carrying out National priorities. This 2022 Corrective Action Plan represents the continued dedication of NASA senior leadership toward fostering a culture of continuous improvement.

Corrective Action Plan Overview

Approach

In January 2022, the NASA Associate Administrator (AA) directed the start of the process to update the High Risk Corrective Action Plan (CAP) with the update targeted for Summer 2022. The CAP Working Group was reconstituted with new cross-Agency membership at the staff/Chief level. The CAP Steering Committee was reconstituted with new cross-HQ membership, including senior leadership at the Mission Directorate Deputy Associate Administrator level or equivalent. Working Group and Steering Committee membership can be found in the [Appendix](#) of this document. The AA delegated executive sponsorship of the CAP to the Chief Program Management Officer (CPMO) and the Chief Financial Officer (CFO). The Steering Committee provided mid-course correction and executive guidance. The Working Group provided regular feedback to develop the initiatives and socialize the efforts within their communities and organizations. Initiative Leads included subject matter experts and maintained ownership of the development of the individual initiatives. The Strategic Investments Division (SID) in the Office of the Chief Financial Officer (OCFO) maintains ownership of CAP documentation, facilitates the update process, and serves as the integrator of information. During the update process, OCFO SID engaged with GAO personnel periodically to ensure stakeholder feedback was considered.

Ownership and Responsibilities

The NASA AA assumes ownership of the CAP and delegates process ownership to the Chief Program Management Officer (CPMO). OCFO SID is responsible for maintaining CAP documentation, tracking and reporting progress against the CAP on an annual basis, and conducting any process updates for subsequent iterations to the CAP. Lead Executives or Lead Organizations as described in the various initiatives in the CAP are responsible for executing upon the initiatives as written, and reporting progress to either OCFO SID or other specific forums as described. The Supporting Organizations, where listed, will aid the identified Lead Executives or Organizations in execution of the initiatives as necessary.

Initiatives

The Corrective Action Plan is comprised of a set of initiatives evaluated by the working group and cross-Agency stakeholders to provide value for Agency acquisition management improvements. The initiatives are categorized by the following actionable characteristics:

- **Implement:** Initiatives that NASA has determined should proceed and become part of regular Agency business cadence. Any actions taken to support execution of the described initiatives will follow all established Agency control and oversight boards, as applicable, to prevent unintended consequences.
- **Pilot:** Initiatives that NASA has determined are likely to provide value in Agency acquisition management but will be implemented on a trial basis until the Agency assesses and reaffirms continued implementation.

- **Research:** Initiatives that are less conceptually mature but may generate value for Agency acquisition management and thus warrant exploration and development.

Each initiative in the CAP includes the following sections:

- **Lead Executive/Organization:** The individual or office responsible for leading the initiative as described, and periodically reporting progress to OCFO SID for internal and external communications and for coordination purposes.
- **Supporting Organization(s):** The organization(s) required to support the Lead Executive/Organization in their execution of the initiative. While the organizations listed are necessary and required to support the initiative, the lists are not necessarily exhaustive, as the Lead Executive/Organization may call on other Organizations for support.
- **Initiative Description:** A brief high-level summary of the initiative.
- **Background/Current State:** A description of the status quo and, as necessary, an overview of relevant background information and any policies, procedures, constraints, or other areas influencing the status quo.
- **Expected Benefits:** A review of the expected improvements from the initiative. The timeline for improvements varies across initiatives, but most often benefits are long-term and difficult to identify causation to improved programmatic performance.
- **Recent Accomplishments:** Where applicable, a review of recent progress and accomplishments regarding the described initiative. Some initiatives already have momentum, which will be reflected here. Others, such as research initiatives to pilot new ideas, will not have content for this section.
- **Planned Next Steps:** A high-level description of the planned progress for the initiative to occur over a period ranging up to two years.
- **Output and Outcome Metrics:** Where applicable, a list of appropriate methods of measurement to track progress and effectiveness of the initiative.
- **Interdependencies:** Where applicable, a description of key dependencies that necessitate coordination or cognizance in support of initiative success.
- **Impediments and Challenges:** A brief description of possible pitfalls, risks, impediments, and challenges that can be reasonably expected to occur during execution of the initiative.
- **Required Resources:** A preliminary assessment of possible resource requirements for successful execution of the initiative. This does not represent committed resources and does not reflect a refined estimate of resources. Any funds required to execute any initiatives will proceed through the regular budget formulation processes for Agency approval.

Areas of Emphasis

NASA will emphasize adherence to current policies and practices, encourage improvements that better position the Agency to manage cost and schedule performance, and capture efforts related to acquisition management improvement conducted outside the CAP process. In contrast to the initiatives in the CAP, Areas of Emphasis capture interrelated yet discrete activities that together constitute a demonstrated effort to improve the Agency's posture in a particular focus area. These activities include those recently implemented as well as an acknowledgement of planned future work. Areas of Emphasis

are primarily differentiated from initiatives in that they are ongoing efforts that do not lend themselves to the structure of a CAP initiative, but are nevertheless critical to improving the Agency's acquisition management performance, therefore important to recognize in the CAP.

Severability

The initiatives contained herein are interrelated with respect to their connection to improving Agency acquisition management but are not mutually dependent on one another for execution purposes unless otherwise identified. As such, if the Agency should determine that any individual initiative be removed from the Corrective Action Plan for any reason, the Plan and remaining initiatives will remain in effect.

Progress Tracking and Reporting

Each initiative in the CAP includes planned next steps and metrics, where applicable. The Lead Organization(s) cited in the CAP will pursue actions as described. A subset of initiatives includes specific forums for reporting progress or deliverables (e.g., Agency Program Management Council (APMC) or Business Performance Review (BPR)). For all efforts in the CAP, OCFO SID will conduct a semiannual checkpoint to measure progress against the CAP. OCFO SID will report the semiannual progress and status update to the BPR forum. OCFO SID will also share and discuss progress with GAO annually at a minimum, and more often when applicable. Moreover, OCFO SID will continue to generate the semi-annual High Risk Metrics Report, which includes aggregate cost and schedule performance metrics, status updates on CAP initiatives, aggregate trending data, and other related High Risk metrics.

Corrective Action Plan Update Schedule

NASA will keep this Corrective Action Plan current and will provide updates to the GAO until GAO removes the High Risk designation for the Agency. The update process in which initiatives and/or areas of emphasis are added, revised, or resolved will occur in the approximate period of January to August of even-numbered years. This timeframe allows an informed GAO consideration of any changes made to the CAP and supports the GAO's timeline for preparation of the biennial publication of the High Risk Report (approximately January to February of odd-numbered years). The AA will retain the authority to revise the CAP at any time.

Areas of Emphasis

NASA takes seriously its commitment to driving improvements to the areas of acquisition management and program management. The initiatives described in the 2022 Corrective Action Plan are those that NASA has determined should be implemented to become part of the regular Agency business cadence; those that show promise to provide value related to acquisition management and implemented as a pilot; and those that are less conceptually mature but warrant researching for potential follow-on activity. Beyond the future work described in the CAP initiatives, NASA has continued to make progress toward improved acquisition and program management outside the CAP structure. Demonstrations of progress related to acquisition management yet not suited for the CAP Initiative format are described below as Areas of Emphasis.

Acquisition Management

In August 2021, the NASA Deputy Administrator initiated a Tiger Team to focus on improvements in acquisition and program/project management throughout the Agency. The Tiger Team provided its findings and recommendations to senior leadership in December 2021. Incorporating the Tiger Team's findings, NASA leadership has worked to create a more robust structure for acquisition planning with several changes:

- The NASA Deputy Administrator now serves as the NASA Chief Acquisition Officer (CAO) (requirement is for a political appointee to hold the CAO designation; previously the Chief Financial Officer). The Assistant Administrator for the Office of Procurement serves as the Deputy Chief Acquisition Officer (no change). This elevates significant acquisition planning to the attention of the agency's most senior officials, ensuring appropriate levels of consideration are applied to the agency's largest acquisitions.
- Addition of a "decision framing meeting" to ensure early discussions on acquisition strategies and plans. The decision framing meeting allows for critical questions to be discussed without formal decisions, but rather steering guidance for the follow-on Acquisition Strategy Meeting (ASM). The Acquisition Strategy Council (ASC) recently exercised this practice with the Space Launch System (SLS) production and operations acquisition.
- Addition of an Analysis of Alternatives (AoA) for Acquisition Strategy Meetings. The AoA should address the trade space of options for acquisition. In addition, alternatives are to be judged against an established set of key drivers prioritized by the proposing organization. The standard drivers include performance, cost, schedule, ownership, policy, and workforce. The AoA should address a comparison of the options against this set of prioritized drivers. Based on this analysis, the proposing organization makes a recommendation on the preferred acquisition approach. The AoA guidance for ASMs is further codified in NASA's acquisition policy (NASA Procedural Directive [NPD] 1000.5C).
- Addition of templates for briefers to follow when producing ASM presentation materials. Guidance contained in NASA's acquisition policy (NPD 1000.5C) has been translated into a common template and updated to include a standard set of decision criteria. The first acquisition to apply this template was the Landsat Next acquisition.

- Addition of an Acquisition Plan for high dollar acquisitions. More formal documentation captures the acquisition and procurement decisions prior to a Request for Proposal (RFP) release. The acquisition plan will be a living document to be updated throughout the life cycle of the procurement.
- Addition of an annual forecast for planning and awareness of upcoming acquisitions. The first acquisition forecast was presented in February 2022 to the ASC. Each Mission Directorate (MD) designated the pre-ASM, ASM, and Procurement Strategy Meetings for the next two calendar years, specifically for the acquisitions that meet the threshold for the ASC. Previewing the MD expectations and flow of acquisition topics enables the ASC to plan the throughput in the near-term calendar, adjusting as needed. Such a forecast will be produced annually at the beginning of the year.
- Conduct quarterly, in-depth reviews of major programs (Category 1 and strategic programs, e.g., those with significant cross-program dependencies) at the Baseline Performance Review (BPR), a monthly assessment of NASA's performance in achieving its missions to ensure senior leadership maintains situational awareness of program/project performance and to understand and integrate issues. The BPR was revised to implement the recommended recurring major program review, with changes such as:
 - Reports briefed by the program/project manager responsible for each program/project
 - Technical Authorities and Office of the Chief Financial Officer afforded opportunity to provide independent perspectives
 - Content includes dedicated section on procurement and partnership performance, leading indicators, and workforce/infrastructure issues
 - Mission Directorates continue to report on Directorate-level commitments, risks, and integration
 - Situational awareness of Category 2 and Category 3 mission issues with sustained focus on major programs
 - Since the changes to BPR were implemented in February 2022, the following major programs/projects have undergone this new process in the associated months, repeating the cadence on a rotating basis:
 - February: Europa Clipper, James Webb Space Telescope, Mars Sample Return, Roman Space Telescope
 - March: Enterprise Ground Systems, Gateway, Orion, Space Launch System, Exploration Extravehicular Activity, Human Landing System
 - April: Electrified Powertrain Flight Demonstration, Low Boom Flight Demonstration, On-orbit Servicing Assembly and Manufacturing, Solar Electric Propulsion, Space Nuclear Power and Propulsion, Commercial Crew Program
 - May: Mission Support

Program Management

NASA leadership recognizes the need for dedicated improvement efforts within the Agency's program management policies and practices. In that spirit, in early 2022, NASA established the Chief Program Management Officer (CPMO) in the Office of the Administrator. The CPMO role includes the scope of responsibilities of the previous Program Management Improvement Officer (PMIO) role, but with

expanded functions that champion the recommendations made by the aforementioned Tiger Team. The CPMO is supported by a small office reporting to the NASA Associate Administrator and will strengthen NASA's enterprise-wide oversight, management, and implementation of program management policies and best practices across Headquarters and Centers. The CPMO office will be augmented with HQ and Center detailees to enable exchange of program management knowledge.

The CPMO's long-term goal is to effect measurable improvement in program/project performance through effective collaborations with Mission Directorates, Centers, Programs, Projects, and mission support organizations. While the CPMO function becomes established and matures, activities underway or planned include but are not limited to:

- Reconstitute the Program/Project Management Board (PPMB) to support Agency program management collaboration and improvement efforts. The PPMB Chair and management has been transitioned from the Office of the Chief Engineer to the CPMO. The PPMB charter will be updated, PPMB membership will be maintained, and the Board will meet monthly.
- Develop and emphasize areas for mentoring and training future project managers, pursuing multiple approaches involving various Agency and Center organizations to potentially include internships, cross-training, temporary detail opportunities.
- Assess and reinvigorate Lessons Learned capture and distribution methods in collaboration with the NASA Chief Knowledge Officer, including "Pause and Learn" sessions at project phase transitions, improvements of information technology infrastructure for easier lesson distribution, Masters' Forums, rotational assignments, and experiential learning.
- Focus on commitments made at Key Decision Points. Support Agency councils, key acquisitions, and performance review meetings. Review and update decision memoranda and supporting datasheet templates. Support discussions at ASM's to include the analysis of alternatives.

To date, the CPMO has provided 24 separate presentations to various NASA communities, including all ten NASA Centers and many NASA HQ offices. The presentation series provides these communities with an on overview of the CPMO office, plans for future work, and invite discussion and feedback from the stakeholders.

Probabilistic Programmatic Policy

NASA Procedural Requirement (NPR) 7120.5F sets forth requirements for conducting probabilistic programmatic analyses at key points in projects' life cycles. The Joint Cost and Schedule Confidence Level (JCL) is NASA's analytical technique to assess a project's programmatic risk posture for the Agency Baseline Commitment (ABC), the baseline against which the Agency's performance is measured during the Implementation phase of the project. The JCL identifies the probability that a given project or program's cost will be equal or less than the targeted cost, and the schedule will be equal or less than the targeted schedule date. The analysis results are valid only for the plan on which the inputs are based and represents a snapshot in time. The JCL facilitates communication of the project's unique risk posture and informs decisions by NASA's senior leadership, ensuring the Agency's commitment to external stakeholders is realistic. The JCL is one of the means of ensuring the project has a robust plan and helps protect the Agency's integrity with regards to cost and schedule performance. The ABC codifies NASA's

commitment to external stakeholders and the JCL analysis quantifies the programmatic health of that commitment.

Established in 2009, the JCL policy described in NPR 7120.5F includes a set of requirements for certain confidence level percentages tied to the Agency Baseline Commitment. However, current policy does provide flexibility for the Decision Authority to approve ABCs at less than the required 70% JCL for ABCs and 50% JCL for Management Agreements (MAs). The MA defines the parameters and authorities over which the program or project manager has management control and should be viewed as a contract between the Agency and the program or project manager. The Decision Authority has the ability to approve, and/or tailor, any requirement within NPR 7120.5F, and JCL policy and confidence level recommendations are not externally driven (e.g., Title 51).

The 2021 Acquisition and Program/Project Management Tiger Team provided a recommendation for NASA senior leadership to not approve program/project MAs below a 50% JCL and to never approve an ABC below a 70% JCL. NASA will be exploring potential paths to implement or emphasize the Tiger Team's recommendation, to potentially include administrative edits to NPR 7120.5F, additional emphasis in supporting handbooks (e.g., Cost Estimating Handbook JCL Appendix or PM Handbook), and/or updates to decision memorandum templates.

Initiatives

[Implement] Schedule Database

Lead Executive/Organization

Office of the Chief Financial Officer

The Agency's Programmatic Analysis and Research Capability (APARC), under the Office of the Chief Financial Officer (OCFO), has a responsibility to progress the Agency's programmatic capabilities, including the PP&C function of Schedule Management.

Supporting Organization(s)

Mission Directorates (MD), Centers, Programs and Projects.

Initiative Description

The Schedule Database initiative, an extension/enhancement of the Schedule Repository initiative, is aimed at turning collected schedule data into actionable schedule information. The Schedule Database will use Schedule Repository schedule submissions as inputs, adding minimal to no additional impact to Programs/projects (P/p).

Background/Current State

Prior to 2019, schedule data was generally not being collected at the Agency, MD, or Center levels on a routine/consistent basis, as no requirements or rigid processes existed (e.g., Cost Analysis Data Requirement [CADRe] collects only mission-level integrated master schedules (IMs) at life cycle review [LCRs]). Thus, there was no centralized repository of detailed P/p schedule information from which other P/p's can draw analogous data for schedule planning, development, and analysis purposes. The NASA Agency Program Management Council (APMC) met on December 6, 2018 and evaluated the Agency's CAP recommendation for a Schedule Repository (i.e., centralized library of schedules). The Schedule Repository was selected as an initiative to pilot and was later recommended for full implementation.

Although the Schedule Repository initiative is now well underway, OCFO has recognized that the utility of the data could be vastly enhanced with the Agency's recent acquisition of various IT platforms and capabilities (i.e., Microsoft Office 365, Microsoft Teams, Power BI, etc.). Implementation of a database capability using a model-based approach will allow for enhanced digital transformation of schedule data into schedule information. OCFO has proactively been piloting a database capability, which is able to calculate metrics and display dashboards on all submitted schedule files with the added capacity to slice and dice information by a variety of filters for a wide range of use cases.

Expected Benefits of Implementation

The Schedule Database will enhance the goals of the Schedule Repository initiative by facilitating the collection of schedule information into one database with consistent formats for analysis and reporting

(i.e., documentation and communication) of schedule status and metrics. Thus, the Schedule Database initiative will help to increase the capacity, capability, and efficacy of NASA's Schedule Management function, including schedule planning, development, and assessment efforts, as well as progress tracking and performance reporting. The Schedule Database will also facilitate continuous improvement of the Schedule Management function by informing best practice development and driving best practice implementation across the Agency.

The Schedule Database will provide the following benefits:

- **A centralized location for the collection and secured accessibility of NASA project schedules.** The Schedule Database will serve as the storehouse of schedule data in union with the Schedule Repository requirement, minimizing the manual effort to collect, store, and maintain the system and users. Once a P/p is complete (i.e., delivered or launched), schedule information (IMs and data/metrics) will be more broadly accessible across NASA. As such, the Schedule Management community will have secured access to historical schedules and data analytics to aid in the planning and development of schedules for future projects. Schedulers will be able to research analogous projects, utilizing the historical data to produce more realistic schedule estimates and preliminary schedules.
- **An analytical capability for in-depth investigation of multiple schedules at individual project and portfolio levels.** The database capability will allow users to simultaneously analyze and report on multiple schedules using relevant metrics at all levels of an organizational hierarchy. This includes multiple schedule iterations representing different time periods for an individual project or components for individual project analysis, or multiple schedules representing a portfolio of projects for cross-cutting analysis. Thus, schedule analysts will be able to execute analyses in a more efficient manner consistent with both the organizational and the schedule file granularity, which will aid in all levels of management and decision making.
- **A roadmap for the continuous improvement of Schedule Management best practices.** The Schedule Database will provide the ability to accumulate general statistics on schedules across projects and at all levels of a hierarchy (e.g., Mission Directorate, Center, Program etc.). This schedule information will allow for assessments of the Agency's definitions of and adherence to best practices, which will help shape future policy (i.e., requirements) and guidance (e.g., handbooks, training, etc.). There may also be opportunities to consolidate desktop tools.
- **A catalyst for organizational change related to data sharing.** Through the deliberate use of recently acquired IT capabilities, the Schedule Database may promote changes in the way projects "do business". For example, the Schedule Database will slice and dice data in new ways that allow project managers or other stakeholders to request schedule data or visualizations that are different from what was previously available. In addition, the Schedule Database will make it easier to communicate schedule data and information across organizations and communities willing to use the data for purposes other than project management. Thus, an organization's preferred analysis and communication tools may change based on new Schedule Database capabilities. Additional use cases might include the development of research papers, articles, NASA Cost and Schedule Symposium presentations, independent assessments, tiger team studies, etc.

The Schedule Database also serves as a pathfinding opportunity with respect to the Agency's usage of various platforms, modularity,¹ scaling, and a model-of-models² approach towards solutions³ that integrate efforts related to the development of existing and new Agency initiatives.

- **A flexible platform that will allow for expandable capabilities**, such as:
 - Collaboration among communities or the establishment of niche communities (e.g., PM community, independent assessment teams, etc.) for enhanced research, assessment, and performance tracking capabilities.
 - Traceability to digitized handbook guidance and requirements that can sync to the database and provide context around metrics and metric thresholds.
 - Organizationally customized schedule performance tracking, trending, and analysis approaches for in-progress projects utilizing unique data submission cadences (monthly, quarterly, etc.) and filtering capabilities by any number of attributes (e.g., MD, Center, Mission/Project Type, Category Level, Risk Class, Destination, Work Breakdown Structure [WBS], etc.) as deemed appropriate by the organization's stakeholders.
 - Ad-hoc analysis through self-discovery and the creation of new metrics, dashboard, and reports.
 - A model-of-models approach to the integration of cost, earned value management (EVM), technical, risk, etc. data for a more holistic view of programatics and project management.
 - Downstream extensibility and modularity that facilitates the establishment of interdependencies with other Agency digital transformation models.

Recent Accomplishments

OCFO completed the following pre-work in preparation for the digital transformation of the schedule capability through the model-based Schedule Database:

- Framework Analysis –
 - Identified gaps between the Schedule Repository and Schedule Database concepts by data mining, analyzing, and documenting similarities and differences in how the collected schedules are developed (e.g., naming conventions, field codes, WBS levels, etc.).
- IT Requirements Research –
 - Identified MS Project Online as the implementation path for schedule analytics.

¹ Modularity – Loosely-coupling different models together to create a larger whole. Source systems, repositories, analytic models, presentation tiers/report packs, etc., can all be built in a modular fashion. At the analytic model level, instead of one massive model or fragmented models in silos, the model “pieces” can be snapped together to create a more holistic whole, such that the analytic top-level model is both wide and deep and can be scaled so that different teams can use different models.

² Model-of-Models – An approach taking two or more of the holistic analytic models based on their own domains and linking them together to create a top-level unified model.

³ Solution – An analytic model that unifies data in this holistic domain so that all information can be consumed simply by talking to the model. The unification approach adds value to the underlying raw data, while the solution lets the user access that data in a business-friendly way that shields the user from the underlying complexity.

- Developed a framework for collecting and housing schedule data that can be queried and further analyzed.
- Reviewed potential project-level data for use in search and queries.
- Developed draft of file intake/upload process.
- Proof-of-Concept (PoC) Environment Development –
 - Identified MS Project Online as implementation path for schedule analytics.
 - Implemented a framework for collecting and housing schedule data that can be queried and further analyzed.
 - Implemented search and query capability with identified project-level data filters.
 - Tested the draft file intake/upload process.
 - Worked with Goddard Space Flight Center (GSFC) to on-board 25 users for access to the PoC and identified user roles and the associated metrics, reports, and dashboards that could facilitate a Center-driven Schedule Database construct.

Planned Next Steps

Continue development and maintenance of core and enhanced database capabilities:

- Identify projects with single-file submissions vs. multi-file submissions.
- Automate intake processing of subsequent file snapshots. Define and establish submission queues (*spreadsheet with file-level checks, etc.*).
- Load all loadable file submissions from the Schedule Repository.
- Define all necessary fields for file submissions for FY24 and beyond. Socialize list to all P/ps that meet the Schedule Repository requirement by Q2 FY23.
- Develop the search and retrieval capability for processed schedule information. Implement a user access request and tracking process with associated approvals and documentation that allows access to completed project schedules to all NASA and NASA Support personnel, but limits access to in-progress project schedule to responsible Center/project staff and SID/APARC staff.
- Maintain the database capability to update the underlying modeling layer to incorporate advanced enhancements.
- Maintain secure access.
- Provide updates to reports and dashboards, as necessary, to complement the analytic capabilities described in NASA guidance documents and current NASA-provided schedule assessment tools.
- Continue to facilitate in-progress, as well as new, project schedule file processing/uploads.
- Develop automation approach for subsequent schedule file processing/uploads.

Facilitate individual MD/Center/P/p schedule digital transformation capabilities:

- Provide administrative support for MS Project Online, TEAMS, and Power BI components of the Schedule Database.
- Identify and select organizations interested in utilizing the Schedule Database’s digital transformation framework/platform to develop their own capabilities.

Output and Outcome Metrics

Metrics include:

- Project and schedule file counts for quarterly Schedule Repository submissions.
- Trends in the adoption of the Schedule Database capabilities for the enhancement or streamlining of HQ/MD/Center/P/p-level reporting.
- Identified future and/or established dependencies on the Schedule Database platform by other organizations' systems, models-of-models, etc. (See *Interdependencies*.) Additional use cases might include Agency/MD/Center-led initiatives, independent assessment teams, etc.

Interdependencies

There are several different initiatives currently in development at the Agency, which have expressed interest in establishing dependencies on the Schedule Database effort; identified *potential* interdependencies:

- Chief Program Management Officer (CPMO, David Mitchell) – Multi-faceted initiative with an explicit goal to expand collaboration with OCFO SID on strengthening Project Management performance. Provides an opportunity to build on the model-of-models approach using the Schedule Database as one such platform.
- Smart Projects And Reviews with Transformative Analytics (SPARTA, Jim Price) – Initiative to pilot a model-based P/p analysis that can automate the deliverables for Monthly Status Reviews, Life Cycle Reviews, etc. Provides an opportunity for SPARTA to establish a dependency of the Schedule Database for schedule information to support their automated review process.
- Digital Transformation/Enterprise Data Platform (DT/EDP, Charles Driessnack) – Initiative to build an Agency-wide analytic platform for any type of mission critical data (e.g., technical, programmatic, etc.). Provides an opportunity for the Schedule Database to be both a publisher and a subscriber to DT/EDP's master datasets.
- Game Changing Development (GCD, Mark Thornblom) – Initiative to integrate model-based analytics for 100+ technology projects. Provides an opportunity for GCD to adopt the mature schedule modeling of the Schedule Database, as well as contributing technical data sub-models to the overall effort.
- Organization-specific use cases (MD, Center, P/p, etc.) – Schedule Database can be customized and rapidly adapted to a growing array of organizations with scope focused on the individual organization. Provides an opportunity for different organizations to perform more detailed analysis that is specific to the organization's particular domain.

Impediments & Challenges

Pathfinding the Schedule Database capability puts this effort toe-to-toe with some of the infrastructure necessary for implementation:

- Buy-in from P/p:

- The Schedule Repository initiative was initially met with some resistance by P/p's because they were concerned about who might have access to schedule data while the P/p was still in development. This concern was resolved by clarification of the point that schedule data would not be made available to the broader NASA schedule community until the P/p was complete (e.g., launched or delivered). Because the Schedule Database is an extension of the original intent of the Schedule Repository, the same access restrictions are true for this initiative. Also, because the Schedule Database initiative will use Schedule Repository submissions as inputs to the database, there will be minimal to no impact to Programs and projects with respect to populating the database with schedule data.
- Schedule Database platform software challenges:
 - An Authority to Operate (ATO) for MS Project Online needs to be in place in order to transition files from the current PoC tenant to the new Schedule Database tenant. It is expected that this ATO will be in place prior to FY23. *Note: All enterprise software needs an ATO to be able to run on NASA computers.*
- Schedule Database user software transition challenges:
 - Schedule Database may require users to adopt new/alternate MS Project licenses:
 - MS Project Standard does not connect to a server, so it will not interface with the Schedule Database.
 - MS Project Professional will allow users access to dashboards and data in the Schedule Database at all levels according to their assigned "user role".
 - MS Project Essentials will allow users to "view" dashboards in the Schedule Database.
 - Schedule Database may require users to adopt new/alternate Power BI licenses:
 - Earlier this year, an ATO was issued at NASA for Power BI Pro, which is for individual user (publisher/consumer) use. Power BI Pro will allow users to create and publish reports from the Schedule Database. Pro users can share that content with other Pro users and consume content shared by others.
 - Power BI Premium is a dedicated capacity with unlimited publishing and sharing, meaning that the license covers all actual content (versus licensing on a user-basis). The Power BI application owner can allocate access to different applications for shared use. The content is stored in Power BI Premium and can be viewed by as many users as needed without additional cost.

This effort may drive organizational change per the necessary adoption of new and revised best practices and software that will facilitate both basic and enhanced capabilities. For instance, the intake processing of schedule files for database consumption is not a one-size-fits-all approach. This effort will require additional software and resources for the following:

- Tagging fields in the files with the appropriate information so that the files can read-in consistent with the Schedule Database metadata framework and format. The near-term intake or upload of schedule files will require additional resources to process the submission files.
- The database capability necessitates single-file schedule submissions, so integrating master schedule files with sub-files may require a 3rd-party software tool (e.g., FK&A Master Schedule

Consolidator Enterprise Edition and Companion Tools) and resources to ensure integration provides accurate results.

Defining user roles and security filters for all potential use-cases will require a phased approach (e.g., Center-by-Center, MD/P/p-by-MD/P/p, etc.).

- For all completed (launched or delivered) programs and projects, and per the Schedule Repository requirement, it is assumed that all schedule data will be made accessible to all users (with appropriate NASA permissions).
- For all in-progress programs and projects, rules will need to be defined for specific use cases associated with certain levels of schedule detail.

Required Resources

The Schedule Database PoC environment is on track to become operational by FY23. Along with this advancement, it has been determined that to implement the “next steps” in this plan, additional resources will be required depending on the Agency’s final strategy. The Schedule Repository requires:

- Additional 2.0 FTE/WYE (internal NASA support) and \$500k annually in contractor (services, licenses, maintenance, support, other direct costs [ODCs], etc.) support to:
 - Maintain/continue development of current Schedule Database capabilities at the Agency/HQ level,
 - Facilitate an automated process for the collection and metadata analysis capability of both NASA- and JPL-provided schedule data,
 - Initiate and facilitate individual use cases for other Centers/organizations/functions across the Agency to allow for specific use-cases employing the Schedule Database platform, and
 - Initiate and facilitate synergies with other Centers/organizations/functions across the Agency to allow for specific use-cases employing the Schedule Database as the platform for the development of integrated, model-of-models capabilities.
- Software required for minimum Schedule Database platform and user capability:
 - Platform Software:
 - MS Project Online – Required for MS Project Online-to-MS Project Online migration of project schedule files from the current PoC tenant to inside the new NASA Schedule Database tenant.
 - Power BI Premium – Required for mission critical, large scale, Agency-wide applications with broad user base, including external. Power BI Premium is needed to build the application and allows for add-on capabilities as the Schedule Database matures (e.g., greater model size, artificial intelligence, etc.).
 - Power BI Pro – Required for individual user (publisher/consumer) use.
 - Utilities Software:
 - FK&A Master Schedule Consolidator Enterprise Edition and Companion Tools – Required for consolidation of MS Project master-/sub-project files into one file for import into the Schedule Database.
 - Solution Software:

- FK&A Project Data Foundation and Dashboard Pack Cloud Edition – This provides the analytic model and dashboards of the Schedule Database.
- User Software:
 - MS Project Essentials/Pro/Premium – Specific software version required based on user role.
 - Power BI Pro/Premium – Specific software version required based on user role.

All software will require active maintenance and support.

The Corrective Action Plan Working Group (CAPWG) recommends that the level of adequacy for Schedule Database resources be assessed during the next logical PPBE budget formulation process and that the results of that assessment be reflected in the budget.

[Implement] Ensure Schedule Capability

Lead Executive/Organization

Office of the Chief Financial Officer

The Agency's Programmatic Analysis and Research Capability (APARC), under the Office of the Chief Financial Officer (OCFO), has a responsibility to progress the Agency's programmatic capabilities, including the PP&C function of Schedule Management.

Supporting Organization(s)

Mission Directorates (MD), Centers, Programs and Projects

Initiative Description

NASA will ensure the schedule capability across the Agency to improve Agency processes. At a minimum, this includes "right-sizing" the PP&C Schedule Management function to enhance the civil servant component for both in-line work and assessment reach-back capacities for inherently governmental work, as well as solidifying the career path development framework and associated training related to the Schedule Management function. This may also include the standardization of Schedule Management toolsets and templates for scheduling, schedule assessments, performance trending, analysis (parametric models, schedule risk analyses [SRAs], and JCLs), and reporting.

Background/Current State

In 2020, the Program Planning and Control (PP&C) Steering Group performed a research effort to determine if NASA's Schedule Management capability is sufficiently staffed. Findings from the research effort concluded that PP&C functions need subject matter experts (SMEs) with core skillsets in PP&C disciplines for implementation, review, and advocacy of the discipline. Specifically, findings highlighted that while the bulk of in-line Schedule Management work consists of scheduling and can almost always be appropriately staffed by Work Year Equivalent (WYE) workforce (i.e., contractor support), a portion of the in-line work and most of the assessment work is inherently governmental and therefore more appropriately staffed by Full Time Equivalents (FTEs), (i.e., civil servants). In general, inherently governmental roles and responsibilities within the Schedule Management function include oversight of the capability's implementation at the home Center and helping to staff Center- and Agency-led independent reviews. Unfortunately, the research also uncovered that there are very few civil servants performing Schedule Management functions throughout the Agency, and an even smaller number of individuals within that set whose day-to-day responsibilities are primarily (>50%) related to Schedule Management.

Example 1: Independent Assessment

In October 2015, the NASA Associate Administrator released a memo regarding a new model for the Independent Assessment of NASA Programs and Projects. The new model emphasized the involvement in independent assessment from talent across the Agency to enhance synergies and learning between diverse mission areas and to achieve efficiencies. It was noted that careful consideration needed to be given in staffing of Standing Review Boards (SRBs) with civil servant personnel to accomplish these objectives, while preserving the use of consultants when their expertise is required. Personnel with the prerequisite expertise performing in-line programmatic work in other projects or mission areas were to be “tapped” to provide SRB support and would “maintain review independence ensuring those NASA experts supporting a review are coming from a different chain of command.” OCFO would also provide qualified personnel to SRBs as needed.

Starting with the dissolution of the Independent Program Assessment Office (IPAO), independent assessment staff, including civil servant schedule analysts, were deployed “to their Centers to solve in-line gaps in programmatic analysis skills”. Although IPAO had purposefully made civil servant schedule analyst hires in early 2015 to enhance the Schedule Management capability in terms of independent assessment, not all programmatic analysts from IPAO moved to roles that allowed them to continue to support independent assessments (e.g., availability issues, etc.).

Over the past three years, the Agency averaged 28 reviews where schedule analysts had been assigned. Reviews generally require 2-3 months of FTE support, and up to 4-6 months when JCLs or two-step reviews are required. Overall, this would require between 6 and 7 FTEs. Data shows that there are only 2.95 FTEs currently supporting “Schedule Management – Assessment”, which equates to 12-14 reviews, or less than half of the support the Agency needs.

Example 2: In-line Work – Scheduling

The lack of civil-servant-led Schedule Management oversight available at Centers means that the Agency cannot confirm that best practices are being consistently applied across projects. This limits the insight available on correcting and addressing any shortcomings in scheduling implementation throughout the project life cycle, but especially in early development stages when planning the project work, estimating the project duration, and establishing the schedule baseline are key to the framework of a successful project.

In addition, the use of different scheduling methods and assessment tools across projects, mean that management reports for different projects may comprise differing levels of input maturity, resulting in differing levels of output reliability.

Data shows that the Schedule Management discipline’s FTE staffing levels are about 11% (15.3 out of 143.5) of the overall capability. Normalizing the data for those individuals that are not directly involved in the Schedule Community, FTEs only make up about 8.9% (12.7 out of 143.5) of the capability. The percentage of FTEs is further reduced to 8.2% (11.8 out of 143.5) when looking at those individuals whose “primary” function (>50% of time spent) is Schedule Management. This is in stark contrast with the Cost Estimating & Analysis and Earned Value Management disciplines, whose FTE makeup is 61% (67.4 out of 109.6) and 47% (22.9 out of 33.6), respectively.

Example 3: In-line Work – Schedule Risk Analyses (SRAs)

As the Agency continues to realize the value in performing probabilistic schedule risk analysis (SRAs) to help inform project decisions even prior to Standing Review Board (SRB) involvement at life cycle reviews, more analysts (both contractor and civil servant) are being requested to develop SRAs. While general guidance is included in Agency handbooks and general sessions have been held through the Agency’s Schedule Community of Practice (SCoPe) and the NASA Cost and Schedule Symposium forums, formal schedule assessment and SRA process and tool training offerings have not been made broadly available to the in-line workforce due to budget constraints. While OCFO is currently working to develop training to address the process aspects of schedule assessment and analysis, there is currently neither dedicated funding to support course development, nor the execution of the training courses once the courses are complete.

Expected Benefits of Implementation

This initiative may yield significant benefits and improvements including, but not limited to:

- Overall addition of discipline into the Schedule Management function/capability
- Easier access to and better communication with senior management
- Empowerment of scheduling SMEs to flag issues without fear of upsetting the “customer”
- Consistency in workforce (e.g., possibility of greater retention of civil servant workforce and associated skillsets and retention of corporate knowledge)
- Reduction of risk (e.g., reduce potential for conflict of interest, ensure appropriate staffing experience/availability with use of SMEs)
- Ability to provide on-going assessment and analysis rather than milestone driven reviews (e.g., an increase in metrics-based schedule assessments and schedule risk analysis to heighten awareness of schedule performance)
- Greater integration between disciplines (e.g., equal part of the team; civil service schedule resources tend to be more effective at bringing project teams and managers forward in thinking and working in an integrated fashion)
- Potential for analytical hubs around the Agency with the ability to more readily and frequently share schedule data and related insights and lessons learned
- Facilitation of consistency in input, processes, and outputs with the standardization of the minimum set of Schedule Management tools
- Reinforcement Schedule Management best practices and skill development through the PP&C Career Path Framework (e.g., training and competency models)
- Increased schedule management and assessment capabilities, thereby providing more consistent analyses and support, producing better schedule estimates

Recent Accomplishments

- The NASA Schedule Management Handbook was updated in 2020 to establish consistent Agency-wide best practices for the purpose of:

- Capturing recommended schedule management processes, methodologies, and techniques based on NASA-specific needs and lessons learned,
- Defining evolving Schedule Management products to be developed during each life cycle phase in accordance with the NASA requirements and policies, and
- Supporting workforce development and professional growth in the programmatic functional area of Schedule Management through definition of best practices and identification of the planning, development, and analytical skillsets and familiarity of tools associated with producing products that meet NASA requirements.
- Several Centers (e.g., LaRC and GRC) have, within the last several years, created and staffed new Schedule Management Lead positions within their PP&C organizations.
- Schedule Management Training Courses and Competency Model Framework:
 - The Schedule Management Competency Model Framework has been developed and incorporated into OCFO's Professional Development Framework (PDF).
 - Three Schedule Management courses are in development, with one having completed content.
 - The Schedule Management Competency Model, based on the Agency's Schedule Management requirements, guidance and best practices has been developed.

Planned Next Steps

- Develop a roadmap to ensure Schedule Management capability improvements in the Agency:
 - Enhance the civil servant component of the Schedule Management function
 - Work with previously identified Centers (from PP&C study) to determine plans forward for establishing civil servant Schedule Management position(s)
 - Leverage knowledge, position descriptions, etc. from Centers that already have civil servant Schedule Management positions
- Create an execution plan to enable optimized utilization of additional schedule subject matter expert FTEs to ensure the Agency's Schedule Management capability is effective
- Schedule Management and Relationship Tool (SMART):
 - Work is underway to add recent missions to the database for analogous project schedule comparisons and updating the associated schedule estimating relationships (SERs) for increased relevance in parametric estimating for new missions.
- Schedule Management Training Courses and Competency Model Framework:
 - Plans are in place to complete course content of 2nd Schedule Management course by 1st quarter FY2023 and have the course ready for deployment in Q2 FY2023.
 - Plans are in place to complete course content for the 3rd Schedule Management course by 1st quarter FY2024. The course should be ready for deployment in Q2 FY2024.
 - The Schedule Management Competency Model Framework is currently being referenced along with other PP&C functions' Competency Models for the development of the PP&C Integration Competency Model Framework, which will be added to OCFO's PDF.

Output and Outcome Metrics

Metrics include:

- Each NASA Center has a civil servant workforce with Schedule Management expertise sufficient to support Center-specific, inherently governmental activities, as well as on-going Agency-led activities, such as life cycle reviews (e.g., SRBs). At a minimum, each NASA Center has one civil servant Schedule Management Lead point of contact to support inherently governmental work activities.
- Schedule Management training courses are developed and maintained.
- Course instructors are identified and available to deploy training courses.
- Schedule Management training courses routinely deployed to meet the needs of the Agency.

Interdependencies

There are several different initiatives currently in development at the Agency, which either feed into or have a direct dependency on the Enhanced Schedule Capability initiative, including the Schedule Database CAP initiative, CFO University PP&C Training, and PP&C Career Framework Development.

Impediments & Challenges

Challenges include the lack of resources available to enhance the Schedule Management capability:

- Lack of civil servant resources to support inherently governmental work:
 - Center-led and Agency-led independent assessments (e.g., Source Evaluation Boards (SEBs), Standing Review Boards (SRBs), Independent Review Teams (IRTs), Performance Evaluation Boards (PEBs), etc.)
 - Center proposal developments
 - Technical Monitors on contracts – including the development of schedule requirements for Statements of Work (SOWs) and oversight of schedule-related contract deliverables
 - Center representation in broader PP&C communities
 - Center insight/oversight to guide and collaborate with contractor scheduling workforce to influence quality of schedules and adherence to NASA best practices and lessons learned
 - Oversight of scheduler staff assignments and ensuring Schedule Management activities are supported (e.g., Schedule Repository, WBS planning, schedule development, schedule assessment/analysis, integrated baseline review [IBR] support, training, etc.)
 - Help to establish, grow, and maintain competencies in Scheduling and Schedule Assessment (e.g., developing policies/guidance, approaches, tools, knowledge/skills), including the development of formalized training consistent with NASA-specific best practices
- Lack of funding available to develop, maintain, and provide training for tools/databases that contribute to the sustainment and enhancement of the Schedule Management capability.

Required Resources

To be successful, the Enhanced Schedule Capability requires an additional 6.0 FTEs (at pre-determined Center locations) and approximately \$500k annually for tool licensing and contractor support. Tool licensing and contractor support includes:

- Agency-enterprise license for MS Project Online (to promote consistency in tool version usage/capability and reduce overall price vs. current Software Center offerings).
- Continued development/enhancement of SMART; requires contractor support.
- Expand Acumen Fuse tool license (commercial off the shelf [COTS]) to include: 1) JPL, and 2) Fuse 360, which helps with schedule optimization.
- Acquire Agency-license for SSI Tools (COTS), which aids in critical path identification/visualization, as well as analytics cross-checks.
- Vendor-provided classes for in person Acumen Fuse training two times per year for the first three years.
- Vendor-provided classes for in person JACS training two times per year for the first three years.

[Implement] Enhance Standing Review Board (SRB) Implementation

Lead Executive/Organization

Chief Program Management Officer (CPMO)

Supporting Organization(s)

Mission Directorates (MDs), Office of the Chief Financial Officer (OCFO), Centers

Initiative Description

Strengthen the Agency's implementation of SRBs to improve independent assessments of major programs and projects in support of performance improvement.

Background/Current State

Independent assessments of life cycle reviews are conducted by an SRB throughout the program and project life cycle. Per NPR 7120.5F, Table 2-2, SRBs for Programs and large-scale projects are convened by the NASA AA, MDAA, Center Directors, NASA Chief Engineer, and NASA Chief Financial Officer. SRBs for smaller-scale projects are convened by the Mission Directorate AAs, Center Directors, and Office of the Chief Financial Officer. The members of the SRBs are independent of the program/project, and their resulting findings and recommendations are presented to the Decision Authority who makes the final decision on readiness for the program/project to continue to the next life cycle phase. The SRB reviews provide the program/project with a credible, objective assessment of their performance. The reviews also provide senior management an understanding of whether the program/project is on the right track; performing according to plan; identify opportunities to remove externally-imposed impediments to program/project success; recommend a schedule and funding level consistent with the JCL analysis; and provide a basis to inform the decision to proceed into the next life cycle phase.

Currently the program/project independent reviews and the SRBs that perform them are managed by the Mission Directorates with support from the Centers. The CPMO provides a focal point on behalf of the NASA AA to facilitate communication, expectations, NASA senior management stewardship, and synergy between different aspects of program management practices and capabilities to promote overall enhancement of program and project performance across NASA and to further mission success.

Expected Benefits of Implementation

Enhancements to NASA SRB implementation will improve the effectiveness of independent assessments; provide an opportunity to identify improvements; enable enhancement of the information to programs, projects, and Agency senior leadership to support performance improvement by serving as part of the basis to support key decision points throughout the program and project life cycle.

Recent Accomplishments

The CPMO recently initiated several enhancements as follows:

- Engage the SRB Convening Authorities earlier in the SRB team formulation:
 - NASA Associate Administrator (AA), along with the CPMO, takes a more active role in selecting the SRB Chair and team members.
 - Decision Authority/AA, SRB Chair and CPMO participate in a kickoff meeting to align expectations of the senior management (i.e, AA, Mission Directorate AA, Center Director).
- Establish list of SRB Chairs to expedite selection process.

Planned Next Steps

The CPMO will assess other potential enhancements to SRB implementation and determine next steps. This includes:

- Strengthen SRB practices by creating communications pathways between CPMO and SRB Chairs to discuss plans going into life cycle reviews and application of best practices on review content (Terms of Reference), conduct, added level of SRB insight, prediction, suggestions around performance, honest assessment of JCLs, etc.
- Develop a community of practice for SRB Chairs/Review Managers (RMs) and a pipeline for future candidate Chairs/RMs. Enable sharing of lessons learned through experienced Chairs/RMs.
- Assess engaging SRBs at key points in the lifecycle in addition to the life cycle reviews nominally conducted by SRBs. This could include potential SRB engagement during the life-cycle pre-formulation/formulation phase, and interim reviews between KDP-C and KDP-D when there is a long period of time between these two KDPs. Interim reviews have already been implemented on some human spaceflight programs and projects in the form of annual sync reviews.

Output and Outcome Metrics

- Expedite the selection of SRB Chairs by establishing a list of candidate Chairs.
- Enhance SRB Chair's understanding of NASA senior management independent assessment review expectations.
- Strengthen SRB practices via CPMO independent assessment (IA) stewardship and communication with SRB Chairs on application of best practices.
- Develop a community of practice and provide a conduit for future candidate Chairs and Review Managers through lessons learned and shared experiences.

Interdependencies

Coordination and support between the CPMO, SRB Chairs, MDs, OCFO, Centers, decision authorities (DAs, i.e., AA, MDAA), and OCE.

Impediments & Challenges

- Continuity of support and coordination from the organizations need to assess and/or implement the various aspects of this initiative.
- Leadership time to invest in SRBs.
- Availability of talented Chairs and Review Managers.
- Throughput of lifecycle reviews over time can overwhelm management of SRBs at AA and MDAA level.
- The Mission Directorates will continue to provide leadership in managing the IA review process and the Standing Review Boards. The CPMO will provide IA integration leadership to ensure proactive involvement and coordination with the NASA senior management for approval of IA approaches, products, and to provide stewardship for maintaining a strong Agency IA capability.

Required Resources

Effort and time associated with CPMO, SRB Chairs, MDs, OCFO Centers, DAs (i.e., AA, MDAA), and OCE to assess and/or implement the various aspects of this initiative. Additional resources may be required to support SRBs if engaged at additional key points in the life cycle beyond the life cycle reviews the SRBs currently nominally conduct.

[Implement] Increase Deep Space Exploration Systems' Transparency of Cost and Schedule (from 2020 CAP)

This initiative is carried over from the 2020 Corrective Action Plan, continuing with implementation until it can complete its planned next steps. It will be proposed for formal closure following the establishment of JCL-informed Agency Baseline Commitments for the Human Landing System, initial Gateway projects, SLS Block 1B, and Mobile Launcher 2. Text in this initiative remains static from the 2020 Corrective Action Plan.

Lead Executive/Organization

Human Exploration and Operations Mission Directorate (HEOMD)

Supporting Organization(s)

ESD/AES (including EGS/Orion/SLS/HLS/Gateway programs); OCFO SID; OCE; HEOMD RMO

Initiative Description

NASA will improve HEOMD's Deep Space Exploration Systems' transparency of cost and schedule for long term plans for human exploration. By making Agency Baseline Commitments for future capability upgrades, reporting through the annual budget process, and reporting performance against year-to-year operating plans, the data will exist to monitor risk and schedule, assess long-term affordability, and enable Congress to make informed budgetary decisions. This initiative will address multiple long-standing open GAO recommendations.

Background/Current State

In the 2018 Corrective Action Plan, NASA established an initiative to improve the overall internal portfolio analysis and planning of HEOMD. The 2018 HEOMD initiative (now retired) was instrumental in comprehensively synthesizing exploration planning to allow for cross-portfolio strategic assessments within the HEOMD. This 2020 initiative builds upon the previous initiative and specifically addresses the need for increased transparency of cost and schedule for Deep Space Exploration Systems.

HEOMD's Deep Space Exploration Systems feature multi-decadal programs with the goal of returning humans to the Moon and beyond to deep space, comprised of the Exploration Systems Development (ESD) and Advanced Exploration Systems (AES) enterprise-level organizational structures. ESD is responsible for programmatic and technical integration of the Space Launch System (SLS), Orion, and Exploration Ground Systems (EGS) programs. AES is responsible for similar integration of the Human Landing System (HLS) and Gateway programs. The Deep Space Exploration Systems programs are in different life cycle phases for the Artemis missions, with many programs executing multiple life cycles concurrently. In terms of the HLS and Gateway programs, these are currently in the Formulation phase and will make future commitments, as discussed in following sections. The ESD Programs are focusing on the Artemis I launch in 2021 and planning for subsequent missions, including the 2024 crewed lunar landing mission. The ESD Programs are also in the design cycle for SLS Block 1B capability upgrades, including Exploration Upper Stage and Mobile Launcher 2 (ML-2).

Since the last Corrective Action Plan, multiple contracts have been awarded within ESD and AES that incorporate better insight into and tracking of contractor performance. NASA has also since

implemented the 2018 ‘Enhance Earned Value Management Implementation’ CAP initiative to monitor the progress of contracts and report Earned Value metrics to the Agency on a quarterly basis.

Additionally, the Agency has recently completed several assessments related to the Artemis I and II launch dates. NASA has conducted an internal HEOMD assessment of the overall Artemis effort, of which SLS and EGS are key components. This assessment included a review of the schedule and technical approaches as well as systems engineering integration and program management. In parallel, NASA has performed an independent technical and programmatic assessment, including a joint cost and schedule confidence level analysis of the SLS and EGS programs to rebaseline per Agency policy. The results of these assessments have informed updates to the Artemis I and II launch planning dates.

Note that this initiative was written during the COVID-19 pandemic and does not include impacts to overall program planning and execution that may result from the pandemic.

Expected Benefits of Implementation

The initiative is expected to increase the overall transparency of cost and schedule for Deep Space Exploration Systems, resulting in:

- Improved cost and schedule performance across ESD/AES programs within Artemis.
- Increased trust and transparency by demonstrating ability to execute to plans and report to external stakeholders.
- Improved clarity of HEOMD major program expenditures for NASA’s planning and execution.

Recent Accomplishments

- The Deep Space Exploration Systems enterprises have recently enhanced reporting in areas such as:
 - Improved ESD Quarterly Program Status and Agency Baseline Performance Reviews (BPRs) with a focus on performance-to-plan schedule metrics and schedule risk identification.
 - Enhanced Earned Value Management implementation and reporting (completed 2018 CAP Initiative); ESD now reports EV metrics to the Agency on a quarterly basis.
- ESD and AES have recently compiled their Procurement Planning Landscapes across the enterprises that couple upcoming and projected contract and procurement milestones with contract status.
 - Recent major ESD contract accomplishments include improved contract structures to aid in tracking performance by mission for Orion and SLS and enable separate tracking of total development cost for Mobile Launcher-2:
 - Mobile Launcher-2 Design-Build Award (June 2019)
 - Orion Production and Operations Contract Award (September 2019)
 - Stages Production and Engineering (CS 3 – 12 and EUS 2 – 9) Letter Contract (October 2019)
 - Recent major HLS/Gateway contract accomplishments include:
 - Gateway Power Propulsion Element Contract Award (May 2019)
 - Gateway Logistics Module Award (March 2020)
 - Human Landing System Award of three contracts (April 2020)
 - Gateway Habitation and Logistics Outpost (HALO) Formulation Phase Contract Definitized (June 2020)
- ESD is implementing NASA/GAO contract management best practices, including monthly and quarterly reporting of EVM data to the Agency, structured approach to reduced

cost, incentives in contracts, and evolving to firm fixed price contracts when production has matured. ESD has:

- Separated out contract line-item numbers (CLINs) to allow for better tracking of cost on all new contracts and during contract actions
 - Shortened period of Fee Determination to 6 months
 - Included technical monitor information in fee evaluation
 - Coordinated fee determination at the Agency level
 - Updated contract areas of emphasis based in part on previous period of evaluation
 - Incorporated incentive fee into contracts
- NASA leadership rebaselined the EGS and SLS Programs, establishing new Agency Baseline Commitments for the EGS and SLS programs and an updated Artemis I launch readiness date to appropriately account for Artemis I costs (Orion's Agency Baseline Commitment is to Artemis II, so they were not rebaselined as part of this activity).
 - A joint cost and schedule confidence level analysis was performed for EGS and SLS as part of the rebaselining activity

Planned Next Steps

- Continue to refine reporting processes:
 - ESD will utilize production contract cost data and annual planning process to establish plans and monitor cost performance relative to the baseline manifest plans
- Further refine Procurement Planning Landscape products. Major upcoming procurement activities include:
 - Stages Production and Engineering Contract (SPEC) Award (CS 3 – 12 and EUS 2 – 9) (Targeted Award Date Q1 FY21)
 - Core Stage Engine – RS-25 Production Restart CLIN 4 - (Labor & Materials) (Targeted Award Date Q3 FY20)
 - Boosters Production and Operations Contract Award (Flights 4 – 9) (Targeted Award Date Q1 FY2021)
 - Orion Main Engine Award (Required for Flight 6 of Orion and beyond) (Targeted Award Date Q1 FY21)
 - Human Landing System Down-select planned for CY21
 - Gateway xEVA Project (including Suits, Vehicle Interface Equipment and Geology Tools) Contract Award (Targeted Award Date CY21)
- Establish future commitments:
 - Agency Baseline Commitments (including Joint Confidence Level analysis) for SLS, EGS and Orion programs' major capability upgrades over \$250M (SLS Block 1B, EGS ML-2, and Orion docking). Timing of commitments is dependent upon Block 1B configuration and manifest.
 - ML-2 Agency Baseline Commitment will follow SLS Block 1B requirements definition
- Evaluate changes to NASA's programmatic policies and existing performance reporting to improve transparency of program schedules, costs, and performance for multi-year, multi-cadence type programs:
 - Develop methods to track and report annual costs and cost variances to operating plans due to content or scope changes, which can be traced year-to-year.
- Prepare for upcoming Key Decision Points (KDPs):
 - KDP-D for Orion to update Artemis II cost and schedule estimates.

- Orion KDP-D will follow NASA’s updated Joint Confidence Level (JCL) Policy outlined in 7120.5E as a result of 2018 CAP Initiative implementation.
- The Gateway program will complete a Program Commitment Agreement (PCA), with cost and schedule estimates, to be formalized at KDP-1. Each Gateway project will develop a Joint Confidence Level analysis to inform an Agency Baseline Commitment at the Project level.
- HLS will develop a Joint Confidence Level analysis and Agency Baseline Commitment. HLS will further conduct Annual Program Status Life Cycle Reviews assessing adequacy of cost, schedule, technical maturity, and integration.

Output and Outcome Metrics

- Schedule performance-to-plan metrics for ESD programs reported through Quarterly Program Status Reviews and provided to GAO.
- Future reporting against ESD’s original Agency Baseline Commitment for Artemis I through Agency reviews and quarterly Office of Management and Budget (OMB) reports.
- Measure against future commitments for ESD capability upgrades above \$250M.
- The HLS/Gateway programs and projects will measure against future commitments once established.

Interdependencies

- HEOMD internal interdependencies between Program Planning & Control managers, HEOMD Resource Management Office, and HEOMD leadership team.
- Continued insight to NASA leadership through Baseline Performance Reviews, Agency Program Management Councils, and recurring communications with the GAO.
- Coordination with Office of the Chief Financial Officer Strategic Investments Division and Office of the Chief Engineer for oversight and analysis.

Impediments & Challenges

- The Agency is challenged in its ability to establish and track baseline costs and schedules given the uncertainty that arises from differing priorities of the Administration and Congress. Differing priorities may result in content changes, which will affect the program baselines.
- The current contract structures in place for ESD have proven difficult to track overall performance by individual missions. However, ESD is addressing these challenges by restructuring existing and future contracts.
- The structuring of firm-fixed-price contracts for Gateway and HLS may lend itself to limited contractor performance insight due to less defined reporting requirements. To address this challenge, the Gateway and HLS programs are partnering with the contractors to ensure the proper deliverables to adequately track performance. In addition, the use of Public Private Partnerships will limit the level of insight into cost and schedule.

Required Resources

- Resource impacts may be realized if NASA Procedural Requirement (NPR) 7120.5E updates or other Agency reporting add additional requirements that programs have not previously planned for (e.g., increased leading indicators, external commitments, or performance metrics).

[Pilot] Firm Fixed Price Data Collection

Lead Executive/Organization

Office of Procurement (OP), Office of the Chief Financial Officer (OCFO)

Supporting Organization(s)

Science Mission Directorate (SMD); Space Technology Mission Directorate (STMD); Exploration Systems Development Mission Directorate (ESDMD) and Space Operations Mission Directorate (SOMD); Aeronautics Research Mission Directorate (ARMD)

Initiative Description

NASA's strategic decision to increase the utilization of Firm Fixed Price (FFP) contracts especially for upcoming ESDMD projects will result in NASA having reduced insight into contract performance and loss of meaningful data for estimating future analogous projects. This initiative will support and enhance NASA's ability to collect programmatic data on Firm Fixed Price contracts to help inform current program/project progress and enable future estimating capabilities. This initiative addresses GAO's desire for NASA to continually improve programmatic and technical insight, especially for larger dollar missions.

Background/Current State

This FFP Data Collection initiative is not an effort to mimic cost oversight methods germane to a cost reimbursement contract. Instead, the FFP Data Collection initiative is designed to enhance the NASA Budget Life Cycle with an effective cost estimating function in support of 51 USC 30104: Baselines and Cost Controls and NPR 7120.5F, NASA Space Flight Program and Project Management Requirements.

FFP acquisitions are becoming more common for high value assets (e.g., Power and Propulsion Element, Human Landing System, etc.). As a result, NASA is not currently receiving adequate programmatic data from FFP procurements. This lack of insight hinders the Agency's ability to be a smart buyer for current contracts and utilize past investments for future estimating capability.

Programmatic data are vast and include such information as:

1. Program/project cost of major systems (both acquisition and operations) (e.g., performance, schedule, financial)
2. Technical performance data in the areas of testing (e.g., planning, activities, execution, results), engineering (e.g., schedule, technical and performance parameters, key performance parameters/key system attributes, engineering plans), earned value (e.g., contract data and assessments, supply chain metrics, systems engineering)
3. Contracts and contractor performance data (e.g., funding, small business status, subcontractor management)

The insight that programmatic data provides is important for developing cost estimating tools and needed to assess contractor performance and progress. Lack of data from FFP acquisition contracts hinders NASA's ability to develop realistic cost estimates for future FFP contracts and adequately assess risk posture.

Expected Benefits of Implementation

The initiative is expected to increase available data on large FFP contracts that is currently unavailable and will accomplish several key benefits:

- Enable NASA to better project future cost of projects using FFP acquisition contracts with improvements to parametric cost estimating.
- Assist in generating added value internal project monthly review metrics including improved BPR reporting metrics, increased risk informed decision-making.
- Bolstering the contract requirement for additional insight on FFP contracts will contribute to NASA's on-going efforts to improve programmatic performance and continue to enable NASA to be a "smart buyer" of hardware and services.
- Improve effective negotiations on future FFP contracts by using sound and reliable data. The newly available data will improve the source selection evaluation process and contract negotiation activities, all of which will help the OP to achieve fair and reasonable prices.
- Directly addresses GAO's desire for NASA to continually improve programmatic and technical insight especially for larger dollar missions.
- Improve NASA's acquisition management practices so all large procurements will provide useful performance information regardless of contract type.

Recent Accomplishments

This is a new initiative, so no prior work has been attempted around meaningful FFP data collection. To date NASA has initiated preliminary discussions with several Mission Directorates to collect inputs and to better understand challenges and impediments.

Planned Next Steps

NASA is proposing several actionable steps all of which will be refined as this initiative matures. There are two focus areas: 1) Pilot for two existing FFP contracts and 2) Actionable steps for new/future FFP contracts after the pilot effort. The steps below represent a notional plan:

Planned Steps to pilot existing FFP Contracts:

To proceed with this pilot initiative, NASA will engage with the Power and Propulsion Element (PPE) project and the Human Landing System (HLS) project to complete the following steps:

- a. Define Requirements by reviewing NASA Federal Acquisition Regulation (FAR), applicable NASA contract clauses and related DoD successes to draft notional 'Government Insight' clauses and 'Acquisition Information' clauses suitable for incorporation on existing contracts.

- b. Engage projects by working individually with PPE and HLS Procurement and PP&C teams to insert clauses and/or DRDs to implement pilot requirements and objectives.
- c. Support and assist with project engagements with respective prime contractors for PPE and HLS and all data collected through the pilot effort.
- d. Evaluate, analyze, and assemble appropriate metrics and methods to track progress and effectiveness of the described pilot initiative.
- e. Upon successful completion of pilot work, proceed with actionable steps for new FFP solicitations and FFP contracts. (See next Section)
- f. Complete lessons learned of the pilot initiative

Planned Steps for New FFP Contracts:

If the pilot effort is determined to be successful, the following actionable steps would serve as a notional framework to proceed for new FFP contracts. The specific path would be agreed to by key stakeholders before proceeding.

- New language will be incorporated into FFP acquisitions notionally titled “Contract and Project Life Cycle Management, Performance, and Insight” to convey how NASA will manage the FFP contract after contract award. This new language will initially focus on development procurements and will be included in draft solicitations for industry feedback, which will specifically give the Government more insight of the contractor’s *performance* rather than contractor *activity*.
- Develop and incorporate a new Data Requirement Description (DRD) with an accompanying Section H special clause to require contract performance and insight data. The DRD and Section H special clause can be used along with an assessment of the cost trade-off of having the contractor produce the data needed. Any Section H special clause should be forward looking and would not apply to existing contracts since contractors will demand consideration for changing the contract to generate and provide the data requested.
- Leverage outreach platforms to engage some of NASA’s major contractors for feedback regarding the initiative:
 - Leverage the acquisition planning process by using the Procurement Strategy Meeting (PSM) to ensure the appropriate programmatic data has been identified and is obtainable to fulfill project management insight needs and comply with NASA Procedural Requirements (NPR) 7120.5E, *NASA Space Flight Program and Project Management Requirements*.

Any actions taken for this initiative will follow established Agency decision processes.

Output and Outcome Metrics

A list of appropriate metrics and methods will be developed to track progress and effectiveness of the described initiative. Metrics will likely include percentages of large FFP acquisitions providing meaningful cost data, as well as metrics of data delivered under FFP acquisitions that will improve Parametric / Cost Estimating Relationships (CER).

Interdependencies

An interdependency exists between Office of Procurement, OCFO, the mission directorates, and the prime contractors. Specifically, a key predecessor is the prime contractor having an accounting system in place to support providing specific cost information to NASA.

Impediments & Challenges

- **Internal Objections:** The creation of special clause to require data submission under FFP could potentially increase estimated development costs for the project even though the likely increase would be minimal. There is a need to overcome possible perceptions by project management that there won't be value added to current project.
- **External Objections:** Vendors may not have the accounting system to support the requirement. Additional costs to comply, creation and submission of requirement would increase cost to FFP contracts. However, appropriate accounting systems are currently in place throughout the government contracting community, so the knowledge, expertise, and systems necessary to implement these changes is readily available.
- **WBS Level Objections:** NASA will need concise verbiage on what level of data is needed by contract, and NASA will encourage submission in the contractor's native format and provide the necessary understanding of the data so that NASA can subsequently map the data as necessary. Additionally, details need to be worked out on how to handle Contractor Furnished Property and cost incurred to vendor that was not part of contract value (e.g. risk dollars).

Required Resources

Based on historical acquisition reform studies on a contractor's compliance costs to do business with a federal agency, the FFP Data Collection initiative will generate an additional cost data point to be estimated within the development costs and life cycle cost of programs/projects.

The Department of Defense (DoD) has commissioned multiple studies to determine the additional costs DoD pays to contractors to cover the cost of complying with DoD-unique statutes and acquisition regulations beyond the cost in a purely commercial environment. More than any other study, the December 1994 study (*DoD Regulatory Cost Premium: A Quantitative Assessment*) conducted by the management consulting firm Coopers & Lybrand, is regarded as a landmark in acquisition reform research. According to the contractors surveyed, the agency-specific acquisition regulations increased the price DoD pays for goods and services by an average of 18 percent.

DoD's 18% cost premium may serve as a benchmark for civilian agencies. By inference, NASA is also currently paying some level of a cost/price premium to contractors to comply with NASA-unique contract terms and conditions. Within the context of the DoD studies and findings, the FFP Data Collection initiative will address the programmatic cost for both NASA and the space industrial base. It is anticipated that the initiative will provide new processes/policies that will be incorporated into the same acquisition and procurement business rhythm that is currently used for cost reimbursable contracts. The same FTEs/WYEs will be used with no additional layers of management insight/oversight, and no new institutional IT resources will be needed.

[Pilot] Realistic Proposal Cost Estimating

Lead Executive/Organization

Office of Procurement, Office of the Chief Financial Officer

Supporting Organization(s)

Mission Directorates

Initiative Description

Leverage National Reconnaissance Office (NRO) and Space and Missile Systems Center (SMC) (now known as the Space Systems Command) initiative that encourages bidders on NASA procurement actions to prepare proposals with cost estimates commensurate with historical performance in a format similar to what is required for an independent estimate. The pilot will be limited to production procurements.

Background/Current State

- Per federal procurement regulations, proposal cost estimates from current NASA bidders are evaluated on a probable cost basis, as opposed to a cost risk basis. Bidders are not normally asked to provide historical context, limiting NASA's ability to assess risk.
- The NRO and SMC have piloted a Realistic Cost Estimate (RCE) approach:
 - Aspects of NRO's success were based on:
 - Use of historical data spanning 40+ years.
 - Trained cost analysts being heavily involved in several cost panel roles (chairs, evaluators, advisors).
 - Technical panels comprised of engineers familiar with and accustomed to evaluating effort at the functional level.
 - NRO's tenets for success cautioned against using the RCE approach if historical data was not available.
- NASA's procurement community believes that RCE may only benefit hardware type procurements.

Expected Benefits of Implementation

- Long term goal is to reduce cost growth as a result of earlier, more accurate, estimates.
- Favorable GAO audits with goal of removing NASA from the High Risk list.
- Use of historical CADRe data, rather than the typical Independent Government Cost Estimates (IGCE), may reduce risk of incumbent advantage.
- Potential unintended benefit could be enhancing CADRe data with historical data provided by bidders.

Recent Accomplishments

- Reviewed NRO RCE Pilot Initiative presentation (dated April 2019 presented at the National Defense Industrial Association (NDIA)).
- Discussed Procurement perspective with HQ Cost Estimating Lead.
- Reviewed CADRe data to determine if historical data met NRO's recommendation.

Planned Next Steps

- NASA HQ Office of Procurement (OP) and the OCFO Strategic Investments Division will jointly identify an appropriate pilot acquisition.
- HQ OP will leverage OCFO SID historical data to prepare reliable independent government estimates for both services and products.
- OP and OCFO SID will jointly develop RFP language for RCE instructions and evaluation will be created.
- OP will coordinate with OCFO SID to create the evaluation criteria.
- OCFO SID will perform the evaluation of proposed RCEs.

Output and Outcome Metrics

Metrics to be determined after identification of pilot to track cost growth after award, measure reductions in proposal size, and measure reductions in proposal evaluation effort.

Interdependencies

- Working with Procurement to:
 - Modify sections L & M contract language.
 - Ensure Cost Estimating expertise is on the evaluation board.
 - Ensure awareness of solicitation process changes.
- Ensure legal review and concurrence.
- Ensure Civil Servant Cost Estimators are available to support effort.
- Ensure Procurement, SEB, and evaluation staff are trained in the RCE approach.
- Ensure/evaluate CADRe data to support historical data evaluation.

Impediments & Challenges

- If the contractor does not have historical data, then it will be difficult to obtain this information to evaluate.
- Use of CADRe for historical basis of estimate may require additional normalization analysis.
- NASA's Statement of Work's (SOWs) are sometimes vague (i.e. specific requirements are not known, organization wants flexibility to determine future requirements) which may immediately lead to scope creep, negating cost growth containment.
- Requirements often change immediately after award. Tracking the cost growth of an award based on RCE may be challenging as requirements rarely remain static.
- Identifying a suitable low risk hardware procurement to pilot.

- Requires comprehensive re-writes of traditional section L and M language related to cost volume and associated attachments.
- Changes to the procurement process may require a large learning curve across several roles (Chair, technical evaluators, cost estimating SMEs, and to the contractors bidding).
- NASA's ability to emulate NRO's success based on trained cost analysts heavily involved in the source selections, supplementing or serving in all roles of the cost panel (chairs, evaluators, advisors).

Required Resources

- Procurement Champion
- RCE Subject Matter Expert (SME)
- Civil Servant Cost Estimators
- CADRE data
- 2 FTE/WYE (HQ OP Internal NASA Support)
- WYE support for implementation (\$200K)

Appendices

Appendix A: Previous Corrective Action Plans & Completed/Closed CAP Initiatives

2007 Corrective Action Plan

NASA sees excellence in program and project management as a core capability and critical if the Agency is to successfully develop and operate technologies and systems for the human exploration of deep space; execute robust programs of robotic missions to monitor the Sun and Earth, explore the planets of our solar system, and observe the universe beyond; and continue to make aviation safer, more efficient, and more environmentally friendly. To that end, the Agency continually assesses how to manage projects and prepare people to lead. As a result, NASA's project management and oversight practices have seen significant improvement since the Agency was first added to GAO's High Risk List in 1990.

GAO originally designated NASA's acquisition management as a "high risk" area in its inaugural High-Risk List released in 1990, citing what was at the time considered a history of persistent cost growth and schedule delays in the majority of the Agency's major products. In 2007, NASA established a Corrective Action Plan consisting of five broad focus areas and seven tactical initiatives that provided an Agency-wide coordinated approach to improve NASA's program and project management activities. The initiatives included in the 2007 Plan were all successfully closed by the end of 2012, and GAO has acknowledged that considerable progress toward strengthening and integrating NASA's acquisition management functions resulted from those efforts. Both the 2015 and 2017 High Risk Reports credited NASA with fully meeting three of the five criteria for removal from the High Risk List (leadership commitment, action plan, and monitoring), as well as partially meeting the remaining two criteria (capacity and demonstrated progress).

A key milestone in the maturity of NASA's programmatic discipline was the Corrective Action Plan developed in 2007. The 2007 plan contained seven initiatives to address potential shortcomings in NASA's acquisition management practices. Those initiatives were: (1) Program/Project Requirements and Implementation Practices; (2) Agency Strategic Acquisition Approach; (3) Contractor Cost Performance Monitoring; (4) Project Management Training and Development; (5) Improve Life-Cycle Cost/Schedule Management Processes; (6) Integrated Enterprise Management Program (IEMP) Process Improvement; and (7) Procurement Processes and Policies. Six of these seven initiatives were operationalized by 2012 through the introduction of new requirements, policies, procedures, training, and other tools to improve how we manage our major acquisitions and ensure our workforce has the necessary associated tools. In 2014, NASA declared that the one outstanding initiative, Contractor Cost Performance Monitoring, was closed. This initiative was originally designed to improve the availability of contractor data to support performance monitoring of programs and projects. The initiative would have been accomplished through enhanced business systems and changes to the contractor cost reporting process. NASA performed analyses at that time to identify gaps in the existing key business systems and concepts and courses of action that could be implemented to address those gaps. As a result of this analysis, NASA and GAO agreed to replace the original objective, and instead instituted several process improvements designed to achieve greater insight into project performance, including contractor cost performance.

These operationalized initiatives have yielded the desired results for NASA's small and medium-class missions, though the Agency recognized that there was still work to be done. Specifically, that NASA needed to do better managing larger, more complex projects, which typically involve the development of a significant number of new technologies, greater risk, and early estimation challenges. The 2018 Corrective Action Plan described below was designed to build upon the successful legacy of its 2007 predecessor, ensuring that NASA continues to enhance its programmatic rigor while pushing forward with the activities that will be necessary to initiate a bold new era of discovery.

2018 Corrective Action Plan

In September 2018, Agency senior leadership determined that a new CAP was necessary to continue driving improvements in NASA's program and project management policies and processes. NASA's Associate Administrator (AA) and the Chief Financial Officer (CFO) jointly issued a memorandum to this effect on September 6, 2018, which can be found as an Appendix to the [2018 CAP](#). The memo required that a new Plan be in place by the end of the 2018 calendar year, and established a working group comprised of relevant experts from across the Agency to develop the initiatives. It also called for the creation of a Steering Committee to provide guidance to the working group at key milestones in the development process. Finally, top-level direction for the new Plan would reside with the NASA AA (in coordination with the CFO), with official approvals routed through the Agency Program Management Council (APMC).

On September 19, 2018, the working group held a kick-off and met or communicated daily throughout the development of the Plan. The working group considered a variety of inputs during the formulation of each of the individual initiatives that comprise the Plan. These inputs include, but are not limited to, previous GAO High Risk Reports, GAO's 2018 Priority Recommendations Letter, reports issued by GAO during its annual programmatic reviews of NASA's major projects, as well as internal analyses conducted by the Agency. Direction from NASA senior leadership, the advice of subject matter experts drawn from across NASA, and feedback from GAO were also considered. Agency-wide stakeholder review was conducted via the APMC community during November 2018, and the final document was approved at the APMC meeting on December 6, 2018.

The 2018 CAP represented an entirely new Plan identifying NASA leadership priorities aimed at improving the programmatic performance of NASA's acquisition management, recognizing that NASA was facing continued struggles in its management of large acquisition programs and that an opportunity existed to make improvements. The Plan was comprised of seven (7) initiatives to implement, one (1) initiative to pilot, and one (1) initiative to research:

- Initiatives to Implement
 - Enhance Earned Value Management (EVM) Implementation
 - Program Planning and Control (PP&C) Training Curriculum
 - Create Technology Readiness Assessment (TRA) Best Practices Document
 - Include Original Agency Baseline Commitment (ABC) for Performance-Driven Rebaselined Projects
 - Update Probabilistic Programmatic Policy

- Enhance Annual Strategic Review Process
- Improve Human Exploration and Operations Mission Directorate (HEOMD) Portfolio Insight and Status
- Initiative to Pilot
 - Create a Schedule Repository
- Initiative to Research
 - Enhance Implementation Indicators for Trends and Projections

The 2018 CAP also included three Areas of Emphasis around the subjects of improving governance of strategic acquisitions, improving risk assessment and concept definition in the early formulation phase, and contractually incentivizing high performance. Leadership wanted to emphasize adherence to current policies and practices in these areas to encourage improvements that better position the Agency to manage cost and schedule performance.

Significant progress was accomplished between the start of the 2018 CAP in December 2018, and the approved 2020 CAP in July 2020. Six initiatives were completed, one was closed and rewritten, and two remained in process at the end of the period. Enhancing EVM implementation and implementing the PP&C training curriculum were intended to be longer-term initiatives. The HEOMD initiative was closed and rewritten to better align the changes to GAO’s associated priority recommendations, and to clarify tracking and closure requirements. The remaining initiatives all successfully completed their plans of action as outlined.

2020 Corrective Action Plan

Per the approved 2018 CAP, NASA leadership pursued an update to the 2018 Plan in spring/summer 2020, timed to inform the GAO as they started their assessments for the 2021 High Risk Report. The working group was reformulated and the Program Management Improvement and Accountability Act (PMIAA) steering group also functioned as the CAP steering committee. The 2020 CAP carried over two existing initiatives from the previous 2018 initiatives while also adding four new initiatives. On August 11, 2022, the APMC Chair and NASA Associate Administrator Robert Cabana approved the closure of five of six 2020 CAP initiatives, as indicated below. The status of all six as of August 2022 is as follows:

1. Enhance EVM Implementation (from 2018 CAP)

Completed. NASA has achieved its stated goal of improving and strengthening the Earned Value Management discipline, working to foster a culture at NASA where EVM is accepted by programs and projects. All applicable projects are submitting EVM data to the EVM central repository. All applicable contracts use the Defense Contract Management Agency (DCMA) for contract EVMS surveillance or an equally effective method as outlined in the project plan that is consistent with the agency’s overall surveillance approach. EVM metrics are reported at the monthly Baseline Performance Review. Routine EVM surveillance has been implemented at the NASA Centers and at the Applied Physics Laboratory, Jet Propulsion Laboratory, and Southwest Research Institute. Moreover, the GAO in early 2022 closed the long-standing priority recommendation related to EVM that was first opened in 2012 in GAO report number GAO-13-

22. While the planned steps as described in the 2018 CAP initiative were all completed, the effort to sustain and further mature EVM is ongoing.

2. PP&C Training Curriculum (from 2018 CAP)

Completed. NASA has completed the initiative as written. A new course on the subject of “Agency Independent Assessments” will be available for enrollment in 2022. Additional courses continue to be developed to build out the curriculum that is reflective of the Agency’s best practices and methods, enabling the growth and strengthening of the Agency’s programmatic capabilities and bridging the gap between the current-state workforce and future-state workforce of highly trained analysts.

3. Implement Schedule Repository

Completed. NASA has successfully moved its Schedule Repository pilot project to implementation. In lieu of codifying the Schedule Repository requirements into a NASA Procedural Requirements document as described in the initiative, the Agency leveraged the June [2019 memo](#) from the Chief Financial Officer to fully implement the initiative with additional guidance provided in an associated [FAQ document](#). NASA streamlined the schedule submission and file collection process via three means: utilizing one interface for schedule submissions, performing data quality checks to provide feedback to submitters on schedule adherence to best practices, and documenting reporting compliance. The Repository now includes 13 quarterly snapshots of project schedules spanning July 2019 through July 2022 and is set to continue collection moving forward. The Schedule Database initiative in the 2022 CAP builds upon the now established Repository.

4. HEOMD ESD/AES Transparency of Cost and Schedule

Mostly completed, continued in 2022 CAP. NASA has improved the Exploration Systems Development Mission Directorate’s (ESDMD) transparency of cost and schedule for long term plans for human exploration by making Agency Baseline Commitments for capability upgrades, reporting through the annual budget process, and reporting performance against year-to-year operating plans. Data now exists to monitor risk and schedule, assess long-term affordability, and enable Congress to make informed budgetary decisions. ESDMD improved quarterly program status and Agency Baseline Performance Reviews with a focus on performance-to-plan schedule metrics and schedule risk identification. EVM implementation and reporting has been enhanced with EV metrics now reported to the Agency on a recurring basis. ESDMD has also separated out contract line item numbers (CLINs) to allow for better tracking of cost on all new contracts and during contract actions, shortened the period of Fee Determination to six months, included technical monitor information in fee evaluation, coordinated fee determination at the Agency level, updated contract areas of emphasis based in part on previous period of evaluation, and incorporated incentive fee into contracts.

NASA leadership established new Agency Baseline Commitments for the EGS and SLS programs, provided an updated Artemis I launch readiness date to appropriate account for Artemis I costs, and rebaselined the Orion program at its KDP-D, incorporating the Orion docking requirement. Joint Cost and Schedule Confidence Level (JCL) analysis was performed for all rebaseline activity.

ESDMD is on track to fully complete this initiative after implementing plans to establish Agency Baseline Commitments for the Human Landing System projects, Gateway program projects, and major capability upgrades including SLS Block 1B, Mobile Launcher-2. While the commitments have not been set, ESDMD will establish ABCs for these programs when the appropriate KDP is reached, effectively cementing a culture change representing the completion of this 2018 CAP initiative as written.

5. CADRe Cat III / Class D Enhancements

Completed. NASA has enhanced its Cost Analysis Data Requirements (CADRe) capability via implementing enhancements to collect robust technical and programmatic data for smaller Category 3 (Cat III) / Class D missions through expanded data collection efforts to all NASA space flight projects above a \$50 million life cycle cost threshold. 18 CADRe's have been captured for 13 Category 3 / Class D projects since the 2020 CAP was issued. This work has significantly increased the available information on smaller missions that will enable NASA to better estimate projects and contribute to NASA's ongoing efforts to improve programmatic performance and be a "smart buyer" of hardware and services. While the CAP initiative has been implemented and completed as written with positive results, it is at serious risk for sustainment due to the current fiscal outlook and associated budget constraints.

6. Risk Assessment and Financial Evaluation of Contractors

Completed. NASA has enhanced the competitive and sole-selection procurement processes by requiring an evaluation of the financial health, stability, and outlook of organizations under consideration prior to selection and contract award via [Procurement Notice 20-05](#) issued on September 21, 2020. The addition of NASA FAR Supplement (NFS) Subsection 1809.105-1, *Obtaining Information, Pre-Award Financial Capability Assessment*, implements new policy and guidance to strengthen the contractor responsibility determination process by performing a comprehensive financial capability assessment during the pre-award procurement process for NASA's most significant contracts for design and development programs and projects with a life cycle cost of \$500 million or more, or otherwise designated by the NASA Associate Administrator. This effort aligns with the FAR requiring the contracting officer to ensure a prospective contractor must have adequate financial resources to perform the contract.

Appendix B: 2022 CAP Steering Committee and Working Group Membership

Steering Committee	
David Mitchell	CPMO/Executive Champion
G. Michael Green	STMD/DAA for Management
Lisa Guerra	OA/Senior Technical Advisor to the NASA AA
J. Craig McArthur	OCFO SID/Performance Improvement Officer and Director
Lee Noble	ARMD/IASP Director
Ned Penley	ESDMD & SOMD/DAA for Management
Wanda Peters	SMD/DAA for Programs
Karla Smith-Jackson	OP/Deputy CAO and AA for Procurement
Working Group	
Kevin Gilligan	OCFO SID/Acting DPIO/CAP Team Lead
Stacey Brooks	STMD/Program Analyst
Tanye Coleman	SMD/Portfolio Performance Management Lead
Fay Collier	ARMD/IASP/Associate Director for Flight Safety
Patricia Daws	AFRC/OCFO/Business Program & Analysis Support
Vickie Gutierrez	JSC/Strategic Business Integration Office Manager
Charley Hunt	OCFO/Analyst
Alicia McPhail	ESDMD & SOMD/SIMD/Program Strategic Integration Supervisor
Andy Prince	MSFC/OSAC/PP&C Office Manager
Matthew Ritsko	GSFC/OCFO/Chief for Resources Management
Brian Rutkowski	KSC/Center Technical Integration
Curtis Smith	OP/Senior Procurement Analyst
Ellen Stigberg	OA/Program Executive
David Walters	OCFO/SPPM&R Branch Chief
Kiersten White	ESDMD & SOMD/SIMD/CESD Program Strategic Integration Deputy

Appendix C: Acronyms List

AA – Associate Administrator	ESD – Exploration Systems Development
ABC – Agency Baseline Commitment	ESDMD – Exploration Systems Development Mission Directorate
AES – Advanced Exploration Systems	EUS – Exploration Upper Stage
AFRC – Armstrong Flight Research Center	EV – Earned Value
AoA – Analysis of Alternatives	EVM – Earned Value Management
APARC – Agency Programmatic Analysis and Research Capability	EVMS – Earned Value Management System
APMC – Agency Program Management Council	FAR – Federal Acquisition Regulation
ARMD – Aeronautics Research Mission Directorate	FFP – Firm Fixed Price
ASC – Acquisition Strategy Council	FK&A – Friedrich, Klatt and Associates
ASM – Acquisition Strategy Meeting	FTE – Full Time Equivalent
ATO – Authority to Operate	FY – Fiscal Year
BI – Business Intelligence	GAO – Government Accountability Office
BPR – Baseline Performance Review	GCD – Game Changing Development
CADRe – Cost Analysis Data Requirement	GSFC – Goddard Space Flight Center
CAO – Chief Acquisition Officer	GRC – Glenn Research Center
CAP – Corrective Action Plan	HEOMD – Human Exploration and Operations Mission Directorate
CAPWG – Corrective Action Plan Working Group	HLS – Human Landing System
CER – Cost Estimating Relationship	HQ – Headquarters
CESD – Common Exploration Systems Development	IA – Independent Assessment
CFO – Chief Financial Officer	IASP – Integrated Aviation Systems Program
CLIN – Contract Line-Item Number	IBR – Integrated Baseline Review
COTS – Commercial Off the Shelf	IEMP – Integrated Enterprise Management Program
COVID-19 – Coronavirus Disease 2019	IGCE – Independent Government Cost Estimate
CPMO – Chief Program Management Officer	IMS – Integrated Master Schedule
CS – Core Stage	IPAO – Independent Program Assessment Office
DA – Decision Authority	IRT – Independent Review Team
DAA – Deputy Associate Administrator	JACS – Joint Analysis of Cost and Schedule
DCMA – Defense Contract Management Agency	JCL – Joint Cost and Schedule Confidence Level
DoD – Department of Defense	JPL – Jet Propulsion Laboratory
DPIO – Deputy Performance Improvement Officer	JSC – Johnson Space Center
DRD – Data Requirement Description	KDP – Key Decision Point
DT – Digital Transformation	KSC – Kennedy Space Center
EDP – Enterprise Data Platform	LaRC – Langley Research Center
EGS – Exploration Ground Systems	LCR – Life Cycle Review

MA – Management Agreement
MD – Mission Directorate
MDAA – Mission Directorate Associate Administrator
ML-2 – Mobile Launcher 2
MS - Microsoft
MSFC – Marshall Space Flight Center
NASA – National Aeronautics and Space Administration
NDIA – National Defense Industrial Association
NFS – NASA FAR Supplement
NPD – NASA Procedural Directive
NPR – NASA Procedural Requirement
NRO – National Reconnaissance Office
OA – Office of the Administrator
OCE – Office of the Chief Engineer
OCFO – Office of the Chief Financial Officer
ODC – Other Direct Costs
OMB – Office of Management and Budget
OP – Office of Procurement
OSAC – Office of Strategic Analysis and Communications
PCA – Program Commitment Agreement
PDF – Professional Development Framework
PEB – Performance Evaluation Board
PIO – Performance Improvement Officer
PM – Project Management
PMIAA – Program Management Improvement and Accountability Act
PMIO – Program Management Improvement Officer
PoC – Proof of Concept
P/p – Program/project
PP&C – Program Planning and Control
PPBE – Planning, Programming, Budgeting, Execution
PPE – Power and Propulsion Element
PPMB – Program/Project Management Board
PSM – Procurement Strategy Meeting
Q - Quarter
RCE – Realistic Cost Estimate
RFP – Request for Proposal
RM – Review Manager
RMO – Resource Management Officer
SCoPE – Schedule Community of Practice
SEB – Source Evaluation Board
SER – Schedule Estimating Relationship
SID – Strategic Investments Division
SIMD – Strategic Integration and Management Division
SLS – Space Launch System
SMART – Schedule Management and Relationship Tool
SMC – Space and Missile Systems Center
SMD – Science Mission Directorate
SME – Subject Matter Expert
SOMD – Space Operations Mission Directorate
SOW – Statement of Work
SPARTA – Smart Projects and Reviews with Transformative Analytics
SPEC – Stages Production and Engineering Contract
SPPM&R – Strategic Planning, Performance Management and Reporting
SRA – Schedule Risk Analysis
SRB – Standing Review Board
STMD – Space Technology Mission Directorate
TRA – Technology Readiness Assessment
USC – United States Code
WBS – Work Breakdown Structure
WYE – Work Year Equivalent
xEVA – Exploration Extravehicular Activity