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NESDIS PROJECT COST AND SCHEDULE STATUS TRACKING HANDBOOK

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1. Introduction

1.1. Purpose

This document defines the processes all National Environmental Satellite, Data, and Information Service (NESDIS) projects will follow to track progress against the approved project cost and schedule baseline, and report the current project status on a regular basis. In this document, the term “project” applies in the widest sense to include projects, programs, portfolios, and major initiatives.

The processes will be scaled to the size and complexity of the project, and may be tailored to meet the needs of the project and its management oversight authority. The organizational and planning processes described in NESDIS-HBK-1221.1, NESDIS Work Breakdown Structure Handbook, NESDIS-HBK-1222.1, NESDIS Project Effort and Cost Estimation Handbook, and NESDIS-HBK-1225.1, NESDIS Project Scheduling Process Handbook, are key enablers to the processes described in this handbook. All four handbooks work together to establish baseline standard management processes for NESDIS projects.

The hierarchy of related documents is shown in Figure 1.

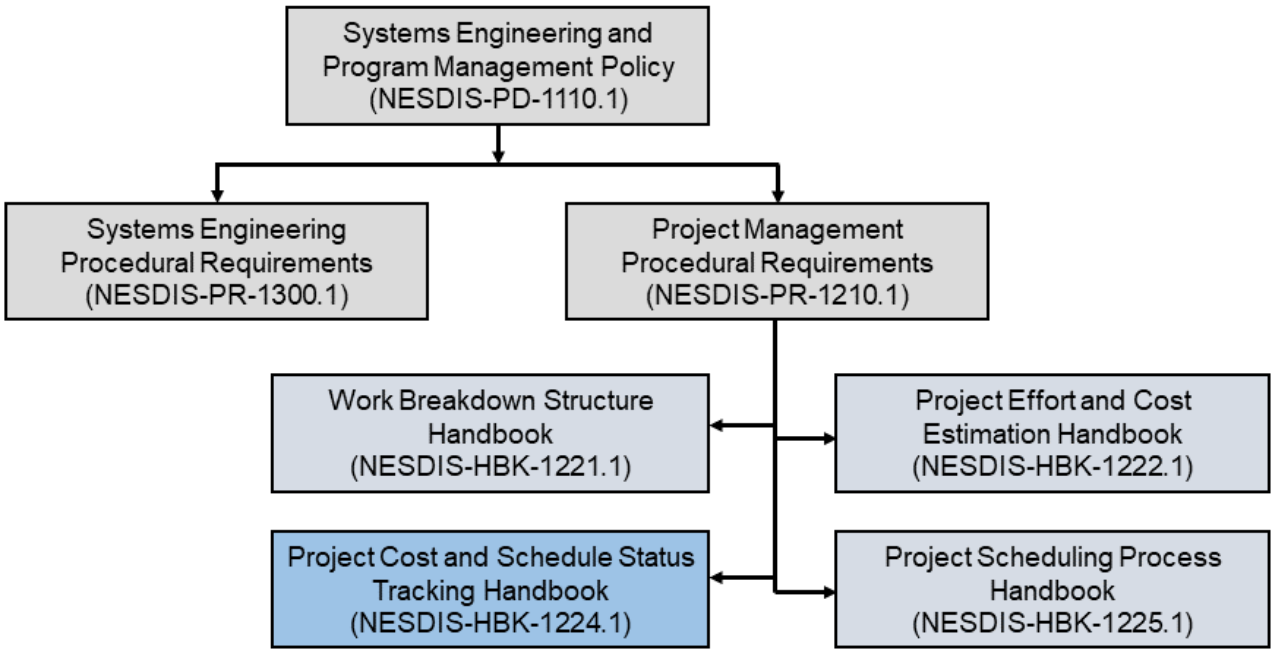

Figure 1: Hierarchy of Related Documents

1.2. Applicability

This handbook applies to all NESDIS Offices (as defined in Appendix A). It applies to NESDIS employees and NESDIS support contractors that contribute to project implementation or management. It applies to other contractors, grant recipients, or parties to agreements only to the extent specified or referenced in the appropriate contracts, grants, or agreements. NESDIS Offices may develop office-level processes that conform to this handbook, if needed.

The processes described in this document are applicable to all projects (as defined in Appendix A). For existing projects, the Director of the Office of System Architecture and Advanced Planning (OSAAP) may approve requests for variance allowing continuation of current practices.

The National Oceanic and Atmospheric Administration (NOAA) collaborates with many domestic and international partners to fulfill its mission. With OSAAP's concurrence, NESDIS Offices may tailor the processes of this handbook or follow the partner's processes. This document should be used as a reference to compare with the partner's processes to verify their completeness.

1.3. Authority

NESDIS-PD-1110.1, NESDIS Systems Engineering and Program Management Policy.

1.4. Applicable Documents

a. NESDIS-PR-1210.1, NESDIS Project Management Procedural Requirements.
b. NESDIS-HBK-1221.1, NESDIS Work Breakdown Structure Handbook.
c. NESDIS-HBK-1222.1, NESDIS Project Effort and Cost Estimation Handbook.
d. NESDIS-PR-1223.1, NESDIS Project Milestones Procedures Requirements.
e. NESDIS-HBK-1225.1, NESDIS Project Scheduling Process.
f. Terms of Reference (TOR) for the NOAA Program Management Council (PMC)/Joint NOAA-NASA Agency Program Management Council (APMC); June 7, 2018.

2. Roles and Responsibilities

2.1. NESDIS Management Oversight

The primary management body responsible for reviewing a project's status, as reported against its baseline, is determined by the complexity, visibility, and authority of the project. The management body is determined by the Milestone Decision Authority (MDA). Projects with smaller cost, duration, and/or scope might primarily report internally within their originating office. Projects with larger cost, duration, scope, and/or necessary support that span multiple offices may be required to report to NESDIS Management.

There are three project categories within NOAA (Table 1). These are defined in the Terms of Reference (TOR) for the NOAA Program Management Council (PMC)/Joint NOAA-NASA Agency Program Management Council (APMC). Category 1 projects are required to use Earned Value Management (EVM) per Federal Acquisition Regulations (FAR). The level of cost and schedule reporting required for Categories 2 and 3 projects will be determined by their respective management body.

Table 1: NOAA Project Categories

Program, Project, Activity Characterization	Category 1	Category 2	Category 3
National Significance	High	Medium	Low
Impact to NOAA's Mission	High	Medium	Low
Visibility	International/Public	National/Academic	Agency/Special Interest
Annual Obligation Authority	>$75M	$20M–$75M	<$20M
Lifecycle Cost	>$250M	$100M–$250M	<$100M
Asset Years (lifetime)	>10 years	5–10 years	<5 years
Complexity	High	Medium	Low
Coordination Level	Significant cross-cutting efforts required between international entities, national agencies, and commercial industry	Cross-cutting efforts required between agencies and Line Offices	Limited to a single Line Office or functional office within NOAA

Projects involving commercial procurements and/or commercial contracts should also consider the contract execution tracking needs of the Contracting Officer when establishing performance tracking processes. Within this handbook, the management body that project staff report to is the “project management oversight body”.

2.2. NESDIS Assistant Administrator

The NESDIS Assistant Administrator (AA) will define the methods to internally monitor the execution progress of all NESDIS projects at a cadence determined by the size, complexity, and impact of the project. This progress monitoring may be in addition to those defined by NOAA TOR or Department of Commerce (DOC) scalable acquisition.

2.3. NESDIS Office of the Chief Financial Officer

The NESDIS Office of the Chief Financial Officer (OCFO) is responsible for the oversight of all NESDIS funding execution. The OCFO defines financial reporting requirements for projects in support of this responsibility and coordinates with NESDIS Financial Management Centers (FMCs) to monitor execution. NESDIS OCFO monitors the utilization of resources, advises on resource alternatives, and identifies the management impact of resource allocation. NESDIS OCFO issues guidance for budget execution and ensures that DOC NOAA finance guidance is implemented throughout the FMCs.

2.4. Office of Systems Architecture and Advanced Planning

OSAAP is responsible for defining the project management requirements and standard processes for NESDIS projects, ensuring that projects comply with these requirements and processes, and approving any tailoring or deviations from these standards.

2.5. Program/Project Manager

a. The Project Manager (PM) has overall responsibility and accountability for executing the project to the cost, schedule, and technical baseline. This includes establishing the project Work Breakdown Structure (WBS), schedule, and Work Packages (WPs) that associate a budget and schedule with a particular task or portion of the work.
b. The PM is also responsible for reporting regularly and accurately on the status of the cost, schedule, and technical performance of the project.

3. Tracking Progress

3.1. Tracking Progress Against Cost

The cost (expenditure) prediction of all project tasks is determined during the Project Formulation Phase, when the project baseline is developed. The project cost baseline lays out how much cost the project is expected to incur against specific WPs making up the total project. Then, for all WPs completed to date, the cost the project incurs is measured against the costs it was expected to incur. WPs not started or not completed are not counted towards the expenditures.

It is the responsibility of the PM to track current cost-to-date information by gathering information from project teams and partners on how much funds have been expended to date. WPs involving equipment purchases, external services, or contracts will show cost in dollars; WPs based on personnel effort will show Full Time Equivalent (FTE) labor costs. Most WPs will contain a mixture of dollar costs and labor costs. Costs can be incurred by payments to subcontractors or Cooperating Institutes, purchases of hardware and/or software, and travel fund expenditures.

The PM will total all costs incurred to date and express that total in terms of their predicted "value" to the project in budget terms versus the actual budget spent.

Calculating the Cost Performance Index

The Cost Performance Index (CPI) is calculated by dividing the predicted total cost of work to date by the cost of completed work to date (CPI = predicted total cost of work to date ÷ cost of completed work to date).

For example, a PM has five WPs to roll up, each with a cost budget of $100,000. Only four are complete at the time of assessment, so their total value is only $400,000. Thus, $100,000 of budget for the fifth WP has not yet been "earned", so any extra budget spent against that task cannot be added to the total at the time of assessment.

If the spending on the five WPs to date has cost a total of $531,000, then the CPI is $400,000 divided by $531,000, or approximately 0.75. This indicates a 25% overrun on actual costs versus completed work. This shows the project is underperforming against the original cost prediction, i.e., the project is spending more funds than originally budgeted to achieve that set amount of work. Even if the final WP is partially complete, its value cannot be counted towards the total until it is fully complete.

In the above example, if it takes only an additional $50,000 to complete the final WP, then the CPI now becomes 0.86 (500,000 ÷ 581,000), or a 14% overrun on costs for completed work to date.

Projects with WPs that are longer in duration than one or two status assessment periods can face challenges in getting sufficient information on current project status. This could lead to schedule or cost overruns that are not evident until they are too late to correct. To compensate for this, WPs should not be more than one or two assessment periods in duration. If this is not

possible, interim schedule and cost milestones should be included in the WP as a percentage of the total cost. For Level of Effort (LOE) tasks, such as Project Management Salary, it should be assumed that the expenditure rate is constant for the entire WP.

3.2. Tracking Progress Against Schedule

Schedule progress is the second metric for calculating project performance. This shows progress through the schedule in terms of the project's level of completion versus the actual time spent to get to that point. Schedule expenditures can be determined by totaling the hours charged against WPs. The evaluation of schedule performance is dependent on an accurate estimation of the number of effort-days required to reach a certain milestone at the project's schedule estimation stage. The tasks contributing to the completed schedule cannot be counted until the task is fully complete. Ongoing tasks that are open-ended or do not have well-defined completion criteria can affect project performance against schedule, since they incur labor efforts spent without reaching their completion until much later in the project. Such open-ended tasks should be avoided.

Calculating the Schedule Performance Index

The Schedule Performance Index (SPI) is calculated by dividing the budgeted schedule of completed work to date by the actual schedule of completed work to date (SPI = budgeted schedule of completed work to date ÷ actual schedule of completed work to date).

For example, a project has taken 100 days to complete four WPs originally budgeted to take 80 days in total. A fifth WP predicted to take another 20 days has started and completed 5 days of effort. The SPI at that point in the project is 0.76 (80÷105). If the last WP is completed in 10 days, the SPI becomes 0.87 (100÷115).

3.3. Project Performance Evaluation

CPI and SPI <1 indicate the work is taking more resources in terms of cost or schedule than originally predicted. Values >1 show WP completion under budget (CPI >1) and/or within schedule (SPI >1).

By tracking costs spent on each WP in terms of dollars and labor, and comparing them to the original predictions, the PM can quickly determine how the project is performing compared to the original baseline. To be an effective measure, the project baseline needs to contain many small, distinct WPs with very clearly defined tasks of a finite duration, and a clear set of completion criteria to consider the WP "complete" and its costs "earned" by the project. Open-ended or indistinct WP should be avoided. WPs should be aligned to major milestones, such that CPI and SPI can be calculated at each major project milestone and show actual task progress compared to expected task progress according to that milestone. It is critical to have WPs with clear start and end points, each with a clear set of goals used to declare the task complete. An example of CPI and SPI calculations against WPs is shown in Table 2.

Table 2: Example CPI/SPI Calculations

WP Completed	Predicted Cost ($K)	Predicted Schedule (FTE-days)	Actual Cost ($K)	Actual Labor Days (FTE)	CPI	SPI
1.1	10	5	10	10	1.0	0.5
1.2	150	20	165	25	0.9	0.8
1.4	210	30	225	25	0.9	1.2
2.2	30	5	25	5	1.2	1.0
2.4	60	5	80	8	0.75	0.6
2.8	80	10	95	12	0.8	0.8
Total	540	75	600	85	0.9	0.88

The conclusion from the above example is that the project is overrunning by both cost and schedule.

3.4. Using Performance Indices in Project Management

It is the responsibility of the PM to execute the project to meet project objectives within the cost and schedule baseline. The cost and schedule performance indices help a PM with this task. For each execution shortfall indicated by a CPI or SPI <1, the PM should understand the reason for this shortfall. Then, the PM can plan how to recover from the shortfall. WPs that show a CPI or SPI >1 indicate available resources that can be used to offset shortfalls in other areas.

Cost and schedule estimating is not an exact science, so it is unlikely that WPs will consistently have CPI and SPI equal to 1. PMs should establish thresholds for CPI and SPI that will allow for a variance analysis. A variance analysis typically consists of three steps: root cause analysis, impact analysis, and corrective action. Each variance (i.e., a WP with a CPI or SPI outside of the threshold) should be examined until the root cause is determined, the impact of the variance is assessed and understood, and a corrective action is devised to recover from the variance.

The cost and schedule performance indices can also be used to forecast the cost and schedule of future work. If a project is running at a CPI of 0.8 and SPI of 0.7, it will complete at 20% over budget (cost) and 30% late (schedule) of the original predictions, if those performance levels hold throughout the project lifecycle. If these levels of CPI and SPI are

seen consistently through the early stages of the project, it is not unreasonable to expect that level of performance through the remainder of the project, and therefore predict cost and schedule overrun.

The CPI and SPI values become key metrics in any project re-baselining exercise, as past performance can be a predictor of future performance. Instead of asking for an arbitrary increase in funding and/or an extension to the project completion date, the PM can use CPI and SPI to show trends in the project performance to date. They can then predict what the final cost and completion date of the project should be by extrapolating the performance trends to date. As a project re-baselining exercise, the total project costs and schedule can be re-estimated, such that the tasks left to complete now track against new targets that reflect the level of performance of the project to date.

3.5. Other Cost and Schedule Metrics

In addition to CPI and SPI, there are other cost and schedule metrics useful to a PM in tracking and managing the cost and schedule performance of their project. The Estimate to Complete (ETC) is an estimate of either the cost or schedule needed to complete a defined scope of work. The Estimate at Completion (EAC) is the total cost or schedule to date plus the ETC for a defined scope of work. This scope can be a single task, all tasks within a budget year, or all tasks remaining for a project. PMs can use these estimates to keep track of annual or project-level budget performance.

Another key metric for the schedule performance is the critical path. The critical path identifies the shortest possible time to complete a project. It is expected that the critical path of the baseline schedule will be determined at the beginning of the project when the schedule is baselined. However, as the project progresses, especially if the SPI is less than 1, it is possible for the critical path to shift. A PM should keep track of the critical path and be aware when it shifts from one set of tasks to a different set of tasks.

4. Reporting Cost and Schedule Performance

The PM should evaluate and track the project's cost and schedule performance on whatever cadence meets their needs for managing the project. External reporting of the cost and schedule performance indices occurs at all major program reviews, as well as at any other reporting intervals required by the project management oversight body. The Project Management Plan (PMP) will identify the project management oversight body, the reporting interval for cost and schedule reporting, and the performance metrics required to be reported. At a minimum, projects track and report the CPI and SPI.

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Appendix A: Glossary

Baseline: An agreed-to set of requirements, designs, budgets, schedules, or documents for a project whose changes are controlled through a formal approval and monitoring process.

Critical Path: The sequence of linked activities in a project schedule that has the longest combined duration and captures the shortest possible timeline for project completion.

Cost Performance Index (CPI): An indicator of cost efficiency; it compares the cost value of completed scope of work against that actual cost spent to accomplish that scope of work.

Estimate at Completion (EAC): The expected total cost of a project when the defined scope of work has been completed and consists of the cost to date and the estimate to complete (ETC) of the scope of work remaining.

Estimate to Complete (ETC): The cost estimate of any remaining work to be completed on a project or a WP.

Milestone Decision Authority (MDA): The individual authorized by NESDIS to make important decisions for programs and projects under their authority.

NESDIS Office(s): A term used in the widest sense to include NESDIS Headquarters elements, NESDIS Operations and Acquisitions offices, the Center for Satellite Applications and Research (STAR), and the National Centers for Environmental Information (NCEI).

Process: A set of activities used to convert inputs into desired outputs to generate expected outcomes and satisfy a purpose.

Program: A strategic investment that has defined goals, objectives, architecture, funding levels, and a management structure that supports one or more projects.

Project: A specific investment that has defined goals, objectives, requirements, lifecycle cost, a beginning, and an end. A project yields products or services that directly address NESDIS' strategic needs. In this document, the term 'project' applies in the widest sense to include projects, programs, portfolios, and major initiatives.

Requirement: A statement that identifies a system, product, or process characteristic or constraint. A requirement statement must be clear, correct, feasible to obtain, unambiguous in meaning, and able to be validated at the level of the system structure at which it is stated.

System: The combination of elements that function together to produce the capability required to meet a need. The elements include all hardware, software, equipment, facilities, personnel, processes, and procedures needed for this purpose.

Tailoring: The process used to seek relief from in the implementation of requirements consistent with program or project objectives, allowable risk, and constraints.

Appendix B: Acronyms

AA	Assistant Administrator
APMC	Agency Program Management Council
CPI	Cost Performance Index
DOC	Department of Commerce
EAC	Estimate at Completion
ETC	Estimate to Complete
EVM	Earned Value Management
FAR	Federal Acquisition Regulations
FMC	Financial Management Center
FTE	Full Time Equivalent
LOE	Level of Effort
MDA	Milestone Decision Authority
NCEI	National Centers for Environmental Information
NESDIS	National Environmental Satellite, Data, and Information Service
NOAA	National Oceanic and Atmospheric Administration
OCFO	Office of the Chief Financial Officer
OSAAP	Office of Systems Architecture and Advanced Planning
PM	Project Manager
PMC	Program Management Council
PR	Procedural Requirements
SPI	Schedule Performance Index
STAR	Satellite Applications and Research
TOR	Terms of Reference
WBS	Work Breakdown Structure
WP	Work Package

Appendix C: References

a. Federal Acquisition Institute, Project Manager's Guidebook.
b. NASA Space Flight Program and Project Management Handbook, NASA/SP-2014-3705 (2015).
c. NASA Project Planning and Control Handbook, NASA/SP-2016-3404.
d. Project Management Book of Knowledge, Project Management Institute (5th Edition).
e. NASA Earned Value Management Implementation Handbook, NASA/SP-2018-599.
f. Office of Management and Budget (OMB) Circular A-11, Part 7, Planning, Budgeting, Acquisition and Management of Capital Assets.
g. SAE EIA-748D. Earned Value Management Systems.

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