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NESDIS Project Scheduling Process 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 develop an Integrated Master Schedule (IMS) and maintain a project schedule. In this document, the term 'project' applies in the broadest sense to include projects, programs, portfolios, and major initiatives.

The organizational and planning processes described in the NESDIS-HBK-1221.1, NESDIS Work Breakdown Structure Handbook, NESDIS-HBK-1222.1, NESDIS Project Effort and Cost Estimation Handbook, and NESDIS-HBK-1224.1, NESDIS Project Cost and Schedule Status Tracking 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 processes established in this handbook may be tailored to meet the needs and constraints of the project. The processes will be scaled to the size and complexity of the project.

The hierarchy of related documents is shown in Figure 1.

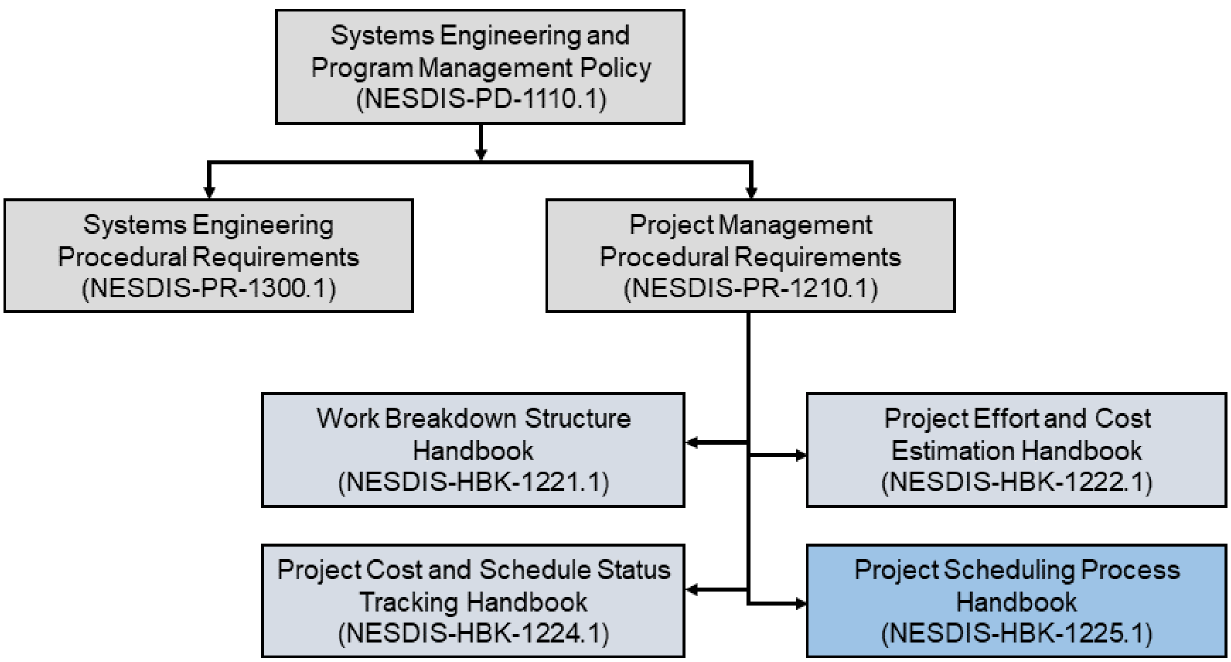

Figure 1: Hierarchy of Related Documents

1.2. Applicability

NESDIS-PR-1210.1, NESDIS Project Management Procedural Requirements, contains requirements relevant to developing and maintaining project schedules. This handbook provides guidance to Program/Project Managers in satisfying the NESDIS procedural requirements pertaining to project schedules.

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, and parties to agreements only to the extent specified in the appropriate contracts, grants, or agreements. NESDIS Offices may develop office-level processes (if needed) that conform to the processes in this handbook.

The processes described in this document apply to all projects as defined in Appendix A. They are not intended for pilot projects, demonstrations, and research efforts. For existing projects, the Director of the Office of Systems Architecture and Advanced Planning (OSAAP) may approve requests for a variance allowing the continuation of current practices.

NOAA collaborates with many domestic and international partners to fulfill its mission. With OSAAP's concurrence and mutual agreement, NESDIS Offices may tailor the processes described in this handbook or follow the partner's approach. 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-HBK-1224.1, NESDIS Project Cost and Schedule Status Tracking Process.

2. Roles and Responsibilities

2.1. 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 for approving any tailoring or deviations from these standards.

2.2. Program/Project Manager

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

3. Schedule Management

From the earliest stages of formulating and planning a project, it is critical to develop and maintain a project schedule at a level of detail necessary for determining project progress; managing the risk of not achieving project goals and outcomes, including deliverables, by their due dates; and clearly defining the required effort to achieve overall success. This handbook is intended to provide the necessary guidelines and recommended practices used to ensure schedule management is implemented adequately and consistently in each project across NESDIS. Project schedules should be fully integrated with the planned budget and technical content of each project for effective integrated project management and control. If the project involves international or interagency arrangements, other NOAA/NESDIS processes and policies may impact project schedules. As such, the Project Manager should work with the International and Interagency Affairs Division (IIAD) to ensure the schedule reflects those considerations.

All projects are not the same and may require different levels of schedule visibility, scrutiny, and control. Project type, value, and complexity are factors that typically dictate which schedule management practices should be employed. Project management should understand that the level of project control achievable is heavily dependent on the level of detail contained in the program schedule.

Project management scheduling software automates many of the standard schedule creation and maintenance processes and techniques. There are many types of project management scheduling software available. Examples include Microsoft Project, Milestone Professional, Jira, and Smartsheet, with each having different levels of functionality and ease of use. Project complexity and project management needs should dictate which tool is used for the project.

3.1. Initial Schedule Development

The first steps in developing a new project schedule include understanding the project work scope, developing a WBS, and understanding project funding dynamics. A WBS is a management tool that provides project structure and a framework for combining schedule development and financial management. The project's WBS Dictionary describes the content and scope of each element in the WBS. See NESDIS-HBK-1221.1, NESDIS Work Breakdown Structure Handbook, for guidance on developing a standard NESDIS project WBS. The structure and format of the schedule should be correlated and compatible with the WBS to enable project progress assessment and control.

Typical steps in developing a schedule aim to:

- Start with the project scope;
- Identify events, accomplishments, and criteria that make up the project (e.g., delivery date and start date);
- Identify the project WBS tasks and subtasks, and estimate the task durations;

- Identify task constraints and relationships with other tasks;
- Discuss and iterate among team members alternatives for task start and finish dates until one or more temporal flows are identified that feasibly support the project's delivery dates;
- Add appropriate schedule margin and contingency; and
- Determine and understand critical path and schedule risks.

Task definition begins with analyzing the project scope. Extending and detailing the WBS down to discrete and measurable tasks is the beginning of the project schedule. Starting with the approved WBS will not only help ensure that the total scope of work is included in the schedule, but also ensure consistency in the integration of cost and detailed schedule development.

The detailed tasks represent the individual portions of work effort that consume resources. These tasks are completed in support of each event or accomplishment that make up the overall program. The WBS task/activity level of detail should be sufficient to allow for a meaningful measure of progress and practical establishment of schedule logic relationships between the tasks/activities.

Constraints and task relationships are the logic that connects the various tasks on a schedule. Typical task scheduling relationships include:

- Finish-to-Start (FS): a link between the completion of one task and the start of another task. FS is the most common type of relationship in a schedule and Defense Contract Management Agency (DCMA) schedule guidance states that 90% of all relationships should be of this type.
- Start-to-Start (SS): a link between the start of one task and the start of another task.
- Finish-to-Finish (FF): a link between the finish of one task and the finish of another task.
- Start-to-Finish (SF) (rarely used): a link between the start of one task and the finish of another task.

Project schedules should minimize use of hard constraints such as "Must Start On," "Must Finish On," "Finish No Later Than," or "Start No Later Than." Hard constraints can hide impacts of schedule adjustments as the project proceeds through its lifecycle. Use of soft constraints (e.g., "Start No Earlier Than," "Finish No Earlier Than") should also be minimized.

Modern scheduling software packages can code in these constraints and relationships. These linkages can be immediate (i.e., on the day that the test finishes, start the data analysis task) or delayed by a lag time (i.e., start a test one week after the test readiness review completes). A lag in a schedule denotes the passage of time between two activities; it delays a successor activity but has no resources assigned to that passage of time. Lead time in a schedule is also called a negative lag; it can be used to accelerate a successor activity but also has no resources assigned to the time duration. An example of a lead time logic is to start Task B two days before Task A completes.

Activity durations should be realistic as determined by the person/organization that performs the activity. If the schedule does not support the target deliverable date, then the Project Manager and teams determine how to realistically compress the schedule, perhaps by adding more resources or adjusting the scope. If tasks in the schedule have artificially short or long durations, it could limit the Project Manager's insight into the schedule risk or schedule margin of the project and impede their ability to effectively manage the project using the project schedule. A good rule of thumb is that each activity should represent 20 to 80 hours of work. Also, activity durations should be no longer than the schedule's reporting period, which is nominally one month.

Schedule contingency is a separately planned quantity of time above the planned duration estimate reflected in the IMS. Schedule contingency should be clearly identifiable when included within a schedule, preferably as a single activity just before reaching the finish milestone. Schedule contingency, sometimes called "schedule reserve," is owned and controlled by the Project Manager. The Project Manager can allocate this contingency to contractors, subcontractors, partners, and others as necessary for their scope of work. For large and complex programs, the amount of contingency should be determined by a schedule risk assessment (SRA). For smaller and simpler programs, a general guideline is that 10% contingency is a high-risk approach, 20% contingency is medium-risk, and 30% contingency is low-risk.

Modern scheduling software can be used to complete an SRA to include minimum and maximum task durations. Shorter or simpler projects may not need the capability for this level of schedule analysis, but Project Managers for larger programs may find it useful. To complete the SRA, the capability must be built into the schedule from the beginning, as each task must be assigned not just a single, most-likely task duration, but also a minimum and maximum task duration. These potential task durations (minimum, most-likely, and maximum) represent the knowledge and experience of the person/organization responsible for completing the task. The scheduling software then uses these durations to do a statistical analysis of the most likely duration of the entire project schedule. The result is a distribution curve of project duration. The Project Manager should choose the level of risk appropriate for the project (i.e., 60% for a high-risk project or 80% for a medium-risk project) and identify the schedule contingency required to meet that level of schedule risk. This is the schedule contingency that should be added to the project schedule.

Schedule margin is the difference between the cumulative task durations for a project and the date by which the project needs to be completed. Schedule margin is intended to reduce the impact of missing overall schedule objectives. Margin is not the same as contingency; contingency is a specific amount of time that the Project Manager can allocate to specific activities as required by the risk assessment to manage the program schedule. Schedule is a measure of how much risk the project has in being completed by the date needed, and is not allocated by the Project Manager.

The project schedule's critical path is the sequence of linked tasks with the longest combined duration, thus capturing the most critical key elements to the project's success. The critical path identifies the shortest possible time to complete a project. Critical path analysis is a key management technique for understanding schedule risk and managing project resources to address issues that have the highest probability of affecting the overall project schedule. A project manager should be aware of the top three longest-duration paths at all times during the project lifecycle. These paths can become the critical path with a schedule slip to a task on the path or with early completion of a task on the critical path. This awareness will allow the project manager to identify potential problems and address them before they can delay the completion of the project.

3.2. Using a Schedule to Help Manage a Project

The detailed schedule guides the day-to-day execution of the project and is an effective tool for managing the project and insight into the progress of the effort. It is used to identify problem areas and help define priorities for management attention and action. Because actual progress can be compared to the planned progress, the IMS is key to providing performance measurement and evaluating remaining work scope and duration. The basics of project cost and schedule progress tracking are described in NESDIS-HBK-1224.1, NESDIS Project Cost and Schedule Status Tracking Process.

Identification and management of the critical path tasks are very important to project success. Managing the critical path tasks provides the opportunity to take timely actions necessary to preclude a schedule slip. If highlighted early enough, resources can be shifted from a non-critical path task to a critical path task, potentially avoiding a program slip. Conversely, completing critical path tasks ahead of schedule is the only way to complete the project ahead of schedule.

The amount of time an activity can slip before the program's date by which completion is needed is affected is known as "total float." Critical path activities by definition have zero float and, therefore, any delay in them generally causes the same amount of delay in the program's date of completion. Knowing the total float for every task and milestone in the schedule will provide management with insight into how each task impacts the project end date. Credible schedule management is not possible without proper analysis of float values.

As described in Section 3.1, schedule risk analysis is used to assess potential schedule risks and duration uncertainty, and to evaluate the schedule contingency needed. Most scheduling software has the ability to evaluate schedule risk with the inclusion of minimum and maximum task durations. Project Managers should weigh the value of the schedule risk analysis against the effort to include the necessary information for this analysis in the project schedule.

3.3. Characteristics of a Good Schedule

This section contains some general guidance for a good project schedule. These are not hard-and-fast rules; however, Program or Project Managers should make an explicit decision using sound logic if any of these guidelines are to be ignored.

The Government Accountability Office (GAO) Schedule Assessment Guide: Best Practices for Project Schedules, GAO-16-89G (December 2015) contains excellent guidance for producing high-quality project schedules. This guide identifies four characteristics of a high-quality, reliable schedule. A schedule should be comprehensive, well-constructed, credible, and controlled. More detail on each characteristic follows.

Comprehensive: A comprehensive schedule includes all activities to accomplish a program's objectives as defined in the program's WBS. It realistically reflects how long each activity will take and allows for discrete progress measurement.

Well-constructed: A schedule is well-constructed if all its activities are logically sequenced with the most straightforward logic possible. The schedule's critical path represents an accurate model of the activities that drive the program's earliest completion date. The schedule’s total float accurately depicts schedule flexibility.

Credible: A schedule is credible if it is horizontally traceable. That is, it reflects the order of events necessary to achieve aggregated products or outcomes. It is also vertically traceable in that activities in varying levels of the schedule map to one another, and key dates presented to management in periodic briefings are synchronized with the schedule.

Controlled: A schedule is controlled if it is kept current using actual progress and logic to realistically forecast dates for program activities. The baseline schedule and current schedule are subjected to change control. The baseline schedule represents the original program plan, including key stakeholder commitments, estimates for work, resource assignments, critical paths, and total float. The current schedule is updated from actual performance data and is the latest depiction of performance and accomplishments, along with the latest forecast of remaining dates and network logic. The current and baseline schedules are compared to track variances from the plan. Project Managers use this insight to target specific areas such as resource assignments, network logic, and other mitigation factors.

Some key questions to guide the development of a good schedule are as follows.

- Is there a valid critical path?
- Do all lowest-level tasks have both predecessors and successors? Exceptions might include initial and final tasks, Government Furnished Equipment (GFE), and deliverables not used by the performing organization. For these exceptions, consider using project start and end tasks as predecessor and successor, respectfully.

- Are there no hard constraints? DCMA guidance states that a robust schedule ideally has no hard constraints; in no case should the schedule have more than 5% of tasks with hard constraints.
- Are most soft constraints of the recommended finish-to-start type? DCMA guidance states that 90% of all relationships in a schedule logic network should be of the finish-to-start type.
- Do any tasks have excessive durations? Durations should be no longer than the schedule reporting period, which is nominally one month.
- Is all schedule float reasonable?
- Are all lead or lag times reasonable?

3.4. Changing the Schedule

Changes to the schedule are expected throughout the life of the project. Traceability from the original baseline schedule to the current schedule should be maintained in a disciplined manner. The original baseline schedule should be archived for references. Any changes to the schedule should follow a documented schedule change process.
This change process should include:

- The process for coordination and approval of a change;
- Identification of roles and responsibilities for the change;
- Identification of how the changes are monitored and controlled; and
- Procedures for how the schedule revisions are published and distributed.

Long-term projects can use rolling wave schedule planning. In this method, near-term tasks are planned to a lower, discrete level of detail. Near-term typically implies six months to one year from the current date. Tasks scheduled to occur beyond one year in the future may be planned at a more summary level of detail but should still be included in the schedule. These summary tasks, while reflecting less detail, should still provide enough definition to future work to allow for identification and tracking of the project critical path that flows to project completion. On a regular basis, tasks that come within the detailed planning window should be defined in a greater level of discrete and measurable detail.

3.5. Schedule Development and Maintenance for Agile Projects

The guidelines provided in this handbook are also applicable to Agile projects. The “Agile WBS” consists of a Release Plan with a certain number of Releases, each broken down into Iterations, which are further broken down into Features, and then Tasks. Sections 3.1 (Initial Schedule Development) and 3.4 (Changing the Schedule) are applicable for creating and maintaining the schedule, respectively. One key difference is that the Agile WBS is refined in an iterative, incremental manner as more is learned about the project and new features are added to the Release Plan.

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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.

Hard Constraint: A constraint that is non-negotiable. Every hard constraint should be respected while creating a schedule, as an activity with a mandatory start or finish date is anchored to that date. A schedule is unacceptable if a hard constraint not met.

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.

Risk: In the context of mission execution, the potential for performance shortfalls, which may be realized in the future, with respect to achieving explicitly established and stated performance requirements. The performance shortfalls may be related to any one or more of the following mission execution domains: (1) safety, (2) technical, (3) cost, and (4) schedule.

Requirement: A statement that identifies a system, product, or process characteristic or constraint. A requirement statement is 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.

Schedule Baseline: The approved schedule of a project. This represents the official program plan and the consensus of all stakeholders regarding the required sequence of events, task durations, resource assignments, and acceptable dates for key deliverables.

Schedule Contingency: A separately planned quantity of time above the planned duration estimate reflected in the IMS. Schedule contingency is based upon risk of executing a task intended to reduce the likelihood of missing overall schedule objectives.

Schedule Float: The amount of time scheduled activities can slip before impacting its dependent activity.

Schedule Margin: The time between the total duration of all project tasks and the required completion date of the project.

Soft Constraint: A soft constraint is negotiable, and exceptions can be made in rare cases. A schedule with a soft constraint that is not met is acceptable.

Stakeholder: A group or individual for whose need or mission a requirement or project is created. Also known as the “customer”.

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 PR requirements consistent with program or project objectives, acceptable risk, and constraints.

Traceability: A discernible association between two or more requirements, system elements, verifications or tasks.

Appendix B: Acronyms

CCR	Configuration Change Request
DCMA	Defense Contract Management Agency
FF	Finish-to-Finish
FS	Finish-to-Start
GAO	Government Accountability Office
GFE	Government Furnished Equipment
HBK	Handbook
IIAD	International and Interagency Affairs Division
IMS	Integrated Master Schedule
NCEI	National Centers for Environmental Information
NESDIS	National Environmental Satellite, Data, and Information Service
NOAA	National Oceanic and Atmospheric Administration
OSAAP	Office of Systems Architecture and Advanced Planning
PR	Procedural Requirements
SF	Start-to-Finish
SS	Start-to-Start
SRA	Schedule Risk Assessment
STAR	Satellite Applications and Research
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 Scheduling Management Handbook, NASA/SP-2010-3403.
f. GAO Schedule Assessment Guide: Best Practices for Project Schedules, GAO-16-89G (December 2015).
g. Department of Defense Integrated Master Plan and Integrated Master Schedule Preparation and Use Guide.
h. National Defense Industrial Association Planning and Scheduling Excellence Guide.
i. DCMA 14-Point Assessment for Project Schedule Health.

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