

3 CHAPTER 3

3.2 TAILORING, SCALING, AND PROGRESSIVELY ELABORATING

This section gives an overview of the process for tailoring, scaling, and progressively elaborating Major Facility and Mid-scale RI management plans for each life cycle stage based on the nature of the proposed activities, the proposer's initial experience and background, and the life cycle stage. The sections dedicated to each life cycle provide detailed discussions with specific guidelines and best practices for tailoring, scaling, and progressively elaborating life cycle plans.

NSF recognizes that the unique nature of the activities under these awards and the related efforts, as described in these plans, should inform how the Awardee approaches its planning and management. A one-size-fits-all approach to development and management can be overly burdensome on smaller efforts and might cloud the objectives for more extensive, complex efforts. Therefore, the ability to select (*tailor*) and adjust (*scale*) the proper management methodologies, which will also aid in establishing the appropriate level of NSF oversight, should be based on the effort's characteristics and allow the managing organization to mature as well. This approach by NSF does not negate the use of project or program management good practices or any requirements established in the funding announcement or the eventual terms and conditions of the award. Instead, it allows Awardees to use their judgement when proposing to NSF and for NSF to apply the appropriate level of oversight with the without reducing rigor. Such flexibility is essential to avoid over-implementation and undue burden on the Awardee's life cycle stage management methods. The ability to progressively elaborate management methods and life cycle plans helps avoid falling into over-implementation early on, as well as present documents to NSF for review that align with project maturity, knowing full well that they will improve with time. This section provides general guidance for tailoring, scaling, and progressively elaborating concepts. These concepts are defined as follows:

1. **Tailoring:** The process of selecting an appropriate framework to define and organize the scope, management, organization, schedule, cost detail, and performance measurement methods.
2. **Scaling:** The process of adjusting the level of detail, degree of formality, tools, and management processes to the characteristics of the planned work and the performance processes.
3. **Progressive Elaboration:** The process of iteratively increasing the level of detail and sufficiency in a life cycle management plan as more accurate information becomes available, commensurate with project or science support program maturity.

3.2.1 Tailoring

When tailoring, Awardees select management models and structures that match the proposed activities. For example, the details in the Concept of Operations (ConOps) Plan presented in the Annual Work Plans (AWP) for the Operations Stage is expected to vary significantly from the ConOps Plan presented in the Design Execution Plan (DEP). However, the ConOps Plan presented in the final evolution of the Project Execution Plan (PEP) for the Construction Stage should transition very closely to what is presented in the first year AWP. Most life cycle management plans and methods fall into three major types, but the resulting plans can be a hybrid of those types. The three types are:

1. Traditional waterfall approach that is product oriented.
2. Cyclical approaches that are team- and process-oriented.
3. Level-of-Effort activities that are service-oriented.

All three employ acceptable methods for managing Major Facilities and Mid-scale RI throughout their life cycles, as long as the methods are well-matched to the activity's characteristics, the life cycle stage, and the institutional culture and experience. The sections below are intended to provide guidance on how the life cycle management plans and methods should be described and documented.

3.2.1.1 Traditional Waterfall Approach

Traditional waterfall project management methods are suited to efforts that can be divided into work plans or phases with well-defined deliverables having concrete timelines and sequencing of events. Significant constraints on time, scope, and cost are well understood and can be easily documented. Work flows logically from one phase to the next. Teams are organized hierarchically with clear authorities, roles, and responsibilities and work linearly toward set goals. Work is complete at the end of each work plan and does not repeat.

While not the only methods, earned value management (EVM) is commonly used to track performance and inform management decisions. See Section 4.5 Monitor Progress Against Plan for further information.

Construction and demolition, for example, are traditionally structured for waterfall project management practices. The method can also be applied to design and development activities and to software programming, although cyclical methods are often preferred for the latter. Still, any shortcomings must be recognized and accommodated with adaptations that ensure proper management insights and status reporting. See Chapter 2 NSF Life Cycle Oversight for further information regarding project reporting.

3.2.1.2 Cyclical Approach

Cyclical project management methods are particularly suited when a detailed path toward the final goal is uncertain or where the significant constraints are not initially well understood. Cyclical approaches assume that the goal will be achieved in several iterative, short cycles rather than linear, as in waterfall methods. Efforts that evolve in time or do not

initially have a clear scope and requirements and/or require teams to work closely on numerous interdependent tasks are good candidates for cyclical management methods. Examples include IT efforts, research and development of new products, and commissioning activities (tests, trials and acceptance) as part of the Construction Stage. .

Agile is one such cyclical method, initially designed for software development project management, that can be applied to many types of projects. Within Agile frameworks, multi-disciplinary teams work cooperatively in stages to model solutions, incorporate feedback, and adjust scope as needed throughout the project life cycle. Analysis, design, implementation, and testing are repeated within each cycle. Rather than employing hierarchical organizational structures, an Agile framework is often matrixed, with team members adapting their roles as needed. Performance management is based on cycles rather than deliverables.

The Government Accountability Office (GAO) *Agile Assessment Guide*¹ offers best practices at a high enough level to be used for any incremental development program, regardless of what type of product or service is being delivered. Agile is not right in all environments. Managing organizations should spend time upfront assessing the environment and culture to determine readiness to employ Agile processes. See Section 5.10 Agile Guidance for more information.

3.2.1.3 Level-of-Effort Approach

Level-of-Effort (LoE) is a method in which staff or vendors provide a variety of services that span long time frames and where progress is typically tracked through monthly salary or periodic invoicing (also known as cost-weighted milestones), rather than discrete tasks and activities. Since the performance measurement is focused on cost-weighted milestones, EVM may not be the most valuable method for performance management if the project or program is composed mainly of LoE activities. However, LoE activities can be smaller components of larger projects that are using EVM if earning rules are appropriately applied.

When tailoring a management model, consider that the Level-of-Effort approach can be suited for project management staff, service contracts, and multi-disciplinary teams that share roles on a limited number of tasks.

3.2.2 Scaling

When deciding on the appropriate approach to scaling, it is important to consider the project or program characteristics. The appropriate scaling level will emerge by matching the characteristics to the level of detail, degree of formality, tools, and management processes needed for success.

1. **Level of detail.** Simple projects or programs might only develop the Work Breakdown Schedule (WBS) to Level 3, which is considering the minimum by industry good practice. In contrast, large construction projects may extend to WBS

¹ <https://www.gao.gov/assets/gao-20-590g.pdf>

Levels 5 or 6 to capture the work packages in the appropriate detail for cost estimating and monitoring performance.

- Control accounts, where scope, budget, actual cost, and schedule are integrated and compared to earned value for performance measurement, should be set to minimize accounting efforts while providing insights into status and issues.
 - Schedules should be developed and tracked appropriately to track work packages accurately. This *right level* for achieving an appropriate or optimal standard for capturing and reporting will vary depending on the scope of work. For example, procurement efforts might have a less detailed schedule than one involving design, prototyping, demolition, and construction activities.
2. **Degree of formality.** The degree of formality built into processes and plans is an important consideration since too much process can detract from the real focus of project management. For example, on a Mid-scale RI design effort an appropriate change control plan might be a simple change log authorized by the Project Manager. On a Major Facility project, it is generally a formal process with tiered thresholds for authorization (including NSF approval), change request forms, reviews by Change Control Boards, and controlled implementation. These are both appropriate given the scale of the project and the size of the project management teams.
- **Tools.** A spreadsheet with cost-weighted milestones may be adequate for simple, straightforward project or program for cost and schedule tracking. More complex projects may need commercial software to develop and maintain resource-loaded schedules and perform variance analysis.
 - **Management processes.** Performance management processes also have varying degrees of formality. For example, NSF oversight requires a Major Facility to have an EVM system that is verified, accepted and has period surveillance reviews during construction. In contrast, a Mid-scale RI implementation project electing traditional waterfall methods can use an EVM system using its own institutional standards or something as simple as weighted-milestone tracking. (See Section 4.5 Performance Measurement and Management for details). For operations, the management process may be handled through routine activity status reporting to NSF with actual costs against the proposed budgets for each operational WBS element.

3.2.3 Progressive Elaboration

The progressive elaboration process refines and advances planning of activities from initial, high-level, rough plans to detailed, mature plans as they pass through life cycle stages, review process milestones such as stage-gate reviews during the Design Stage, or internal readiness reviews. The progressive elaboration of plans is both necessary and expected, not only because of the maturity of the project but also the nature of the project or program itself.

For example, in Agile methodology for performance measurement and management, prototypes support the concept of progressive elaboration because they are used in iterative cycles of mock-up creation, user experimentation, feedback generation, and prototype revision to reduce risk. Rolling wave planning, which involves detailed planning (work package or equivalent) for near-term efforts and more summary-level planning (planning packages or equivalent) for subsequent attempts, may also be considered a type of progressive elaboration that increases detail for near-term work.

Consider design efforts for Major Facilities in the Conceptual Design Phase or a pre-proposal for a Mid-scale RI based on the funding announcement. The level of detail might have the following characteristics:

- Budgets are based on parametric estimates or determined top-down.
- WBS and schedule might be only at Level 2 or 3.
- Management processes and organization for the Construction Stage or implementation may be in early development.
- Initial risk analysis is preliminary and might be qualitative.
- A process describing how further plans will be developed or matured would be outlined in the Design Execution Plan.

As the design progresses and the Construction Stage or implementation nears, more details are provided through the Final Design Phase or the Mid-scale RI full proposal. The level of detail will have been progressively elaborated to show the following characteristics:

- Detailed WBS and dictionary in the latest Project Execution Plan.
- Bottom-up budget estimates with a robust GAO-compliant Basis of Estimate.
- Detailed schedules, time-phased budget, and funding profile.
- In-depth risk analysis and risk exposure estimate used to set contingencies.
- Management plans are fully developed (change control, cost estimating, cyberinfrastructure, etc.), scaled and tailored to project complexity.

Some planning cannot be completed until after the Construction Stage or implementation has begun, for example:

1. Process for Quality Assurance/Quality Control (QA/QC) should be well defined, but specific plans may need to be developed later.
2. Refined commissioning plans may need to be informed by test results.
3. Some late-stage WBS elements may still be at the planning package level.