

Through the Eyes of an Auditor

Overview of GAO Best Practice Guides and Audit Results

Karen Richey

Former Assistant Director for GAO's Applied Research and Methods Team

May 9, 2019

GAO OUTLINE

- Overview of GAO
- GAO's Best Practices Guides
- Audit Results



The Role of GAO in Government

Known as the investigative arm of Congress, GAO exists to support Congress in meeting its constitutional responsibilities.

To that end, GAO works to

- Help improve the performance of federal government
- Ensure government agencies and programs are accountable to the American people
- Examine the use of public funds, and
- Evaluate federal programs by providing analyses and recommendations to help Congress make informed oversight and funding decisions



Importance of Best Practice Guides

- Legislators, government officials, and the public want to know
 - Whether government programs are achieving their goals
 - What these programs are expected to cost and when they will be finished
- Developing reliable program cost and schedule estimates are critical to
 - Effectively using public funds
 - Meeting OMB's capital programming process
 - Avoiding cost overruns, missed deadlines, and performance shortfalls



GAO Best Practice Guides

- Purpose of the Guides are to
 - Address best practices for ensuring credible program cost and schedule estimates for both government and industry
 - Provide a detailed link between cost estimating, scheduling, and EVM
 - OMB has endorsed EVM for measuring cost, schedule, and technical performance
 - Guide demonstrates how realistic cost and schedule estimates are necessary for setting achievable program baselines and managing risk
- GAO develops best practice guides to
 - Establish consistent best practices that can be used across the federal government
 - Provide auditors with a standardized approach for analyzing program costs, earned value management (EVM) data, and schedules

GAO Development of Best Practice Guides

- GAO seeks input from a wide range of experts, starting with planning and design through report development
- Guides are developed through an iterative, consultative process which involves a committee of experts in the related domain(s)
 - Members are from government agencies, private companies, independent consultant groups, trade industry groups, and academia
- Expert meetings are open to anyone with the requisite experience and interest in the topic
 - Meeting minutes are extensively documented and archived after review by the GAO team and all participants

GAO's Published Best Practices Guides

- GAO Cost Estimating and Assessment Guide:
<http://www.gao.gov/products/GAO-09-3SP>
- GAO Schedule Assessment Guide:
<http://www.gao.gov/products/GAO-16-189G>
- GAO Technical Readiness Assessment Guide:
<http://www.gao.gov/products/GAO-16-410G>

GAO Cost Guide Update Schedule

- GAO Cost Guide is now 10 years old (final version published in March 2009) and is in the process of being updated
 - March 2016 : Formal announcement to experts that the update was underway
 - June–July 2016: Collected comments on current guide
 - August 2016: Started incorporating comments and updating draft guide
 - December 2019: Publish updated cost guide (TBD)

- Improved definitions of criteria and leading practices based on
 - Lessons learned over 10 years of application
 - Latest industry and government practices
- Updated references to existing laws and federal guidance
- Updated integration with Schedule Guide, Tech Readiness Guide, Software Agile Guide, and Standards for Internal Control
- Modernized graphics and new case studies

- The Guide consists of 20 chapters with supporting appendices
 - Chapters 1-17 address the importance of developing credible cost estimates and discuss in detail a 12 step cost estimating process for developing high quality cost estimates
 - Chapters 18-20 address managing program costs once a contract has been awarded and discuss
 - EVM
 - Risk management
 - Other program management best practices
- The Guide also provides case studies of prior GAO audits to showcase typical pitfalls that can occur in the cost estimating process

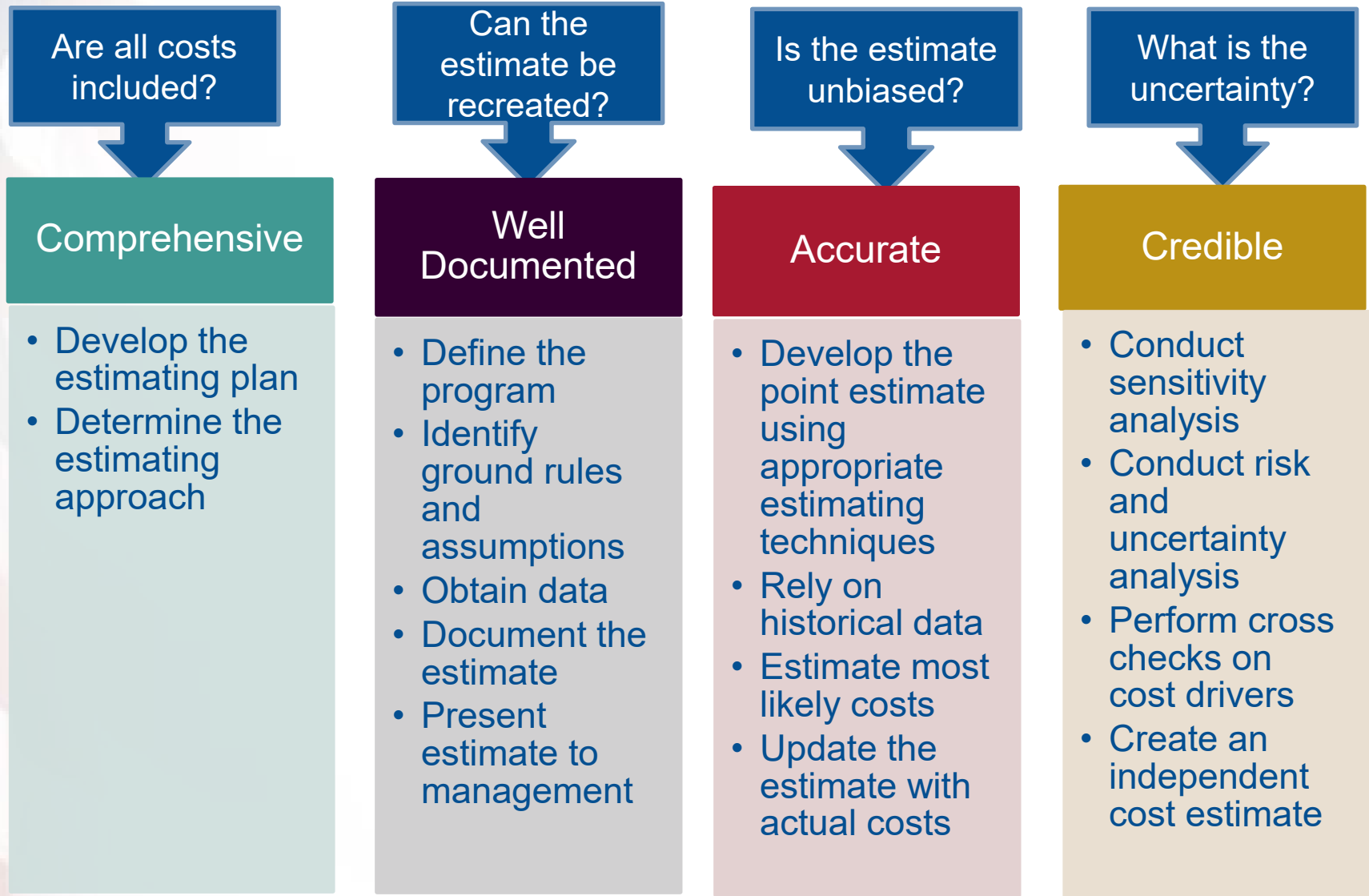


The Updated Cost Guide's Layout

- The updated Guide will consists of 22 chapters with supporting appendices
- Organized by these sections
 - Section 1: Introduction
 - Section 2: Overview
 - Section 3: 12 Steps for Creating a Cost Estimate
 - Section 4: Best Practices Criteria for Evaluating a Cost Estimate
 - Section 5: EVM
- The Guide will also reflect new case studies of prior GAO audits to showcase typical pitfalls that can occur in the cost estimating process

- Chapters 1-3 provide an overview of cost estimating and explains how the 12 steps relate to the best practice criteria.
- Chapters 4-15 describe in detail a 12 step cost estimating process for developing high quality cost estimates.
- Chapters 16-19 address the importance of developing credible cost estimates and discuss the 4 best practice criteria.
- Chapters 20-22 address managing program costs once a contract has been awarded and discuss **EVM**

GAO Characteristics of Reliable Cost Estimates



- EVM indicates how past performance may affect future performance
 - The data isolates cost and schedule variances by WBS elements allowing for:
 - An understanding of technical problems
 - Opportunities to reallocate effort to mitigate risk
- The two main purposes for implementing an EVM system are to:
 1. Encourage the use of effective internal cost and schedule management controls
 2. Allow the customer to rely on timely and accurate data for determining contract performance

GAO The Thirteen Steps in the EVM Process

1. Define the scope of work using a WBS
2. Identify who in the organization will perform the work
3. Schedule the work
4. Estimate the labor and material required and authorize budgets including MR
5. Determine objective measure of earned value
6. Develop the performance measurement baseline
7. Execute the work plan and record all costs
8. Analyze EVM performance data and record variances from PMB plan
9. Forecast EACs using EVM
10. Conduct an integrated cost-schedule risk analysis
11. Compare EACs from EVM in Step 9 with EAC from risk analysis in Step 10
12. Take management action to mitigate risks
13. Update the PMB as changes occur

Is the EVM system certified and comprehensive?

Is the EVM data reliable?

Is Management using the EVM data?

Comprehensive

- Certified EVM system
- IBR conducted
- Reliable schedule
- EVM surveillance

Accurate

- No data anomalies
- Consistent data
- Realistic EAC

Informative

- Regular reviews conducted
- Corrective action plans
- Updated PMB



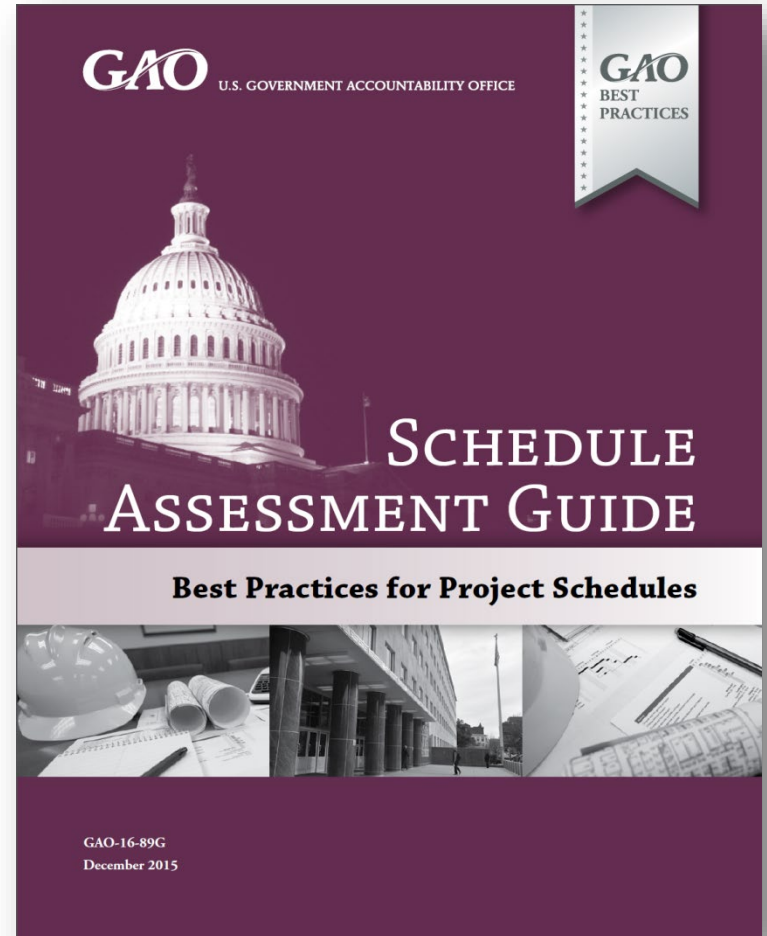
GAO's Schedule Assessment Guide

The GAO *Schedule Assessment Guide* develops the scheduling concepts introduced in the GAO *Cost Estimating and Assessment Guide*.

- Best practices for developing and maintaining high-quality schedules
- Contains explanatory text, illustrations, and detailed case studies
- Includes appendixes that list key questions, documentation, and technical guidance

Public exposure draft released 2012-2013 and over 1,000 comments received

The Final version of the GAO Schedule Guide can be downloaded for free at www.gao.gov/products/GAO-16-89G

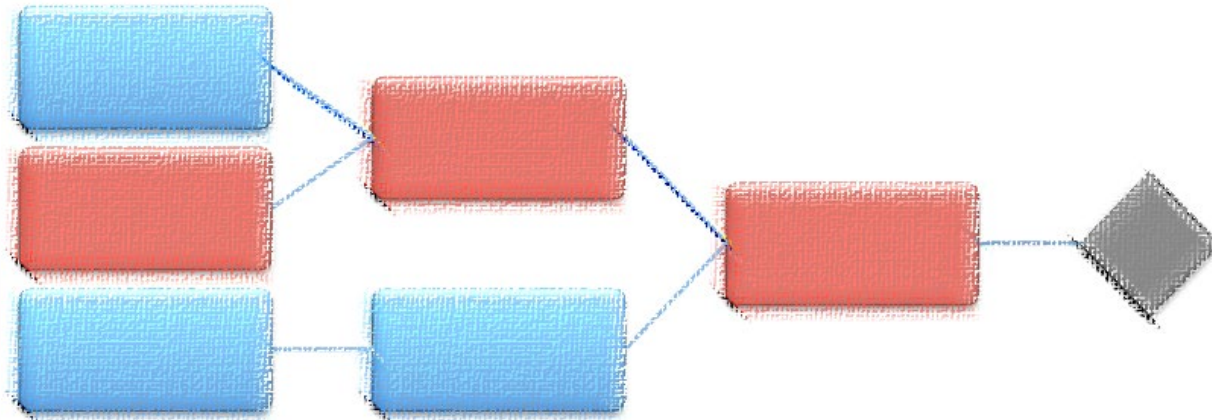


- Origin
 - Expands on the scheduling concepts introduced in the Cost Guide
 - Intended to be an appendix to an updated version of the Cost Guide, but became its own publication
- Purpose
 - Allow GAO auditors to assess the reliability of reported program dates through an assessment of project schedules
 - Useful for agencies to create or append existing policies and guidance on creating and maintaining project schedules

The success of a program depends in part on having an integrated and reliable master schedule

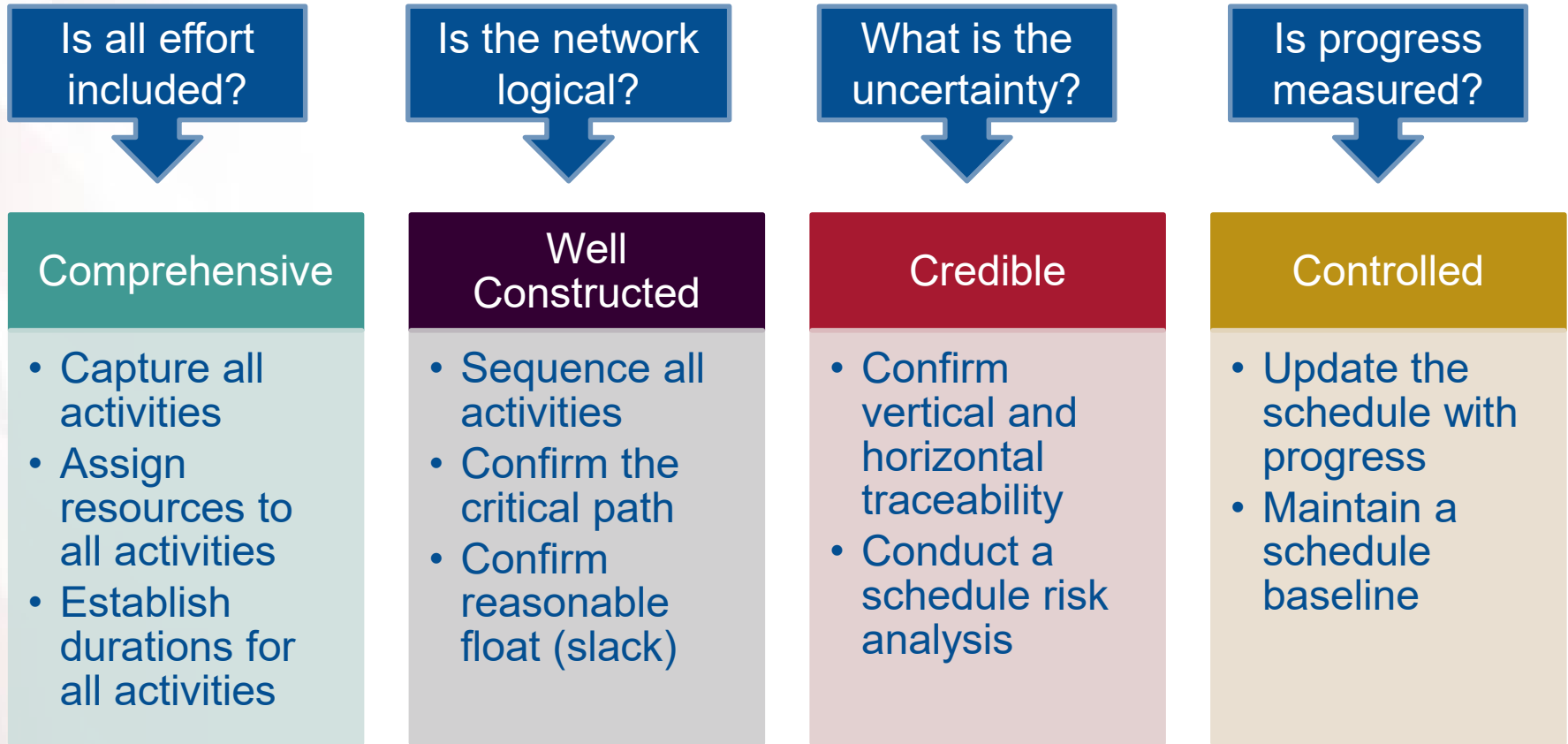
A schedule is the roadmap for project execution by:

- Defining when and how long work will occur and how each activity is related to the others
- Determining a time sequence for the duration of a program's activities
- Providing the means by which to gauge progress



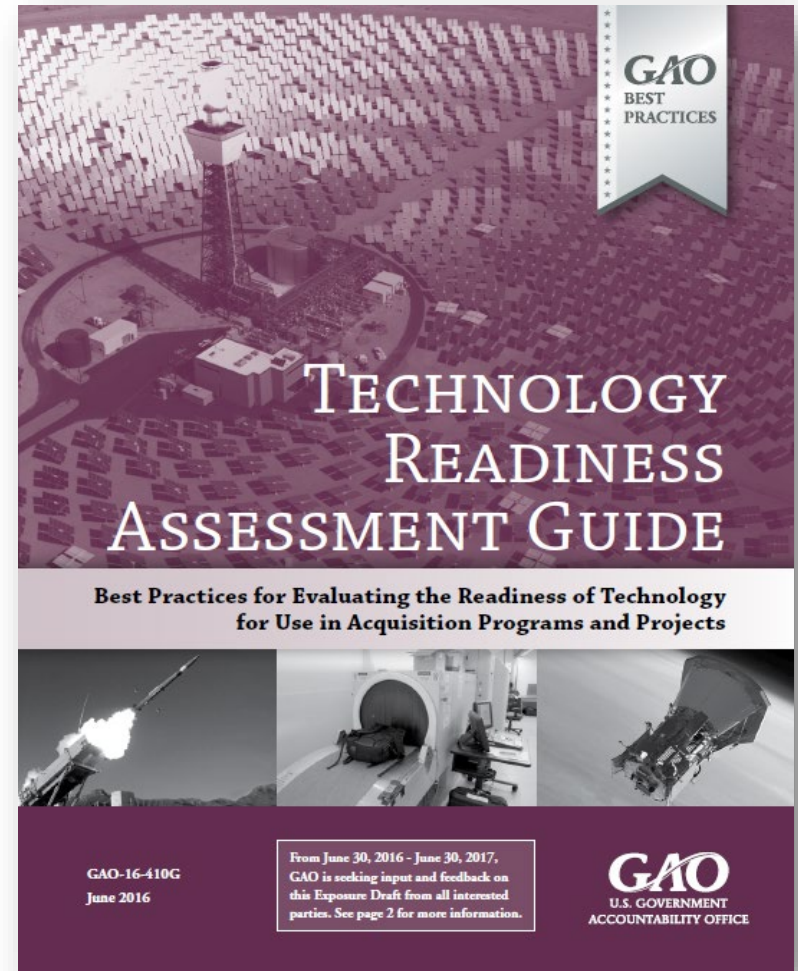
Our research has identified ten best practices associated with developing and maintaining a reliable schedule

1. Capturing all activities
2. Sequencing all activities
3. Assigning resources to all activities
4. Establishing the duration of all activities
5. Verifying that the schedule can be traced horizontally and vertically
6. Confirming that the critical path is valid
7. Ensuring reasonable total float
8. Conducting a schedule risk analysis
9. Updating the schedule using actual progress and logic
10. Maintaining a Baseline Schedule



GAO Technology Readiness Assessment Guide

- Drafted from 2015-2016 with the release of public exposure draft in June 2016
- Outlines GAO's criteria for evaluating technological readiness assessments
- Contains 10 chapters with supporting appendixes
 - Chapters 1 & 2 define TRAs and describe their importance and limitations
 - Chapter 3 outlines a reliable process for conducting TRAs
 - Chapters 4-10 address the associated best practices
- Provides case studies of prior GAO audits to show typical findings related to technology readiness



GAO Technology Readiness Assessment Guide

- Fills criteria void for “performance” in the “cost-schedule-performance” trio of management elements of capital acquisition programs.
- Designed to bring understanding and practice of technology readiness assessments
 - Invented decades ago by NASA
 - Utilized extensively in DOD, and
 - Available to other agencies without a large technical staff.
- Allows GAO auditors to assess the reliability of the identification and management of technologies critical to the success of a given capital acquisition program.
- Useful for agencies to create or append existing policies and guidance on creating and maintaining technology readiness assessments
 - Can be applied to ongoing, day-to-day project management or to support major milestone decision points.

GAO Six Steps to Develop a High Quality TRA

Define Purpose

- Determine purpose, level of detail, scope, TRL definition
- Obtain pertinent information
- Align assessment strategy to SE management plan

Develop Strategy, Plan, and Assemble Team

- Develop schedule and events
- Determine specific team members and needed expertise
- Outline the approach
- Identify a plan for handling dissenting views

Select Critical Technologies

- ID purpose, system, and performance characteristics in a technology baseline document
- Use a Work Breakdown Structure that characterizes the system to select critical technologies
- Use key questions and environment to determine if a technology is critical



Six Steps to Develop a High Quality TRA

Evaluate Critical Technologies

- Determine TRL definitions and required evidence prior to assessment
- Determine acceptability of test articles and environments
- Determine if testing results are sufficient and acceptable
- Document all relevant information

Prepare and Submit the TRA Report

- Prepare an official report that documents actions from previous steps
- Obtain report comments and explain dissenting views

Use TRA Results and Develop a Technology Maturation Plan

- Use TRA results to make decisions about the program's development priorities
- Program management identifies TRA-related concerns and risks, including potential effects on cost and schedule estimates
- Develop a technology maturation plan to track progress

- Agile methods are being widely used by federal agencies to shorten development timeframes and deliver functionality in smaller segments.
 - Continuous software delivery and the use of automated testing enable agencies to keep pace with ever changing technology
 - Regular feedback from users ensures that the most important features are delivered first
- Agile approaches invert the traditional cost, schedule, and performance triangle by holding cost and schedule fixed while performance can vary.
 - This radical approach helps agencies adjust to uncertain budgets
 - Agile allow for an agency to constantly update and change requirements based on user needs
 - Does not lock an agency into developing requirements that are not necessary

- GAO has previously reported on the challenges agencies face when transitioning from traditional waterfall to Agile development
 - Issues with contracting, documentation review, measuring progress, stakeholder support, coaching and training, etc. have occurred
 - A lack of guidance has contributed to these problems
- GAO is developing the Agile Software Development and Implementation Guide that provides best practices to ensure that
 - A high quality and reliable Agile implementation framework is established and
 - An agency is following program management best practices when using Agile

GAO Software Agile Guide – In development

- **Purpose**: to identify and address leading practices and structural barriers to overcome when implementing Agile methodologies at the agency level and to discuss the relationship of those methodologies to common program control disciplines.
- GAO meets with an Agile Expert Panel three times a year and in between meetings provides draft chapters for review and input prior to releasing an exposure draft
 - To volunteer for the Agile Expert Panel contact Jennie Leotta (leottaj@gao.gov) or Mat Bader (baderm@gao.gov)
 - Exposure Draft Release Date: October 2019
- The exposure draft will be released on the GAO website to obtain comments from the general public

Current Outline

- Chapter 1: Background
- Chapter 2: Compliance and Past Work
- Chapter 3: Agile Adoption Best Practices
 - Team Activities, Program Processes, Organizational Environment
- Chapter 4: Agile Implementation Challenges
- Chapter 5: Agile Metrics
- Chapter 6: Requirements Decomposition
- Chapter 7: Agile and the Federal Acquisition Process
- Chapter 8: Agile and Program Management Factors
- Chapter 9: Agile and Program Control Best Practices
 - Cost Estimating, Scheduling, EVM, and AOA Best Practices
- Appendixes
 - Tentative topics: Glossary/Rosetta Stone, Debunking Agile Myths, Agile Methodologies, Questions for Auditors and Managers, Gap analysis with other Agile guides, etc.

A blue speech bubble with a white border and a tail pointing towards the bottom left. It contains the text 'Subject to Change, Additional Topics TBD' in white, bold, sans-serif font.

Subject to Change,
Additional Topics
TBD

How Is the Government Performing?

To What Extent are Agencies Meeting Established Cost and Schedule Goals Reported to Congress



How Is The Government Performing in Developing Cost Estimates?

Agency	Comprehensive	Well Documented	Accurate	Credible
DOD	Substantially	Substantially	Substantially	Minimally
DHS	Substantially	Substantially	Partially	Minimally
IRS	Substantially	Partially	Partially	Minimally
DOE	Substantially	Partially	Partially	Minimally
VA	Substantially	Substantially	Minimally	Minimally
MDA	Minimally	Minimally	Minimally	Minimally
DOT	Substantially	Substantially	Partially	Minimally
DOC	Partially	Minimally	Minimally	Not Met
HUD	Minimally	Minimally	Minimally	Minimally
DOA	Minimally	Not Met	Not Met	Not Met
DOJ	Substantially	Partially	Substantially	Minimally
NASA	Substantially	Substantially	Substantially	Partially





High-level Summary of Cost Assessments

In general, government program offices

- Exclude all program life cycle costs and do not break out costs into sufficient detail
- Rarely use standardized product-oriented work breakdown structures with common support elements
- Do not reflect historic or risk data and do not assess the risk impacts if major assumptions fail
- Do not document the cost estimate to a level that would allow a cost analyst unfamiliar with the program to replicate the results
- Conduct limited sensitivity analyses based on engineering judgment rather than historic data
- Do not perform cost risk and uncertainty analysis and fail to document the risks associated with assumptions
- Cannot show that their estimates are unbiased (i.e., do not identify a level of confidence along with contingency)
- Fail to crosscheck estimating methodologies or reconcile with an independent cost estimate
- Cannot demonstrate that management has understood and approved all facets of the cost estimate
- Fail to update the cost estimate to reflect actual costs and reasons for variances

Many government program offices lack effective internal controls

Program offices generally have no

- Centralized cost estimating organization that includes experienced and trained cost analysts to develop high-quality cost estimates
- Policy or guidance for developing high-quality cost estimates that include steps to follow, time that is needed, and how estimates will be updated
- Infrastructure or staff for collecting and storing historic cost and technical data
- Independent cost estimating organization that can test whether the cost estimate is accurate and realistic

Program offices generally do not

- Link cost and schedule variances to risks in the cost uncertainty analysis
- Update cost estimates regularly (e.g., monthly)
 - with actual cost data from an earned value management system,
 - to capture the reasons for variances with links to risks identified in the risk register,

GAO EVM Findings from Recent Audits

- Many civil agency programs do not use product-oriented Work Breakdown Structures
- Schedules underpinning the EVM system are not meeting many best practices
- IBRs are not occurring in a timely manner and are often not robust reviews
- Programs often re-baseline due to overly optimistic cost and schedule estimates
- EVM data anomalies are widespread and recurring
 - Government program offices are not rejecting the EVM reports
- Format 5 variance analyses are too vague to be useful and do not address corrective actions
- EVM data are not being used to proactively manage the program
- Program managers do not integrate EVM data with the risk management process
- Civil agencies do not have access to independent surveillance functions
- Government and contractor staff need additional training on EVM
- Contractors are not properly implementing their EVM systems



How Is The Government Performing In Developing and Maintaining Schedules?

Agency	BP1	BP2	BP3	BP4	BP5	BP6	BP7	BP8	BP9	BP10
DHS	Partially	Substantially	Minimally	Substantially	Partially	Minimally	Minimally	Not Met	Partially	Not Met
DOD	Substantially	Substantially	Partially	Substantially	Partially	Partially	Partially	Minimally	Substantially	Partially
NASA	Substantially	Substantially	Substantially	Substantially	Partially	Partially	Partially	Minimally	Substantially	Substantially
DOE	Substantially	Substantially	Substantially	Substantially	Substantially	Substantially	Partially	Partially	Substantially	Partially
MDA	Partially	Partially	Partially	Substantially	Substantially	Partially	Partially	Minimally	Substantially	
DOT	Partially	Minimally	Partially	Substantially	Partially	Minimally	Minimally	Not Met	Substantially	
VA	Substantially	Substantially	Substantially	Substantially	Substantially	Substantially	Substantially	Not Met	Substantially	
HHS		Partially				Minimally	Partially			

Fully Met	Substantially	Partially	Minimally	Not Met
-----------	---------------	-----------	-----------	---------

Results reflect agencies and departments with three or more GAO schedule assessments



High Level Schedule Assessment Findings

In general, government program offices fail to

- Include all effort in the IMS for the entire program
- Provide traceability of activities to the statement of work
- Set a schedule baseline (or track against one)
- Properly sequence activities using correct logic to ensure the schedule is dynamically networked
- Document justification for constraints
- Perform schedule risk analysis
- Identify distinct start and finish milestones.

Further, government program offices

- Appreciate the concept of a critical path but not the consequences of unrealistic float
- Assume unlimited resources by failing to resource load their schedules
- Do not consistently update schedules or record a status/data date
- Use constraints and lags moderately to force activities to occur on predetermined dates
- Include activities of long duration that are difficult to objectively status and manage

- Contractor schedules are usually more reliable than government program office schedules
 - Many contract deliverables require an integrated network schedule
 - Government program offices typically have a 1-page IMS developed in PowerPoint
- Government program office IMS's usually fail to span an entire program, regardless of how many increments, steps, blocks, contracts, or milestones the program is divided into
- Activity names in government programs tend to be too general, causing problems when filtering the schedule to look for missing logic or status issues
- Schedules are not created by the critical path method and therefore cannot be
 - Used to conduct schedule risk analysis
 - Relied on by management to evaluate progress and make decisions
- Schedulers -- rather than the program manager -- are too often held responsible for updating and managing schedules.

GAO Conclusions

- The GAO Cost, Schedule, and TRA Guides can provide criteria to evaluate many types of large technology-oriented and/or capital acquisition projects.
- Risk assessments such as technology readiness assessments and independent cost and schedule risk assessments are
 - Often not performed, or
 - If done, they tend to be incomplete or too optimistic resulting in significant program risk and cost overruns.
- GAO recommendations have been aimed at improving oversight to keep projects on cost and schedule and to manage risk in complex acquisitions.
- Programs/projects that follow the best practices experience greater success in terms of outcomes and resource utilization.



GAO on the Web

Web site: <http://www.gao.gov/>

Copyright

This is a work of the U.S. government and is not subject to copyright protection in the United States. The published product may be reproduced and distributed in its entirety without further permission from GAO. However, because this work may contain copyrighted images or other material, permission from the copyright holder may be necessary if you wish to reproduce this material separately.