

GAO Cost Estimating, Scheduling, and Earned Value Management

Best Practices and Recent Audit Findings

Karen Richey

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Presentation Overview

- Background on GAO
- Overview of the GAO Cost and Schedule Guides
- EVM General Findings
- GAO-13-22: NASA Earned Value Management Implementation Across Major Spaceflight Projects is Uneven

Government Accountability Office

- Named changed from General Accounting Office to underscore mission
 - Independent, nonpartisan agency reporting directly to Congress
 - Conducts audits to evaluate economy, efficiency, and effectiveness of government programs (all agencies)
- Known as the Investigative arm of Congress, GAO exists to support Congress in meeting its constitutional responsibilities. To that end, GAO works to
 - 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

GAO's Role in Government and How It Relies on Best Practice Guides to Develop Audit Findings

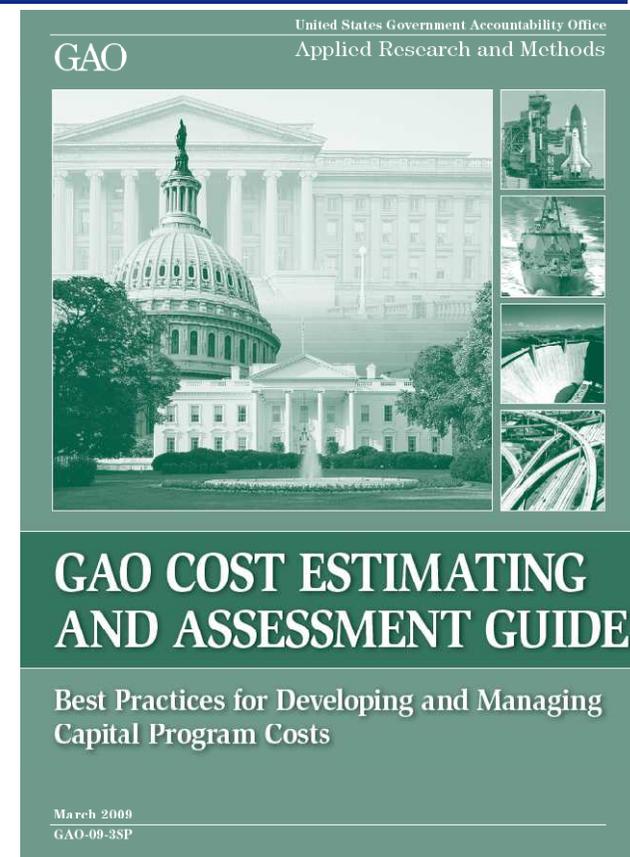
- GAO assists Congress in its oversight of the federal government including agencies' stewardship of public funds
 - Legislators, government officials, and the public want to know
 - Whether government programs are achieving their goals
 - What these programs are expected to cost and when they will be 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
- We developed the GAO Cost and Schedule 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

Why the GAO Cost Assessment Guide is Important

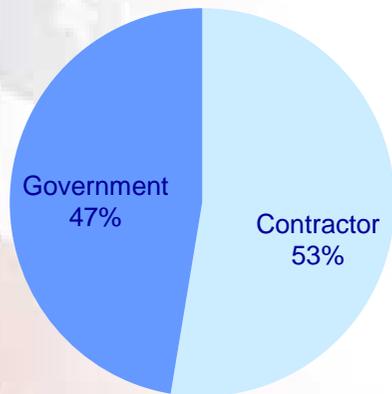
- Purpose of the Guide is to
 - Address best practices for ensuring credible program cost estimates for both government and industry
 - Provide a detailed link between cost estimating and EVM
 - OMB has endorsed EVM for measuring cost, schedule, and technical performance
 - Guide demonstrates how realistic cost and schedule estimates are necessary for setting achievable program baselines and managing risk
- Original intent was to provide auditors with a standardized approach for analyzing program costs
 - Our research, however, found federal guidelines to be limited on the processes, procedures, and practices for ensuring credible cost estimates
 - We decided to fill the gap and shifted the intent of the Guide from an auditor's manual to a best-practice manual
 - To help GAO auditors fully utilize this Guide, we included a number of "auditor checklists" for use on program assessments

How the March 2009 GAO Cost Guide was Developed

- We developed this Guide in consultation with a “community of experts” from the federal government and industry.
 - Formal kick-off began at the Society of Cost Estimating and Analysis conference in June 2005
 - Since then, the community of experts helping to review and comment on the Guide has grown
 - Their contributions have been invaluable both in
 - Providing historical information and experience
 - Keeping the Guide current with industry trends
- Together with these experts, we developed a Guide which
 - Clearly outlines GAO’s criteria for assessing cost estimates and EVM during audits
 - OMB has cited as a key reference document for use by federal agencies in its June 2006 Capital Programming Guide
- The Guide can be downloaded for free at:
 - <http://www.gao.gov/products/GAO-09-3SP>
- Comments are always welcome
 - We continually strive to keep the Guide updated and relevant to changes in policy and methods



The expert group's vast experience, both governmental and private



AACE International	Dept. of Interior	Johns Hopkins APL	Parsons Brinckerhoff
Aberdeen Proving Ground	Dept. of Treasury	Johnson Space Center	Performance Results Corporation
Accenture	DNDO	Kaiser Permanente	Pinnacle Management Systems, Inc.
Acumen	DOT	Kalman & Company, Inc.	Pratt & Whitney
AFCAA	Edwards Project Solutions	Kearney & Company	Price Systems
Agilekiwi	FAA	KPMG	Price Waterhouse Coopers
Department of the Army	FLOUR	L-3 Stratis	Project Pro
AzTech International	Galorath Incorporated	Learning Tree	Rand
Bath Iron Works	George Mason University	Legis Consultancy	Raytheon
Battelle	German Aerospace Center	Lockheed Martin	Robbins Gioia
Boeing	Grant Thornton	ManTech Team	Rockwell Collins
Booz Allen Hamilton	GSA	Marathon Oil	SAIC
CDC	GWU	MBP	ServQ
Census	Herren Associates	MCR Federal, LLC	Sikorsky
Center for Naval Analysis	HNTB Corporation	MDA	SPAWAR
Chevo Consulting	HPTI	Microsoft	SRA International
Computer Sciences Corp.	HUD	Ministry of Defense - Japan	SSA
DAU	IntePros Federal	MITRE	Steelray
DCMA	iParametrics	NASA	TASC - DNDO support
Deloitte Consulting LLP	IRS	National Defense University	Technomics
Deltek	GWU	National Science Foundation	Tecolote Research, Inc.
Department of Education	Herren Associates	NAVAIR	Textron
Department of Interior	HNTB Corporation	Naval Center (NCAA)	The Rehancement Group, Inc.
Department of Navy	HPTI	NAVSEA	Transportation Security Administration
Department of State	HUD	Navy Postgraduate School	UK MOD
Department of Veterans Affairs	IntePros Federal	NNSA	US Army Corps of Engineers
Dept of Energy - Oakridge	iParametrics	NOAA	US Coast Guard
Dept of Labor	IRS	Northrop Grumman	USPS
Dept. Homeland Security	Japan Defense Research Center	OMB	VA
Dept. of Commerce	JAXA - Japan	OSD PARCA	Wyle

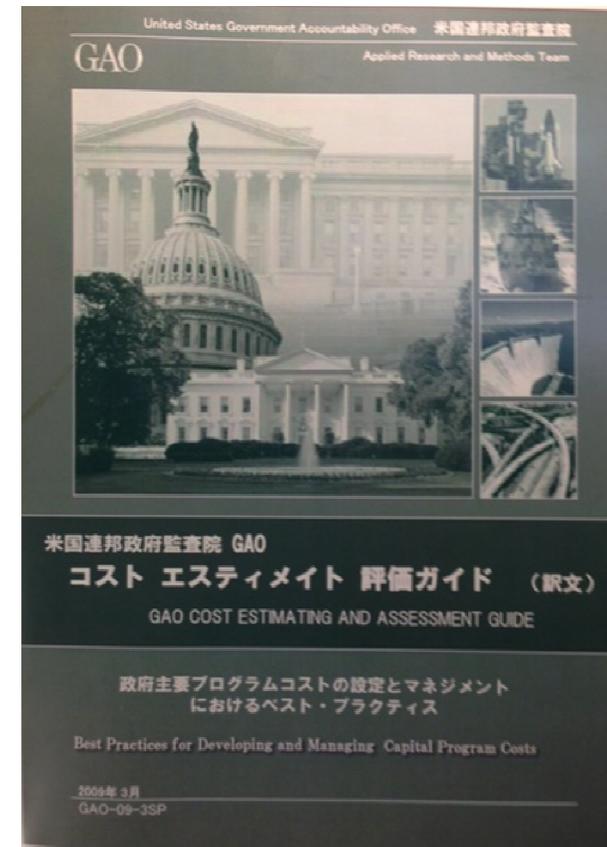
Foreign government interest in the GAO cost guide

In 2009, Japan translated the entire guide into Japanese and had it bound and professionally published.

Other foreign governments showing great interest in the guide include

- Canada,
- Great Britain,
- India, and
- Peru.

These countries recognize that GAO's Cost Guide is based on long-standing industry and government cost estimation best practices that existed before GAO published them in the guide's concise form.



The Cost Assessment Guide's Layout

- 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

A Reliable Process for Developing Credible Cost Estimates

- Certain best practices should be followed if credible cost estimates are to be developed.
- These best practices represent an overall process of established methods that, if followed correctly, will result in high-quality cost estimates that are comprehensive, accurate, and easily updated / replicated.
 - In searching for documentation on best practices, we found a 1972 GAO report on cost estimating
 - We reported that cost estimates were understated and causing unexpected cost growth
 - Many of the factors causing this problem are still relevant today

Initiation and research

Your audience, what you are estimating, and why you are estimating it are of the utmost importance

Assessment

Cost assessment steps are iterative and can be accomplished in varying order or concurrently

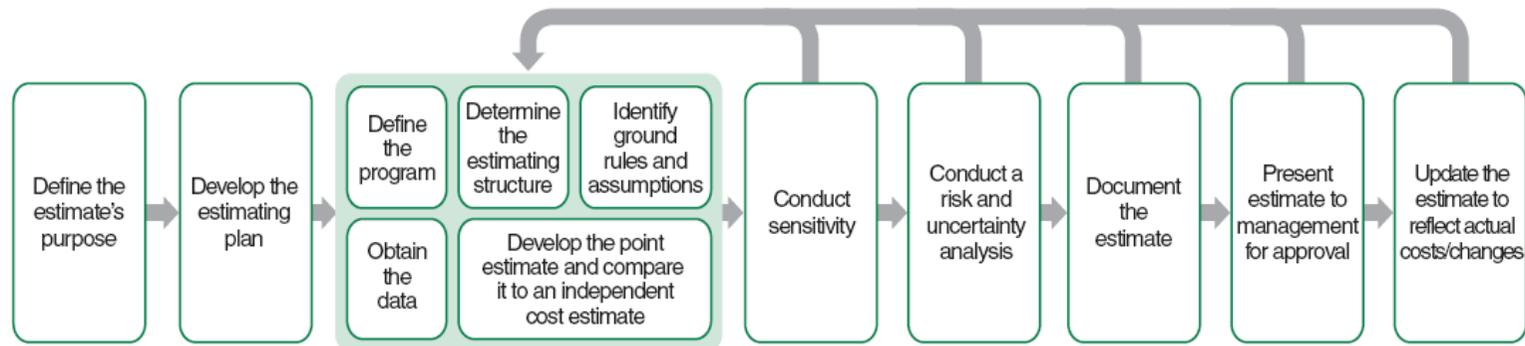
Analysis

The confidence in the point or range of the estimate is crucial to the decision maker

Presentation

Documentation and presentation make or break a cost estimating decision outcome

Analysis, presentation, and updating the estimate steps can lead to repeating previous assessment steps



Source: GAO.

Mapping the 12 steps to the four characteristics of a credible cost estimate

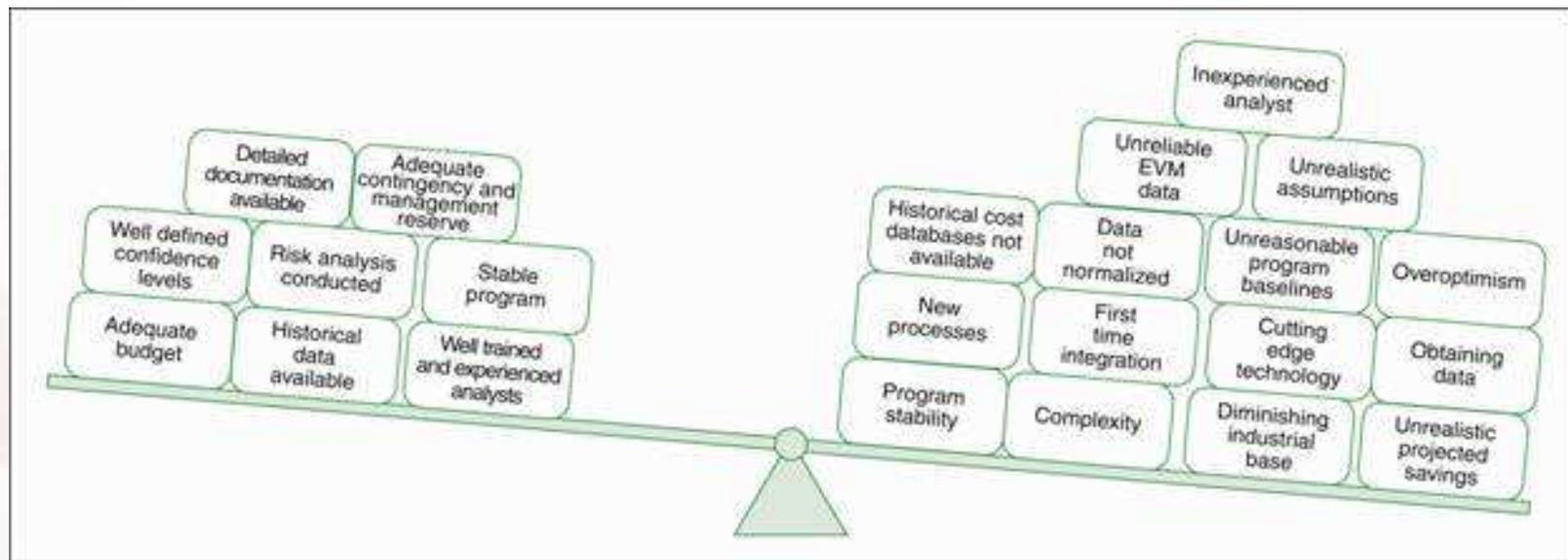
Characteristic	Related step
Well documented <ul style="list-style-type: none"> • The estimate is thoroughly documented, including source data and significance, clearly detailed calculations and results, and explanations for choosing a particular method or reference. • Data have been traced back to the source documentation. • A technical baseline description is included. • All steps in developing the estimate are documented, so that a cost analyst unfamiliar with the program can recreate it quickly with the same result. • All data sources for how the data was normalized are documented. • The estimating methodology and rationale used to derive each WBS element's cost are described in detail. 	<ul style="list-style-type: none"> 1. Define the estimate's purpose 3. Define the program 5. Identify ground rules and assumptions 6. Obtain the data 10. Document the estimate 11. Present estimate to management
Comprehensive <ul style="list-style-type: none"> • The estimate's level of detail ensures that cost elements are neither omitted nor double counted. • All cost-influencing ground rules and assumptions are detailed. • The WBS is defined and each element is described in a WBS dictionary; a major automated information system program may have only a cost element structure. 	<ul style="list-style-type: none"> 2. Develop the estimating plan 4. Determine the estimating approach

Mapping the 12 steps (continued)

Characteristic	Related step
<p>Accurate</p> <ul style="list-style-type: none"> • The estimate is unbiased, not overly conservative or overly optimistic, and based on an assessment of most likely costs. • It has few, if any, mathematical mistakes; those it has are minor. • It has been validated for errors like double counting and omitted costs. • Cross-checks have been made on cost drivers to see if results are similar. • The estimate is timely. • It is updated to reflect changes in technical or program assumptions and new phases or milestones. • Estimates are replaced with EVM EAC and the Independent EAC from the integrated EVM system. 	<ul style="list-style-type: none"> 7. Develop the point estimate and compare it to an independent cost estimate 12. Update the estimate to reflect actual costs and changes
<p>Credible</p> <ul style="list-style-type: none"> • Any limitations of the analysis because of uncertainty or biases surrounding data or assumptions are discussed. • Major assumptions are varied and other outcomes recomputed to determine how sensitive outcomes are to changes in the assumptions. • Risk and uncertainty analysis is performed to determine the level of risk associated with the estimate. • An independent cost estimate is developed to determine if other estimating methods produce similar results. 	<ul style="list-style-type: none"> 7. Develop the point estimate and compare it to an independent cost estimate 8. Conduct sensitivity analysis 9. Conduct risk and uncertainty analysis

Challenges in developing credible estimates

Chapter 2 of the GAO Cost Guide discusses a 1972 GAO report that found that estimates of the cost to develop and produce weapon systems were frequently understated with costs increasing \$15.6 billion over early development estimates. Many factors causing those cost increases are still relevant today.



Program management's success requires reliable schedules

Developing an integrated schedule is key for

- Managing program performance and
- Determining the work that remains and its expected cost.

Therefore, a program's success depends on its having a reliable schedule of

- When its set of work activities and milestone events will occur,
- How long they will take, and
- How they are related to one another.

Reliable schedules provide

- A road map for the program's systematic execution,
 - The means by which to gauge progress, and
 - A way to identify and address potential problems and promote accountability.
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GAO's May 2012 schedule assessment guide

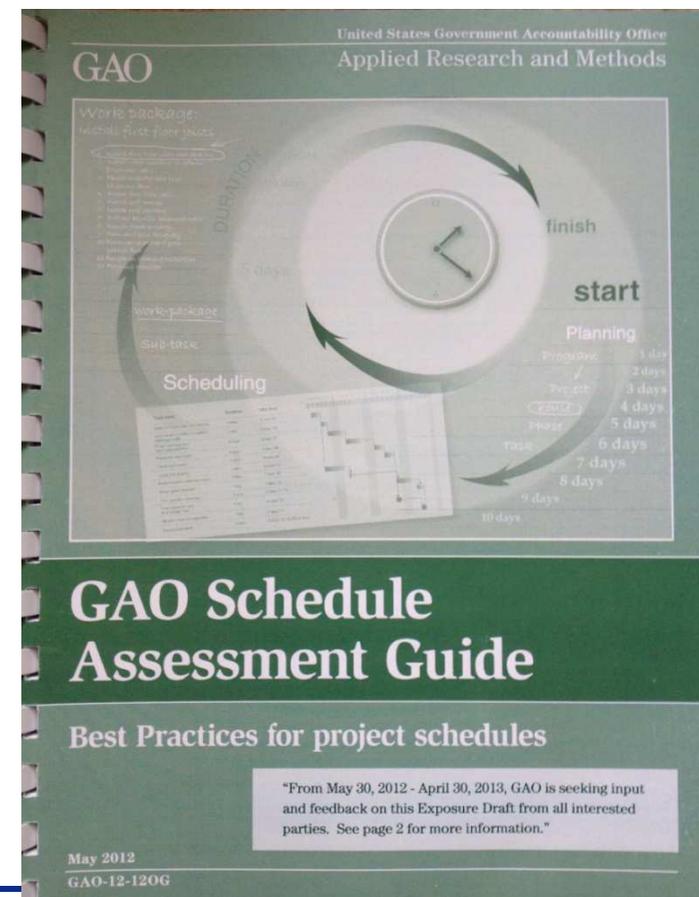
The GAO Schedule Guide further develops the scheduling concepts introduced in the GAO Cost guide. It

- Outlines 10 scheduling best practices for developing and maintaining high-quality schedules that forecast credible dates
- Contains explanatory text, illustrations, and detailed case studies to help program staff identify a schedule's logic and risk elements
- Includes appendixes of key questions and documentation.

Project teams that develop a project's schedule will find the guide indispensable

The guide will inform agencies that have no formal policy for creating schedules of GAO's criteria for assessing a schedule's credibility.

It can be downloaded for free at www.gao.gov/products/GAO-12-120G.



GAO's May 2012 schedule assessment guide (continued)

An exposure draft was developed from Nov. 2010 through May 2012 from

- Five cost expert meetings and
- Comments from 548 expert readers.

Work on the final draft began May 2012 with

- Additional expert meetings in Sept. 2012 and March 2013
- The receipt of 575+ additional comments
- Input from a subgroup of experts developing an appendix on scheduling in an Agile environment
- Reviews from private industry (80), government departments and agencies (29), and trade groups and universities (4).

The final draft will include updated figures, schedule risk analysis, and an appendix on scheduling in an Agile development environment.

Best practices identified in GAO's schedule assessment guide

GAO's research has identified 10 best practices in developing and maintaining a reliable schedule:

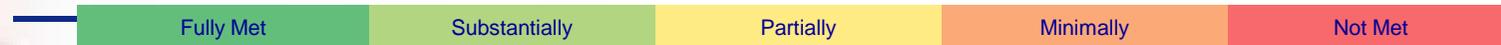
1. Capturing all activities
2. Sequencing all activities
3. Assigning resources to all activities
4. Establishing the duration of all activities
5. Verifying that the schedule can be traced horizontally and vertically
6. Confirming that the critical path is valid
7. Ensuring reasonable total float
8.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

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?

	Comprehensive	Well Documented	Accurate	Credible
Veterans Affairs (VA)	Green	Green	Orange	Orange
DOT	Green	Green	Light Green	Orange
DOD	Green	Green	Light Green	Yellow
Missile Defense (MDA)	Yellow	Orange	Orange	Orange
IRS	Green	Yellow	Yellow	Orange
DHS	Green	Light Green	Light Green	Yellow
DOE	Green	Light Green	Yellow	Orange
Agriculture	Orange	Red	Red	Red
Commerce	Green	Orange	Yellow	Red



Data based on agencies and departments with three or more GAO cost estimate assessments

GAO's high-level summary of cost estimate 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,
 - at major milestones.

How is the government performing in developing and maintaining schedules?

	BP 1 All effort	BP 2 Logic	BP 3 Resources	BP 4 Durations	BP 5 Traceable	BP 6 Critical Path	BP 7 Float	BP 8 Risk	BP 9 Statusing
Veterans Affairs (VA)	Fully Met	Fully Met	Fully Met	Fully Met	Fully Met	Fully Met	Fully Met	Not Met	Fully Met
DOT	Partially	Partially	Partially	Substantially	Partially	Minimally	Minimally	Not Met	Partially
DOD	Substantially	Partially	Partially	Substantially	Partially	Minimally	Minimally	Partially	Substantially
Missile Defense (MDA)	Partially	Partially	Partially	Substantially	Partially	Minimally	Minimally	Partially	Substantially
DHS	Partially	Partially	Partially	Substantially	Partially	Minimally	Minimally	Not Met	Partially
DOE	Fully Met	Substantially	Partially	Fully Met	Fully Met	Fully Met	Minimally	Partially	Substantially
NASA	Fully Met	Partially	Not Met	Substantially	Partially	Substantially	Partially	Not Met	Fully Met

Fully Met	Substantially	Partially	Minimally	Not Met
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Results reflect agencies and departments with three or more GAO schedule assessments

GAO's high-level findings on schedule assessments

In general, government program offices fail to

- Include all effort in the IMS for the entire program or 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 (e.g., missing relationships and dangling activities)
- Use constraints and lags moderately to force activities to occur on predetermined dates
- Document their justification
- Include activities of long duration that are difficult to objectively status and manage
- Perform schedule risk analysis

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 status schedules or record a status and data date
- Miss distinct start and finish milestones.

Additional schedule assessment findings

- 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
- Program offices resource-load schedules only at the prime and subcontractor levels, believing that resource loading a schedule is overkill
- Government program office IMSs 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 Findings Related to EVM

A summary of Audit Findings

EVM is an Important Management Decision Support Tool

- 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 or address issues
- 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

EVM Data Should be Examined for Reliability Before Using It to Make Decisions or Calculate EAC Projections

- For EVM data to be of any value it must be reliable
 - The data should be generated by a system that has been deemed compliant with the ANSI 32 guidelines
 - The performance measurement baseline should be validated by an Integrated Baseline Review in a timely manner
 - EVM surveillance by independent and qualified staff should be continually monitoring the implementation of the system
 - The contractor's financial accounting system has received an unqualified opinion
 - Data anomalies like negative values for BCWS, BCWP, and ACWP or missing performance data (e.g., BCWP with no BCWS or ACWP) should be rare
 - If these anomalies occur they should be fully explained in the variance analysis portion of the report

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

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 rebaseline 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

GAO Findings Related to NASA

**Earned Value Management Implementation Across
Major Spaceflight Projects is uneven**

(Report # GAO-13-22)

NASA Congressional Request

- NASA has historically experienced cost growth and schedule slips in its portfolio of major projects
 - NASA is using EVM to help project managers monitor risks
- GAO was asked to examine
 - The extent to which NASA is using EVM to manage its space flight acquisitions
 - Challenges NASA has faced in implementing an effective EVM system
 - NASA's efforts to improve its use of EVM
- To address these questions, GAO
 - Obtained contractor and project EVM data
 - Used established formulas and tools to analyze the data, and
 - Assessed NASA's implementation of EVM on 10 major spaceflight projects

GAO Findings for 10 NASA Spaceflight Projects Using Three Fundamental EVM Practices and Reliability of the Data

	Used A certified EVM system compliant with ANSI/EIA standard	Conducted an integrated baseline review	EVM System surveillance is being performed	Data resulting from the EVM system are reliable
Global Precipitation Measurement	●	●	●	◐
James Webb Space Telescope	●	●	●	◐
Landsat Data Continuity Mission	●	●	●	◐
Lunar Atmosphere and Dust Environment Explorer	○	●	◐	◐
Magnetospheric Multiscale	○	●	◐	◐
Mars Atmosphere and Volatile Evolution Mission	◐	●	◐	●
Orbiting Carbon Observatory 2a	●	●	◐	●
Radiation Belt Storm Probes	○	●	◐	●
Stratospheric Observatory for Infrared Astronomy Project	◐	◐	◐	◐
Tracking and Data Relay Satellite Replenishment	●	●	●	◐

NASA's 10 Major Spaceflight Projects Have not Fully Implemented EVM

- More than half the projects did not use an EVM system that was fully certified as compliant with the industry EVM standard
 - 4 projects had a certified EVM system, 3 did not, and 3 had a mixture in which some contractors / subcontractors had certified systems and some did not
 - The Jet Propulsion Lab, an FFRDC that the California Institute of Technology manages under a contract with NASA, was the only NASA Center with a certified EVM system
 - NASA does not require a certified EVM system for their in-house work.
 - A system that has been certified has the assurance that it can produce reliable and valid data from which to manage a project.

NASA Did not Fully Meet Selected EVM Fundamental Guidelines for Some of Its Projects

- **Using the master schedule and contract performance reports, we assessed the EVM data against 3 fundamental EVM guidelines**
 - Work Breakdown Structure (WBS) consistency between the schedule and EVM
 - We found that even projects with certified EVM systems had discrepancies in the hierarchical structure and numbering schemes for various WBS elements
 - JWST had differing WBS numbers for mission assurance efforts for its contractors making the integration of cost, schedule, and EVM data more difficult
 - Underlying schedules identified significant task interdependencies
 - About half of the schedules supporting the EVM system baselines were missing predecessor and/or successor dependencies and had constraints preventing the schedule from properly responding to updates
 - An improperly sequenced scheduled brings into question the reliability of the EVM data.
 - Project identified a time-phased budget baseline
 - 4 of the 14 schedules we analyzed were not resource loaded
 - Costs needed to be spread over time using some other method that may not be as straightforward as having the costs integrated directly into the schedule.

Majority of the Projects Conducted an Integrated Baseline Review (IBR)

- In keeping with best practices, 9 out of 10 projects conducted IBRs to
 - Verify that the performance measurement baseline was realistic and
 - Make sure that the contractor and the government mutually understood the potential project risks
- Officials for the SOFIA project did not conduct an IBR at the project level
 - The project's prime contractor for the engineering and modification of the airborne observatory platform did conduct an IBR
 - A project level IBR was not conducted due to the EVM system being implemented "on the fly" late in the development phase for SOFIA as a result of an audit recommendation.

Majority of the Projects Did Not Have a Comprehensive Surveillance System in Place

- Four out of 10 projects had a comprehensive EMV surveillance system, but out of the remaining 6 projects
 - One had formal surveillance at the project level, but its contractor did not;
 - Two did not have formal surveillance at the project level, only their prime contractors did; and
 - The remaining three contractors did not have any formal surveillance but provided information that EVM data was reviewed on a monthly basis
- NASA delegates surveillance of contractor EVM systems to the Defense Contract Management Agency (DCMA)
 - There is no independent surveillance function at NASA to ensure that EVM efforts performed in-house or by nonprofit organizations are meeting the ASNI/EIA-748 standard
 - Without an independent surveillance function, an organization's ability to use EVM as intended may be hampered
 - Surveillance monitors problems with the performance measurement baseline and EVM data, and
 - If these problems go undetected, the EVM data may be distorted and may not be meaningful for decision making

Unreliable EVM Data Limit NASA's Ability to Measure Project Performance

- Only 3 out of the 10 projects we reviewed (MAVEN, RBSP, and OCO-2) produced fully reliable data for managing the project and reporting status
 - The other 7 projects had questionable EVM data, some of which had multiple data anomalies. For example,
 - Several EVM reports showed no work was planned or accomplished, but actual costs were incurred without an explanation;
 - Some reports showed work was planned and actual costs were incurred but a negative amount of work was performed;
 - Several instances where there was an estimate at completion but no budget at completion; and
 - EVM reports with several negative values
 - When explanations were provided the reasons were mostly due to using estimated vs. actual values or adjustments from prior periods due to mistakes such as:
 - Over-reporting of earlier progress, mischarges by employees, delayed cost postings, or inappropriate use of charge codes
 - These data anomalies can cause the EVM data to become skewed and distort true performance

NASA Culture Seen as Not Valuing EVM

- Cultural and other challenges impeded the use of EVM at NASA
 - The agency's culture has traditionally focused on managing science and engineering challenges and not on monitoring cost and schedule data
 - Several NASA officials said that EVM data traditionally has not been valued across the agency
 - There is an insufficient number of NASA staff with the skills to analyze EVM data
 - NASA does not have the policies in place to ensure correct implementation of EVM
 - While the policy requires projects to comply with the 32 ANSI/EIA-748 guidelines and has developed processes and tools for projects to meet this requirement through the use of its new EVM system, the policy
 - Lacks a requirement for rigorous surveillance of how projects are implementing EVM, and
 - Does not require the use of the agency's newly developed EVM system to help meet new requirements

GAO Recommendations to NASA

GAO made recommendations to the NASA Administrator, to:

- Improve the reliability of project EVM data by modifying the NASA Procedural Requirements (NPR) 7120.5 to implement a formal surveillance program that:
 - Ensures anomalies in EVM reports are identified and explained, and report periodically on relevant trends in the number of unexplained anomalies,
 - Ensures the consistent use of WBS's for both the EVM report and the schedule and that the lower level EVM data reconcile to the project level EVM data using the same WBS structure, and
 - Improves underlying schedules so that they are properly sequenced using predecessor and successor dependencies and are free of constraints to the extent practicable
- Establish a timeframe for requiring new spaceflight projects to implement its new EVM system;
- Conduct an EVM skills gap assessment; and
- Develop a change management plan for EVM

NASA concurred with the recommendation to conduct an EVM Skills gap analysis and to develop a change management plan, but it partially concurred with the other two recommendations citing resource constraints.

Invitation to Participate in Further Updates and Discussion about Best Practices

- GAO invites interested parties to meet with us and other experts to discuss further updates to the Cost and Schedule Guides so that they continually reflect best practices
 - If interested, please e-mail your contact info to:
 - Karen Richey - richeyk@gao.gov