

***GAO Cost Assessment Guide:
Best Practices for Estimating and Managing Program Costs***

***by Karen Richey
Carol Cha
Jennifer Echard***

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Outline

- Why is the GAO Cost Assessment Guide important?
- How the Guide was developed
- An overview of the Guide
- Recent GAO Reports Highlighting Cost Estimating Issues
- Invitation to participate in future expert meetings at GAO to discuss follow-on development of the Guide

Why is the GAO Cost Assessment Guide important?

- 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
 - Developing reliable program cost estimates is critical to
 - Effectively using public funds
 - Meeting OMB's capital programming process
 - Avoiding cost overruns, missed deadlines, and performance shortfalls
 - Many of our program assessments find that unreliable estimates are the cause
- We developed this Guide to
 - Establish a consistent methodology based on best practices to be used across federal government for the development and management of its program cost estimates

Why is the GAO Cost Assessment Guide important? (continued)

- 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
- 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 Earned Value Management (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

Why is the GAO Cost Assessment Guide important? (continued)

- Managers and auditors alike should find this Guide to be a useful manual as they assess:
 - The credibility of a program's cost estimate for budget and decision-making purposes
 - Program status using EVM
- To help GAO auditors fully utilize this Guide, we are including a number of “auditor checklists” for use on program assessments
 - These checklists will assist auditors in
 - Identifying whether a program meets best practices
 - Looking for common pitfalls that may undermine the reliability of cost estimates and program baselines

How the 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 have developed a Guide which
 - Clearly outlines GAO’s criteria for assessing cost estimates and EVM during audits
 - Has been endorsed by OMB and cited as a key reference document for use by federal agencies in its June 2006 Capital Programming Guide

***GAO Cost Assessment Guide:
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Program Costs***

An Overview of the Guide

GAO's Cost Assessment Guide 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

GAO Cost Guide: Objectives

- Provide auditor checklists for cost estimating and EVM best practices
- Discuss pitfalls to look for in cost estimates and EVM data
- Link EVM to the cost estimate by showing how
 - Cost estimates set the foundation for the EVM Performance Measurement Baseline
 - EVM can allow for transparent tracking of risks identified by the cost estimate
 - EVM provides actual costs that can be fed back into the cost estimate to make it more accurate over time

GAO CAG : Table of Contents

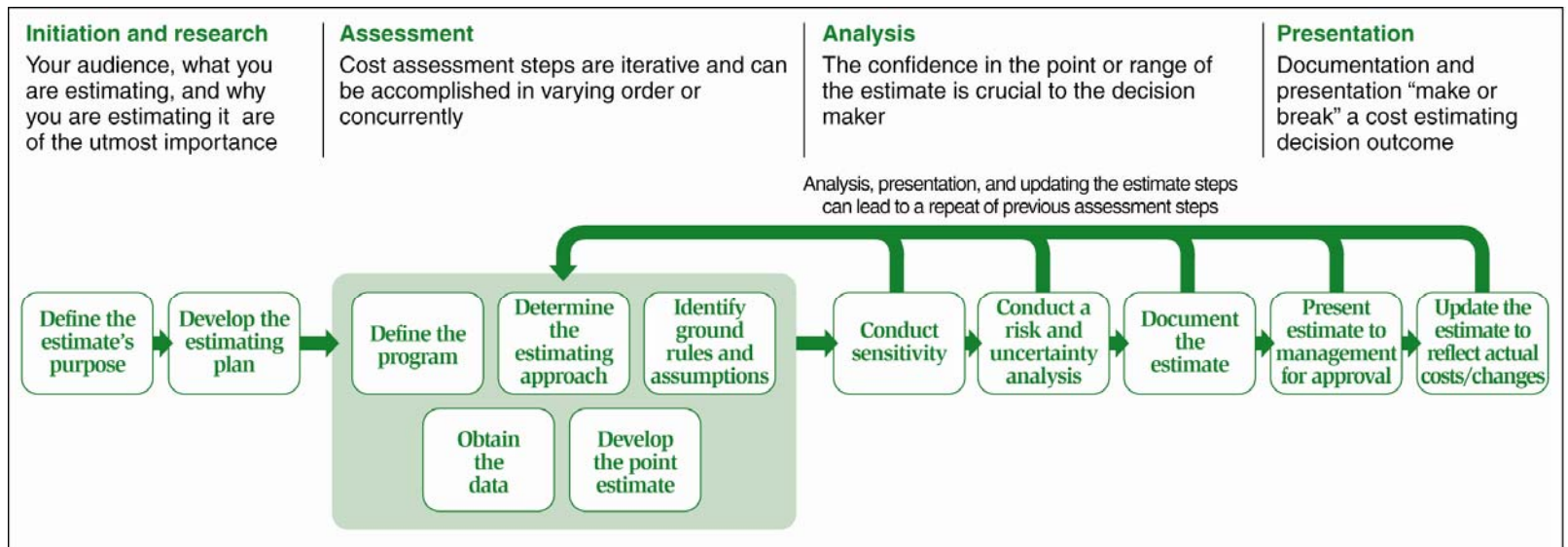
- Chapter 1: Characteristics of credible cost estimates and a reliable process for creating them
- Chapter 2: Why cost estimates are required for government programs and challenges associated with developing credible results
- Chapter 3: Criteria related to cost estimating/Earned Value Management and data reliability
- Chapter 4: Cost Analysis Overview
- Chapter 5: The Cost estimate's Purpose, Scope, and Schedule
- Chapter 6: The Cost Assessment Team
- Chapter 7: Technical Baseline Description
- Chapter 8: Work Breakdown Structure
- Chapter 9: Ground Rules and Assumptions
- Chapter 10: Data

GAO CAG: Table of Contents (cont)

- Chapter 11: Developing the Point Estimate
- Chapter 12: Software Cost Estimation
- Chapter 13: Sensitivity Analysis
- Chapter 14: Cost Risk/Uncertainty
- Chapter 15: Validating the Estimate
- Chapter 16: Documenting the Estimate
- Chapter 17: Presenting the Estimate
- Chapter 18: Managing Cost - Planning
- Chapter 19: Managing Cost - Execution
- Chapter 20: Managing Cost – Updating
- Appendices

Chapter 1: Characteristics of credible cost estimates and a reliable process for creating them

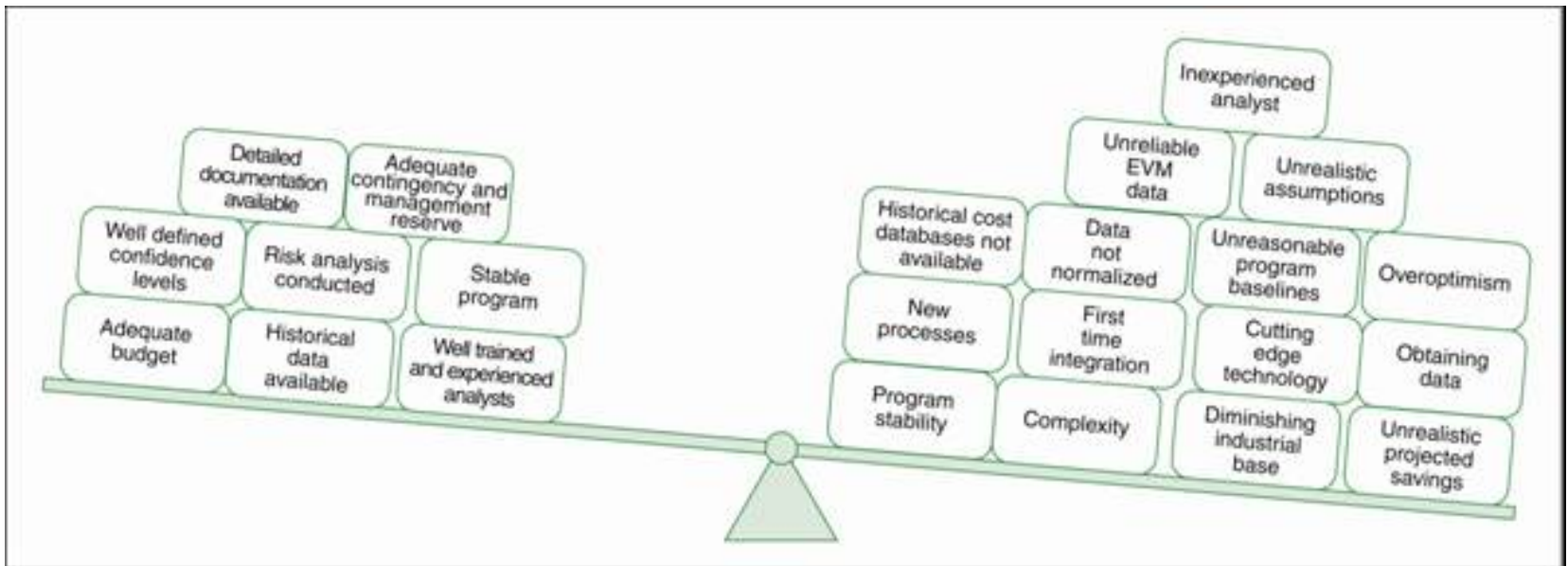
- This chapter discusses a 1972 GAO report on cost estimating
 - We reported that cost estimates were understated and causing unexpected cost growth
 - Many of the factors causing this problem are still relevant today
- We also discuss a 12 step process for producing high quality cost estimates



Source: GAO.

Chapter 2: Why cost estimates are required for government programs and challenges associated with developing credible results

- Introduces why cost estimates are required for government programs
 - Developing annual budgets, supporting management decisions about which program to fund, and evaluating resource requirements at key decision points
- Discusses various challenges associated with developing credible results

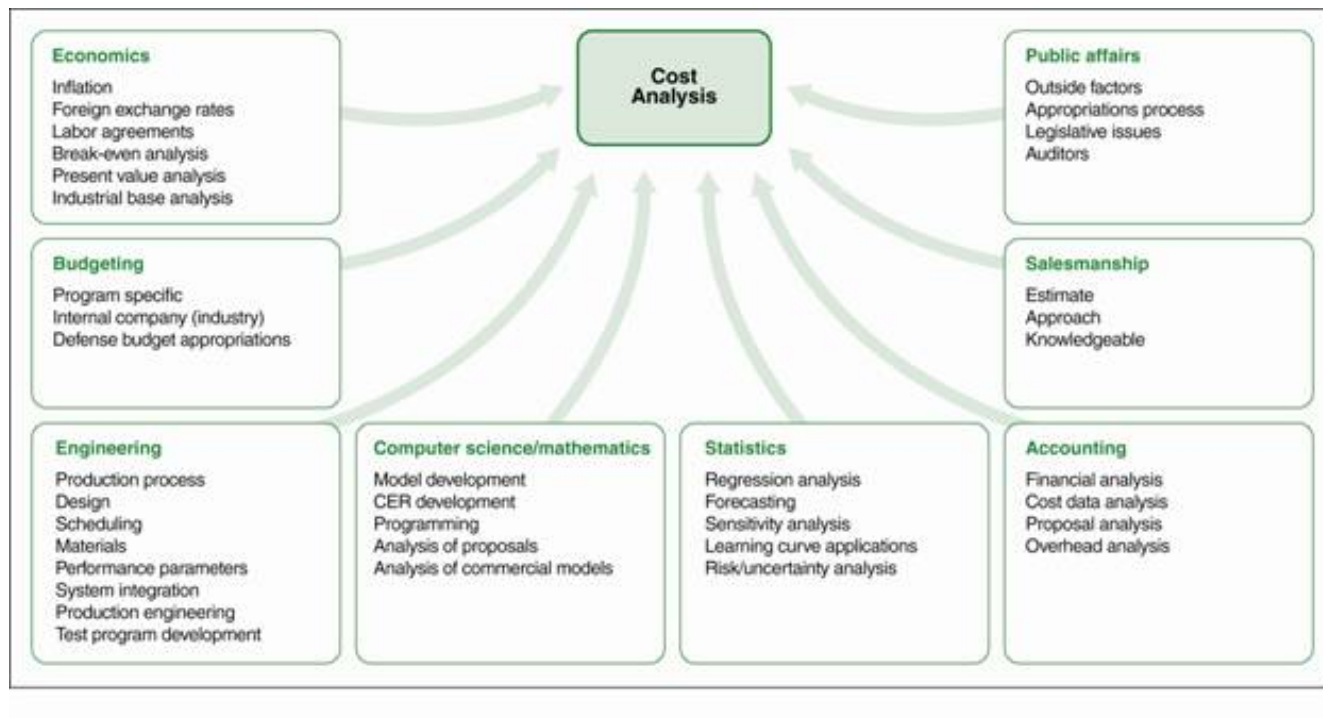


Chapter 3: Criteria related to cost estimating/EVM and data reliability

- We address how auditors rely on criteria to provide a benchmark for measuring how well a program is performing
 - Criteria provide a context for what is required, what the desired state should be, and what the program was expected to accomplish
 - Criteria are the laws, regulations, policies, procedures, standards and expectations that define what should exist
- We discuss how we researched legislation, regulation, policy and guidance for those most related to cost estimating and EVM
 - DOD, by far, had the most guidance on these subjects
 - Based on our research, we provide tables outlining various criteria that pertain to cost estimating and EVM such as:
 - GPRA, Clinger-Cohen Act, FAR EVMS Changes (7/5/06), Selected Acquisition Reports, 10 USC ICE, 10 USC Nunn-McCurdy, OMB Circulars (A-11, A-94, A-109, etc.), OMB Capital Programming Guide, DOD 5000.1, 5000.2, 5000.4, and the NDIA Guides (EVM Intent, Implementation, Surveillance, Application, System Acceptance, and Integrating EVM and Risk Management)
- We also address the importance of data reliability for cost estimating and EVM

Chapter 6: The Cost Assessment Team

- The estimating team must manage a great deal of risk, including making assumptions and interpreting what historical data represents
 - Many times, these decisions are subjective and require the estimator to possess many skills
 - Cost estimators must have good organization skills in order to pull together disparate data and package it in a meaningful way



Chapter 6: The Cost Assessment Team (continued)

- The size of the team is driven by the estimate type
 - A ROM estimate requires less skill and time than a LCCE
- Enough time should be allotted for
 - Collecting and understanding historical data
 - Clarifying technical program aspects with experts
- A best practice is centralizing the cost estimating team and process
 - Facilitates the use of standard processes
 - Results in a strong organizational structure and leadership support
 - Allows for the identification of resident experts
 - Enables better sharing of resources
 - Encourages commonality of tools and training for cost estimating
 - Provides for more independence and less bias
 - Presents opportunities for advancement within the cost estimating field
- Certifications, training, and practical experience are necessary for cost estimators and EVM analysts to effectively perform their job

Chapter 15: Validating the Estimate

- Cost estimates should be validated against these best practice characteristics:
 - They are comprehensive, well-documented, accurate, and credible
 - Cost estimates are considered comprehensive if they
 - Completely define the program and reflect the current schedule
 - Include all possible costs using a logical WBS that accounts for all requirements
 - Ensure that no costs are omitted nor double-counted
 - Explain and document key assumptions that are technically reasonable
 - Cost estimates are well-documented if
 - They can be easily repeated or updated and traced to original sources through auditing
 - Supporting documentation identifies the data sources, justifies all assumptions, and provides a description of each estimating methodology for every WBS cost element
 - Schedule milestones and deliverables are traceable and consistent with the cost estimate documentation
 - Cost estimates are accurate if
 - They are not overly conservative or too optimistic
 - Based on an assessment of most likely costs and adjusted properly for inflation
 - Contain few, if any, mistakes that are minor in nature
 - Are updated when assumptions or requirements change to reflect current status
 - CERs and parametric cost models are validated to ensure they are good predictors of costs
 - Data is current and applicable to the new program,
 - The relationships between technical parameters are logical and statistically significant
 - Results are tested with independent data

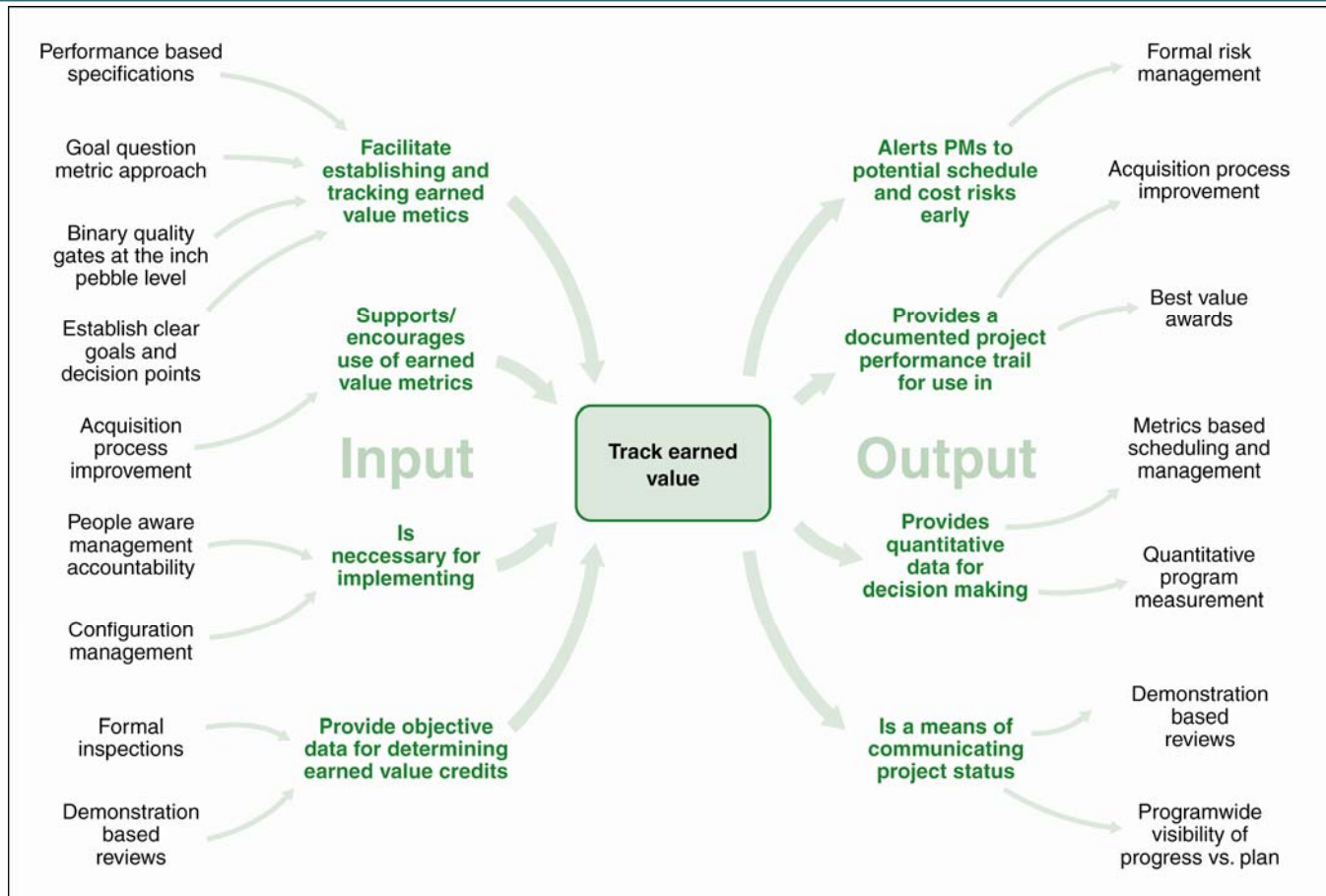
Chapter 15: Validating the Estimate (continued)

- Cost estimates are credible if
 - They clearly identify any limitations because of uncertainty or biases surrounding the data or assumptions
 - Results are similar to cross-checks and an independent cost estimate derived using different methodologies
 - ICEs performed by estimators farthest away from the acquiring program office represent a best practices because they
 - Tend to produce higher and more accurate cost estimates than those performed by staff sharing a common supervisor with the program office
 - Produce more credible estimates than other types of independent estimate reviews which may not be as inclusive as an ICE (e.g., IGCE, ICA, Sufficiency Review, etc.)
 - A sensitivity analysis has been performed to identify cost drivers and the impacts of varying assumptions
 - A risk / uncertainty analysis has been performed to determine the level of risk associated with the point estimate

Chapter 18: Managing Cost - Planning

- Discusses how the cost estimating effort does not end once a program has been approved
 - Instead, the next steps involve
 - Assigning someone (government and/or contractor) responsibility for developing, producing and implementing the program
 - Converting the cost estimate into a realistic and executable program baseline to manage program cost, schedule, and technical goals
- This chapter also introduces EVM including a discussion of
 - Its background, concept, benefits, industry standards (ANSI/EIA-748B), and EVM guidelines
 - 11 steps in the EVM Process
 - Define the scope with a WBS, Identify who will do the work, Schedule the work to a timeline,
 - Estimate resources / authorize budgets, Determine an objective measure for earned value,
 - Develop the PMB, Execute the work plan and record all costs, Analyze EVM data and variances,
 - Forecast estimates at complete, Take management action to mitigate risk, and
 - Update PMB as changes occur
 - Performing a Pre-award Integrated Baseline Review (IBR)
 - Including the the pros and cons
- It also addresses:
 - Setting up effective Award Fee criteria
 - Including tying award fee to objective outcomes/milestones that can be corroborated with EVM data
 - Validating the EVM system

Chapter 18: Inputs and Outputs (Benefits) of Tracking Earned Value

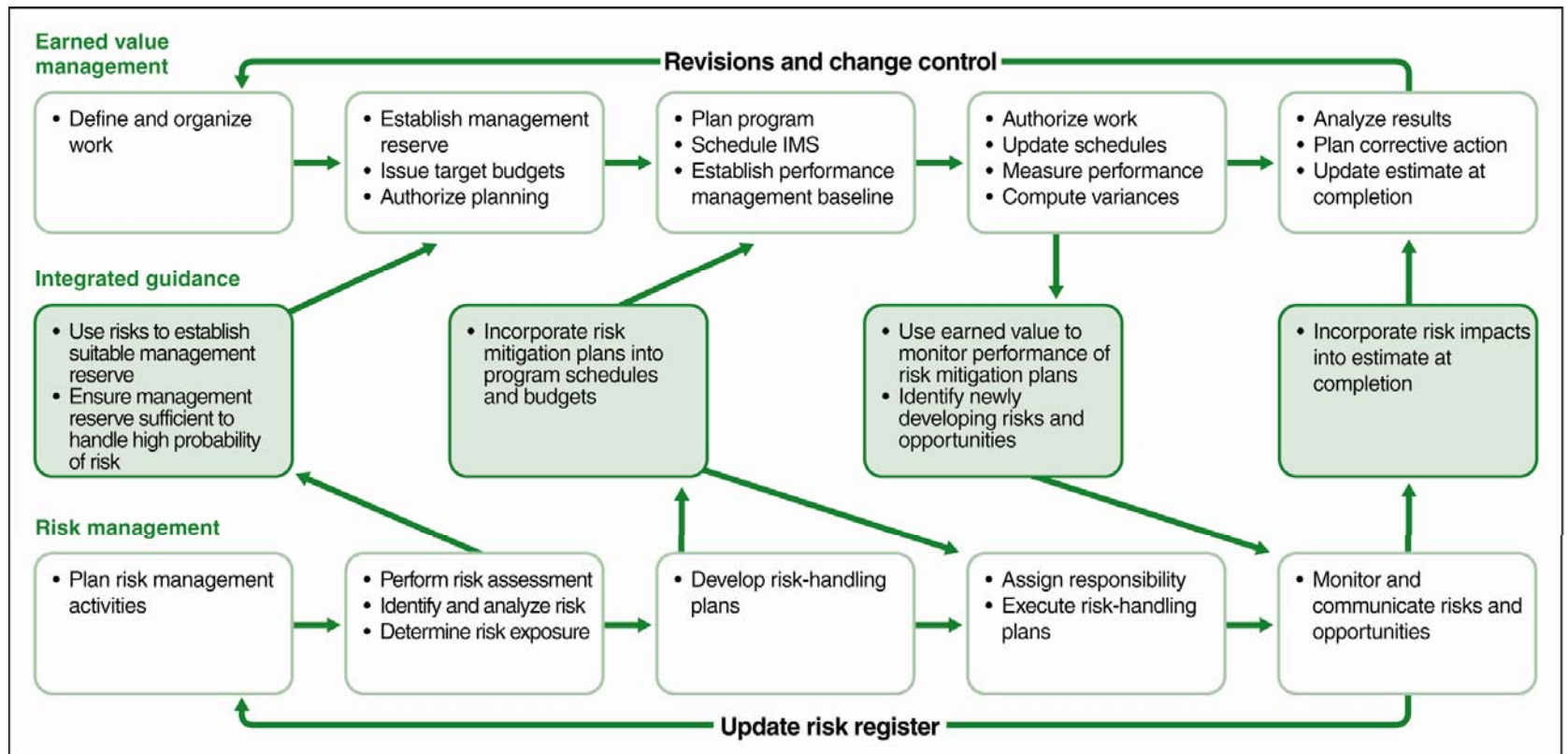


Source: DOD and GAO.

Chapter 18 – Best Practice to Link Cost Estimating and EVM

- Government cost estimating and EVM are often conducted by different groups that barely interact
 - Once the cost estimate has been developed and approved, cost estimators tend to move on to the next program, often not updating the cost estimate with actual costs after a contract has been awarded.
 - In some cases, cost estimators do not update a cost estimate unless significant cost overruns, schedule delays or modifications occur
- EVM analysts, too, are usually not that familiar with a program's technical baseline document, GR&As, and cost estimate data and methodology.
 - They tend to start monitoring programs without adequate knowledge of where and why risks are associated with underlying cost estimate.
- Limited integration can mean that
 - Cost estimators may update the program estimate without fully understanding what the earned value data represent,
 - EVM analysts do not benefit from cost estimators' insight into the possible cost and schedule risks associated with the program, and
 - Neither fully understands how risks identified with the cost estimate S curve (or cumulative probability distribution) translate into the program's PMB.
- Therefore, it is considered a best practice to link cost estimating and EVM analysis.

Chapter 18: Best Practice to Link EVM and Risk Management



Source: © 2007 National Defense Industrial Association (NDIA) Program Management Systems Committee (PMSC).

Chapter 19: Managing Cost - Execution

- This chapter discusses:
 - Performing an Integrated Baseline Review to validate the PMB and determine risks
 - Monitoring risks using a formal risk management plan
 - EVM risk “watch list” items derived from the cost risk/uncertainty analysis
 - Contract Performance Reports (CPRs) for summarizing EVM data
 - The CPR should reflect current contract status and reasonably project future program performance.
 - When CPR data are reliable, the report can facilitate informed, timely decisions by a variety of program staff—engineers, cost estimators, financial management personnel, among others.
 - CPR data are also used to confirm, quantify, and track known or emerging problems
 - Performing monthly EVM analysis
 - **Analyze performance:** check data to see if they are valid, determine what variances exist, probe schedule variances to see if activities are on the critical path, develop historical performance data indexes, graph the data to identify any trends, and review the format 5 variance analysis for explanations and corrective actions.
 - **Project future performance:** identify the work that remains, calculate a range of EACs and compare the results to available funding, determine if the contractor’s EAC is feasible, calculate an independent date for program completion.
 - **Formulate a plan of action and provide analysis to management.**
 - Rolling Wave Planning of remaining work

Chapter 20: Managing Cost - Updating

- This chapter addresses:
 - Incorporating authorized changes into the PMB, including Engineering Change Proposals (ECPs)
 - Performing continual EVM surveillance to ensure PMB is realistic and reflects current requirements
 - Requires a surveillance organization that is independent of the program staffed with EVM specialists
 - Implementing Over Target Baselines and Over Target Schedules
 - Updating program cost estimate with actual costs
 - Continually reporting updated Estimates at Completion (EACs) to management
 - Best practices require updated EACs, at a minimum, during quarterly program reviews
 - Incorporating lessons learned and document reasons for cost and / or schedule variances

GAO Report on FY06 Exhibit 300s

Agencies Need to Improve the
Accuracy & Reliability of
Investment Information
(Report # GAO-06-250)

Exhibit 300s: Congressional Request

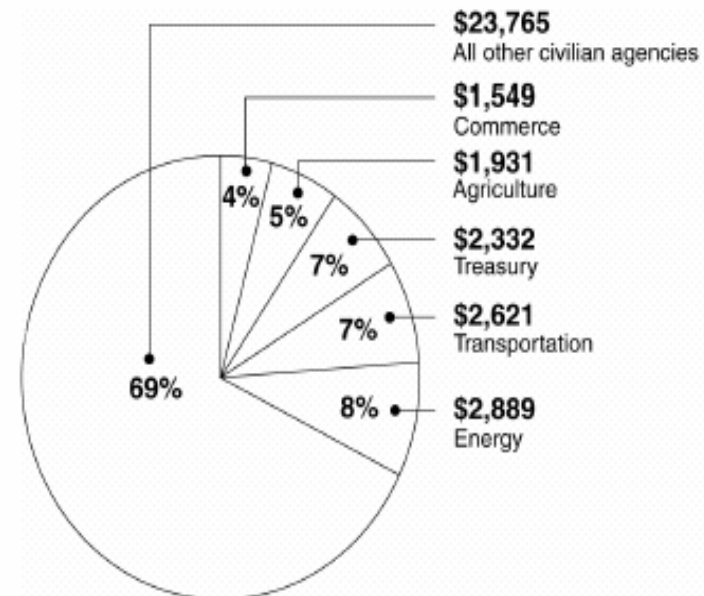
- OMB uses the exhibit 300 to:
 - make quantitative decisions about budgetary resources
 - make qualitative assessments about whether the agency's investments are consistent with OMB policy and guidance
 - identify and correct poorly planned or performing investments
 - find real or potential systemic weaknesses in federal information resource management
- House Government Reform asked GAO to determine the extent to which selected agencies have underlying support for the information in their FY 2006 exhibit 300s.

Exhibit 300s: GAO Methodology

- The 5 selected agencies made up about one-third of civil planned FY 2006 expenditures. These were:

- USDA
- Commerce
- Energy
- Transportation
- Treasury

Figure 1: Breakdown by Civilian Agencies of Planned \$35 Billion in Fiscal Year 2006 IT Investments



Source: GAO analysis of OMB data.

Exhibit 300s: GAO Methodology

- Areas of the exhibit 300 that were assessed:
 - Analysis of Alternatives
 - Performance Goals and Measures
 - **Project & Funding Plan (i.e., EVM Section)**
 - **Risk Management**
 - Security & Privacy
 - **Summary of Spending**

Exhibit 300s: GAO Findings

Risk Management

Findings:

- While most investments provided documentation to show that some risk were being managed (security), most of the other risks identified by OMB were not being managed (75% investments).
- Risk management plans were out of date or did not reflect the current operating environment.

Cause:

- Officials stated that some of the 19 risks were not applicable to their investment.
- Officials did not understand some of the risk categories.

Exhibit 300s: GAO Findings

Project & Funding Plan

Findings:

- 15 of the 21 investments did not implement ANSI-compliant EVM processes.
- 6 of 8 steady state investments did not conduct an operational analysis.

Cause:

- Lack of understanding at the department and project levels on what EVM is and how to implement it.
- Lack of guidance from OMB on what constitutes an operational analysis.

Exhibit 300s: GAO Findings

- In all cases, cost information reported in the exhibit 300 was derived from ad hoc processes rather than from cost-accounting systems with adequate controls.
 - Summary of Spending – figures for FY04 were not reliable.
 - Project & Funding Plan – government costs were derived from ad hoc systems.

Exhibit 300s: GAO Conclusions

- Usefulness of the exhibit 300 business case as a mechanism to support the selection and oversight of federal IT investments is undercut by the kinds of weaknesses displayed in the 29 business cases reviewed.
- Collectively, our findings raise questions on whether fundamental project management processes are in place, whether project managers are adequately trained in these processes.

Exhibit 300s: GAO Recommendations

- Recommendations to OMB included:
 - Directing agencies to determine the extent to which information contained in the exhibit 300s is accurate and reliable and disclose where it is not and how the agency plan to remedy the problem.
 - Developing and promulgating clearer guidance.
- OMB accepted the findings of our review.

*GAO Report on
Department of Homeland
Security*

**DHS Radiation Detection
Equipment
(Report # GAO-06-389)**

DHS Radiation Detection Congressional Request

- To address the threat of radioactive material being smuggled into the United States, DHS began deploying radiation detection equipment at US ports of entry
- The US has over 380 border sites at which DHS plans to deploy more than 3,000 radiation detectors by 2009. The volume of traffic adds to the size and complexity of the job.
 - Each day DHS processes about 64,000 containers arriving in the US via ships, trucks, and rail cars; 365,000 vehicles, and more than 1.1 million people
 - Goal of this program is to screen all this traffic without delaying its movement into the nation
- Congress asked us to assess what progress has been made in deploying radiation detection equipment and what problems exist

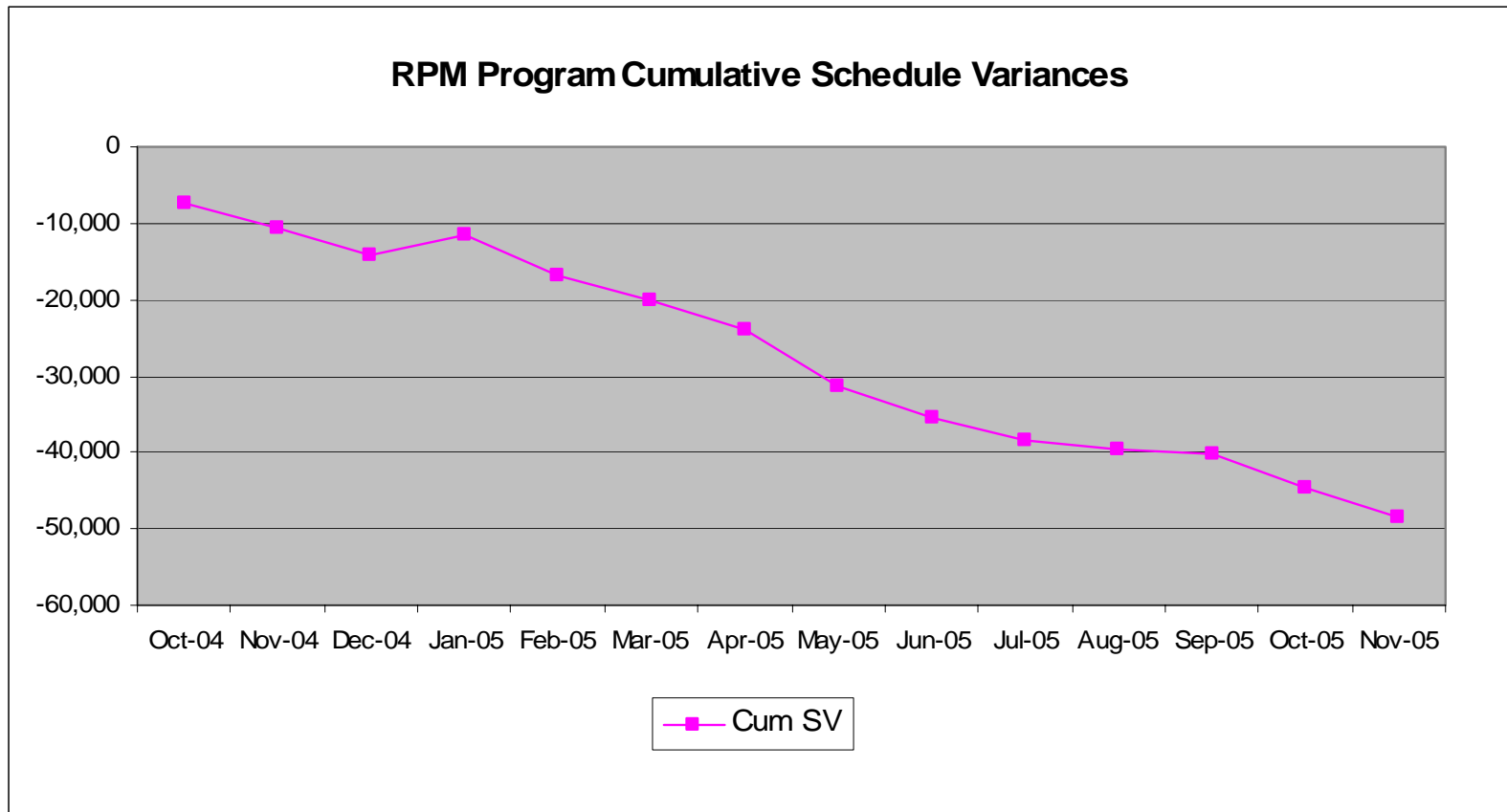
GAO Findings for DHS Radiation Detection Equipment

- Between October 2000 and October 2005, the US has spent about \$286 million to deploy radiation detection equipment, but will likely miss its 2009 completion date
 - To meet its long term goal, DHS would have to deploy about 52 portal monitors a month for the next 4 years—a rate that far exceeds the 2005 rate of about 22 per month
- The program's estimated cost of \$1.3B is highly uncertain and overly optimistic
 - Our analysis of EVM deployment data indicates the program will probably experience a significant cost overrun of between \$88 - \$596 million, with a most likely overrun of \$342 million

GAO Analysis of DHS Radiation Detection Equipment Schedule Delays

- None of the planned portal monitor deployments has progressed according to schedule
 - Monthly deployments would have to increase by almost 230% to meet the September 2009 completion date
 - For example, in November 2005, deployments at land crossings were about 20 months and \$1.9 million behind schedule while seaports were about 2 years and \$24 million behind schedule
 - The contractor, reported that the overall project schedule should not extend beyond September 2009, despite a cumulative negative schedule variance of \$48.6 million in November 2005
- Our analysis of the 14-month trend from October 2004 to November 2005 shows the contractor to be falling further behind schedule

Radiation Detection Equipment Schedule Trend October 2004 – November 2005



GAO Analysis of DHS Radiation Detection Equipment Schedule Delays

- Reasons for the significant schedule delay due to:
 - Customs Border Patrol (CBP) has been chronically late in providing funding to the contractor causing the program to miss deployment goals
 - For example, the contractor did not receive fiscal year 2005 funding until September 2005 resulting in planned activities being delayed or halted due to lack of funds.
 - Negotiations with seaport operators have also been slow
 - Seaport operators, concerned that screening for radiation will adversely affect the flow of commerce through their ports, have
 - Insisted on late stage design changes,
 - Insisted on inefficient construction schedules, and
 - Delayed their final review and approval of project designs.

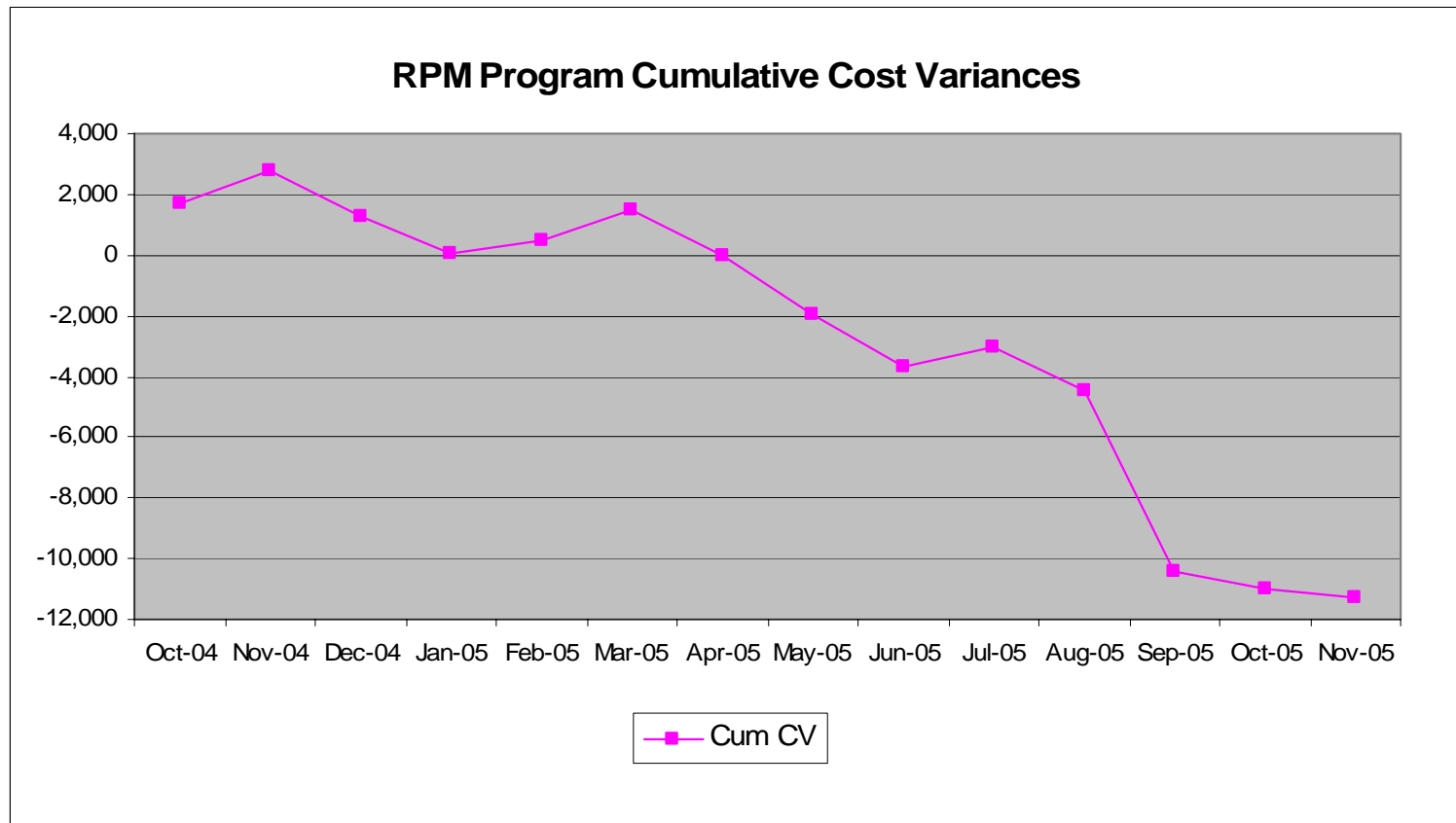
GAO Analysis of DHS Radiation Detection Equipment Schedule Delays

- Reasons for the significant schedule delay due to:
 - Seaport operators concern that conducting secondary inspections on trains as they prepare to depart could back up rail traffic
 - This could disrupt rail schedules potentially costing a port thousands of dollars in lost revenue
 - If a rail car alarms as it passes through a portal monitor, that car will possibly have to be separated from the remaining train—sometimes a mile long—to undergo a secondary inspection
 - Trains transport numerous types of cargo containing large quantities of naturally occurring radioactive material, CBP faces the challenge of maintaining a nuisance alarm rate that does not adversely affect commerce
 - Unforeseen design and construction problems
 - Deployments have taken longer than planned due to port expansion activities
 - Deployments have been hampered by poor weather including extreme cold in the northern sites that caused some unexpected work stoppages/equipment failures and major flooding at southern border sites

GAO Analysis of DHS Radiation Detection Equipment Cost Overruns

- In November 2005 the contractor reported that the radiation detection equipment deployment program could experience an overall cost overrun of \$36 million
 - Our analysis of the contractor's EVM data indicates an expected cost overrun between \$88 and \$596 million based on historical trend analysis.
 - Recent cumulative program trends have been negative, indicating that the program's cost overruns are deepening over time
 - The contractor noted that \$62 million of management reserve should cover the anticipated overrun
 - We disagree and believe the cost overrun will far exceed the contractor's estimate of \$36 million
 - The contractor would have to operate at an efficiency level of 98 percent when it has consistently been delivering about \$0.86 worth of work for every dollar spent.
 - Studies of over 700 programs show that once a program is 15 percent complete, cost performance almost never improves and tends to decline

Radiation Detection Equipment Cost Trend October 2004 – November 2005



GAO Analysis of DHS Radiation Detection Equipment EVM Data Reliability

- To meet the Generally Accepted Government Auditing Standards (GAGAS) for EVM data reliability and validity, we requested copies of the EVM System Validation and Integrated Baseline Review (IBR) results for the DHS Radiation Detection Equipment program
 - We found that the contractor's EVM system has not been certified to show it complies with the guidance developed by American National Standards Institute / Electronic Industries Alliance (ANSI/EIA-748-98)
 - Guidance identifies 32 criteria that a reliable EVM system should meet
 - We also found that an IBR was not conducted to ensure that the EVM baseline for the portal monitoring
 - Represents all work to be completed
 - Includes adequate resources

GAO Recommendations for Improving DHS Radiation Detection Equipment Program

We made the following recommendations to the secretary of Homeland Security:

- To devise a plan to close the gap between the current deployment rate and the rate needed to complete deployments by September 2009
- To analyze the benefits and costs of deploying advanced portal monitors
- To develop procedures for effectively screening rail containers and develop new technologies to facilitate inspections
- To direct the Radiation Detection Equipment program contractor to have its EVM system validated so it complies with guidance developed by the ANSI/EIA
- To direct CBP and the contractor to conduct an Integrated Baseline Review to ensure its EVM data is reliable for assessing risk and developing alternatives

Invitation to Participate in Further Development of the Guide

- GAO invites interested parties to meet with us and other experts to discuss further development of the Guide during the year long exposure draft period
 - If interested, please e-mail your contact info to:
 - Karen Richey - richeyk@gao.gov
 - Jennifer Echard – echardj@gao.gov
 - Carol Cha – chac@gao.gov