Strategic Management Solutions LLC

ICEAA SoCal 2025 Workshop:
Challenges in Implementing GAO's Estimating Best Practices

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Challenges in Implementing GAO's Estimating Best Practices: Agenda

I. Setting the Stage
II. GAO's Characteristics of Reliable Cost Estimates/12-Step Process
III. GAO Step 6: Obtain the Data
IV. GAO Step 7: Develop the Point Estimate
V. GAO Step 8: Conduct Sensitivity Analysis
VI. GAO Step 9: Conduct Risk and Uncertainty Analysis
VII. Conclusion/Questions
VIII. Presenter Bio/Experience and Additional Details

Setting the Stage: GAO's High Risk List

In 1990, the Government Accountability Office (GAO) began program to report on USG operations they identified as "high risk"

- Since then, they have reported on the status of progress to address high-risk areas and update their list
- Serious weaknesses have been identified in areas involving substantial resources and/or providing critical services to public
- Congress views these high-risk problems as serious concerns and has threatened cutting funding for agencies failing to show progress toward addressing them

GAO's Characteristics of Reliable Cost Estimates and their 12-Step Process for Creating Them

Four Characteristics of Reliable Cost Estimates

Comprehensive:

- **Includes all life cycle costs**
- Based on a technical baseline that defines the project/program and schedule
- Reflects a "product-oriented" work breakdown structure (WBS)
  - Deliverable rather than phase-based
- Documents all assumptions

Four Characteristics of Reliable Cost Estimates (cont'd)

Well-Documented:

- Shows the source and reliability of data used
- Describes the estimating methodology in a way that allows it to be replicated
- Mirrors the technical baseline
- Provides evidence of management's acceptance

Four Characteristics of Reliable Cost Estimates (cont'd)

Accurate:

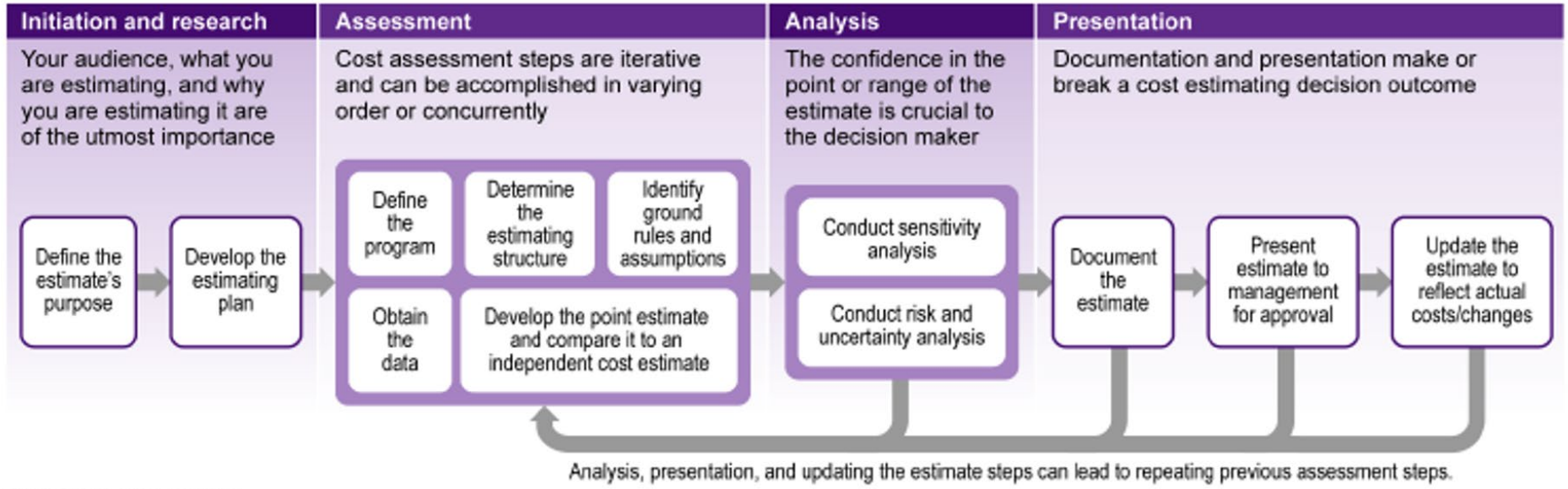
- Each WBS element based on best method and data collected
- Properly adjusted for inflation
- Contains few errors, if any
- Updated to reflect changes
- Explains variances
- **Based on history**

Four Characteristics of Reliable Cost Estimates (cont'd)

Credible:

- **Includes sensitivity analysis**
- **Quantifies risk and uncertainty showing a range of possible outcomes**
- Employs cross-checks on major elements
- **Compared to an independent cost estimate (ICE) to examine its overall validity**

GAO's Cost Estimating Best Practices Embodied in a 12-Step Process



Source: GAO. | GAO-20-195G

GAO Step 6 – Obtain the Data

Cost, Schedule, Technical and Programmatic Data Should Underlie Every Estimate

All WBS elements need data as basis to support their corresponding estimates (basis of estimate/BOE)

Historical cost and non-cost data should be collected to support various estimating techniques:

- Cost data usually include labor dollars (with supporting labor hours and direct costs and overhead rates), material costs, overhead, facilities capital cost of money, and profit
- Schedule or project/program data provide parameters that affect cost

Data Should Always be Validated Before Using in Estimates

It is important to ensure that the collected data apply to the cost estimate

- For example, do not use data from a mainframe technology if the new project/program will use servers

To address data limitations, an analyst must:

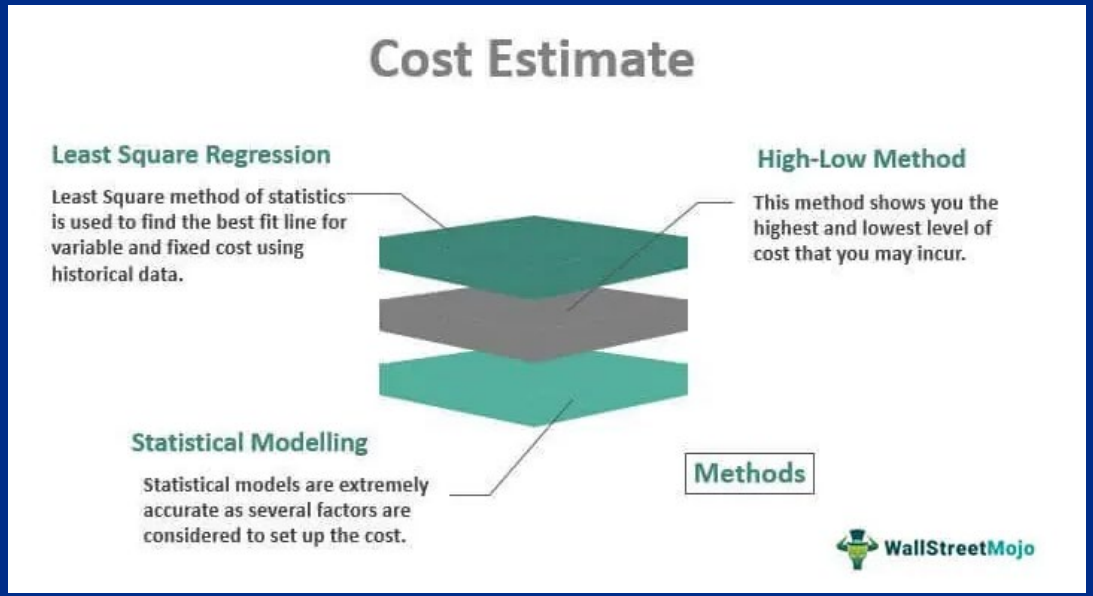
- Ensure that the most recent data are collected
- Have a thorough knowledge of the data's background
- Discuss limitations and uses with the data provider
- Identify the correlation between cost and performance data

Data Must be Documented to Provide Context

Data must be documented and stored for future use including information about the:

- Source of data
- Work product content
- Time
- Units
- Assessment of data accuracy and reliability

GAO Step 7 – Develop the Point Estimate



Analysts Follow Sequential Steps to Create Valid Cost Estimates

To develop a point estimate, an estimator must:

- Develop the cost estimate for each WBS element choosing from a variety of methods based on data collected
- Include all estimating assumptions in the cost model
- Express costs in constant-year dollars
- Time-phase the results by spreading the costs in the years they are expected to occur based on the project/program schedule
- Add up all WBS elements to develop the overall point estimate

Analysts Follow Sequential Steps to Create Valid Cost Estimates (cont'd)

Once the overall point estimate has been developed, the estimator must then:

- Validate the estimate by looking for errors like double-counting or omitting costs
- **Compare the estimate to an ICE and examine differences**
- Perform crosschecks on cost drivers to see if results are similar
- Update the cost model as more data become available

Independent Cost Estimates are the Best/Most Reliable Way to Validate Estimates

ICEs are usually performed by organizations higher in the decision-making process:

- Provide an independent view of expected project/program costs
- Test the reasonableness of the project/program office's estimate
- Use different methods and are less burdened with organizational bias
- Incorporate adequate risk and tend to be more conservative

Quality of ICE improves as separation from acquiring project/program office increases

GAO Step 8 – Conduct Sensitivity Analysis

Sensitivity Analysis Accounts for Estimate Uncertainty by Looking at the Effect of One Change at a Time

All estimates are uncertain due to the inherent variation associated with the estimating method used or from technical assumptions

- **Sensitivity analysis quantifies which cost elements represent the most risk**

The sources supporting the assumption or factor ranges should be well documented and reasonable

Sensitivity analysis should be done as part of a quantitative risk assessment and not based on arbitrary +/- percentages

- Not just an output of Monte Carlo-based risk/uncertainty analysis

Sensitivity Analysis Accounts for Estimate Uncertainty by Looking at the Effect of One Change at a Time (cont'd)

Sensitivity analysis reveals how the cost estimate is affected by **manually** changing one assumption at a time, while holding all other variables constant

- Identifies which variable most affects the cost estimate
- Examines the effect of multiple assumptions changing for a specific scenario
- Focuses on varying **high-cost drivers** and assumptions
  - Examples include configuration changes, testing requirements, labor rates, and alternative assumptions

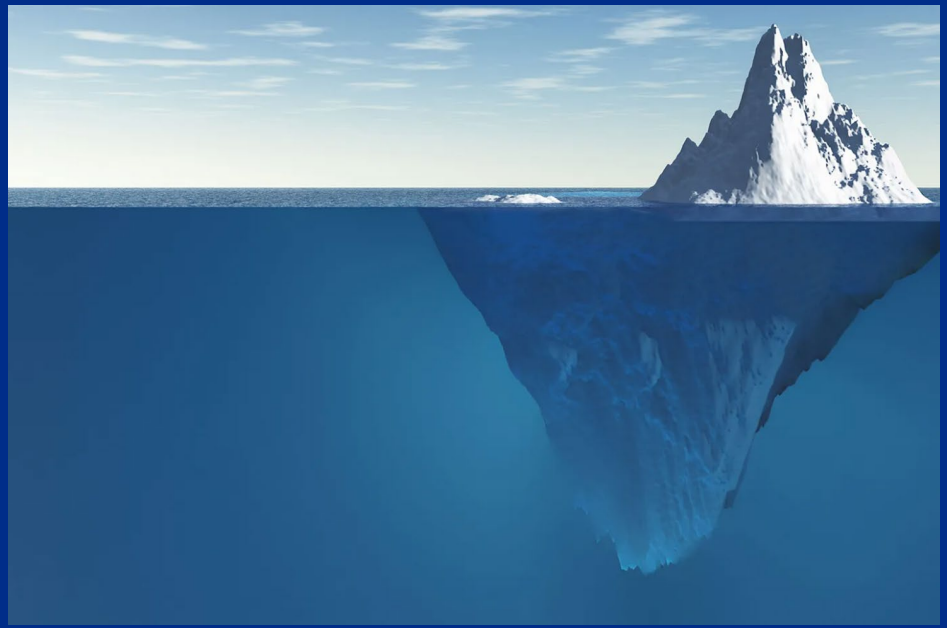
A Sensitivity Analysis Should be Used to Create a Range of Best and Worse Cases

Analysis results should be well documented and presented to management to inform their decision-making

Sensitivity analysis is useful because it:

- Aids decision makers in choosing the best alternative
- Focuses management on what drives project/program cost the most
- Establishes a method for performing what-if analysis

GAO Step 9 – Conduct Risk and Uncertainty Analysis



Difference Between Risk and Uncertainty

Risk: A situation in which outcome is subject to uncontrollable random event stemming from known probability distribution

- Roll of two dice is an example since the roll can result in one of 11 possible outcomes
- These types of risks are often called "known-unknowns"

Uncertainty: A situation in which outcome is subject to uncontrollable random event stemming from unknown probability distribution

- Example: Will it rain two weeks from today? There is no past data available from which to establish a probability distribution of potential outcomes
- This type of risk is often called "unknown-unknowns"

Cost estimating falls more into the range of uncertainty than risk, but most managers use the term risk analysis

Why do Risk and Uncertainty?

A point estimate, by itself, is meaningless—management needs to know:

- The range of all possible costs
- The level of certainty associated in achieving the point estimate in order to make a wise decision
- Whether a realistic baseline has been estimated for the project/program
  - Unrealistic baselines have resulted in costs overrunning and projects/programs failing to deliver promised functionality on time

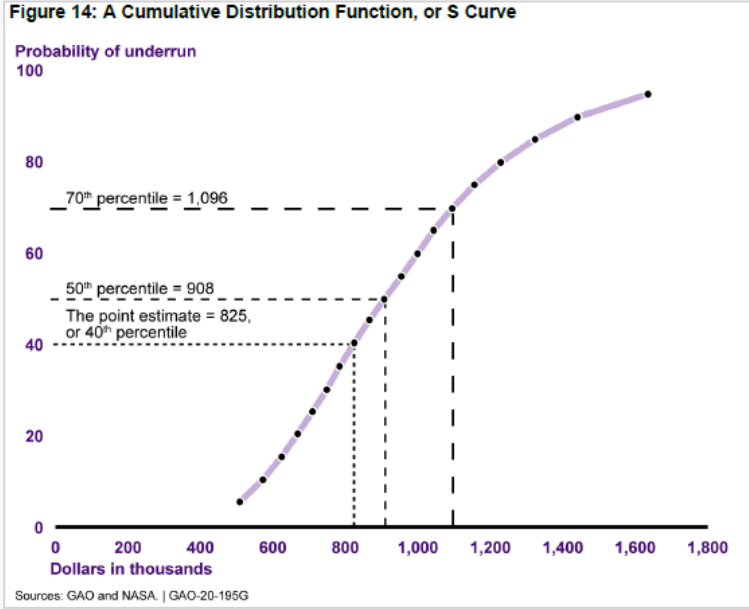
Determining a Level of Confidence to Identify Amount of Contingency Required

Determine if a project/program is realistically budgeted by performing a Monte Carlo simulation-based uncertainty analysis

- Identifies the probability associated with achieving the point estimate
- This probability comes from the cumulative probability distribution, known more commonly as an "S-curve"
  - Portrays the uncertainty implications of various cost estimates
- *Lack of "correlation" between risks and cost elements has been identified by DoD as area of concern*
  - *More credence given to sensitivity analyses due to manual nature*

S-curve Shows Levels of Confidence (Percentiles) and the Associated Cost

- Shows the likelihood associated with different cost estimates
- Allows management to know the probability of an overrun
- Enables management to devote resources to monitor specific risks
- Reveals that to reach higher confidence levels, substantial investment is needed



Conclusion

Despite DOE/NNSA efforts to have large projects removed from GAO High Risk List, specific elements of reliable estimating characteristics/best practices continue to be a challenge across the Complex

- Preparation of comprehensive life cycle cost estimates (LCCE) for major projects
- Development/maintenance of historical cost database(s) that can inform new estimates
- Comparing/reconciling point estimate to independent cost estimate (ICE)
- Conducting Sensitivity Analysis
- Conducting Risk and Uncertainty Analysis

In an effort to address these challenges, some sites have begun incorporating GAO best practices into their internal estimating processes/procedures

Questions?

Presenter Biography/Experience

Work

- 35 years of overall experience in leadership and management of professional services in support of government/commercial projects
- Functional responsibility for multiple departments in excess of 100 people, deployed at project/program sites around the world
- Lead for several practices providing cost engineering and EVMS consulting services
  - Clients included DOE/NNSA and their M&O contractors across Complex
- Past President (2011 – 2012) and current Fellow at AACE International
- National/international presenter and author of multiple technical papers/publications
  - Named contributor to GAO Cost Assessment Guide

Education and Certifications

- Bachelor of Arts in Geology: University of Rochester (NY) – May 1988
- Master of Engineering Management (MEM): George Washington University – January 2000
- AACE International Certified Cost Professional (CCP) – 2001
- AACE International Planning & Scheduling Professional (PSP) – 2004

Recommended 5-Step Process for Developing a Credible Sensitivity Analysis

Step 1: Identify key cost drivers, ground rules, and assumptions for sensitivity testing

Step 2: Re-estimate the total by choosing one of the identified cost drivers or assumptions and varying it between two set amounts

- The amounts chosen may represent maximum and minimum, various performance thresholds, or alternative assumptions
- Ranges should be documented during data collection and cost estimating

Step 3: Document the results

Step 4: Repeat Steps 2 and 3 until all factors identified in Step 1 have been independently tested

Step 5: Evaluate results to determine which drivers affect the cost estimate the most

6-step Process for Creating a Cost Estimate S-Curve

1. Determine the project/program cost drivers and associated risks
2. Develop probability distributions to model various types of uncertainty (e.g., programmatic, technical, cost estimating, schedule, etc.)
3. To properly capture risk, account for correlation between cost elements
4. Perform uncertainty analysis using Monte Carlo simulation
5. Identify the probability level associated with the point estimate
6. Recommend sufficient *contingency reserves* to achieve desired level of confidence