

2020 Census Cost Life Cycle Cost Estimate (LCCE):
Using the GAO Cost Estimation and Analysis Guide to Drive
Enhancements

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U.S. Census Bureau

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About the Presenter: Ed Kobilarcik

Ed Kobilarcik is a Special Advisor leading Cost Estimation and Analysis for the Decennial Budget Office (DBO) at the U.S. Census Bureau Headquarters in Suitland, MD.

- ❖ Ed is a career Census employee and has been involved in resource allocation for over 25 years and is the “resident expert” on cost estimation for the Decennial Census Programs.
- ❖ Ed is a Certified Cost Estimator/Analyst (CCEA) as recognized by the International Cost Estimating and Analysis Association (ICEAA).
- ❖ Ed has worked to continuously evolve cost estimating for Decennial Censuses starting with the 2000 Decennial Census.
- ❖ Ed has been engaged with oversight (GAO, OIG, etc.) on cost estimation issues for much of his career.
- ❖ Ed recently received a Department of Commerce Silver Medal in 2018 for his efforts to improve the 2020 Census LCCE.



About the Presenter: Neala Jones

Neala Jones is the Lead Estimator with the Cost Estimation and Analysis Staff for the Decennial Budget Office (DBO) at the U.S. Census Bureau Headquarters in Suitland, MD.

- ❖ Neala is a career Census employee and has been involved in resource allocation for nearly 20 years.
- ❖ Neala helped orchestrate the architecture of the Decennial Budget Integration Tool (DBiT), which is a sophisticated suite of cost modeling and analytical capabilities.
- ❖ Neala utilizes large budget datasets based on cost data from DBiT output to analyze the data and prepare reports for senior management staff.
- ❖ Neala recently received a Department of Commerce Silver Medal in 2018 for her efforts to improve the 2020 Census LCCE.
- ❖ Neala is a Certified Cost Estimator/Analyst (CCEA) as recognized by the International Cost Estimating and Analysis Association (ICEAA).



Briefing Objectives

- Share a brief overview of the 2020 Decennial Census Program.
- Discuss the results of the most recent GAO assessment of the 2020 Census cost LCCE.
- Showcase the 2020 Census LCCE team's experience with the GAO Cost Estimation and Analysis Guide.
- Explore how the 2020 Census LCCE team used the GAO's assessment to identify and prioritize the elements needed to improve the estimate.
- Highlight lessons learned.

Agenda

1. Background
2. Overview of the 2020 Census LCCE
3. GAO Cost Estimate Assessments
4. How GAO Cost Guide Was Used
5. Lessons Learned
6. Final Thoughts and Discussion

1. Background



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Census Overview



ESTABLISH WHERE TO COUNT

Identify all addresses where people could live.

Conduct a 100-percent review and update of the nation's address list.

Minimize in-field work with in-office updating.

Use multiple data sources to identify areas with address changes.

Get local government input.



MOTIVATE PEOPLE TO RESPOND

Conduct a nationwide communications and partnership campaign.

Work with trusted sources to increase participation.

Maximize outreach using traditional and new media.

Target advertisements to specific audiences.



COUNT THE POPULATION

Collect data from all households, including group and unique living arrangements.

Make it easy for people to respond anytime, anywhere.

Encourage people to use the online response option.

Use the most cost-effective strategy to contact and count nonrespondents.

Streamline in-field census taking.

Knock on doors only when necessary.



RELEASE CENSUS RESULTS

Process and provide Census data.

Deliver apportionment counts to the President by December 31, 2020.

Release counts for redistricting by April 1, 2021.

Make it easier for the public to get information.



Decennial Census Factoids

What is the magnitude of the enumeration operation?

- 330 million people counted living within 146 million housing units.
- 800,000+ people hired nationwide to conduct enumeration operations.
- 600,000+ people needed to go door-to-door to count 55 million non-responses.
- 1.0+ billion forms printed.
- Personal data collected is treated as confidential and must be protected during and after the census.

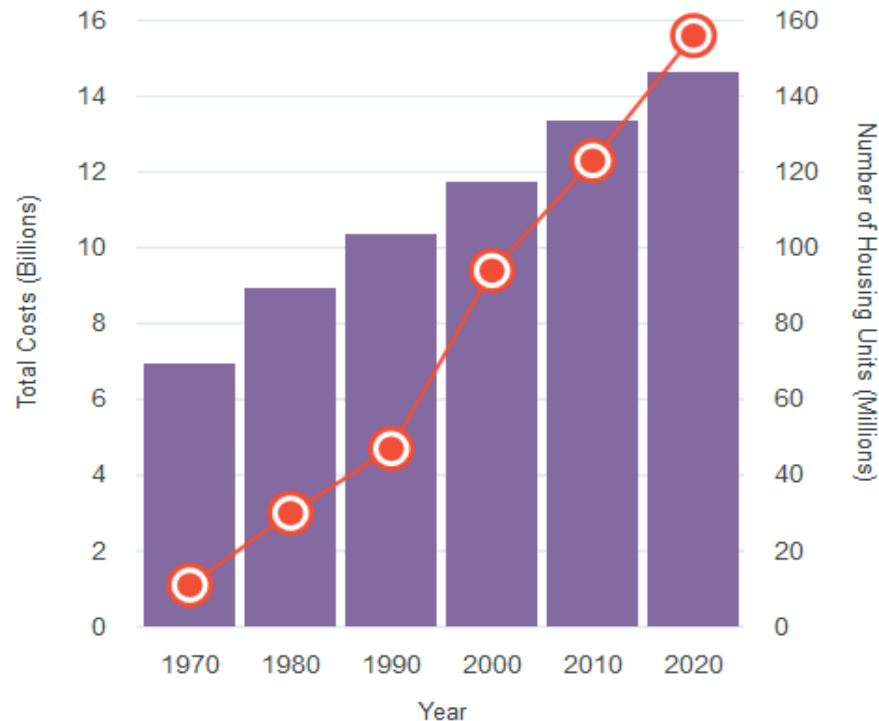
What is the projected cost and budget?

- The total risk-adjusted projected cost is over \$15.6 billion spanning a 12-year life cycle.
- Over 80% of the costs are in the 2018-2021 years.
- IT accounts for nearly 33% of the total cost.

Why is it conducted and how often?

- Mandated by the U.S. Constitution (Article 1, Section 2) (Fourteenth Amendment Section 2).
- Used for Congressional Apportionment and Redistricting.
- Basis for distributing more than \$675 billion (each year) in federal funds.
- Occurs every 10 years.

Illustrative Decennial Census Cost Growth

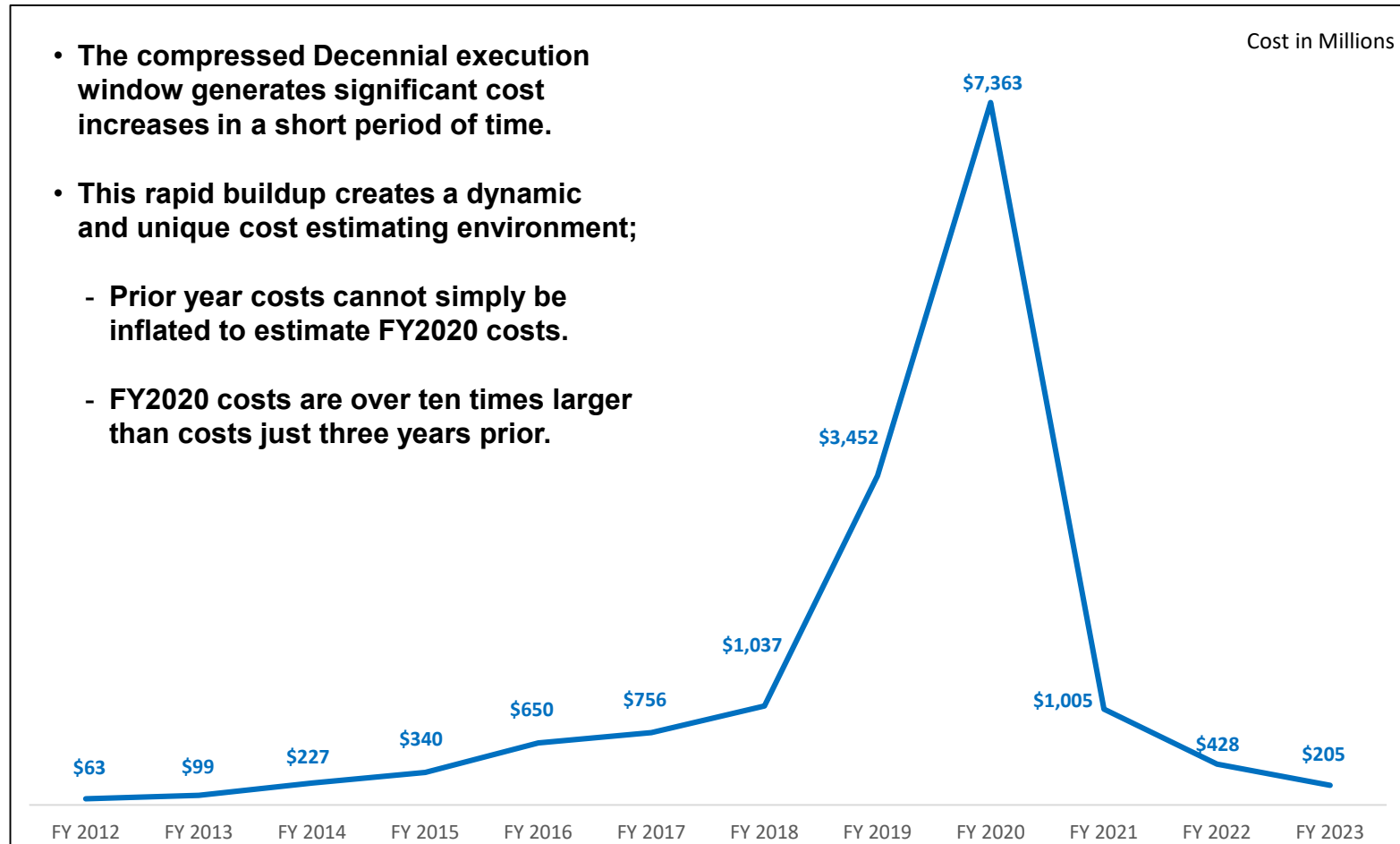


○ Total Costs (Billions) ■ Number of Housing Units (Millions)

Challenges Drive Rising Costs

- Constrained fiscal environment
- Rapidly changing use of technology
- Information explosion
- Declining response rates
- Distrust in government
- Increasingly diverse population
- Informal, complex living arrangements
- A mobile population

2020 Census Cost Profile



2. Overview of 2020 Census LCCE



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2020 Census LCCE Snapshot

- The 2020 Census LCCE is a large and complex estimate – the scale of the cost estimate mirrors the 2020 Decennial Census Program – “largest peacetime mobilization effort in U.S”.
- Since 2011, the 2020 Census LCCE had historically been a “black box” to both Census leadership and GAO.
 - GAO audited the 2020 Census LCCE in June 2016 and found that the *Census Bureau Needs to Improve Its Life-Cycle Cost Estimating Process*.
 - In 2017 the 2020 Census LCCE team succeeded in documenting its LCCE in a formal Basis of Estimate (BoE) and in creating numerous supporting documents.
 - The most recent GAO assessment was released in August 2018 found that the 2020 Census LCCE had made “significant progress” in improving the estimate.

Large and Complex Estimate

- **Program Magnitude and Complexity**

- The 2020 Census is a major investment (ACAT 1 in DoD terms) and a Major Program under the Department of Commerce.
- 35 distinct operations in work breakdown structure.
- Over 600 million pieces of mail.
- Over 245 temporary field offices.
- Over 50 major IT systems.
- Approximately 2.5 million field enumerator recruits.
- Over 800k selectees to be processed, fingerprinted, and badged.

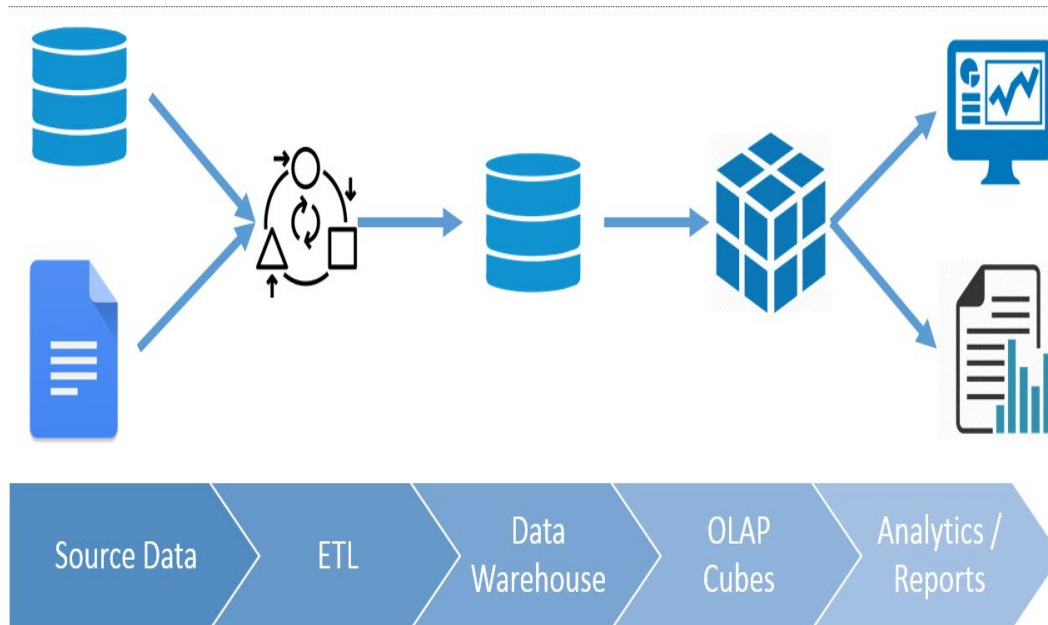
- **Cost Estimate Complexity**

- Over 50 data flows, over 300 cubes, over 600 dimensions, and over 500 links within Cognos TM1 cost model.
- Over 100,000 funding requests throughout the decade.
- Over 30 Portfolio-level Risk Register entries.
- Sensitivity and uncertainty analysis conducted for a dozen consolidated variables.

- **Cost Model Documentation Size**

- Over 300 pages created for the LCCE Basis of Estimate document and hundreds of supporting documentation files, including algebra sheets, QUBEdocs, and sourced assumptions tables.

Data → Information → Informed Decision Making



Decennial Budget Integration Tool (DBIT) is a suite of applications with tools and processes to support the Decennial Budget.

2020 Census LCCE Tools

- IBM Cognos TM1
- Microsoft Excel

DBiT Capabilities

DBIT provides single source of trusted data that can support:

- Cost Estimation
- Budget Formulation
- Budget Execution
- Reporting
- Analysis

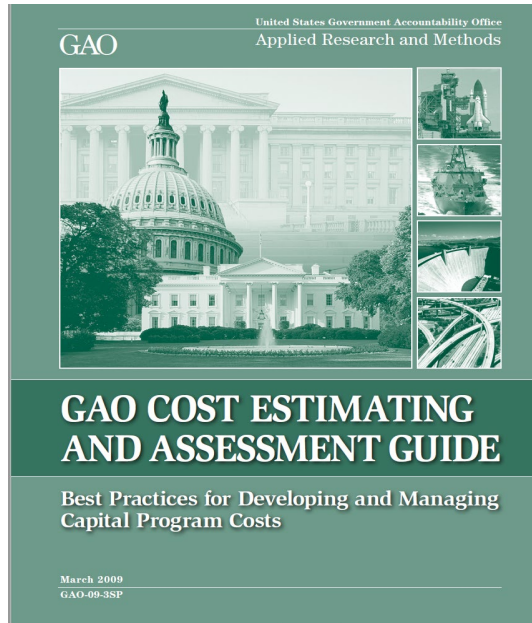
3. GAO Cost Estimate Assessments



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GAO Cost Guide Overview



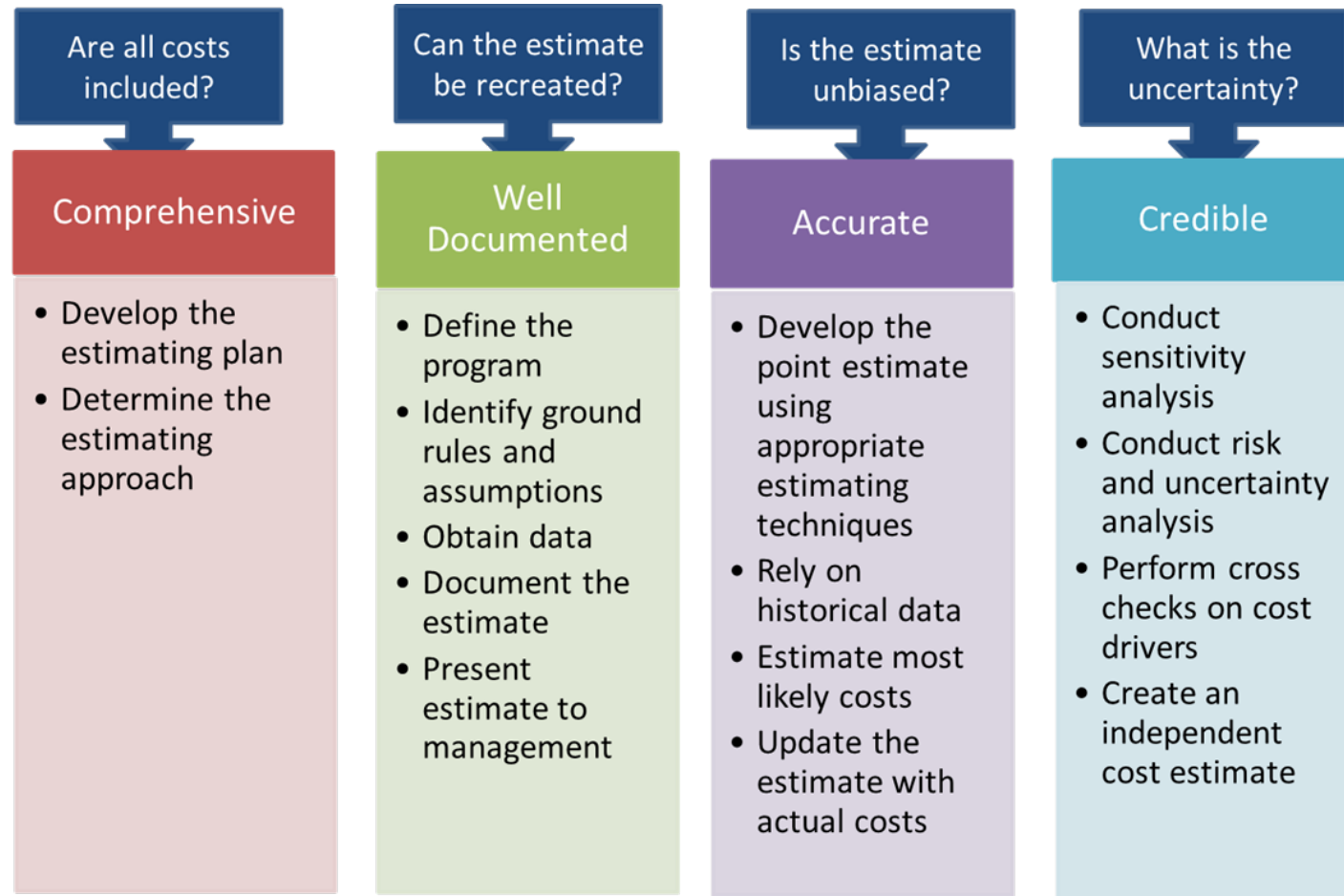
- First published 2009
- Length: 421 pages
- 20 Chapters
- 16 Appendices

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- New version to be released in 2019
- Updates developed in partnership with cost community (ICEAA members included)
- Indication that the update is more of a refinement rather than significantly reworked










What Is A Reliable Estimate?








Overview of GAO's Scoring Methodology

- GAO measures LCCE reliability using four Characteristics:
 1. Comprehensive
 2. Well Documented
 3. Accurate
 4. Credible
- The Characteristics have 20 individual Best Practices that GAO verifies in its audit.
- GAO assigns ratings based on a 1-5 scale: Not Met = 1, Minimally Met = 2, Partially Met = 3, Substantially Met = 4, and Met = 5.
- A cost estimate is considered reliable **IF** the overall assessment ratings for all four characteristics are Substantially Met or Met.
- If any of the characteristics are Not Met, Minimally Met, or Partially Met, the cost estimate cannot be considered reliable (i.e. Pass/Fail).







GAO August 2018 Assessment: Overall Score

Characteristic	2015 Assessment	2017 Assessment
Well-Documented	 Minimally Met	 Partially Met
Accurate 	 Partially Met	 Substantially Met
Credible	 Minimally Met	 Substantially Met
Comprehensive	 Partially Met	 Met

 Met
  Substantially Met
  Partially Met
  Minimally Met
  Not Met

Source: GAO

GAO Assessment: Well-Documented Score Details

Characteristic	Best Practice	Individual Assessment	
Well-Documented 	The documentation should capture the source data used, the reliability of the data, and how the data were normalized.	<input type="radio"/> Partially Met	 Not Passing Grade
	The documentation describes in sufficient detail the calculations performed and the estimating methodology used to derive each element's cost.	<input checked="" type="radio"/> Substantially Met	 Passing Grade
	The documentation describes step by step how the estimate was developed so that a cost analyst unfamiliar with the program could understand what was done and replicate it.	<input type="radio"/> Partially Met	 Not Passing Grade
Overall Assessment <input type="radio"/> Partially Met	The documentation discusses the technical baseline description and the data in the baseline is consistent with the estimate.	<input type="radio"/> Partially Met	 Not Passing Grade
	The documentation provides evidence that the cost estimate was reviewed and accepted by management.	<input checked="" type="radio"/> Substantially Met	 Passing Grade

Met
 Substantially Met
 Partially Met
 Minimally Met
 Not Met

Source: GAO analysis of U.S. Census Bureau data. | GAO-18-635

Source: GAO

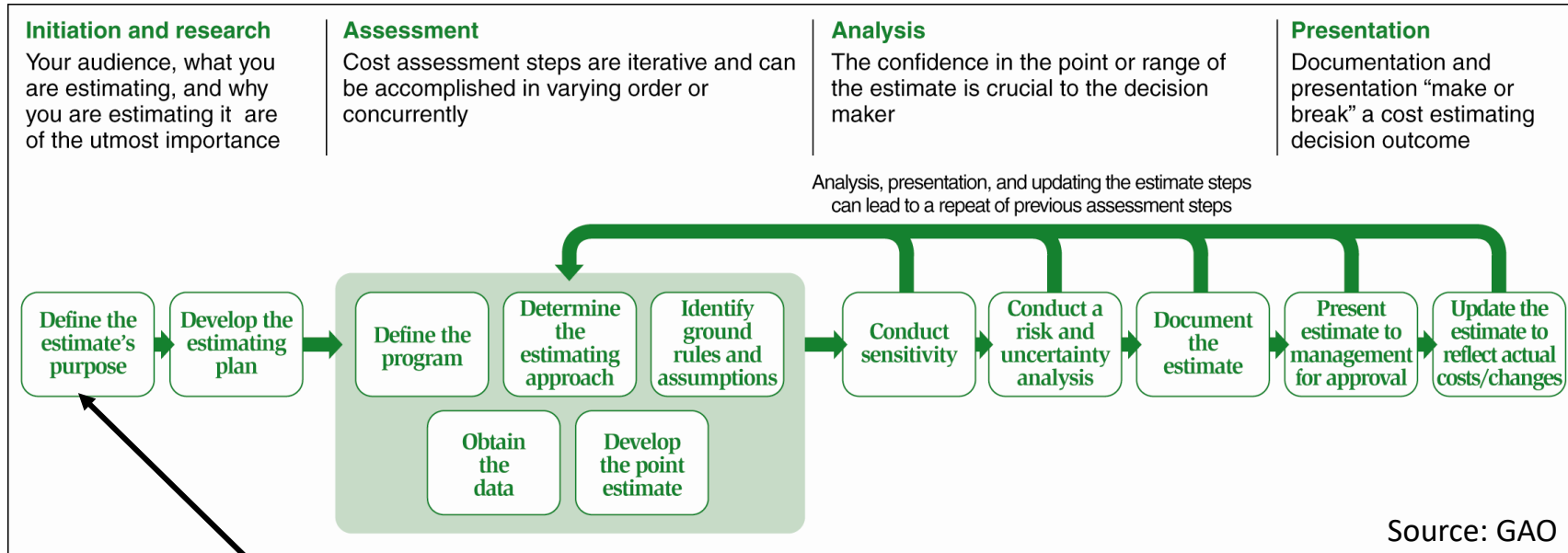
4. How the GAO Cost Guide Was Used



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GAO Questions Align to GAO Cost Process



Step 1 - Define estimate's purpose

- 1.1 Is the purpose of the cost estimate defined and documented?
- 1.2 Is the level of detail the estimate is conducted at consistent with the level of detail available for the program?
- 1.3 Have all applicable program costs have been estimated (i.e., government and contractor), including all life-cycle costs?
- 1.4 Is the scope of the estimate defined and documented?

GAO's Record of Analysis (ROA) Best Practice Audit

1) **Score:** (Partially Met)



2) **Best Practice Being Measured:** The cost estimate includes all life-cycle costs

3) **Definition:** (i.e., **Chapter 4:** The cost estimate should include both government and contractor costs of the program over its full life cycle, from inception of the program through design, development, deployment, and operation and maintenance to retirement of the program.)

4) **Actual findings and score justification:** It is not clear how the Multiple area in the LCCE fits with the major areas listed in the Bureau's WBS or the Decennial Budget WBS and thus it is not clear if all life-cycle costs are being included in the cost estimate.

5) **Reinforcement of the Best Practice. In the perfect world...:** A life cycle cost estimate should encompass all past (or sunk), present, and future costs for every aspect of the program, regardless of funding source, including all government and contractor costs. Unless estimates account for all costs, life-cycle cost estimates cannot enhance decision making by allowing for design trade off studies to be evaluated on a total cost basis as well as on a technical and performance basis. Without fully accounting for life-cycle costs, management will have difficulty successfully planning program resource requirements and making wise decisions.

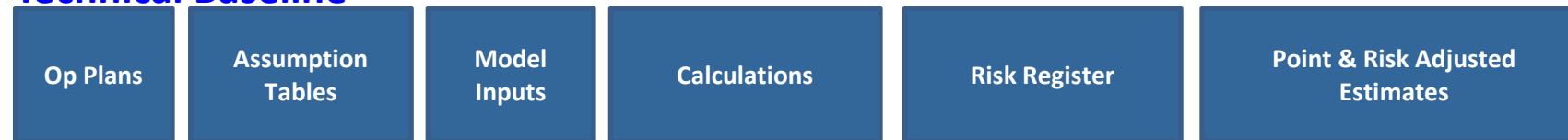
Unique Cost Estimation Challenges for 2020 Census (GAO 2016 Assessment)

Approach & Methodology	Results																						
<ul style="list-style-type: none"> ▪ Leveraged the specificity of GAO's Record of Analysis. ▪ Created a WBS for the four characteristics (Comprehensive, Well Documented, Accurate, Credible) and their 38 underlying Best Practices. ▪ Studied each Best Practice and developed an action plan to address it. ▪ Developed framework to measure progress against the original GAO score. 	<table border="1"> <thead> <tr> <th colspan="2" data-bbox="1352 475 2163 535">COUNTS</th> </tr> </thead> <tbody> <tr> <td data-bbox="1352 535 1862 595">Data & Calcs</td> <td data-bbox="1862 535 2163 595">13</td> </tr> <tr> <td data-bbox="1352 595 1862 655">Risk</td> <td data-bbox="1862 595 2163 655">7</td> </tr> <tr> <td data-bbox="1352 655 1862 715">WBS</td> <td data-bbox="1862 655 2163 715">6</td> </tr> <tr> <td data-bbox="1352 715 1862 775">ICE</td> <td data-bbox="1862 715 2163 775">3</td> </tr> <tr> <td data-bbox="1352 775 1862 835">GR&A</td> <td data-bbox="1862 775 2163 835">3</td> </tr> <tr> <td data-bbox="1352 835 1862 895">Replace Opinion</td> <td data-bbox="1862 835 2163 895">2</td> </tr> <tr> <td data-bbox="1352 895 1862 955">Variances</td> <td data-bbox="1862 895 2163 955">2</td> </tr> <tr> <td data-bbox="1352 955 1862 1015">Affordability</td> <td data-bbox="1862 955 2163 1015">1</td> </tr> <tr> <td data-bbox="1352 1015 1862 1075">Approval</td> <td data-bbox="1862 1015 2163 1075">1</td> </tr> <tr> <td data-bbox="1352 1075 1862 1103">Total</td> <td data-bbox="1862 1075 2163 1103">38</td> </tr> </tbody> </table>	COUNTS		Data & Calcs	13	Risk	7	WBS	6	ICE	3	GR&A	3	Replace Opinion	2	Variances	2	Affordability	1	Approval	1	Total	38
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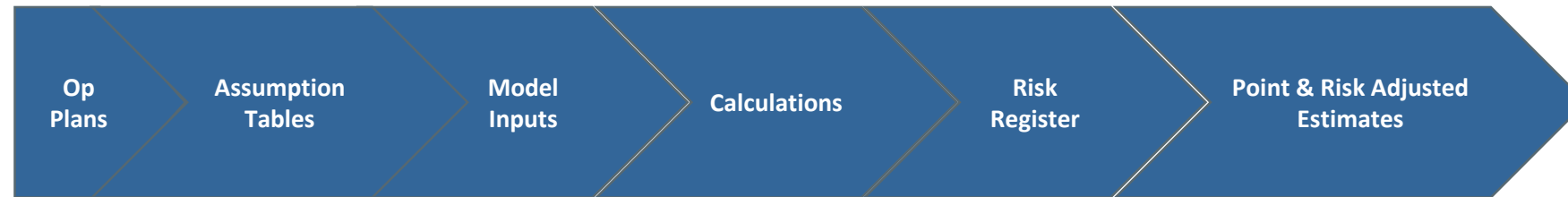
Traceability and Transparency

Cost data need to be easily traceable to their source documents and transparent in their usage.

Technical Baseline



There should be a clear-line-of-sight where costs can be easily followed from one stage to the next:



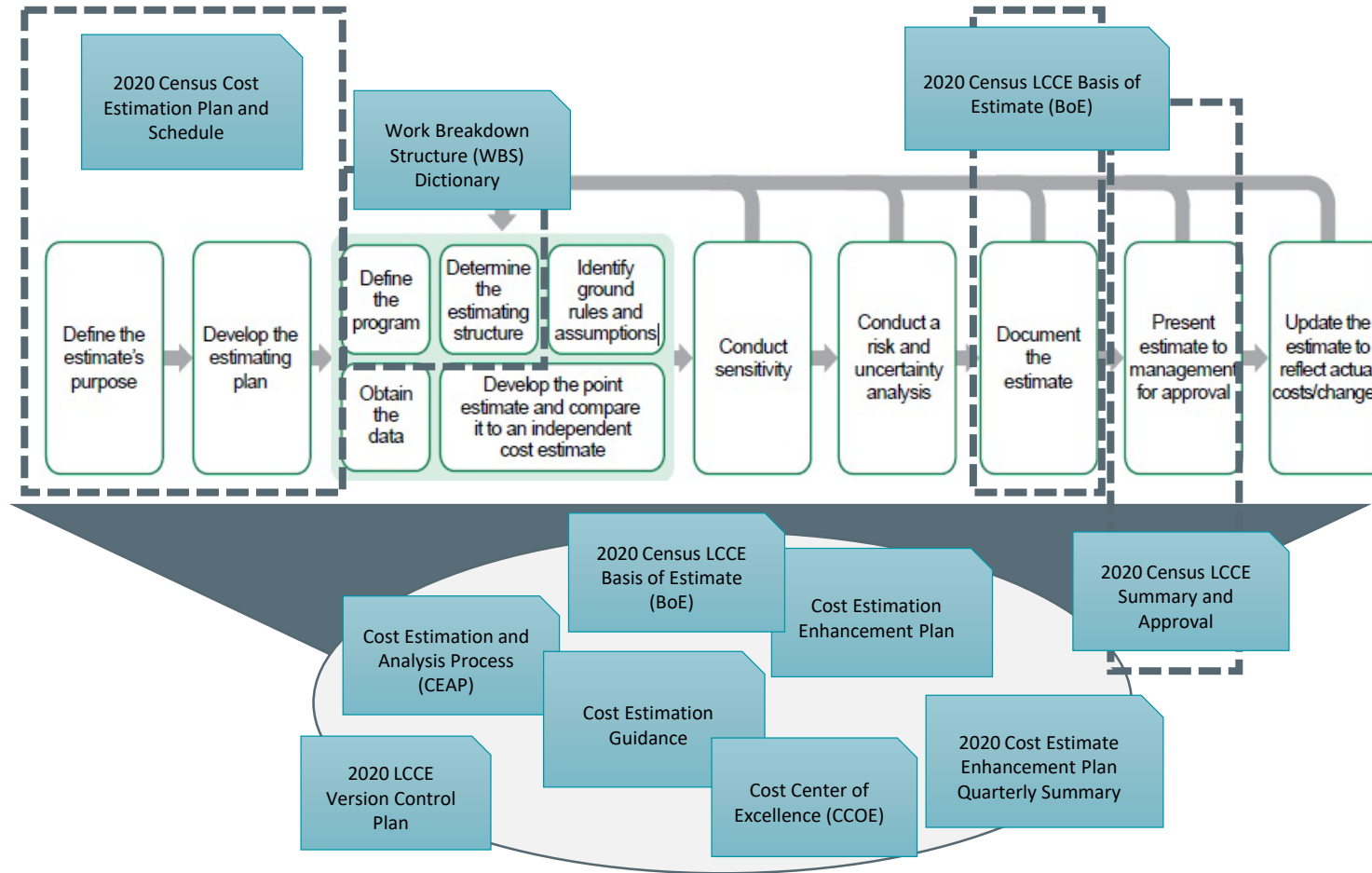
Technical Baseline

GAO needs to be able to “verify” the data and calculations in order for LCCE to be considered reliable.

Basis of Estimate (BoE) Documentation Suite

Artifact	Descriptions
2020 LCCE Basis of Estimate (BoE)	<ul style="list-style-type: none"> • Provides comprehensive documentation so that a person unfamiliar with the program can recreate the estimate • Describes the scope of the estimate, the cost estimating process and methods, the cost estimating structure and relationships, the data sources and assumptions, the risk and sensitivity analysis, etc.
Algebra Sheets	Presents what make up a cost element of the estimate, including dimensions, cost formulas, and inputs and outputs.
Assumptions and Source Documents	Provides critical assumptions and source information, including number of housing units, inflation rates, self-response rates/non-response follow-ups, workloads for address canvassing, among other key data and sources.
Detailed Outputs	Shows detailed cost estimates by fiscal year down to each Level-3 WBS element and broken into IT and non-IT costs.
QUBEdocs	<ul style="list-style-type: none"> • Produces automated documentation about the TM1 cost model, including dimensions, cubes, business rules and processes targeting dimensions and cubes. • Generates a representation of the model with flow diagrams, formulas, and other model objects.
WBS Dictionary	Depicts the 2020 Census Program Product-Oriented Work Breakdown Structure (WBS), used as the cost estimating structure in modeling the 2020 Census Program.

Cost Policy, Process and Guides



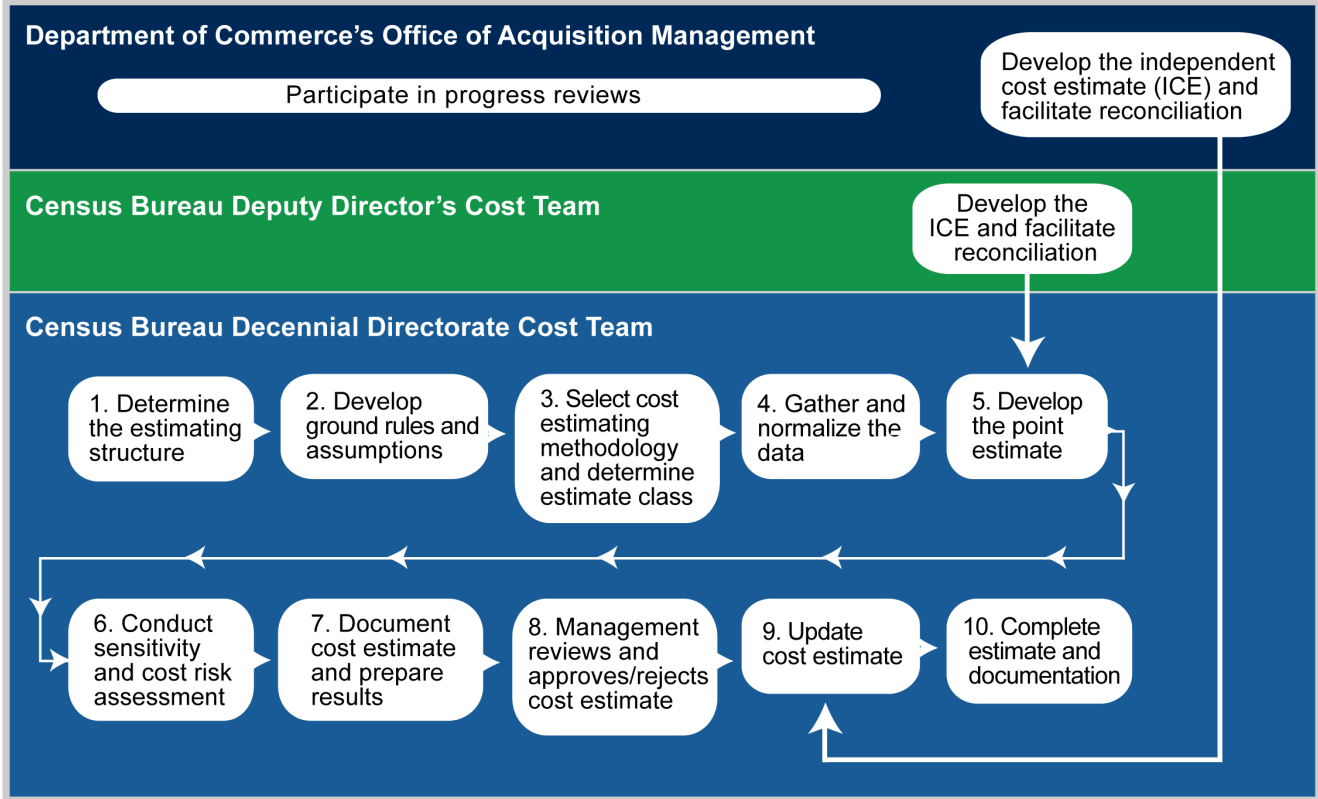
GAO: Decennial Cost Guidance to Develop Cost Estimates Meets Best Practices

Table 2: Cost Estimation Guidance and Policy Documents

Title	Description
Cost Estimation and Analysis Guidance	Establishes the overall authority, requirements, activities, roles, and responsibilities for cost estimation and supporting analysis specifically within the Decennial Census Programs Directorate.
Cost Center of Excellence Charter	Charter for the core cost estimation body responsible for coordinating, facilitating, and supporting cost estimation and analysis activities across the 2020 Census Program.
Cost Estimate and Analysis Process	Step-by-step guidance and a framework for how the 2020 Census Program conducts cost estimation and analysis.
2020 Life-Cycle Cost Estimate Version Control Plan	Establishes a disciplined approach to cost estimate updates, changes, and releases.

Source: GAO analysis of U.S. Census Bureau documents. | GAO-18-635.

Decennial Directorate's Cost Process



Source: GAO analysis of U.S. Census Bureau data. | GAO-18-635

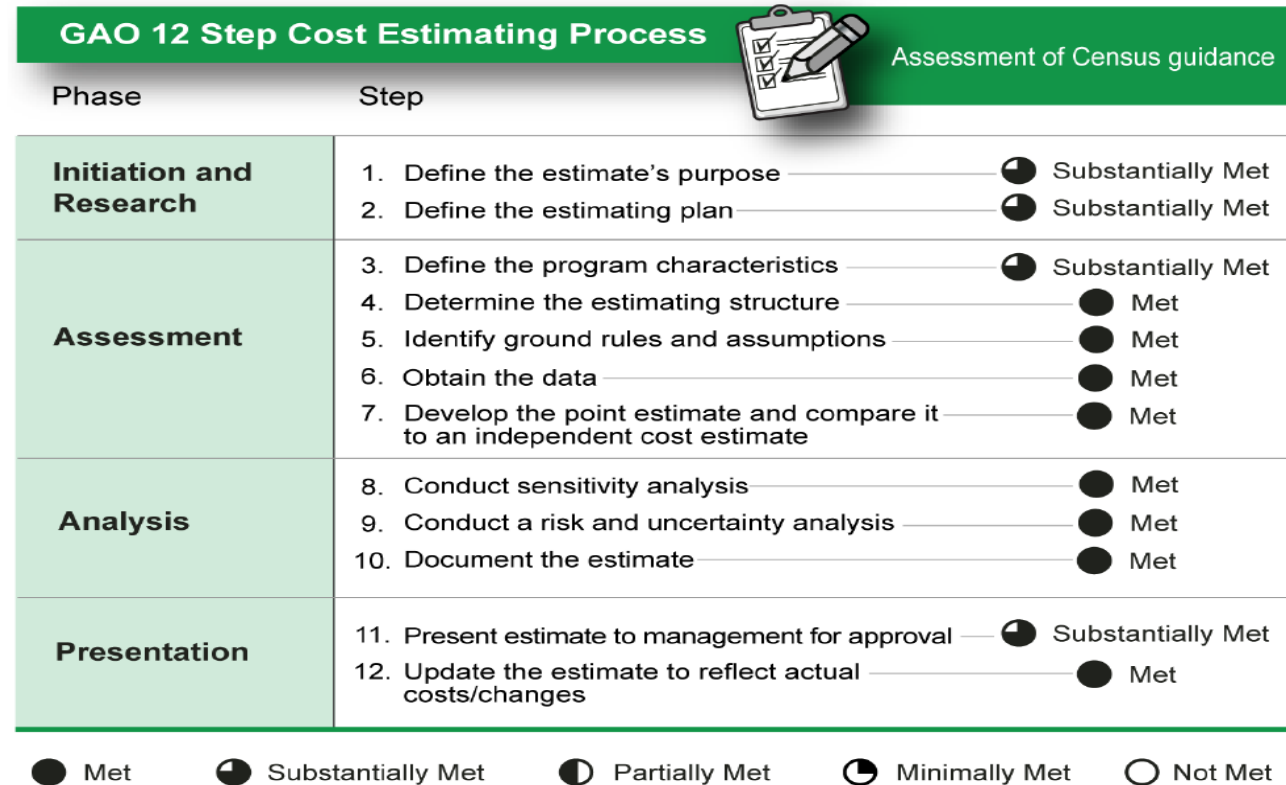


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GAO Assessment of Our Cost Process

Figure 8: Assessment of Census Bureau Cost Estimation Guidance



Source: GAO analysis of U.S. Census Bureau data. | GAO-18-635

GAO: LCCE Used by Management to Inform Decisions

- Bureau officials stated the cost estimate is used to examine the cost impact of program changes.
 - For example, the cost estimate served as the basis for the fiscal year 2019 funding request developed by the Bureau.
- The Bureau also said it used the 2020 Census life cycle cost estimate to establish cost controls during budget formulation activities and to monitor spending levels for fiscal year 2019 activities.
- According to the Bureau, as detailed operational and implementation plans are defined, the 2020 Census life cycle cost estimate has been and will continue to be used to support ongoing “what-if” analyses in determining the cost impacts of design decisions.

Example of Analysis Supporting Management Decisions

Major Cost Drivers in 2020 Census LCCE.

Cost Category	Cost (\$K)	Percent	Cumulative Percent
04. Major Contracts and CEDCaP	\$ 4,056,500	25.9%	25.9%
02. Field Operations	\$ 2,050,400	13.1%	39.0%
03. Overhead (nonCEDCaP)	\$ 1,477,200	9.4%	48.5%
01. Program Risk	\$ 1,426,900	9.1%	57.6%
01. Secretarial-Controlled Contingency	\$ 1,181,000	7.6%	65.2%
09. HQ LOE	\$ 757,900	4.8%	70.0%
05. ACO Staffing	\$ 696,700	4.5%	74.5%
06. Program Management	\$ 515,600	3.3%	77.8%
07. Staffing Operations - CSHarP	\$ 500,900	3.2%	81.0%
08. Other	\$ 2,978,500	19.0%	100.0%

Source: [2020 Census Life-cycle Cost Estimate Executive Summary, December 21, 2017 Version 1.0](#)

5. Lessons Learned



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Lessons Learned: GAO Assessment

- GAO wants costs to be traceable back to the technical baseline, and transparent in how they are calculated.
- Data and calculations are not the sole focus of the audit.
 - Data and calculations underscore many of the assessment areas as they are also the most fundamental elements upon which cost estimates are built.
 - Data primarily equates to the descriptions of the data sources the estimate is built upon. Data mostly address matters surrounding cost traceability.
 - Calculations show how the data are combined to derive the estimate. Data and Calculations combined mostly address matters surrounding cost transparency.
- A good score on GAO assessment brings many positive outcomes for the program and the cost estimation team, such as improved trust in program data and analysis.
- Important to establish a plan to meet GAO criteria that is based upon a data-driven analysis and schedule.
- Documentation needs to be understood as a necessary “cost of doing business”.
- Need to make it efficient for the GAO assessment team to do their job and understand the estimate.

Lessons Learned: GAO Scoring System

- The GAO scoring system is essentially pass-fail.
 - Scores across sections are not cumulative.
 - Must get met or substantially met.
- To get credit, there must be verifiable evidence (documentation along with proofs of calculation).
- The questionnaire from GAO looks for evidence that the 12-step Cost Estimation Process is being followed.
- The GAO record of analysis clearly lays out why and how an assessment is scored.
- Beneficial to engage at the working level to discuss the preliminary scores from GAO.

Lessons Learned: Using the GAO Cost Guide

Good Points

- Establishes widely-accepted government standard for cost estimation.
- Comprehensive cradle-to-grave explanation of cost estimation in federal government. Covers a wide variety of topics across the full spectrum of cost estimation and analysis.
- Sets context for cost estimation and provides a good explanation of WHY along with use cases.
- Chapter 13 Sensitivity Analysis and 14 Cost Risk and Uncertainty contain useful information and were key in enhancing how these areas were treated and in educating management on topics such as why not to use a point estimate for budgeting.
- Addresses advanced topics, such as learning curves and schedule risk that are often hard to find in a broader search.

Areas for Improvement

- GAO guidance is focused on “gold standard” but does not address how a program might use the guide to iteratively improve towards the “gold standard.”
- While the GAO cost guide addresses a broad range of topics, the GAO assessment is more narrow – which tends to result in a focus on symptoms rather than root causes.
- It would be useful if there were guidance or templates that could be used by lower-maturity programs to develop a “minimally acceptable” or “passable” set of artifacts, models, etc.
- Ideally, there would be clear guidance on how a program should manage/govern cost estimation – such as how cost estimation relates to internal controls – and if there was a score associated with this area.
- Heavily leans on Department of Defense (DoD) examples, which are not directly applicable to non-DoD organizations.

Assessment Key Take-aways

- GAO assessment is an audit.
 - A checklist is used and followed.
 - Results are yes/no and scored accordingly.
 - Few areas are subject to context/subjectivity.
 - Documentation is critical.
- Scope of the assessment is fairly narrow.
 - Roles/responsibilities of higher-headquarters cost estimation organization is not part of assessment.
 - Major contributing estimates (as well as the Independent Cost Estimates) are not subject to GAO assessment.
- Remember to demonstrate professional courtesy.
 - Establishing and maintaining a mutually positive relationship is important.
 - Make it efficient for the GAO team to do their job.
- ICEAA certification makes a difference. The cost team's qualifications are important.

6. Final Thoughts and Discussion



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Closing Thoughts

- Cost Estimation
 - Cost estimation is a discipline.
 - A good cost estimator needs to understand the program being modeled.
 - Need to use systems thinking.
 - Avoid the world of “should” – focus on “good enough” and make that happen.
 - Your modeling approach must be flexible.
- Cost Estimation Goodness Factors
 - Sound data is key. Sound data depends on effective data management. Data = traceability. Calculations = transparency.
 - Documentation is foundation of credibility and is a way to preserve knowledge.
 - Data analysis is the value-added information that the cost model (calculation engine) produces.
- Cost Estimation Intangibles
 - You have to become used to others not understanding or appreciating cost estimation.
 - Change takes time. It has taken decades to get to this point.
 - Thick skin necessary in full-contact cost estimation world.
 - Communication is key but also entails significant effort and continuous attention.