

GAO Best Practice Guides



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About GAO

Who We Are

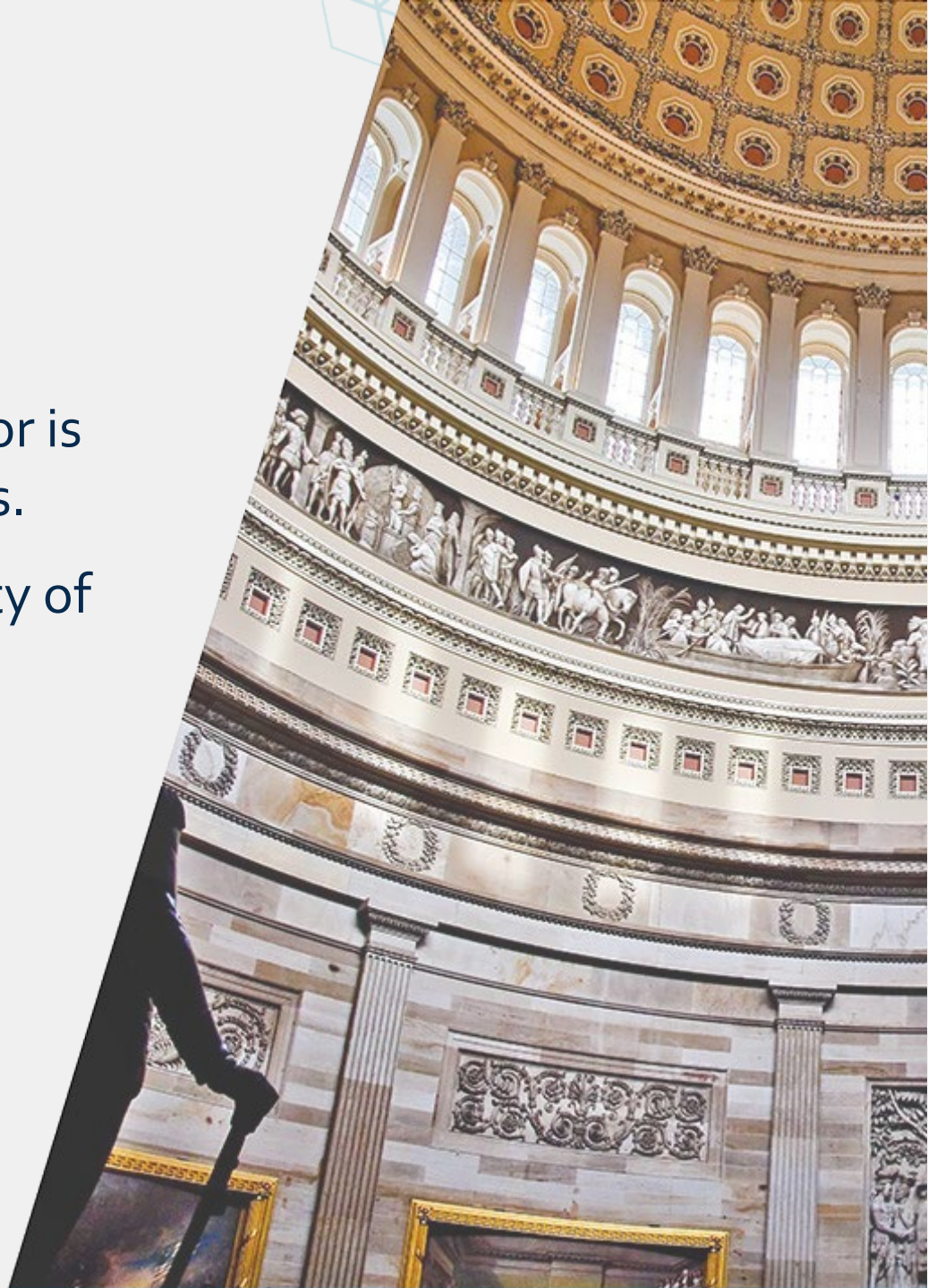
- GAO is an independent, nonpartisan agency serving the Congress and helps improve the performance and ensure the accountability of the federal government.
- Core values: Accountability, Integrity, and Reliability
- To ensure independence, the Comptroller General (CG) is appointed to a 15-year term by the President. Other than the CG, there are no political appointees at GAO.

Oversight,
Insight,
Foresight

Our Work

- GAO work is primarily done at the request of congressional committees or subcommittees or is mandated by public laws or committee reports.
- We also undertake research under the authority of the Comptroller General.

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Our Work

- Some examples of our work include:
 - Auditing agency operations to determine whether federal funds are being spent efficiently and effectively
 - Investigating allegations of illegal and improper activities
 - Reporting on how well government programs and policies are meeting their objectives
 - Performing policy analyses and outlining options for congressional consideration
 - Issuing legal decision and opinions, such as bid protest rulings and reports on agency rules



For more information visit www.gao.gov



GAO Best Practice Guides

The guides provide:

- 1) audit criteria and 2) agency guidance, if needed

Cost Estimating and Assessment Guide

GAO-20-195G | March 2020

Schedule Assessment Guide

GAO-16-89G | December 2015

Technology Readiness Assessment Guide

GAO-20-48G | January 2020

Agile Assessment Guide

GAO-20-590G | September 2020

COMPANION

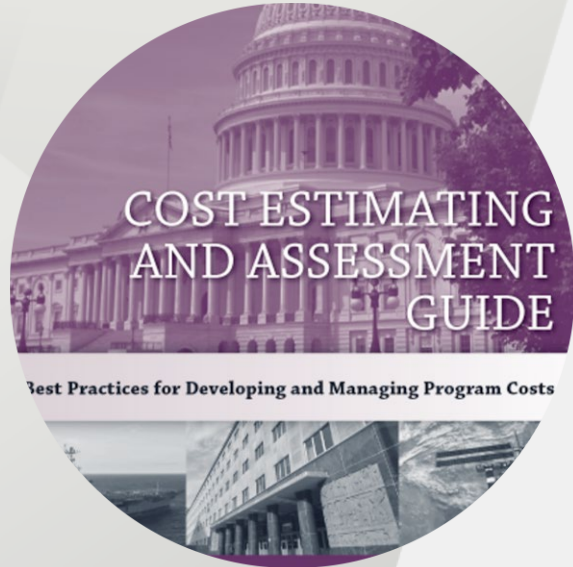
Agile Spotlight

GAO-20-713SP



Expert Group Process

- To develop these guides, GAO convenes a group of experts in a community of practice to discuss best practices
- For example, the Cost Expert Group was established in 2005 and met twice a year through 2020
 - The group expanded beyond cost estimating to include scheduling, earned value management, and other program management topics
- GAO also assembled a group of experts in technology readiness to support the development of the TRA guide
- GAO brought together experts in Agile software development to support development of the Agile guide
 - That group will be reconvened to support finalizing the Agile guide



Cost Estimating and Assessment Guide

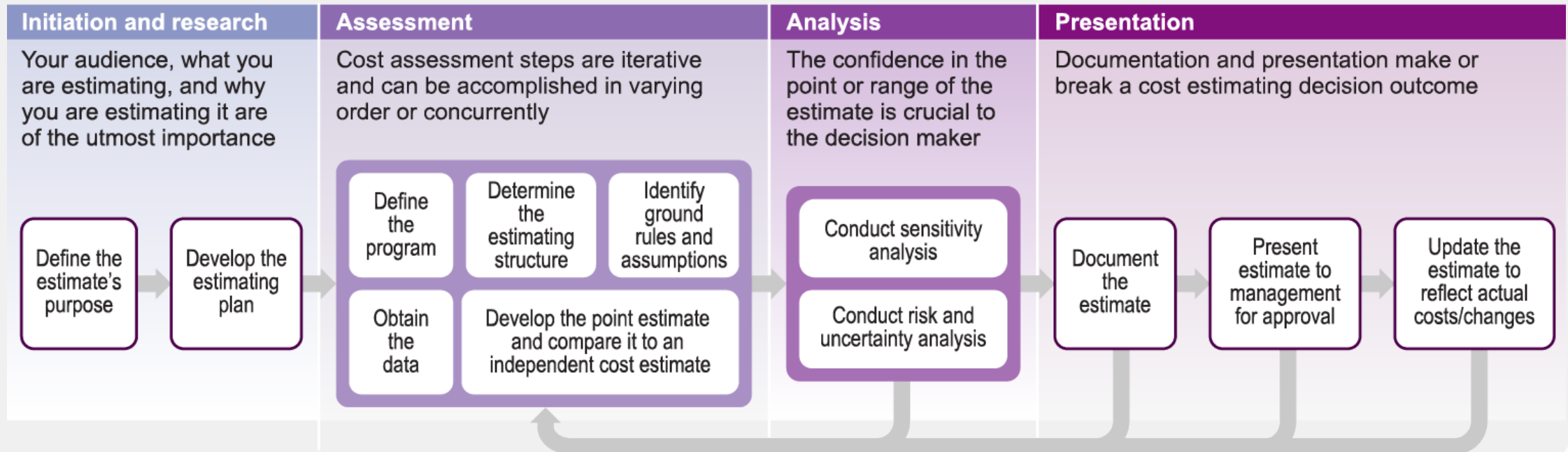
Cost estimate assessment criteria described step-by-step in chapters 4-15

- Each chapter contains a list of best practices and effect statements at the end

Estimate characteristics summarized in chapters 3 and 16

- Some best practices are associated with each characteristic

Cost Estimating 12-Step Process



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

Source: GAO.

Four Characteristics of a Reliable Estimate

1 Comprehensive

- Includes all life cycle costs
- Based on technical baseline description
- Documents cost-influencing ground rules and assumptions
- Based on a product oriented work breakdown structure

2 Well-Documented

- Shows source data used
- Describes step by step how estimate was developed
- Discusses technical baseline description
- Provides evidence that cost estimate was reviewed and accepted

3 Accurate

- Adjusted properly for inflation
- Based on historical record
- Uses best methodology from the data collected
- Contains few, if any, minor mistakes
- Documents and explains variances
- Regularly updated

4 Credible

- Conduct sensitivity analysis
- Conduct risk and uncertainty analysis
- Perform cross checks
- Compare to an independent estimate

Orion Multi-Purpose Crew Vehicle

GAO-16-620

- Orion is NASA's first crew capsule that could transport humans beyond the moon. In September 2015, NASA established a commitment baseline of \$11.3 billion and an April 2023 launch readiness date for the program's second exploration mission. NASA used a joint cost and schedule confidence level (JCL) analysis—a point-in-time estimate that, among other things, includes all cost and schedule elements and incorporates and quantifies known risks—to establish the commitment baselines at a 70 percent confidence level, as required by NASA policy.

Orion Multi-Purpose Crew Vehicle

GAO-16-620

- GAO was asked to assess the reliability Orion's cost and schedule estimates:
 - The program included source data for some of the contractor and historical data used to support its cost assumptions. However, the source data lacked support in many instances throughout the estimate, which calls the reliability of the data into question.
 - Both the methodology used to perform the estimate and how it was developed were lacking in detail and would make replicating the work difficult for anyone unfamiliar with this estimate.
 - The estimate does not link directly to the program's technical baseline, which is used to benchmark life-cycle costs and identify specific program and technical risks. Without a proper linkage to the technical baseline, the cost estimate will lack specific information regarding technical and program risks.

Orion Multi-Purpose Crew Vehicle

GAO-16-620

- NASA's JCL analysis was informed by its unreliable cost and schedule estimates.

2020 Census

GAO-16-628

- GAO found that Census Bureau carried out a risk and uncertainty analysis for the 2020 Census life cycle cost estimate, but only for a portion of estimated costs for fiscal years 2018 to 2020. According to Bureau officials, they scoped the analysis narrowly to those 3 years when most of the census costs occur.
- GAO found that, as a result, the Bureau's risk and uncertainty analysis covered \$4.6 billion, only about 37 percent of the \$12.5 billion total estimated life cycle cost, and less than one-half of the total estimated cost of the census during future fiscal years.

2020 Census

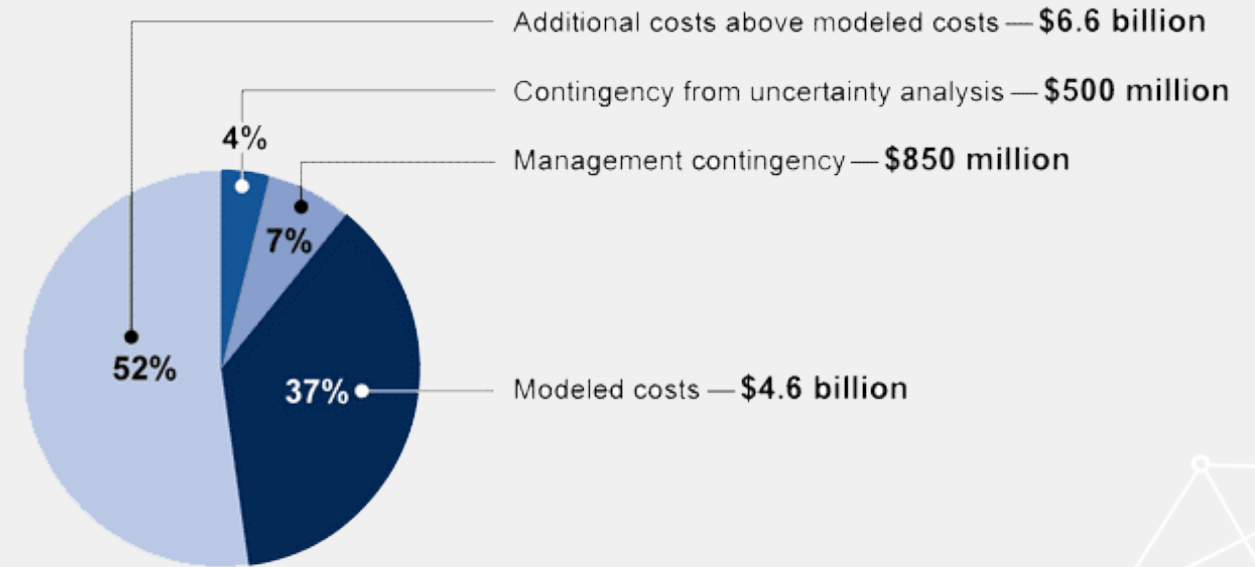
GAO-16-628

- The Bureau used management discretion to determine how much contingency to add on top of the remaining costs. An additional 10 percent was added for fiscal years 2018 through 2020, for a total additional contingency of \$829 million. However, officials were not able to justify the 10 percent factor and there was no Bureau documentation justifying the additional contingency.

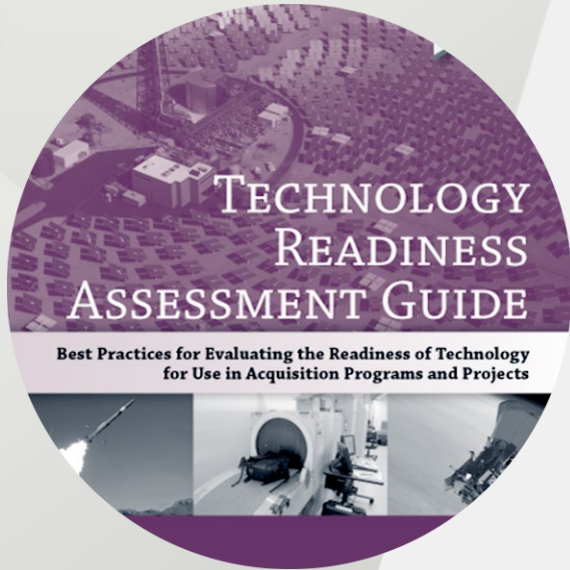
2020 Census

GAO-16-628

- Because the Bureau only carried out its uncertainty analysis on a portion of the cost estimate, GAO could not determine if it fully identified the level of risk associated with the estimate. Nor could GAO validate the Bureau's reported confidence level of the total life cycle cost estimate or how it related to the Bureau's total contingency.



Source: GAO analysis of Census Bureau information. | GAO-16-628



Technology Readiness Assessment Guide

Similar to the Cost Guide, TRA assessment criteria are described step-by-step

- Each chapter contains a list of best practices at the end

TRA characteristics are summarized in one section

- Some number of best practices are associated with each characteristic

Framework for Conducting a TRA

The guide describes **5 steps** for conducting a high-quality TRA:



Source: GAO. | GAO-20-48G

Framework for Conducting a TRA

There are **29 best practices** associated with
4 characteristics of a high-quality TRA:

1

Credible

8 best practices

2

Objective

8 best practices

3

Reliable

9 best practices

4

Useful

4 best practices

Definition of the Four High-Quality Characteristics for TRAs

1

Credible

TRAs are conducted with an understanding of the requirements that guide development of the critical technologies (CT) and system, the relevant or operational environment in which it will function, and its integration or interaction with other technologies

2

Objective

TRAs are based on objective, relevant and trustworthy data, analysis, and information, and the judgements, decisions, and actions for planning and executing the assessment is free from internal and external bias or influence

3

Reliable

TRAs follow a disciplined process that facilitates repeatability, consistency, and regularity in planning, executing, and reporting the assessment

4

Useful

TRAs provide information that has sufficient detail and is timely and can be acted upon

Applying the TRA Guide: **Biodefense Acquisition**

- DHS is developing Biodetection for the 21st Century (BD21), a system-of-systems approach and iteration of a prior failed attempt. BioWatch is the biodefense program that started in response to the 2001 anthrax attack to provide early indication of an aerosolized biological attack.
- We used best practices from GAO's TRA guide to evaluate the DHS's TRA guide. We found DHS's guide did not fully incorporate all the best practices.
- DHS concurred with our recommendations to fully incorporate the best practices outlined in GAO's TRA best practice guide.

 Report available at <https://www.gao.gov/products/GAO-21-292>

Applying the TRA Guide: COVID-19 Vaccine Development

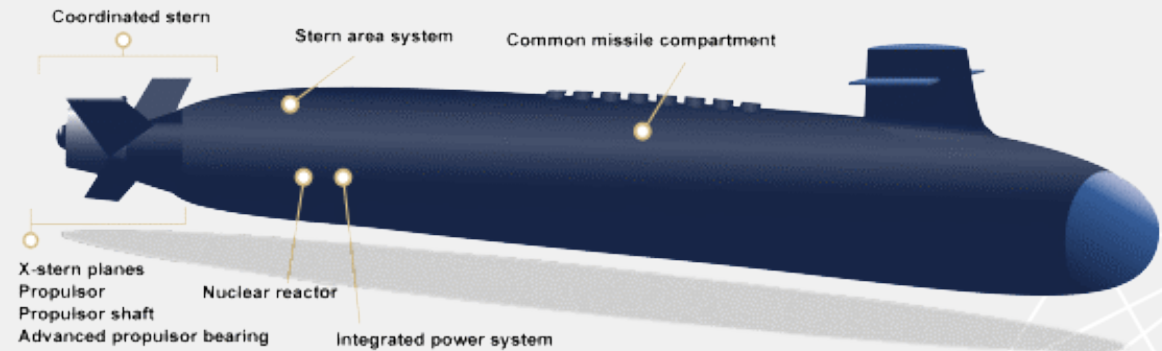
- Operation Warp Speed (OWS)—a partnership between the Departments of Health and Human Services (HHS) and Defense (DOD)—aimed to accelerate development of COVID-19 vaccine.
- We used criteria from GAO’s TRA Guide and HHS to analyze the extent to which efforts to develop vaccine candidates followed traditional practices.
- We found the companies generally followed traditional practices, with some adaptations, such as some overlap in the clinical trial phases. The main difference from a non-pandemic environment was compressed timelines.

Report available at <https://www.gao.gov/products/GAO-21-319>

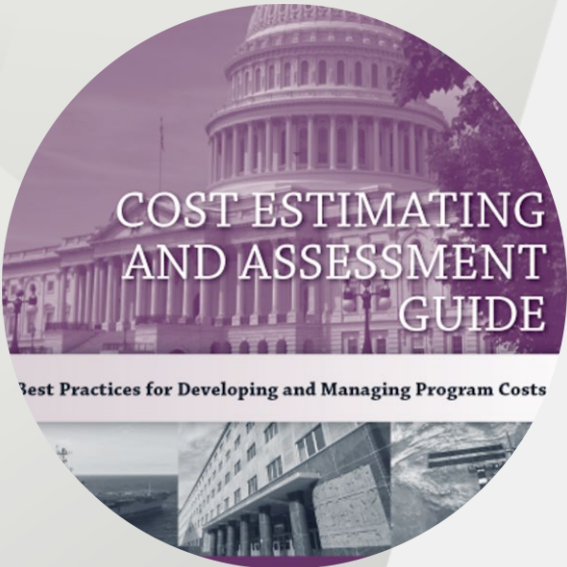


Applying the TRA Guide: Columbia-class Submarine

- The Columbia-class program is a \$126 billion effort to build 12 new nuclear powered ballistic missile submarines.
- We used criteria in GAO's TRA Guide to evaluate the quality and completeness of the Navy's technology readiness and risk assessment.
- We reported that the Navy did not follow our identified best practices for identifying the critical technologies for the program, resulting in an underrepresentation of the technical risk. The Navy's definition of critical technology was more restrictive than GAO's criteria.



Report available at <https://www.gao.gov/products/GAO-18-158>

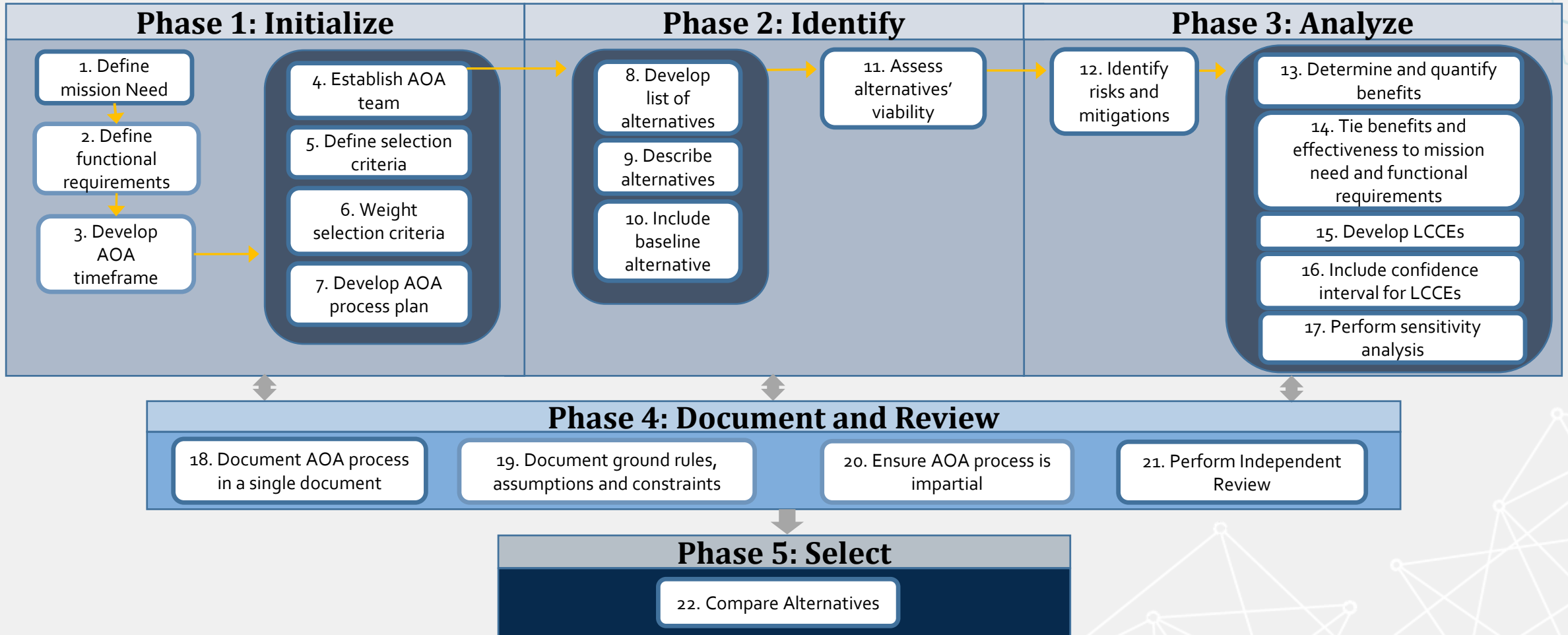


AOA Best Practice Criteria

AOA best practices are discussed in Appendix XI of the Cost Estimating and Assessment Guide

Similar to the Cost Guide and TRA Guide, the AOA process is described in 22 steps and summarized into 4 characteristics

AOA Phases and Corresponding Best Practices



Four Characteristics of a AOA Process and Corresponding Best Practices



1 Well-Documented

- Describe alternatives
- Identify significant risks and mitigation strategies
- Tie benefits / effectiveness to mission need and functional requirements
- Document AOA process in a single document
- Document ground rules, assumptions, and constraints



2 Comprehensive

- Define mission need
- Define functional requirements
- Develop AOA time frame
- Develop list of alternatives
- Assess alternatives' viability
- Develop life cycle cost estimates (LCCEs)



3 Unbiased

- Establish AOA team
- Weight selection criteria
- Develop AOA process plan
- Determine and quantify benefits and effectiveness
- Ensure AOA process is impartial
- Compare alternatives



4 Credible

- Define selection criteria
- Include baseline alternative
- Include a confidence level or range for LCCEs
- Perform sensitivity analysis
- Perform independent review

Amphibious Combat Vehicle

GAO-16-22

The 2014 AOA could not be analyzed in isolation because it built on an existing body of work.

- Studies related to the Expeditionary Fighting Vehicle (EFV) and Advanced Amphibious Assault Vehicle (AAAV)
- Marine Personnel Carrier (MPC) and ACV requirements documents
- 2008 MPC AOA and 2012 ACV AOA
- 2013 ACV Special Project on high water speed
- Systems Engineering Overarching Product Team (SEOPT) analysis



GAO-16-22 Findings

- GAO found that the 2014 ACV AOA met best practices overall and could be considered reliable.

Characteristic	Rating
Well-Documented	Substantially Met
Comprehensive	Met
Unbiased	Substantially Met
Credible	Met

- There are often many studies that inform the AOA report.
- DOD provided adequate resources to complete a successful AOA process, including a diverse AOA team and oversight body to review the AOA process.
- DOD did not include a full list of assumptions and constraints. As a result, it could be difficult for decision makers to make comparisons and trade-offs between alternatives.

Thank you!



Guides available online and downloadable in PDF

GAO Cost Estimating and Assessment Guide

<http://www.gao.gov/products/GAO-20-195G>

GAO Schedule Assessment Guide

<http://www.gao.gov/products/GAO-16-89G>

GAO Technology Readiness Assessment Guide

<http://www.gao.gov/products/GAO-20-48G>

GAO Agile Assessment Guide

<https://www.gao.gov/products/GAO-20-590G>

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