Summary of GAO Cost Estimate Development Best Practices and GAO Cost Estimate Audit Criteria

Characteristic	Best Practice	Estimate Package Component / GAO Audit Criteria

Comprehensive	Step 2: Develop the estimating plan	**Documented in BOE or Separate Appendix to BOE.**
		
		An analytic approach to cost estimates typically entails a written study plan detailing a master schedule of specific tasks, responsible parties, and due dates. Enough time should be scheduled to collect data, including visits to contractor sites to further understand the strengths and limitations of the data that have been collected. If there is not enough time, then the schedule constraint should be clearly identified in the ground rules and assumptions, so that management understands the effect on the estimate's quality and confidence. ***Reference: GAO-09-3SP, Chapter's 5 & 6.***
		
		GAO Evaluation Criteria:
		
		1) Did the team develop a written study plan that:
		   a) Determined the estimating team's composition and whether the team is from a centralized office
		   b) Identified which subject matter experts the team will rely on for information
		   c) Outlined the estimating approach (see Step 4)
		   d) Identified a master schedule for completing the estimate that provided adequate time to do the work

	Step 4: Determine the estimating structure	**BOE and Project Execution Plan should present Project WBS**
		
		A work breakdown structure (WBS) is the cornerstone of every program or project because it defines in detail the work necessary to accomplish a program or project's objectives. The WBS reflects the requirements, resources, and tasks that must be accomplished to develop a program. Thus, the WBS is a valuable communication tool between systems engineering, program management, and other functional organizations because it provides a clear picture of what needs to be accomplished and how the work will be done. Accordingly, it is an essential element for identifying activities in a program's integrated master schedule and it provides a consistent framework for planning and assigning responsibility for the work. Initially set up when the program is established, the WBS becomes successively detailed over time as more information because known about the program.
		
		A WBS deconstructs a program's end product into successive levels with smaller specific elements until the work is subdivided to a level suitable for management control. By breaking the work down into smaller elements, management can more easily plan and schedule the program's activities and assign responsibility for the work. It also facilitates establishing a schedule, cost, and earned value management (EVM) baseline. Establishing a product-oriented WBS is a best practice because it allows a program to track cost and schedule by defined deliverables, such as a hardware or software component. This allows a program manager to more precisely identify which components are causing cost or schedule overruns and to more effectively mitigate the root cause of the overruns. Standardizing the WBS to level 3 enables an organization to collect and share data among programs and results in more consistent cost estimates and more efficient program execution. ***Reference: GAO-09-3SP, Chapter 8.***
		
		GAO Evaluation Criteria:
		
		1) Is there a defined work breakdown structure (WBS) and/or cost element structure?
		   a) Is the WBS product-oriented, traceable to the statement of work, and at an appropriate level of detail to ensure that cost elements are neither omitted nor double-counted?
		   b) Is the WBS standardized so that cost data can be collected and used for estimating future programs?
		   c) Does the cost estimate WBS match the schedule and earned value management (EVM) WBS'?
		   d) Is the WBS updated as the program becomes better defined and to reflect changes as they occur?
		   e) Is there a WBS dictionary that defines what is included in each element and how it relates to others in the hierarchy?

Comprehensive
(continued)
	Step 5: Identify ground rules and assumptions	**Documented in BOE**
		
		Cost estimates are typically based on limited information and therefore need to be bound by the constraints that make estimating possible. These constraints usually take the form of assumptions that bind the estimate's scope, establishing baseline conditions the estimate will be built from. Ground rules represent a common set of agreed on estimating standards that provide guidance and minimize conflicts in definitions. Without firm ground rules, the analyst is responsible for making assumptions that allow the estimate to proceed. Assumptions represent a set of judgments about past, present, and future conditions postulated as true in the absence of positive proof. The analyst must ensure that assumptions are not arbitrary, that they are founded on expert judgments rendered by experienced program and technical personnel. Many assumptions profoundly influence cost; the subsequent rejection of even a single assumption by management could invalidate many aspects of the estimate. Therefore, it is imperative that cost estimators brief management and document all assumptions well, so that management fully understands the conditions the estimate was structured on. Failing to do so can lead to overly optimistic assumptions that heavily influence the overall cost estimate, to cost overruns, and to inaccurate estimates and budgets. *Reference: GAO-09-3SP, Chapter 9.*
		
		GAO Evaluation Criteria:
		
		1) Are there defined ground rules and assumptions that document the rationale and any historical data to back up any claims?
		  a) Have risks associated with any assumptions been identified and traced to specific WBS elements?
		  b) Have budget constraints, as well as the effect of delaying program content, been defined?
		  c) Have inflation indices and their source been identified?
		  d) If the program depends on a participating agency or agency's equipment have the effects of these assumptions not holding been identified?
		  e) Have items excluded from the estimate been documented and explained?
		  f) If technology maturity has been assumed, does the estimate address the effect of the assumption's failure on cost and schedule?
		  g) Did cost estimators meet with technical staff to determine risk distributions for all assumptions so they could use this information for sensitivity and uncertainty analysis?

Well Documented	Step 1: Define the estimate's purpose	**Documented in the BOE.**
		
		The purpose of a cost estimate is determined by its intended use, and its intended use determines its scope and detail. Cost estimates have two general purposes: 1) to help managers evaluate affordability and performance against plans, as well as the selection of alternative systems and solutions, and 2) to support the budget process by providing estimates of the funding required to efficiently execute a program. The scope of the cost estimate will be determined by such issues as the time involved, what elements of work need to be estimated, who will develop the cost estimates, and how much cost estimating detail will be included.
		
		A life-cycle cost estimate is a best practice because it provides an exhaustive and structured accounting of all resources and associated cost elements required to develop, produce, deploy, and sustain a program. As such, 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. Life-cycle costing enhances decision making, especially in early planning and concept formulation of acquisition. Design trade-off studies conducted during this period can be evaluated on a total cost basis, as well as on a performance and technical basis. A life-cycle cost estimate can support budgetary decision, key decision points, milestone reviews, and investment decisions. Because they encompass all possible costs, life-cycle cost estimates provide a wealth of information about how much programs are expected to cost over time. *Reference: GAO-09-3SP, Chapter 5.*
		
		GAO Evaluation Criteria:
		
		1) Are the purpose and scope of the cost estimate defined and documented?
		  a) Is the level of detail the estimate is conducted at consistent with the level of detail available for the program?
		  b) Have all applicable costs been estimated, including life cycle costs?
		  c) Is the scope of the estimate defined and documented?

Well Documented (continued)	Step 3: Define the program characteristics	**BOE should include summary-level reference to the project documentation that defines the performance objectives and technical characteristics of the project or program being acquired. The cost estimate back-up file should include all pertinent project requirement documentation that formed the basis for the life-cycle cost estimate.**
		
		Key to developing a credible estimate is having an adequate understanding of the acquisition program—the acquisition strategy, technical definition, characteristics, system design features, and technologies to be included in its design. The cost estimator can use this information to identify the technical and program parameters that will bind the cost estimate. The amount of information gathered in a single document directly affects the overall quality and flexibility of the estimate. Less information means more assumptions must be made, increasing the risk associated with the estimate. Therefore, the importance of this step must be emphasized, because the final accuracy of the cost estimate depends on how well the program is defined. *Reference: GAO-09-3SP, Chapter 7.*
		
		GAO Evaluation Criteria:
		
		1) Is there a documented technical baseline description that is contained in a single document? If yes, does it include the following:
		   a) What the program is supposed to do—requirements;
		   b) How the program will fulfill its mission—purpose;
		   c) What it will look like—technical characteristics;
		   d) Where and how the program will be built—development plan;
		   e) How the program will be acquired—acquisition strategy;
		   f) How the program will operate—operational plan;
		   g) Which characteristics affect cost the most—risk.

	Step 5: Identify ground rules and assumptions	**Documented in BOE**
		
		Cost estimates are typically based on limited information and therefore need to be bound by the constraints that make estimating possible. These constraints usually take the form of assumptions that bind the estimate's scope, establishing baseline conditions the estimate will be built from. Ground rules represent a common set of agreed on estimating standards that provide guidance and minimize conflicts in definitions. Without firm ground rules, the analyst is responsible for making assumptions that allow the estimate to proceed. Assumptions represent a set of judgments about past, present, and future conditions postulated as true in the absence of positive proof. The analyst must ensure that assumptions are not arbitrary, that they are founded on expert judgments rendered by experienced program and technical personnel. Many assumptions profoundly influence cost; the subsequent rejection of even a single assumption by management could invalidate many aspects of the estimate. Therefore, it is imperative that cost estimators brief management and document all assumptions well, so that management fully understands the conditions the estimate was structured on. Failing to do so can lead to overly optimistic assumptions that heavily influence the overall cost estimate, to cost overruns, and to inaccurate estimates and budgets. *Reference: GAO-09-3SP, Chapter 9.*
		
		GAO Evaluation Criteria:
		
		1) Are there defined ground rules and assumptions that document the rationale and any historical data to back up any claims?
		   a) Have risks associated with any assumptions been identified and traced to specific WBS elements?
		   b) Have budget constraints, as well as the effect of delaying program content, been defined?
		   c) Have inflation indices and their source been identified?
		   d) If the program depends on a participating agency or agency's equipment have the effects of these assumptions not holding been identified?
		   e) Have items excluded from the estimate been documented and explained?
		   f) If technology maturity has been assumed, does the estimate address the effect of the assumption's failure on cost and schedule?
		   g) Did cost estimators meet with technical staff to determine risk distributions for all assumptions so they could use this information for sensitivity and uncertainty analysis?

Well Documented *(continued)*	Step 6: Obtain the data	**Individual cost elements should be documented in the Life-cycle Cost Estimate. All data sources, global adjustments, and cost basis documented in BOE at a summary level. Historical cost, with adjustments, and any vendor quotes provided in BOE or estimate back-up.**
		
		Data are the foundation of every cost estimate. How good the data are affects the estimate's overall credibility. Depending on the data quality, an estimate can range anywhere from a mere guess to a highly defensible cost position. Credible cost estimates are rooted in historical data. Rather than starting from scratch, estimators usually develop estimates for new programs by relying on data from programs that already exist and adjusting for any differences. Thus, collecting valid and useful historical data is a key step in developing a sound cost estimate. The challenge in doing this is obtaining the most applicable historical data to ensure that the new estimate is as accurate as possible. One way of ensuring that the data are applicable is to perform checks of reasonableness to see if the results are similar. Different data sets converging toward one value provides a high degree of confidence in the data. ***Reference: GAO-09-3SP, Chapter10.***
		
		GAO Evaluation Criteria:
		
		1) Was the data gathered from valid historical actual cost, schedule, and program and technical sources?
		   a) Do the data apply to the program being estimated and have they been analyzed for cost drivers?
		   b) Have the data been collected from primary sources and adequately documented as to the source, content, time, units, an assessment of the accuracy of the data and reliability, and any circumstances affecting the data?
		   c) Are data continually collected and stored for future use?
		   d) Did analysts meet with the data sources to better understand the program and ask them about the data?
		   e) Were the data reviewed and benchmarked against historical data for reasonableness?
		   f) Were the data analyzed using scatterplots and descriptive statistics and were they normalized to account for cost, sizing units, etc. so they are consistent for comparisons?

	Step 10: Document the estimate	**BOE and Cost Estimate Back-up Files (important that the BOE makes reference to specific documentation contained in any cost estimate back-up or supporting files).** *Critical that anyone can independently correlate all estimates supporting documents back to the point estimate and recreate the cost estimate independently.* **When several cost estimates are prepared to support a single project or program, cost estimate summary sheets should be prepared to present the total life-cycle cost for each project's sub-project or component parts.**
		
		Documentation provides total recall of the estimate's detail so that it can be replicated by someone other than those who prepared it. It also serves as a reference to support future estimates. Documenting the cost estimate makes available a written justification showing how it was developed and aiding in updating it as key assumptions change and more information becomes available. Estimates should be documented to show all parameters, assumptions, descriptions, methods, and calculations used to develop a cost estimate. A best practice is to use both a narrative and cost tables to describe the basis for the estimate, with a focus on the methods and calculations used to derive the estimate. With this standard approach, the documentation provides a clear understanding of how the cost estimate was constructed. Moreover, cost estimate documentation should explain why particular methods and data sets were chosen and why these choices are reasonable. It should also reveal the pros and cons of each method selected. Finally, there should be enough detail so that the documentation serves as an audit trail of backup data, methods, and results, allowing for clear tracking of a program's costs as it moves through its various life-cycle phases. ***Reference: GAO-09-3SP, Chapter16.***
		
		GAO Evaluation Criteria:
		
		1) Did the documentation describe the cost estimating process, data sources, and methods step by step so that a cost analyst unfamiliar with the program could understand what was done and replicate it?
		   a) Are supporting data adequate for easily updating the estimate to reflect actual costs or program changes and using them for future estimates?
		   b) Did the documentation describe the estimate with narrative and cost tables and did it contain an executive summary, introduction, and descriptions of methods, with data broken out by WBS cost elements, sensitivity analysis, risk and uncertainty analysis, management approval, and updates that reflect actual costs and changes?
		   c) Did the detail address best practices and the 12 steps of high-quality estimates?
		   d) Was the documentation mathematically sensible and logical?
		   e) Did it discuss contingency reserves and how they were derived from risk and uncertainty analysis?
		   f) Did the documentation include access to an electronic copy of the cost model and are both the documentation and the cost model stored so that authorized personnel can easily find and use them for other cost estimates?

Well Documented *(continued)*	Step 11: Present estimate to management for approval	**A cost estimate summary document should be prepared to present the total life-cycle cost for each project's sub-project or component parts. The cost estimator(s), cost estimate independent peer reviewer, and appropriate project management authorities, and project sponsor should all approve the cost estimate. This cost estimate summary document should be part of the official cost estimate package.**
		
		A cost estimate is not considered valid until management has approved it. Since many cost estimates are developed to support a budget request or make a decision between competing alternatives, it is vital that management is briefed on how the estimate was developed, including risks associated with the underlying data and methods. Therefore, the cost estimator should prepare a briefing for management with enough detail to easily defend the estimate by showing how it is accurate, complete, and high in quality. The briefing should present the documented life cycle cost estimate with an explanation of the program's technical and program baseline. ***Reference: GAO-09-3SP, Chapter17.***
		
		GAO Evaluation Criteria:
		
		1) Was there a briefing to management that included a clear explanation of the cost estimate so as to convey its level of competence?
		   a) Did the briefing illustrate the largest cost drivers by presenting them logically with backup charts for responding to more probing questions?
		   b) Did the briefing include an overview of the program's technical foundation and objectives, the life cycle cost estimate in time-phased constant year dollars, a discussion of ground rules and assumptions, the method and process for each WBS cost element estimate including data sources, the results of sensitivity and risk/uncertainty analysis along with a confidence interval, the comparison of the point estimate to an independent cost estimate with a discussion of any differences and whether the point estimate is reasonable, an affordability analysis based on funding and contingency reserves, a discussion of any concerns or challenges, conclusions, and recommendations for approval.
		   c) Was any feedback from the briefing including management's acceptance of the estimate acted on and recorded in the cost estimate documentation?

Accurate	Step 7: Develop the point estimate and compare it to an independent cost estimate	**Cost Estimate Plan (CEP), Life-cycle Cost Estimate (LCCE) and BOE. The BOE provides a record of the procedures, ground rules and assumptions, data, environment, and events that underlie a cost estimate's development or update. Good documentation supports the cost estimate's credibility, aids in the analysis of changes in program cost, enables reviewers to effectively assess the cost estimate, and contributes to the population of EM data bases for estimating the cost of future programs. The BOE should be sufficiently complete and well organized such that a cost estimating professional can use the documentation by itself to understand and assess the estimate.**
		
		This Step pulls all the information together to develop the point estimate—the best guess at the cost estimate, given the underlying data. High-quality cost estimates usually fall within a range of possible costs, the point estimate being between the best and worst case extremes. The cost estimator must perform several activities to develop a point estimate: develop the cost model by estimating each WBS element, using the best methodology, from the data collected; include all estimating assumptions in the cost model; express costs in constant-year dollars; time-phase the results by spreading costs in the years they are expected to occur, based on the program schedule; and add the WBS elements to develop the overall point estimate.
		
		Having developed the overall point estimate, the cost estimator must then validate it by thoroughly understanding and investigating how the cost model was constructed. For example, all WBS cost estimates should be checked to verify that calculations are accurate (no double counting) and account for all costs, including indirect costs. Moreover, proper escalation factors should be used to inflate costs so that they are expressed consistently and accurately. Finally, the cost estimator should compare the cost estimate against the independent cost estimate and examine where and why there are differences; perform cross-checks on cost drivers to see if results are similar; and update the model as more data become available or as changes occur and compare the results against previous estimates. ***Reference: GAO-09-3SP, Chapter's 11, 12 & 15.***
		
		GAO Evaluation Criteria:
		
		1) Did the cost estimator consider various cost estimating methods like analogy, engineering build up, parametric, extrapolating from actual costs, and expert opinion (if none of the other methods can be used)?
		   a) If the parametric method was used as the estimating method, were the cost estimating relationships (CER) statistics examined to determine its quality?
		   b) Were learning curves used if there was much manual labor associated with production and were production rate and breaks in production considered?
		   c) Was the point estimate developed by aggregating the WBS cost estimates by one of the cost estimating methods?
		   d) Were results checked for accuracy, double-counting, and omissions and were validated with cross checks and independent cost estimates?
		   e) If software is a major component of the cost estimate were software estimating best practices from Chapter 12 of the GAO Cost Estimating Best Practices Guide addressed?

Accurate
(continued)
	Step 12: Update the estimate to reflect actual costs and changes	**Cost Estimate Plan (CEP), Life-cycle Cost Estimate (LCCE), BOE, and LCCE Reconciliation (between update and prior version) should be updated and published every time the LCCE is updated. Update the life-cycle cost estimate to reflect changes in technical or program assumptions or keep it current as the program passes through new phases (critical decisions or life-cycle phases) or milestones. LCCEs should also be updated if program or project performance (earned value management) is trending poorly.**
		
		The cost estimate should be regularly updated to reflect all changes. Not only is this a sound business practice; it is also a requirement outlined in OMB's Capital Programming Guide. The purpose of updating the cost estimate is to check its accuracy, defend the estimate over time, shorten turnaround time, and archive cost and technical data for use in future estimates. After the internal agency and congressional budgets are prepared and submitted, it is imperative that cost estimators continue to monitor the program to determine whether the preliminary information and assumptions remain relevant and accurate. Keeping the estimate fresh gives decision makers accurate information for assessing alternative decisions. Cost estimates must also be updated whenever requirements change, and the results should be reconciled and recorded against the old estimate baseline. The documented comparison between the current estimate (updated with actual costs) and old estimate allows the cost estimator to determine the level of variance between the two estimates. In other words, it allows estimators to see how well they are estimating and how the program is changing over time. ***Reference: GAO-09-3SP, Chapter's 16, 18, 19 & 20.***
		
		GAO Evaluation Criteria:
		
		1) Is there a process for the estimating team to update the estimate with actual costs as it becomes available?
		   a) Was the estimate updated to reflect changes in technical or program assumptions and was there a discussion how these changes affected the cost estimate?
		   b) Did the cost estimates get replaced with actual costs? Were the actual costs from an EVM system?
		   c) Did the estimate discuss lessons learned for elements whose actual costs or schedules differed from the estimate?

Credible	Step 8: Conduct sensitivity analysis	**Risk Management Plan, Life-cycle Cost Analyses (CD-1), LCCE Cost Uncertainty Analysis, and traditional EM Technical and Programmatic Risk Assessment (T&PRA) documentation.**
		
		A sensitivity analysis should be conducted and documented for all cost estimates because it examines the effects of changing assumptions and ground rules. Since uncertainty cannot be avoided, it is necessary to identify the cost elements that represent the most risk and, if possible, cost estimators should quantify the risk using both a sensitivity and uncertainty (see step 9) analysis. In order for sensitivity analysis to reveal how the cost estimate is affected by a change in a single assumption, the cost estimator must examine the effect of changing one assumption or cost driver at a time while holding all other variables constant. By doing so, it is easier to understand which variable most affects the cost estimate. This analysis should then be factored into the cost uncertainty analysis, and the various cost estimates developed to evaluate the uncertainty used to establish the worst case, best case, and most likely cost estimate ranges that are used in the resultant contingency analysis (Monte Carlo analysis). ***Reference: GAO-09-3SP, Chapter 13.***
		
		GAO Evaluation Criteria:
		
		1) Did the cost estimate included a sensitivity analysis that identified using a range of possible costs the effects of changing key cost driver assumptions or factors? Were the following steps taken:
		   a) Key cost drivers were identified
		   b) Cost elements representing the highest percentage of cost were determined and their parameters and assumptions were examined
		   c) The total cost was re-estimated by varying each parameter between its minimum and maximum range
		   d) Results were documented and the re-estimate repeated for each parameter that was a key cost driver
		   e) Outcomes were evaluated for parameters most sensitive to change

Credible
(continued)
	Step 9:
	Conduct risk
	and
	uncertainty
	analysis
		Risk Management Plan, Life-cycle Cost Analyses (CD-1), LCCE Cost Uncertainty Analysis, and traditional EM Technical and Programmatic Risk Assessment (T&PRA) documentation.
		
		Because cost estimates predict future program costs, uncertainty is always associated with them. Moreover, a cost estimate is usually composed of many lower-level WBS elements, each of which comes with its own source of error. Once these elements are added together, the resulting cost estimate can contain a great deal of uncertainty. Risk and uncertainty refer to the fact that because a cost estimate is a forecast, there is always a chance that the actual cost will differ from the estimate. A lack of knowledge about the future is only one possible reason for the difference. Another equally important reason is the error resulting from historical data inconsistencies, assumptions, cost estimating equations, and factors typically used to develop an estimate. In addition, biases are often found in estimating program costs and developing program schedules. The biases may be cognitive—often based on estimators' inexperience—or motivational, where management intentionally reduces the estimate or shortens the schedule to make the project look good to stakeholders. Recognizing the potential for error and deciding how best to quantify it is the purpose of risk and uncertainty analysis.
		
		Since cost estimates are uncertain, making good predictions about how much funding a program needs to be successful is difficult. In a program's early phases, knowledge about how well technology will perform, whether the estimates are unbiased, and how external events may affect the program is imperfect. For management to make good decisions, the program estimate must reflect the degree of uncertainty, so that a level of confidence can be given about the estimate. Quantitative risk and uncertainty analysis provide a way to assess the variability in the point estimate. Using this type of analysis, a cost estimator can model such effects as schedules slipping, missions changing, and proposed solutions not meeting user needs, allowing for a known range of potential costs Having a range of costs around a point estimate is more useful to decision makers, because it conveys the level of confidence in achieving the most likely cost and also informs them on cost, schedule, and technical risks. ***Reference: GAO-09-3SP, Chapter 14.***
		
		GAO Evaluation Criteria:
		
		1) Was a risk and uncertainty analysis conducted that quantified the imperfectly understood risks and identified the effects of changing key cost driver assumptions and factors? Were the following steps performed:
		  a) A probability distribution was modeled for each cost element's uncertainty based on data availability, reliability, and variability.
		  b) The correlation (i.e., relationship) between cost elements was accounted for to capture risk.
		  c) A Monte Carlo simulation model was used to develop a distribution of total possible costs and an S curve showing alternative cost estimate probabilities.
		  d) The probability associated with the point estimate was identified.
		  e) Contingency reserves were recommended for achieving the desired confidence level.
		  f) The risk-adjusted cost estimate was allocated, phased, and converted to then year dollars for budgeting, and high-risk elements were identified to mitigate risks.
		  g) A risk management plan was implemented jointly with the contractor to identify and analyze risk, plan for risk mitigation, and continually track risk.

Credible *(continued)*	Step 7: Develop the point estimate and compare it to an independent cost estimate	**Cost Estimate Plan (CEP), Life-cycle Cost Estimate (LCCE) and BOE. The BOE provides a record of the procedures, ground rules and assumptions, data, environment, and events that underlie a cost estimate's development or update. Good documentation supports the cost estimate's credibility, aids in the analysis of changes in program cost, enables reviewers to effectively assess the cost estimate, and contributes to the population of EM data bases for estimating the cost of future programs. The BOE should be sufficiently complete and well organized such that a cost estimating professional can use the documentation by itself to understand and assess the estimate.**

This Step pulls all the information together to develop the point estimate—the best guess at the cost estimate, given the underlying data. High-quality cost estimates usually fall within a range of possible costs, the point estimate being between the best and worst case extremes. The cost estimator must perform several activities to develop a point estimate: develop the cost model by estimating each WBS element, using the best methodology, from the data collected; include all estimating assumptions in the cost model; express costs in constant-year dollars; time-phase the results by spreading costs in the years they are expected to occur, based on the program schedule; and add the WBS elements to develop the overall point estimate.

Having developed the overall point estimate, the cost estimator must then validate it by thoroughly understanding and investigating how the cost model was constructed. For example, all WBS cost estimates should be checked to verify that calculations are accurate (no double counting) and account for all costs, including indirect costs. Moreover, proper escalation factors should be used to inflate costs so that they are expressed consistently and accurately. Finally, the cost estimator should compare the cost estimate against the independent cost estimate and examine where and why there are differences; perform cross-checks on cost drivers to see if results are similar; and update the model as more data become available or as changes occur and compare the results against previous estimates. *Reference: GAO-09-3SP, Chapter's 11, 12, & 15.*

GAO Evaluation Criteria:

1) Did the cost estimator consider various cost estimating methods like analogy, engineering build up, parametric, extrapolating from actual costs, and expert opinion (if none of the other methods can be used)?
   a) If the parametric method was used as the estimating method, were the cost estimating relationships (CER) statistics examined to determine its quality?
   b) Were learning curves used if there was much manual labor associated with production and were production rate and breaks in production considered?
   c) Was the point estimate developed by aggregating the WBS cost estimates by one of the cost estimating methods?
   d) Were results checked for accuracy, double-counting, and omissions and were validated with cross checks and independent cost estimates?
   e) If software is a major component of the cost estimate were software estimating best practices from Chapter 12 of the GAO Cost Estimating Best Practices Guide addressed?