Welcome to Cost Estimating

Cost estimates are necessary for governmental programs for many reasons: supporting decisions about whether to fund one program over another, developing annual budget requests, evaluating resource requirements at key decision points. The PPBE process is the resource allocation system in which these funding decisions are made and therefore, credible cost estimates are critical for successful execution of the PPBE process. The LCL will be called upon to provide life cycle cost estimates for all the elements of logistics support. Note that these estimates will not only include acquisition and procurement costs but the costs to support the system throughout the life cycle until disposal.

Objectives

Upon completion of this lesson, you will be able to:

- Identify three cost estimating techniques used to estimate logistics funding requirements.
- Identify the steps in the logistics cost analysis process.

Cost Estimating Techniques

The LCL is responsible for providing the Program Manager with the cost/budget estimates required to implement the program support strategy. An LCL should understand the various cost estimating techniques available in order to identify potential cost constraints and provide credible budget estimates during the Materiel Solution Analysis phase. As the acquisition life cycle progresses, increasingly precise cost estimates are possible due to increased data availability.

The choice of cost estimating technique depends upon:

- The maturity of a program from the identification of a materiel solution to design/development to production.
- The availability of cost, technical, and economic data.
- The type of system being estimated.

Cost Estimating Techniques, Cont.

The three estimating techniques commonly used during the different phases of a program life cycle are aligned to the life cycle phases during which they are most commonly applied. These three techniques are:

1. Analogy – widely used technique when the proposed system is related to an existing system
2. Parametric – must be able to associate proposed system characteristics to a cost relationship
3. Engineering build-up – requires detailed system data

Cost Estimating Techniques by Life Cycle Phase

Phase → / Technique ↓	Materiel Solution Analysis	Technology Development	Engineering & Manufacturing Development	Production & Deployment	Operations & Support
Analogy	Applicable	Applicable	Sometimes Applicable	Sometimes Applicable	Sometimes Applicable
Parametric	Applicable	Applicable	Sometimes Applicable	Sometimes Applicable	Applicable
Engineering Build-up	Sometimes Applicable	Applicable	Applicable	Applicable	Sometimes Applicable

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Long Description

The chart is a matrix with the life cycle phases along the top horizontal column, and the estimating techniques (analogy, parametric, and engineering build-up) along the left vertical column. The matrix shows the Analogy technique is applicable in the Materiel Solution Analysis and Technology Development phases. The Parametric technique is applicable during the Materiel Solution Analysis, Technology Development and Operations and Support phases. The Engineering Build-up technique is applicable during the Technology Development, Engineering and Manufacturing Development, and Production and Deployment phases. The remaining squares of the matrix are labeled “Sometimes Applicable”.

Cost Estimating Techniques, Cont.

Below are the three cost estimating techniques. Select each one to read a definition.

ANALOGY

PARAMETRIC

ENGINEERING BUILD-UP

Popup Text:

Analogy Cost Estimating

The analogy cost estimating technique involves a comparison between your system and a similar existing system. The estimator will take a fielded system's data and adjust it to account for any differences between the new and existing systems. This technique places heavy emphasis on expert opinion so it is important to document the rationale for selecting the analogous system and making adjustments.

Parametric Cost Estimating

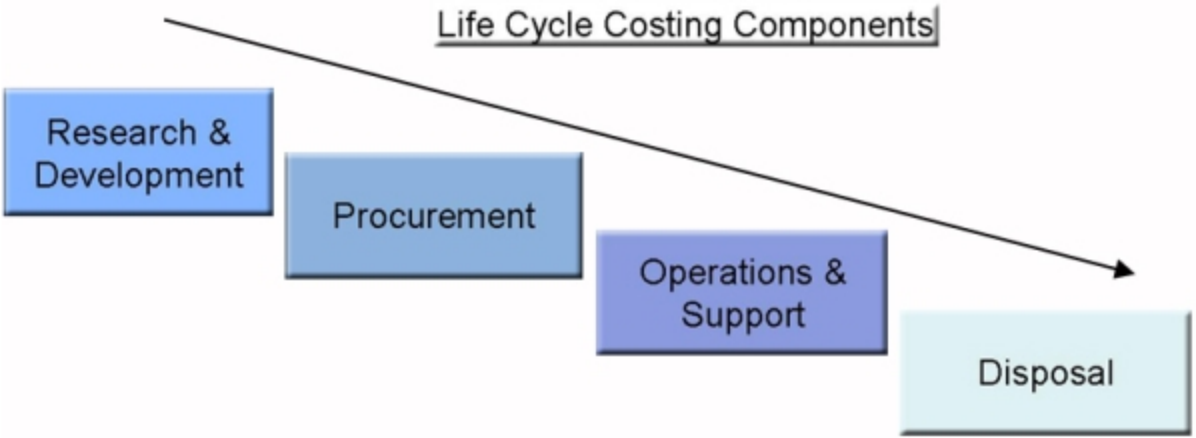
The parametric cost estimating technique uses statistical analysis to compare your system to many similar fielded systems. This approach uses regression analysis to establish relationships between system characteristics and costs. For example, a component that weighs X lbs. costs $X to support. That cost per pound measurement can be applied to a similar system to estimate support costs.

Engineering Build-up

The engineering build-up estimating technique requires more detailed information than the other two cost estimation methods used. This technique is a bottoms-up estimate based on a work breakdown structure (WBS) of the new system. Individual cost components, such as material, design hours, and labor hours, are priced to arrive at a total cost estimate.

Life Cycle Cost (LCC) Estimates from Cost Estimation Techniques

A Life Cycle Cost (LCC) estimate is most often performed to support budget submissions and support technical design trade-off decision making. The goal of utilizing an LCC approach to communicate costs is to minimize the cost of system ownership to the government and to allow decision makers to assess the affordability of a system before making funding decisions. LCC uses an iterative process to calculate the total cost of a program to the government from the acquisition through the ownership of a system over its useful life. The estimates provide a structured accounting of resources necessary to identify cost elements across the research and development, procurement, operations and support, and disposal cycles of a system.



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Long Description:

There is a diagrammatic representation of the Life Cycle Costing Components where four rectangular boxes are used to represent the four iterative process:

1. Research & Development
2. Procurement
3. Operations & Support
4. Disposal

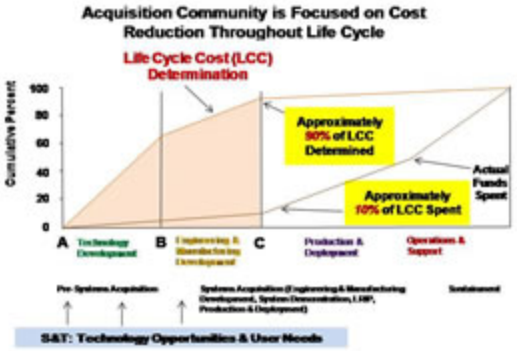
Life Cycle Cost Estimates, Cont.

Because there are very few comprehensive, end-to-end LCC models, a typical DoD LCC estimate is service/agency specific and combines the outputs of multiple cost techniques. There are potential hazards for inaccurate cost estimates. Overestimating the LCC may result in the program being deemed unaffordable; underestimating the LCC may prevent decision makers from allocating the proper funding to a project.

LCC analyses can be especially useful during the early planning and concept formulation phase of a project or program. The graphic on the right illustrates that as a program progresses further along its operational maturity curve (from research and development through operations and sustainment), costs become more and more difficult to reduce.

KEY: The best time to reduce life cycle costs is early in the acquisition process.

Metrics Across the Life Cycle - Cost



Click here to enlarge image

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Long Description:

There is a graph with the y-axis labeled “Cumulative Percent” and ranges from 0 to 100 in increments of 20. The x-axis represents the acquisition life cycle and critical milestones. From left to right it is marked as Milestone A, Technology Development, Milestone B, Engineering and Manufacturing Development, Milestone C, Production & Deployment, and Operations & Support Phase.
There is an upper line that goes from Milestone A through Technology Development to Milestone B at an approximate slope of 1. The line then moves through Engineering and Manufacturing Development to Milestone C at an approximate slope of ½. The line continues through Production & Deployment and Operations & Sustainment in an approximately horizontal manner.

There is a lower line that goes from Milestone A through Technology Development to Milestone B in an approximately horizontal manner. The line then moves through Engineering and Manufacturing Development to Milestone C at a slightly increased slope. The line continues through Production & Deployment at an approximate slope of ½ and through Operations & Sustainment at an approximate slope of 1. The upper line is labeled as “Life Cycle Cost (LCC) Determination” and the lower line is labeled as “Actual Funds Spent”. The chart is often referred to as the football chart because the upper life cycle cost determination line and the lower life cycle cost spent line together resemble the shape of a football.

There are vertical lines through the LCC Determination and Actual Funds Spent lines at Milestones B and C. At the intersection of the LCC Determination line and the vertical line at Milestone C is the indication that “approximately 90% of the LCC is determined”. At the intersection of the Actual Funds Spent line and the vertical line at Milestone C is the indication that “approximately 10% of the LCC is spent”. Above the graph is the note that the acquisition community is focused on cost reduction throughout the life cycle. “Pre-systems Acquisition” is noted below the x-axis between Milestones A and B. “Systems Acquisition (Engineering & Manufacturing Development, System Demonstration, LRIP, & Production & Deployment)” is noted below the middle of Engineering & Manufacturing Development through Production & Deployment. “Sustainment” is noted below Operations & Support. Below Milestone A and continuing through the middle of Production & Deployment there is the phrase “S&T: Technology Opportunities & User Needs”. Three arrows point from this phrase toward the x-axis.

Logistics Cost Estimate

Below are two types of cost estimating. Select each for a description. The LCL must support required cost estimation efforts at both the program and Defense staff levels by providing logistics cost estimates.

PMO Cost Estimate

Independent Cost Estimate (ICE)

Popup Text:

PMO Cost Estimate

The Program Management Office (PMO) life cycle cost estimate, generally required at each acquisition milestone to facilitate high-level decision-making, includes the projected logistics costs. These logistics cost estimates are based on predicted system effectiveness, operational efficiency, logistics and manpower requirements, and the effects of the reliability, maintainability, and supportability of the system. The PMO life cycle cost estimate is normally performed as early in the acquisition process as feasible and serves as the baseline for future financial tracking and auditing.

Independent Cost Estimate (ICE)

While the PMO Cost Estimate is performed at the program level, the ICE is executed at the Defense staff level. Title 10 USC § 2434 is the law that requires independent estimates prior to proceeding with either the Engineering and Manufacturing Development phase or the Production and Deployment phase. The Cost Assessment and Program Evaluation (CAPE) prepare the life cycle ICE and provides it to the Milestone Decision Authority (MDA).

DoD Instruction 5000.02 directs the CAPE to provide ICEs at major decision points (Milestones A, B, and C, or prior to the full-rate production decision). Also, the Defense Acquisition Board (DAB) may request an ICE at any time during the acquisition process.

Logistics Funding Profile

The LCL's portion of the Program Manager's budget is documented in the logistics funding profile. The logistics funding profile should have a section for each logistics element that provides a cost estimate for all planned expenditures. The logistics elements are displayed below. Select each to read details.

- Maintenance
- Technical Data
- Supply Support
- Support Equipment
- Computer Support Resources
- Facilities
- Training and Training Support
- Acquisition Logistics Management
- Related Programs

Popup Text:

Maintenance

Actual repair-type maintenance including depot and intermediate investment costs, test-bed facilities investment, repair costs including depot and intermediate repair, and support-/training-related repair. (Note: there is special emphasis on contractor maintenance costs)

Technical Data

Costs of procuring technical manuals and depot repair standards.

Supply Support

Funding for spares and repair parts.

Support Equipment

Costs of support equipment for maintenance, test sites, and training sites.

Computer Support Resources

Computer resources for the software support of material systems.

Facilities

Costs associated with construction, public works/ facilities, and utilities.

Training and Training Support

All training course requirements including training equipment, aids, and training simulators.

Acquisition Logistics Management

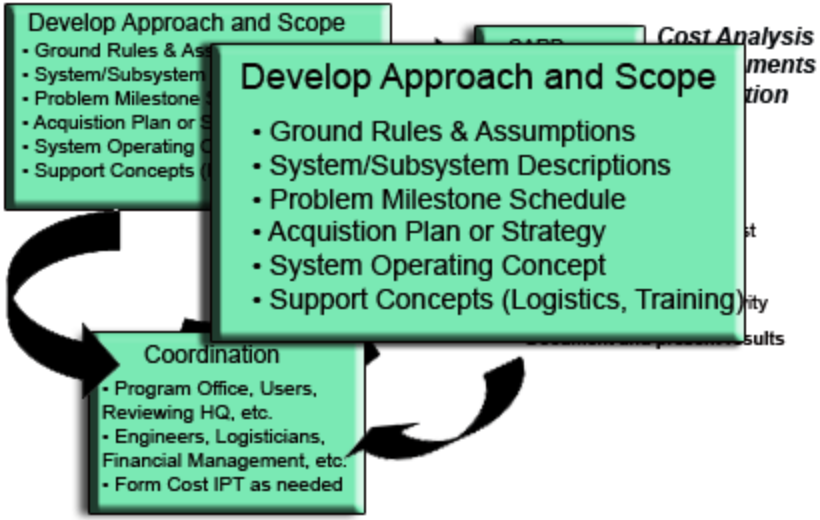
All management activities (including all supportability analyses not covered in the other elements) for the entire logistics system.

Related Programs

All other supports elements under the Program Manager's purview including configuration management, installation, handling equipment, containers, packaging, handling, storage, transportation, and hazardous material control and management.

Logistics Cost Analysis

LCC estimates are required at various points throughout the acquisition life cycle and are subject to review by outside groups, including the Defense Acquisition Board (DAB) and the Cost Assessment and Program Evaluation (CAPE). During the Integrated System Design effort, it is useful for the LCL to understand the analytical approach for life cycle cost estimates that is recommended in chapter 3 of the Defense Acquisition Guidebook (DAG). The following graphic illustrates this process:



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Long Description:

From the DoD Acquisition Guidebook, Chapter 3, Section 3.7, the recommended approach for life cycle cost estimation. The three main steps are: Develop Approach and Scope, Coordination, and Prepare Estimate. Develop Approach and Scope and Coordination are interconnected by arrows, indicating an iterative relationship. Prepare Estimate and Coordination are also interconnected with arrows, indicating that they also have an iterative relationship.

The following elements are pertinent to Develop Approach and Scope: ground rules and assumptions; system/ subsystem descriptions; program milestone schedule; acquisition plan or strategy; system operating concept, and support concepts (logistics, training). The following stakeholders are pertinent to Coordination: program office, users, reviewing HQ, engineers, logisticians, financial management, and cost IPT (as needed).
The following elements are pertinent to Prepare Estimate: select methods/ models; collect, validate, and adjust data; estimate costs; and assess risk and sensitivity. The output of Develop Approach and Scope is a cost analysis requirements description (CARD) or CARD-like document. Prepare Estimate logically comes after Develop Approach and Scope. The output from Prepare Estimate is a document and presentation of results.

Logistics Cost Analysis – Steps

Below are the steps in the recommended cost analysis process. Select each step for a description.

- Step 1: Develop Approach and Scope
- Step 2: Prepare the Estimate
- Step 3: Document and Present Results

Popup Text:

Step 1: Develop Approach and Scope

This initial step involves documenting assumptions, determining the scope of analysis, and fully defining the system and major sub-systems. The LCL must ensure that systems support concepts are included in the definition of the system. The Cost Analysis Requirements Description (CARD), to be described in more detail on a future slide in this section of the module, is a useful, and sometimes required, format for formal program documentation. It is important that the approach is reviewed and accepted by key stakeholders prior to moving forward with the cost analysis.

Step 2: Prepare the Estimate

The first step in preparing the cost estimate is to select the appropriate method(s) or model(s). These cost estimation models – analogy, parametric and engineering – were described on earlier screens. As more data becomes available, actual costs are substituted for these estimates. Next, the cost analyst collects the necessary data to support the selected cost estimation method. The LCL will assist the cost analyst by providing support-related data as required. The cost analyst will often adjust, or normalize, the data. After the cost analyst assembles the data, he/she computes the cost estimates. Following the computation, cost analyst will deal with the uncertainty of the data through sensitivity analysis and/or a formal risk assessment. As in step 1, coordination with key stakeholders is critical.

Step 3: Document and Present Results

The formal documentation of the cost estimate provides an audit trail that identifies the sources of data, methods used, and the results. It is important to include all assumptions and the complete system documentation as described in step 1. Further, the final documentation should consist of the final cost estimation as well as the results of the sensitivity analysis and/or risk assessment as presented in step 2.

Cost Analysis Requirements Description (CARD)

The DoD Cost Analysis Guidance and Procedures (DoD 5000.4-M) outlines the detailed process for preparing and presenting the CARD. The CARD includes text descriptions as well as cost data and is prepared using the following outline:

LCL focus is on system support

- System description and characteristics
- System quality factors
- PM's assessment of program risk and risk mitigation measures
- System operational concept
  - System support concept
  - System logistics concept
  - Hardware maintenance and support concept
  - Software support concept
  - System training concept
- Time-phased system quantity requirements
- System manpower requirements
- System activity rates (OPTEMPO or similar information)
- System milestone schedule
- Acquisition plan or strategy

The LCL supports the cost analysis specialists by providing functional inputs (i.e., elements of the life cycle sustainment plan) that have life cycle cost impacts (e.g., number of warehouses, inventory levels, etc.).

Cost As An Independent Variable (CAIV) Plan

The DoD Acquisition Guidebook, Section 3.2.4 presents the following typical elements that will appear in the CAIV plan:

Set Cost Goals – establish challenging, but achievable, targets for unit production cost and operations and support cost.

Perform Trade-off Studies – document timing, content, and approach for trade-off analysis for cost, schedule, and performance within established thresholds.

Establish Cost Performance Integrated Team – the Program Manager should create a team that includes logistics and acquisition professionals, the system contractor, and the user to implement and oversee the trade-off studies.

Provide Incentives – describe contractor cost-reduction incentives (both positive and negative) such as sharing of savings, penalties, and award fees.

Establish Metrics – identify plan for establishing, monitoring, and updating metrics that measure progress towards achieving cost goals.

Because small design changes can have large cost impacts, the trade-off process is more effective the earlier it occurs in the acquisition process. DoD expects greater success when CAIV is implemented in the Materiel Solution Analysis, Technology Development, or the Engineering and Manufacturing Development phases.

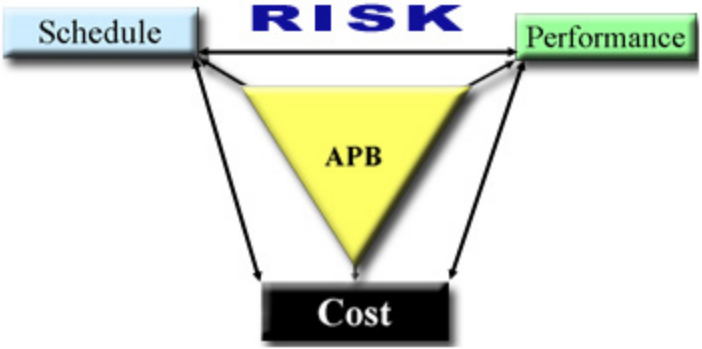
Earned Value Management (EVM) – Overview

This module provides a brief introduction to the concept of EVM. For a detailed discussion of the topic, please visit the DAU EVM learning center to view a narrated EVM tutorial.

The Program Manager's primary role is to manage risk in three areas outlined in the Acquisition Program Baseline (APB)—performance, schedule, and cost. In addition, cost as an independent variable (CAIV) mandates the consideration of total ownership costs as a military requirement. EVM provides the Program Manager with a tool to measure and manage contractor performance, cost, and schedule using dollars or hours as a common unit of measure.

EVM will allow the Program Manager to answer the following questions about a project:

- Are we overrunning the cost budget?
- What percentage of the work has been completed?
- Do we have enough money budgeted to complete the work?
- What is the estimated completion date?



EVM – Policy

On March 7 2005, the acting USD (AT&L) issued a memorandum revising DoD's EVM policy. The following were the primary changes:

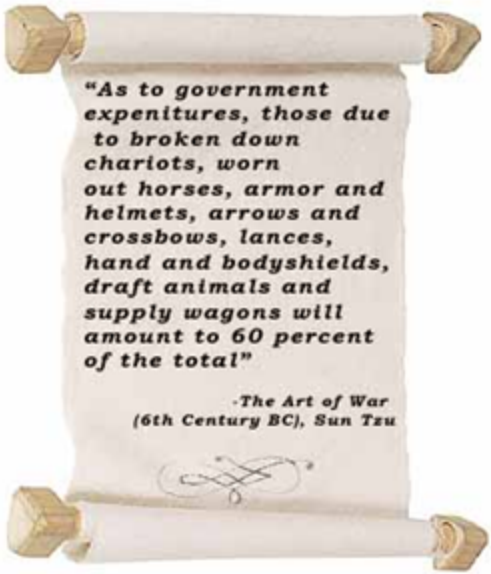
- Cost or incentive contracts and agreements valued at $20 million or more must implement EVM systems. For contracts greater than $50 million, the EVM system must be validated and accepted by the contracting officer.
- A contract performance report (CPR) and an integrated master schedule (IMS) are required whenever EVM is required.
- Integrated baseline reviews are required for EVM compliance.
- EVM is discouraged for firm-fixed price, level of effort, and time and materials efforts.
- The use of EVM for cost or incentive contracts valued at less the $20 million is optional and should be based on a program management risk assessment.

Note: The DAU ACC website contains significant learning materials related to EVM.

Total Ownership Costs (TOC)

As weapon systems age, the operations and support (O&S) costs tend to increase. The increased costs of O&S consume resources that could otherwise be spent on new research and development. This situation can result in a less modern military that is less able to meet future challenges. The intent of looking at total ownership costs (TOC) is to reduce O&S costs over the life of a system.

It is important to note that total ownership costs include not only acquisition costs, but also indirect costs, such the costs associated with program management and program support costs. The LCL can support the reduction of TOC by re-engineering the logistics system. To accomplish this, the LCL must meet aggressive Cost as an Independent Variable (CAIV) and TOC targets for new systems. The LCL must also reduce TOC for fielded systems.



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Popup Text:

Cost as an Independent Variable (CAIV)

Achievable Life Cycle Cost (LCC) objectives and managing achievement of these objectives by trading off performance and schedule, as necessary. Cost objectives balance mission needs with projected out-year resources, taking into account anticipated process improvements in both DoD and industry. CAIV has brought attention to the government's responsibilities for setting/adjusting LCC objectives and for evaluating requirements in terms of overall cost consequences. (DAU Glossary, pp. B-36 to B-37).

To learn more about CAIV, you may take CLB 012: Cost as an Independent Variable. Select here to learn more about this DAU continuous learning module.

Long Description:

"As to government expenditures, those due to broken down chariots, worn out horses, armor and helmets, arrows and crossbows, lances, hand and body shields, draft animals and supply wagons will amount to 60 percent of the total"- The Art of War (6th Century BC), Sun Tzu

Reduction of Total Ownership Costs (R-TOC)

Because of shrinking acquisition budgets, defense systems are operated well beyond their anticipated lives. This has increased operations and support (O&S) costs, which in turn has further reduced available acquisition funding for new weapons system procurement. This situation has been termed the "death spiral."

R-TOC is a DoD-wide effort to reduce total ownership costs by increasing system reliability and process efficiency. The Under Secretary of Defense for Acquisition, Technology, and Logistics (USD (AT&L)) defined the following three key R-TOC approaches:

- Reliability and maintainability (R&M) improvements
- Reduction of supply chain response time and reduction of logistics footprint
- Competitive product support

Starting in FY99, DoD initiated more than 30 R-TOC pilot projects (including the SLAM-ER guided missile pictured on this screen) with ambitious cost reduction goals. DoD remains committed to the R-TOC concept.

For more information on R-TOC, visit DAU ACC, "Reduction of Total Ownership Costs (R-TOC) Best Practices Guide DTD July 2003."

Knowledge Review

Which of the following is an applicable cost estimating technique used during the Materiel Solution Analysis Phase? Select all that apply.

- [x] Analogy
- [x] Parametric
- [ ] Engineering Build-up
- [ ] Funding Appropriations

Check Answer

Engineering Build-up is only applicable sometimes, but **Analogy** and **Parametric** are always applicable.

Knowledge Review

Which of the following are steps in the recommended cost analysis process?

- [ ] Develop Approach and Scope
- [ ] Prepare the Estimate
- [ ] Document and Present Results
- [x] All answers are correct

Check Answer

All of the above are steps in the reccommended cost analysis process.

Cost Estimating Summary

You have completed Cost Estimating and should now be able to:

- Identify three cost estimating techniques used to estimate logistics funding requirements.
- Identify the steps in the logistics cost analysis process.

Lesson Completion

You have completed the content for this lesson.

To continue, select another lesson from the Table of Contents on the left.

If you have closed or hidden the Table of Contents, click the Show TOC button at the top in the Atlas navigation bar.