



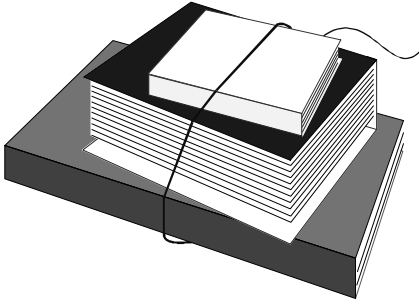
Section 1.5: Types of Cost Estimates/Lessons Learned



Section 1.5



Types of Cost Estimates/ Lessons Learned





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This section compares traditional construction, DOE construction, and Environmental Restoration (ER) and Waste Management (WM) projects for the following types of estimates:


- Order of Magnitude/**Planning/Feasibility Study**
- Budget/Conceptual/**Preliminary**
- Definitive/**Detailed**

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Section 1.5: Types of Cost Estimates/Lessons Learned

Estimate Types

	Industry Standard	DOE Construction	DOE ER - Assessment Phase	DOE ER - Clean-Up Phase
Level of detail and reliability increases 	Order of Magnitude	Planning/Feasibility Study	Planning	Planning
	Budget	Budget/Conceptual Design	Preliminary	Feasibility
		Preliminary Design (Title I)		Preliminary
	Definitive	Detailed/Design Estimate (Title II)	Detailed	Detailed

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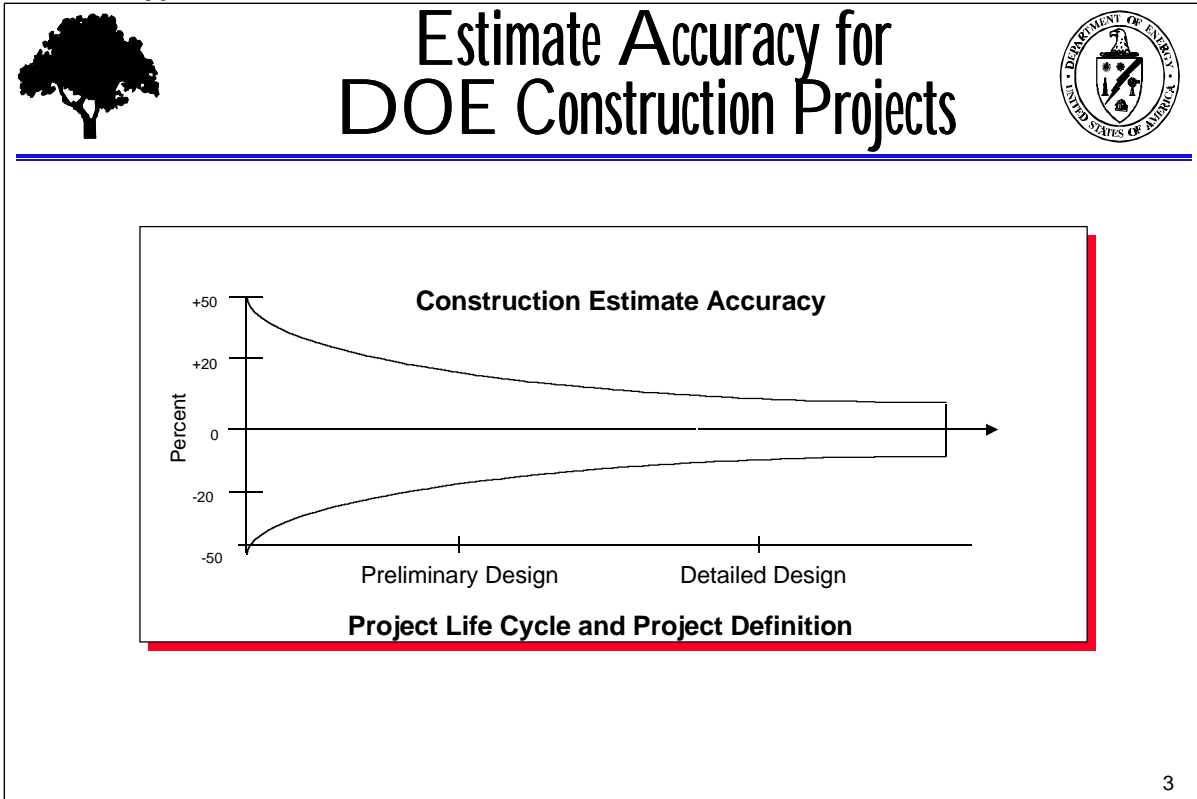
Discussion Leader/Facilitator Notes: *The facilitator should reinforce the fact that this chart clearly presents differences that exist in the terms used and how estimate types are defined. Project managers need to be aware that people may be using terms differently. The table above was referenced from the “DOE Cost Estimating Guide” (DOE G 430.1-1).*

This chart compares the terms used for estimate types by DOE Construction and Environmental Restoration to traditional industry terms Association for the Advancement of Cost Engineering, International (AACE). This chart clearly points out why confusion often exists in how we categorize or what we call an estimate. Because communication is vital to project and program managers, one must understand that differences exist in estimate-type terms.

- The levels of accuracy and confidence in the estimate are based on the type and detail of the estimate. They increase in accuracy as the project life cycle increases.
- The accuracy of the estimate depends on both the amount of quality information available and the judgment and experience of the estimator. As the amount of information and specific details increases, so does the degree of accuracy.
- Each type of estimate has a separate purpose, basis, and design scheme.

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Discussion Leader/Facilitator Notes: The facilitator should point out that they may also see this graph showing a beginning range of +50% and -30%, instead of +50% and -50%. Industry standards typically assume an initial range of +50% and -30%.

This graph depicts a DOE construction-type project life-cycle estimate accuracy range. Industry standards depict this same graph but show an initial range of +50% and -30% instead of +50% and -50%.

- As the project progresses through its life cycle and project definition improves, the accuracy of the estimate will also improve.
- When preparing estimates, you should always strive for the best and most accurate cost estimate possible given the data available.
- Note that the accuracy range provided includes the estimate for contingency. Therefore, the total estimate, including contingency, should establish the upper bound of the estimate based on the technical scope and schedule.

Notes / Discussion Points / Lessons Learned: _____

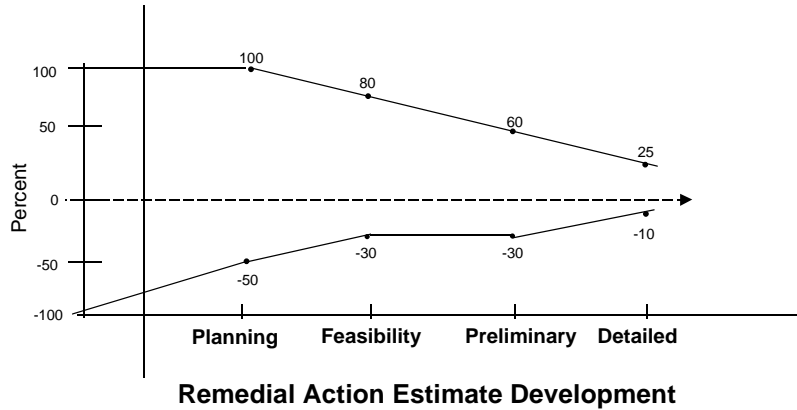
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Estimate Accuracy for Remedial Actions



ER Cost Estimate Accuracy

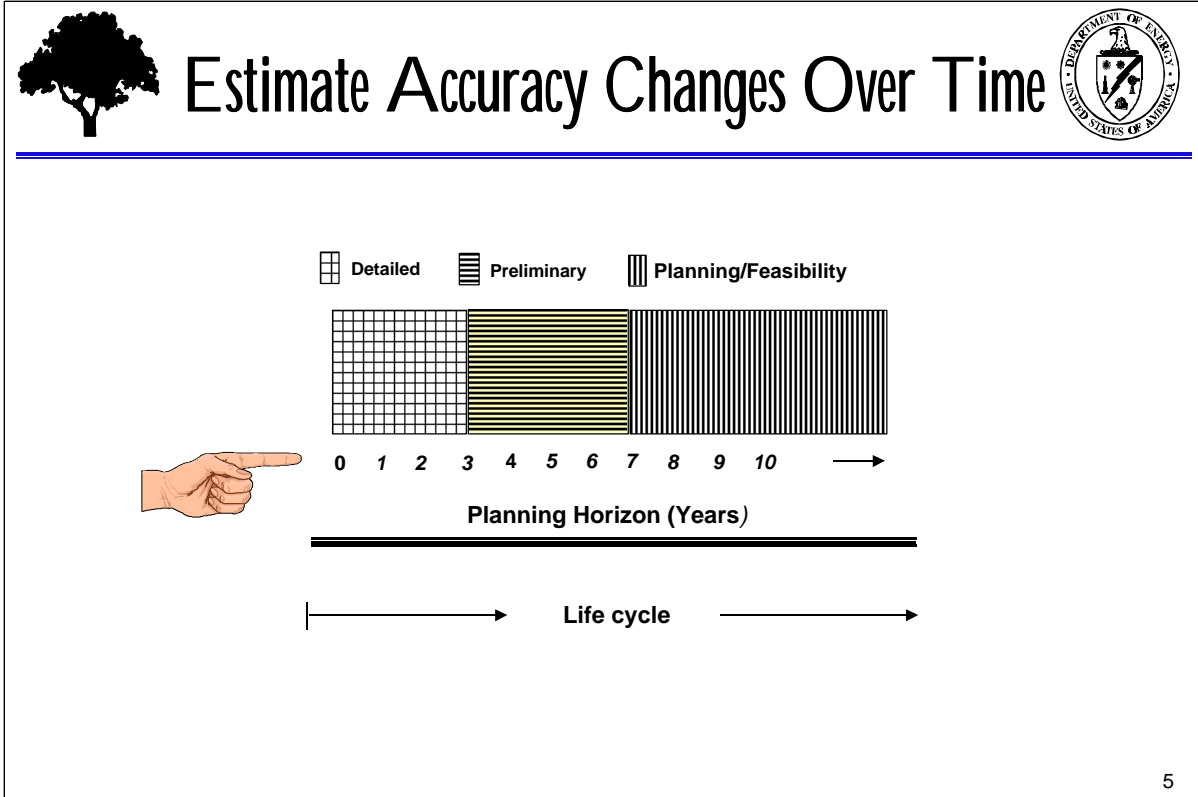


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- This graph depicts a remedial actions-type project life-cycle estimate accuracy range.
- Estimate accuracy ranges are based on estimate accuracy for environmental restoration per DOE G 430.1-1, *Cost Estimating Guide*.

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Discussion Leader/Facilitator Notes: Introduce the term “life cycle” here.

Life-cycle cost estimates encompass all costs associated with an ER project from the beginning of assessment to the end of remedial action, including postclosure and verification activities. Life cycle is defined by life cycle asset management (DOE Order 430.1) as “the life of an asset from planning through acquisition, maintenance, operation, and disposition.”

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Estimate Types and Their Applications

Order-of-Magnitude/Planning/Feasibility Study							
Industry Standard		DOE Construction		Environmental DOE Restoration-Assessment Phase		Environmental DOE Restoration-Clean-up Phase	
Purpose	Accuracy Range	Purpose	Accuracy Range	Purpose	Accuracy Range	Purpose	Accuracy Range
Order of Magnitude 1. Assess project feasibility 2. Screen alternative designs (also referred to as "conceptual" or ball park)	+ 50% to - 30%	Planning 1. Scoping Studies 2. Preliminary budget estimates of Total Project Cost 3. Support Critical Decision 0	+ 50% to - 50%	Planning Assist in the preliminary planning and budgeting of a project	- 50% to + 100%	Planning 1. Assist in preliminary planning and budgeting of the cleanup. 2. Required for budgetary purposes for inclusion in planning documents. 3. Included in the EM 5-Year Plan. 4. Basis for funds represented in the ADSs.	- 50% to + 100%
						Feasibility Used to evaluate the numerous technical solutions developed to remediate a site.	- 30% to + 80%

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Discussion Leader/Facilitator Notes: The facilitator should again point out the differences between how DOE and industry define estimate types. Understanding these differences may eliminate communication problems.

The industry standards used are AACE. The DOE definitions are obtained from the DOE G 430.1-1, "Cost Estimating Guide." Participants should note that outside auditors need to be reminded of the acceptable cost-estimate ranges approved by DOE.

This table compares the industry standard definition of an order-of-magnitude estimate with how DOE defines a planning/feasibility estimate for construction and environmental restoration projects.

- **Industry Standard Order-of-Magnitude Estimate** (sometimes referred to as "conceptual" or "ball park")
 - Purpose: These estimates are made without detailed engineering data. They have important applications, including use in determining quickly the feasibility of a project or screening several types of alternative designs.

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- Basis: The basis for an order-of-magnitude estimate must describe the purpose of the project, basic criteria, significant features and components, proposed methods of accomplishment, and proposed construction schedule. Order-of-magnitude estimates are based on cost-capacity curves, ratio estimates, and other cost-estimating relationships based on past history and expert opinion.

- **DOE Construction - Planning Estimate**
 - Purpose: These estimates are normally prepared for a proposed project before the conceptual design is completed. They are used for scoping studies and for preliminary budget estimates of total project costs. They should support Critical Decision 0.
 - Basis: The basis for the planning estimate must describe the purpose of the project, general design criteria, significant features and components, proposed methods of accomplishment, proposed construction schedule, and any known research and development requirements. Any assumptions that the estimator makes in this phase shall be documented for review and concurrence. Planning estimates are based on past cost experience with similar type facilities, where available.

- **DOE Environmental Restoration Assessment Phase - Planning Estimate**
 - Purpose: The planning estimate assists in the preliminary planning and budgeting of the project.
 - Basis: The basis for the planning estimate is very limited because a large amount of information is unknown and/or highly uncertain. Only the location of the work, likely contamination, and prior use of the land may be known. Therefore, analogies, simple cost-estimating relationships, and more sophisticated parametric tools are used for the estimate.
 - When sufficient detail is unavailable, historical data may be used.

- **DOE Environmental Restoration Clean-up Phase Planning Estimate**
 - Purpose: The planning estimate is required for budgetary purposes or for inclusion in planning documents. This estimate is the basis for the funds represented in the Activity Data Sheets (ADSs).

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- Basis: Minimal design information is available; therefore, use of historical cost data is helpful. All information gathered during the Assessment Phase is used in the computation of this estimate.

- **Feasibility Estimate**



- Purpose: Feasibility estimates are used to evaluate and compare potential options or alternatives, including numerous technical solutions developed to remediate a site. Because of the early time period in the project life cycle during which these estimates are made, they usually have an order-of-magnitude level of accuracy. These estimates perform two functions: (1) they present a total estimated cost of each alternative on the basis of the best information available, and (2) they provide a logical, traceable framework for comparing alternatives with each other.

These estimates can be used to establish the probable, costs of a program/project budget, evaluate the general feasibility of a project, evaluate cost consequences of proposed modifications, establish a preliminary budget for control purposes during the design phase, and screen a number of alternative projects so one or more can be given a more detailed examination.

- Basis: Use the lowest level of detail possible and takeoffs from available drawings.

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Estimate Types and Their Applications

Industry Standard		Budget/Conceptual/Preliminary					
Purpose	Accuracy Range	DOE Construction		Environmental DOE Restoration - Assessment		Environmental DOE Restoration - Clean-up Phase	
Purpose	Accuracy Range	Purpose	Accuracy Range	Phase	Accuracy Range	Purpose	Accuracy Range
Budget 1. Budget preparation 2. Planning estimate	-15% to + 30%	Conceptual Design Estimate 1. Ensure project feasibility 2. Develop reliable project cost estimate 3. Establish baseline project definitions, schedules, and costs 4. Support Critical Decision 1 (design 10% to 15% complete)	± 30%	Preliminary Used as a budgetary tool and are included in the EM 5-Year Plan.	- 30% to + 70%	Preliminary A more detailed cost estimate that is developed after a remediation alternative is selected.	- 30% to + 60%

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Discussion Leader/Facilitator Notes: *The facilitator should again point out the differences between how DOE and industry define estimate types. Understanding these differences may eliminate communication problems.*

The industry standards used are AACE. The DOE definitions are obtained from DOE G 430.1-1, "Cost Estimating Guide." Participants should note that outside auditors need to be reminded of the acceptable cost-estimate ranges approved by DOE.

This table compares the industry standard definition of a budget estimate with how EM-40 defines a conceptual and preliminary estimate for environmental restoration projects.

- **Industry Standard - Budget Estimate**
 - Purpose: A Budget Estimate is used in establishing the owner’s budget or planning purposes.
 - Basis: This estimate is developed with the help of design flow diagrams, layouts, and equipment details. In other words, enough preliminary engineering has taken place to define further the project scope.

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• DOE Construction - Conceptual Design Estimate

- Purpose: A Budget/Conceptual Design Estimate is required to request Congressional authorization for funding. This request is required for each Line Item Construction Project and each contingency-type project. The fundamental purposes of a Budget or Conceptual Design estimate are as follows:
 - To ensure project feasibility and attainable performance levels;
 - To develop a reliable project cost estimate consistent with realistic schedules;
 - To establish baseline project definitions, schedules, and costs; and
 - To support Critical Decision 1.

- Basis: The basis for a Budget or Conceptual Design Estimate shall include as many of the detailed requirements in the Conceptual Design Report (CDR) as possible.

• DOE Environmental Restoration Assessment Phase - Preliminary Estimate



- Purpose: A more detailed estimate can be completed after some basic information is available from a preliminary assessment or site inspection. Preliminary Estimates are used as a budgetary tool.
- Basis: This estimate is developed after the preliminary assessment is completed. The estimate is more detailed. Unit cost is applied at this point to some project categories in the assessment phase, such as laboratory analysis and monitor well drilling.

• DOE Environmental Restoration Clean-up Phase - Preliminary Estimate

- Purpose: After a remediation alternative is selected, a more detailed cost estimate is developed. This estimate shall be in sufficient detail that it can be used as one of the project control tools.
- Basis: This estimate shall show all costs incurred to date. All future estimated costs—such as equipment costs, vendor pricing, or materials pricing—shall be as accurate as possible.

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Section 1.5: Types of Cost Estimates/Lessons Learned

Estimate Types and Their Applications

Industry Standard		Definitive/Detailed					
		DOE Construction		Environmental DOE Restoration - Assessment Phase		Environmental DOE Restoration - Clean-up Phase	
Purpose	Accuracy Range	Purpose	Accuracy Range	Purpose	Accuracy Range	Purpose	Accuracy Range
Definitive 1. Bid estimates 2. Construction estimates 3. Control estimates	+ 15% to - 5%	Title I Estimate 1. Verify that Title I details remain within project funding. 2. Support Critical Dec. 2 (Design 25% to 35% comp.)	± 20%	Detailed Used to decide alternatives for remediating a site.	- 25% to + 55%	Detailed Verify the contractor's figures in lump sum and negotiated fee projects.	- 10% to + 25%
		Title II Estimate 1. Accurate estimate of construction cost, before the competitive bidding and construction activities. 2. Support Critical Dec. 3 (Design 60 to 100% comp.)	- 5% to + 15%				
		Construction Estimate 1. Estimate is based on bid information (Design 100% complete)	- 5% to + 10%				

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Discussion Leader/Facilitator Notes: *The facilitator should again point out the differences between how DOE and industry define estimate types. Understanding these differences may eliminate communication problems.*

The industry standards used are AACE. The DOE definitions are obtained from DOE G 430.1-1, "Cost Estimating Guide." Participants should note that outside auditors need to be reminded of the acceptable cost-estimate ranges approved by DOE.

This table compares the industry standard definition of a definitive estimate with how EM-40 defines a detailed estimate for environmental restoration projects.

• Industry Standard - Definitive Estimate

- Purpose: A Definitive Estimate is used for many purposes, including bid proposals and control estimates
- Basis: These estimates are prepared from very defined engineering data, including, as a minimum, fairly complete plot plans and elevations, piping and instrument diagrams, single-line electrical diagrams, equipment data sheets and quotations, structural sketches, soil data, sketches of major foundations, and a set of specifications.

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- **DOE Construction - Title I Design Estimate**

- Purpose: The Title I Design Estimate is an intermediate estimate used to verify that the Title I design details remain within the project funding. The Title I design details are written in the Title I design phase; this is the initial work accomplished under an approved project.

The purpose of the Title II Estimate is to estimate construction costs as accurately as possible before competitive bidding and construction activities begin. As Title II design specifications and drawings are developed, the Title II Estimate is completed. The completed Title II Estimate is in support of Critical Decision 3.

- Basis: The basis for the Title I Estimates shall include all items mentioned in the Conceptual Design Report estimate basis and all the refinements (developed during the workshop) of producing the Title I Engineering package, including all drawings, outline specifications, data sheets, bills of material, schedule refinements, definitions of scope, methods of performance, changes in codes, standards, and specifications.

The basis for the Title II cost estimate must include all of the approved engineering data, methods of performance, final project definition and parameters, project schedule, and final exact detailed requirements.

- **DOE Environmental Restoration Assessment Phase - Detailed Estimate**

- Purpose: Detailed Estimates are used to decide between the alternatives for remediating a site. There are numerous detailed estimates, one of each remediation alternative. The Detailed Estimates are the final estimates of the Assessment Phase.

- Basis: The basis of the Detailed Estimate includes all information gathered during the Assessment Phase.

- **DOE Environmental Restoration Clean-up Phase - Detailed Estimate**

- Purpose: This estimate is used to verify the contractor's figures in both lump sum and negotiated fee projects.

- Basis: The basis of the final Detailed Estimate for an environmental restoration project includes the final approved drawings, specifications, calculations, schedule, and expected method of accomplishment of the project goals. This estimate shall be performed as an independent contractor would perform the estimate for bidding purposes.

Notes / Discussion Points / Lessons Learned: _____

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CERCLA Feasibility Study Estimates



**By EPA guidance, CERCLA
Feasibility Study (FS) Estimates
should have an accuracy of at
least +50% to -30%
(Order of Magnitude)**



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Caution:

- EPA guidance requires that CERCLA Feasibility Study Estimates have an accuracy of at least +50% to -30%, which is an order-of-magnitude accuracy level by industry standards (ACE and PMI). It is not, however, within the accuracy levels of a DOE ER project planning, feasibility, or preliminary estimate.
- Superfund EPA *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA/540/G-89/004) page 6-13 states:

Accuracy of Cost Estimates - site characterization and treatability investigation information should permit the user to refine cost estimates for remedial action alternatives. It is important to consider the accuracy of costs developed for alternatives in the FS. Typically, these “study estimate” costs made during the FS are expected to provide an accuracy of +50 percent to -30% and are prepared using data available from the RI. It should be indicated when it is not realistic to achieve this level of accuracy.

Notes / Discussion Points / Lessons Learned: _____

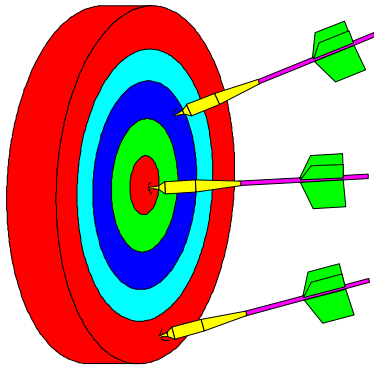
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Estimate Type Summary



Terms used in the rest of this workshop



Preliminary

Detailed

**Planning/
Feasibility**

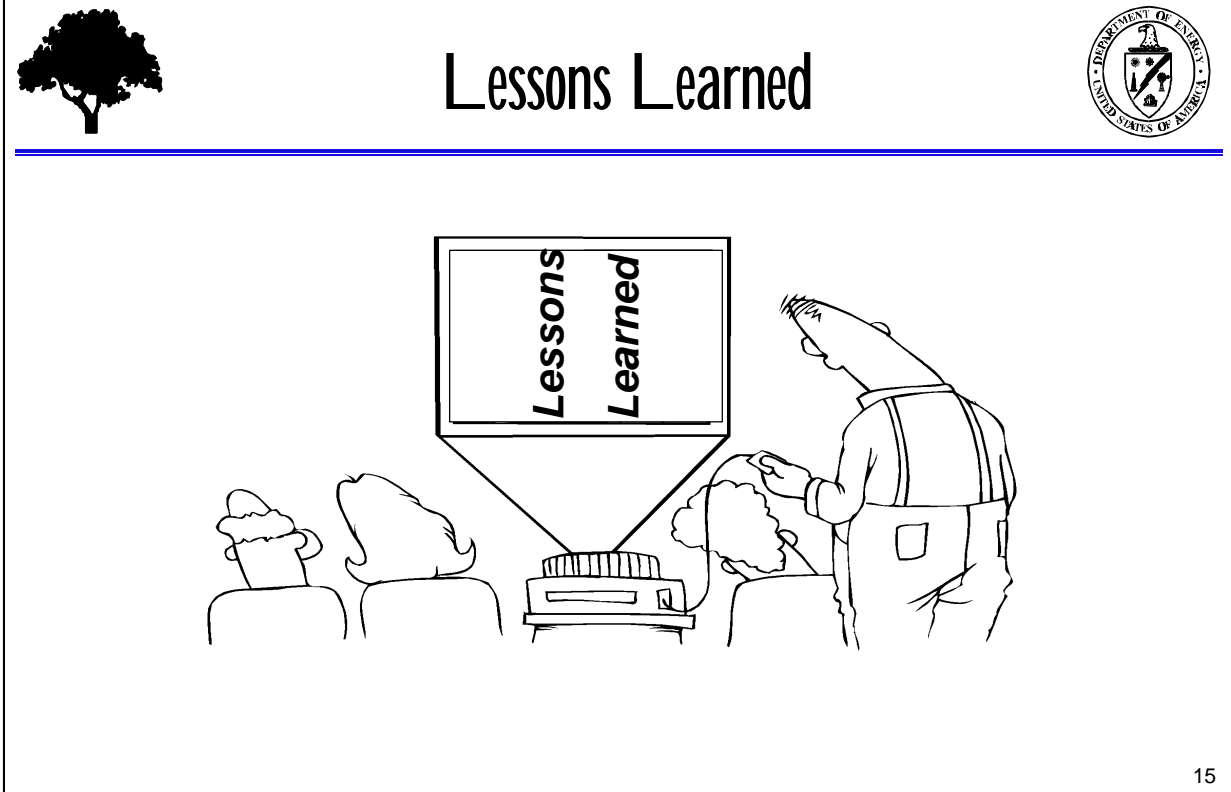
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Clearly, terminology can be a problem in communicating something as simple as estimate types. Throughout the rest of this workshop, we will use the following terms:

- Preliminary
- Detailed
- Planning/Feasibility

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Section 1.5: Types of Cost Estimates/Lessons Learned



1. What is done/required to ensure that everyone understands and uses the estimate type information?

How has this created problems or misuse of your estimate?

What can be done to correct or improve the situation?

2. In obtaining source/comparative data, what problems have you encountered in finding comparative estimates from other organizations and their different titles for different types of estimates?

3. Does everyone agree with the application and use of each type of estimate?

Have you ever experienced a situation in which a certain type of estimate was used incorrectly?

Does this happen very often?

What can be done to prevent it?

Notes / Discussion Points / Lessons Learned: _____

