Costing Procedures
Plans for Risk Analysis
Contingency Estimation
Agenda

• Costing Approach/Procedures
  – Common/Generic System Teams Plus Special Areas
  – Cost Models
  – Written Guidelines

• Risk Analysis
  – Developing Plan for a Comprehensive Plan
    • Conventional Facilities Draft Plan Available
  – Modified U.S. Atlas Risk Scoring Approach
  – Cost Estimates: Point Estimates versus Probability Distributions

• Contingency Estimation
  – “Conventional” Approach
  – Monte Carlo Approach
Costing Approach/Procedures

- Cross-Functional Teams Formed for Common/Generic Systems
- Specialized Areas Covered Separately
- Objectives:
  - Ensure Nothing is Omitted or Duplicated
  - Construct Most Credible/Defensible Cost Model
  - “Standardize” Where Feasible; Highlight Differences Where Not
- Published Guidelines for Cost Estimating
  - Overall Philosophy, Format, Definitions, Make/Buy, Rates, “How Safe a Cost to Provide”, Accounting for Quantity, Reliability
- Cost Reviews
  - Automatic Peer Review in Cross-Functional Teams
  - SLAC Cost Reviews Underway (Three Month Rolling Schedule)
- Costing Approach Reasonably Well-Developed (Some Say Over-Developed) Considering Pre-Conceptual Phase
  - Cost Model Detail Proportional to Familiarity of Design
  - Costing Has Lagged Machine Changes
Risk Analysis Plans

• Eventually Need to Develop a Comprehensive Risk Plan
  – By Component, by Activity, by Project Phase
  – Cost, Schedule, Performance, Reliability
  – Internal Factors (e.g. Project Software Limitations) and External Factors (e.g. Environmental Impact)

• Currently, Only Dealing with Cost Estimate Risk
  – Modified U.S. Atlas Risk Scoring Methodology
    • Performed at Component/Task Level by Estimator
    • Concept is That Cost Risk is Mirrored by Scoring Five Attributes:
      – Design Risk, Design Maturity, Supplier Risk, Cost Estimate Maturity, Schedule Risk Each Scored From 1 to 10
    • Input and Analyzed Using ACCESS Database
  – In Parallel, Using Probabilistic Costs to Bracket Point Estimates
    • Direct Estimate of Possible Range in Cost of Item
Point Estimates Plus Risk Scoring versus Probability Distributions

• **Point Estimates**
  – Point Estimates Requested at the 50% Point (50% Chance of a Higher Number) to do Some Normalization
  – Database of Risk Scores Makes Sorting and Analysis Easy
  – Converting Risk Scores Into Defensible Predictors of Actual Cost Exposure/Risk is Very Problematical
    • Have Established Algorithm to Calculate Contingency

• **Probability Distributions**
  – Just Ask Estimator For the Possible Range in Cost Due to Any and All Factors
  – No Other Algorithm or Manipulation Needed
Contingency Estimation
“Conventional” Approach

- Performed at Project Manager Level (Not by Estimators)
- Algorithm Runs Inside ACCESS Using Risk Scores
  - High Scores are Emphasized; Low Scores De-Emphasized
    - Baseline Algorithm is Cubic
  - Scoring is Weighted: Technical and Manufacturing High (100);
    Schedule Low (20); Others at 40-50
- Contingency Generated at 30% Level for Total Project
  with Little Normalizing
Contingency Estimation
Appraisal of “Conventional” Approach

• Advantages
  – Common Approach for DOE Projects
    • Familiar and Comfortable to Reviewers
    • Fairly Straightforward to Generate Risk Scores

• Disadvantages
  – No Proof or Evidence That This Approach Generates the Appropriate Contingency
  – Considerable Experience That This Approach Does Not Always Work
  – Dynamic Range Always Less Than Reality Provides For

• Premise
  – We Must Adopt an Approach That is Bullet-Proof
Contingency Estimation
Monte Carlo Approach

- Single Point Estimates are Replaced by the Range of Possible Costs from Each Estimator
- Each Range Has Defined Probabilities of Occurrence
- The Range of Possible Total Project Costs is Generated by a Monte Carlo Simulation of All the Project Activities/Items
- The Contingency is Automatically Generated Along With a Probability of Occurrence
Monte Carlo Example
(Using $2.9 B of Lehman Costs)

NLC Monte Carlo Histogram Results
All Hardware and All Conventional Facilities Completely Correlated Within Themselves

Probability of Cost Within Histogram Interval

Probability of a Lower Cost

CD-1 = $2.9 B
Mean = $3.1 B

Cumulative Probability

Total Project Cost in $B

Cost Estimation and Analysis
Factors Affecting Choice of Contingency Mechanism

• Problems with Point Estimates to Generate a Contingency
  – Unacceptable per OMB Rules (OMB Circular A-94)
    • Will Fail to Pass an Independent Project Review
  – Not Recommended for Major Projects by Project Management/Risk Literature
  – Dynamic Range Always Less Than Reality Provides For
  – Allows Risk Information to Remain Buried Within Point Estimates
  – Cause Every Other DOE Project Difficulty

• Problems with Probabilistic Approach
  – Not Established DOE Practice
  – Obtaining Probability Distributions Requires Much More Work
  – More Complex, Different, and Sometimes Arbitrary Approach

• Benefits of Probabilistic Approach
  – Contingency Becomes Automatic and Defensible
  – Dollar Consequence of Uncertainty and Risk Explicitly Quantified
Summary

• Continue to Refine Machine/Project Costing
• Risk Scoring à la U.S. Atlas Will be Performed
• Contingency Calculation Based on Risk Scores Will be Performed
• Probability Distributions on Major Cost Items (~20-30) Will be Obtained
• Contingency Calculation Based on a Monte Carlo of These Distributions Will be Performed