

Module Objectives

Risk Management Process

- Identify the components that comprise a successful Risk Management Plan

Elements of Risk

- Recognize the three types of risks that affect the cost of a program

Cost Risk Analysis

- Identify the fundamental reasons and expectations for conducting cost risk analyses for defense acquisition programs

Approaches for Estimating Cost Risk

- Compare five analysis methods

Cost as a Probability Distribution

- Examine how cost is treated as a Probability Distribution

Monte Carlo Simulation in Cost Risk Analysis

- Identify the process of conducting a Monte Carlo simulation for the cost risk analysis



Module Summary

Cost analysts attempt to develop the best possible cost estimate from available information. For each element in the estimate a most likely value is computed. Because every assumption that drives a cost estimate represents a point within a range of possible values, this type estimate is sometimes called the point estimate.

A cost risk analysis estimates the uncertainty of the point estimate and provides a basis for determining probabilities associated with budgets and funding levels. A good cost risk analysis is a step toward cost control.

Lesson One – Risk Management Process

- **Five Key Activities:**

- Risk Identification
- Risk Analysis
- Risk Mitigation Planning
- Risk Mitigation Plan Implementation
- Risk Tracking



Module Summary, Cont.

Lesson One - Risk Management Process, Cont.

- **Components of Risk:**
 - Future Root Cause
 - Probability
 - Consequence
- **Risk Assessment:**
 - Risk Identification
 - Risk Analysis
- **Risk Planning:**
 - Answers the questions "who, what, where, when, and how"; describes and schedules the tasks for risk identification, risk analysis, risk mitigation planning, resourcing, risk mitigation plan implementation, and risk tracking



Module Summary, Cont.

Lesson Two - Elements of Risk

- Performance Related Risks
 - Performance can be affected by...
 - Technical Risk
 - Supportability Risk
 - Configuration Uncertainty
 - Programmatic Risk
- Schedule Related Risks
 - Schedule changes may be affected by...
 - System Requirements
 - Design Requirements
 - Strategy
 - Funding Sources
 - Personnel



Module Summary, Cont.

Lesson Three – Cost Risk Analysis

- **Cost estimating:** Process of developing an expected future dollar cost for a system, item, or service
- **Cost risk:** Assesses potential variability in these unknown future costs
- **Cost risk analysis:** Identifies individual probability distributions (PDs) for each cost element
- **Monte Carlo Simulation:** Iteratively pulls a cost from each cost element PD and calculates a total cost. Thousands of iterations allow development of total system cost PDF
- **Risky situation:** Has known uncontrollable random events; PD possible
- **Uncertain situation:** Has unknown uncontrollable random events; PD not possible
- **Cost Uncertainty/Risk Analysis (CU/RA):** Process of quantifying the cost impacts of uncertainties
- **Typical Outputs:**
 - Probability Density Function
 - Cumulative Density Function



Module Summary, Cont.

Lesson Four – Approaches for Estimating Cost Risk

- There are five analysis methods:
 - Subjective Estimators Judgment
 - Expert Judgment
 - Sensitivity Analysis
 - High/Low Analysis
 - Mathematical Approaches

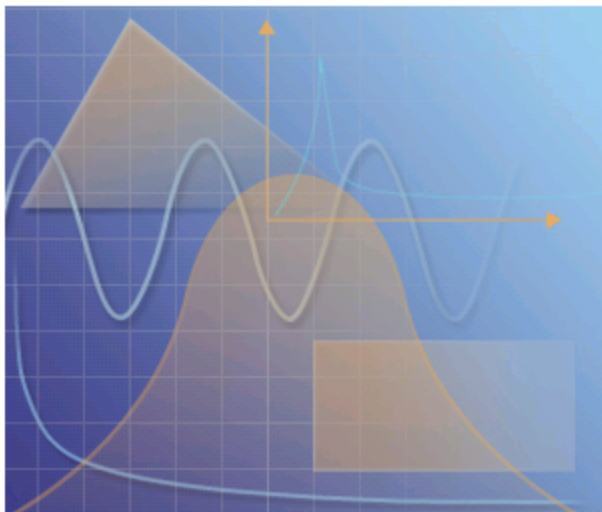
Lesson Five – Cost as a Probability Distribution

- Cost Risk Analysis:
 - Identify a probability density function for each cost element (input)
 - Combine the input PDFs into a Total Cost PDF
- Two mathematical Approaches:
 - Symmetric Approximation (Summation of Moments)
 - Monte Carlo Simulation



Module Summary, Cont.

- **Uniform Distribution:**
 - High Value and Low value only
 - Used when there is no likelihood information
- **Triangular Distribution**
 - High, Low and Most Likely
- **Normal Distribution**
 - Bell Curve
 - Symmetrical - Standard Deviation is about the mean
 - Requires mean and standard deviation
- **Beta Distribution**
 - No district shape
 - Requires α and β
 - Assume PERT Beta
- **PERT (Program Evaluation and Review Technique)**
 - Three estimates



Module Summary, Cont.

Lesson Six - Monte Carlo Simulation in Cost

- Coefficient of Correlation - R
- R values range from -1 to +1
- R (correlation) measures the degree of linear relationship
- If the relationship is non-linear, then it will not be properly represented by R
- If correlation between the cost drivers and the cost elements is not properly modeled, the Monte Carlo results will be less accurate
- Correlation Rule of Thumb: _
 - [Click here to see the Rule of Thumb table](#)
 - Causality - the cause-and-effect between two variables
 - The Monte Carlo Simulation is an alternative to Symmetric Approximation

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Correlation Rule of Thumb Table

Correlation Coefficient	Correlation Strength
$R = +1$	Perfect Positive Correlation (upward slope) Perfect
$+0.7 < R \leq +1.0$	Strong Positive
$+0.3 < R \leq +0.7$	Moderate Positive
$0 < R \leq +0.3$	Weak Positive
$R = 0$	None – Indicates statistical Independence No slope
$-0.3 \leq R < 0$	Weak Negative
$-0.7 \leq R < -0.3$	Moderate Negative
$-1.0 < R < -0.7$	Strong Negative
$R = -1$	Perfect Negative Correlation (downward slope) Perfect
Correlation Coefficient	Correlation Strength

Module Summary, Cont.

Lesson Six - Monte Carlo Simulation in Cost, Cont.

- Monte Carlo Steps:
 - **Step One:** Draw one observation from each input distribution
 - **Step Two:** Calculate total project cost with the set of input values
 - **Step Three:** Repeat Steps One and Two: 1,000 - 10,000 iterations is usually sufficient
 - **Step Four:** Final Result; A Cumulative Distribution
- Correlation is the simultaneous variation of attributes (cost elements)
 - If you have historical data, a pairwise correlation matrix is the best way to determine levels of linear relationships between variables
- Classic Monte Carlo simulation requires all cost elements to be statistically independent
- If your cost elements are highly correlated (positive or negative) contact an expert to properly model these correlations within the Monte Carlo model

Module Summary, Cont.

Lesson Seven – Good Risk Analysis

- Takes into account the Program Management Office's (PMO) identification and management of risk:
 - Risks are well understood by all involved
 - Measurements are developed and applied to control risks
- Takes into account cost estimating methodologies
- A good risk analysis examines Schedule Risk and Technical Risk
- Takes into account the Program Office Estimate (POE) measurement of environment cost
- A good risk analysis keeps communication open to all participants in its development throughout the life cycle of the acquisition

Module Completion

You have completed the content for this lesson.

At this point you should have completed all of the lessons in this module.

Please take the Module Exam and complete the Module Survey so you may receive credit for this course.

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