

# COST ESTIMATING—BACK TO BASICS

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Presented to: 2009 ISPA/SCEA  
Conference

Presented on: 2-4 June 2009

# COST ESTIMATING OVERVIEW

- Cost Estimating Definitions
- Presentation of a Model
- Process of Cost Estimate Development
- Role of Theory in Cost Estimating
- Economic Theory in Cost Estimating
- Uses of Cost Estimating Model
- Final Perspectives

# COST ESTIMATING DEFINED

- An analytical process for developing or assessing resource requirements to produce a specified output. Resources are then translated to cost. The process includes a statement or report of the assessment and related conclusions

# COST ESTIMATING ELEMENTS

- Cost Estimating is **NOT**:
  - Analysis of cost
  - Undisciplined
  - A black art
  - Mostly number crunching
- Cost Estimating **IS**:
  - Knowledge of program content (output), production processes, and resources (inputs)
  - A disciplined process
  - Significant use of thought, preferably logical

# THE MODEL

Inputs → Processes → Outputs

# ELEMENTS OF THE MODEL

- Outputs = Quantity, Quality, and Description of Item(s) Being Estimated
- Processes = Ways the Inputs are Mixed to Achieve Desired Output
- Inputs = Quantity, Quality, and Description of the Resources Needed to Accomplish the Desired Output

# ESTIMATING PROCESS

- Determine Output
- Identify Processes (How Resources Mix)
  - Work Flow Defined into Tasks
  - Value (Output) Added at Each Station
  - Output Qty per Input Qty Goals (efficiency) Desired at Each Station
  - Document the Processes

# ESTIMATING PROCESS Cont'd

- Estimate Resource Quantities Needed
  - By Function (i.e., Engr, Mfg, QA) for Labor
  - Material/Vendor Parts by quality and quantity
  - Capital resource needs (bldg, equip, tools)
  - Determine quality of resources (labor, parts/material, and capital)
  - Identify Resources as Fixed or Variable
- Dollarize Resources



# ESTIMATING PROCESS, Cont'd

- Document the Estimate
- Remember Your Audience
  - Get Feedback On the Estimate
  - Adjust the Estimate As Required
  - Translate to Executable Document (Budget, Price Estimate, Decision Brief)

# WHO DEFINES OUTPUT

- Customer in Terms of Measurable Desired Outcomes
- Technical Community in Terms of What it Takes to Get Desired Outcomes
- Technical Community Who Translates Desired Outcomes to Quality Levels
- Technical Community Who Provides Task Level Definitions

# WHO DEFINES PROCESSES

- Technical Community
- Government (ie.CAS, EVMS)
- Information Technology
  - Data Base Interface
  - Organizational Interface
  - Data Base Structure
- Management Through Decision-making and/or Organizational Structure

# WHO TRANSLATES TO \$

- Cost Estimator
- Accounting
- Price Analyst
- Cost/Price Estimating Automated System
- Automated Parametric Cost Model
- Management Through Feedback

# WHY IS WHO IMPORTANT?

- Defines Who is Responsible for Estimate
- Defines What Part Each Organization or Player Has in the Estimate
- Opportunity to Get the Right Players Involved and the Wrong Players Excluded
- Often Determines the Quality of the Cost Estimate (Variance of Accuracy)
- May Be Essential to Estimate “Buy-in”

# ESTIMATOR RESPONSIBILITIES

- Ensure the Process Is Followed Religiously
- Get the Right Players Involved When and Where They Belong
- Integrate Diverging Viewpoints Into a Cohesive Whole
- Ensure Strict Analytical Sterility and Integrity of the Finished Cost Estimate

# ROLE OF THEORY

# THEORY DEFINED

- Random House College Dictionary—A coherent group of general propositions used as principles of explanation for a class of phenomena
  - Theory deals with the **WHY** of the analytical process
  - Theory deals with the **HOW** of the analytical process



# WHY USE THEORY

- To conduct an analysis one must have expectations as a baseline to measure what actually happened
- Theory provides the expectations baseline
  - Processes and data relationships
  - Type, quality and quantity of output
  - Sequence of events
  - Anticipated results

# TEXTBOOK THEORY

- Comes from education—explains ***what, why, how***
- Does ***NOT*** occur in training—explains only “mechanics of doing”
- Takes research to acquire, learn, apply
- Necessitates study for comprehension
- Requires some judgment in application

# HOW TO USE THEORY

- Establish a baseline of expectations
- Measure variance explanations against this baseline of expectations
- Accept/reject variance explanations based on theory
- Develop relationships of data/information using theory
- Reject theory only rarely (hardly ever)

# MISUSE OF THEORY

- Apply wrong theory in a given situation
- Misname theory for training or program realities (exclude why and/or what)
- Determine expectations after explanations or actual occurrence
- Lack faith in “real world” use of theory
- Fail to use theory at all

# ECONOMIC THEORY APPLICATIONS IN COST ESTIMATING

# ECON THEORY #1

- Goal Incompatibility
  - Maximize Profits
  - Maximize Sales
  - Minimize Cost
- Government Goal: Minimize Cost
- Contractor Goal: Maximize Profits or Sales
- Quantity, Revenue, and Costs Usually Different for Each Goal

# ECONOMIC GOAL PARAMETERS

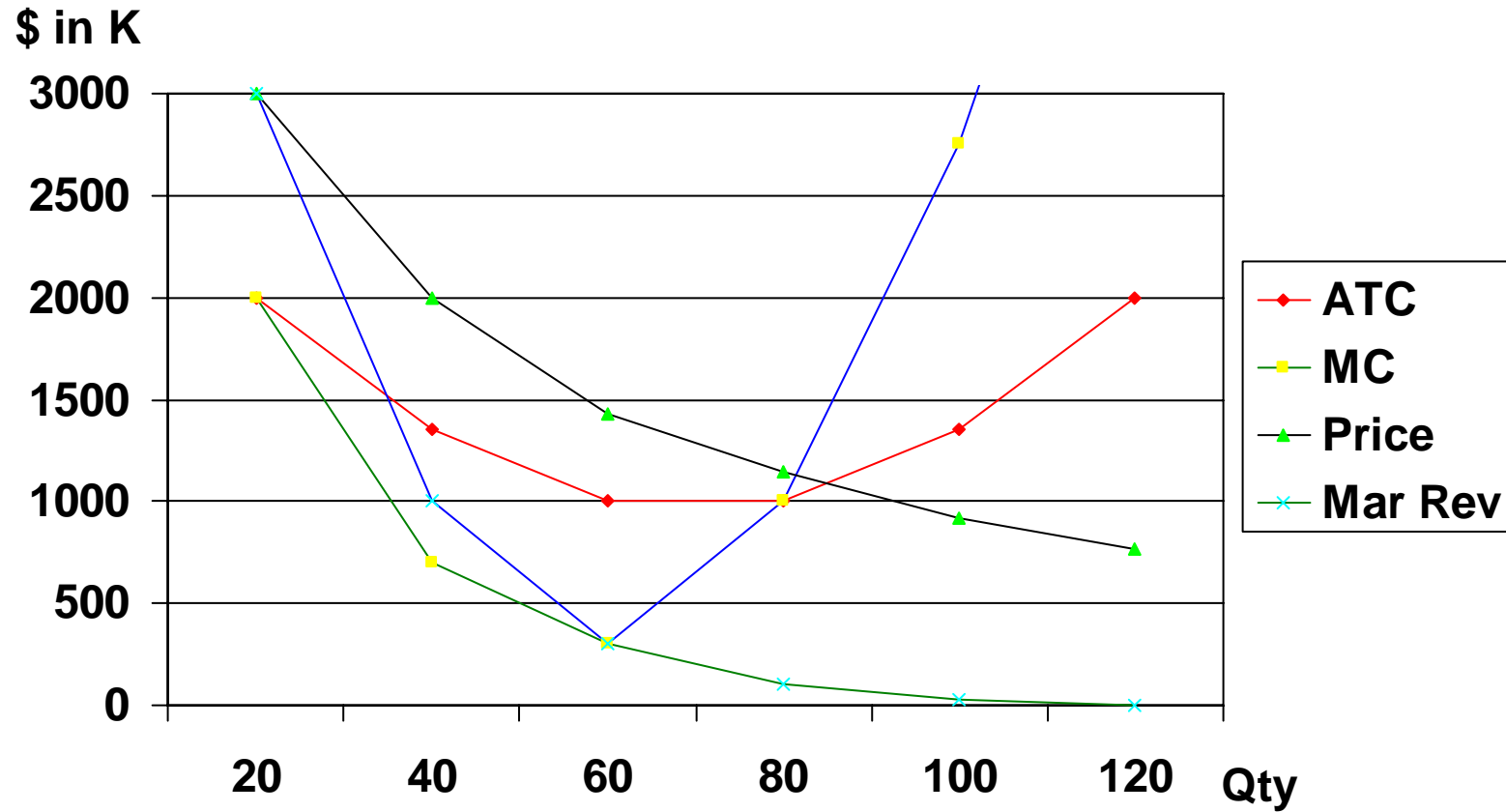
- Maximize Profits: Production Qty where:
  - Marginal Revenue = Marginal Cost and
  - Marginal Cost is Increasing
- Maximize Sales: Production Qty where:
  - Marginal Revenue = 0
- Minimize Cost: Production Qty where:
  - Marginal Cost = Average Total Cost and
  - Marginal Cost is Increasing

# Economic Theory #2

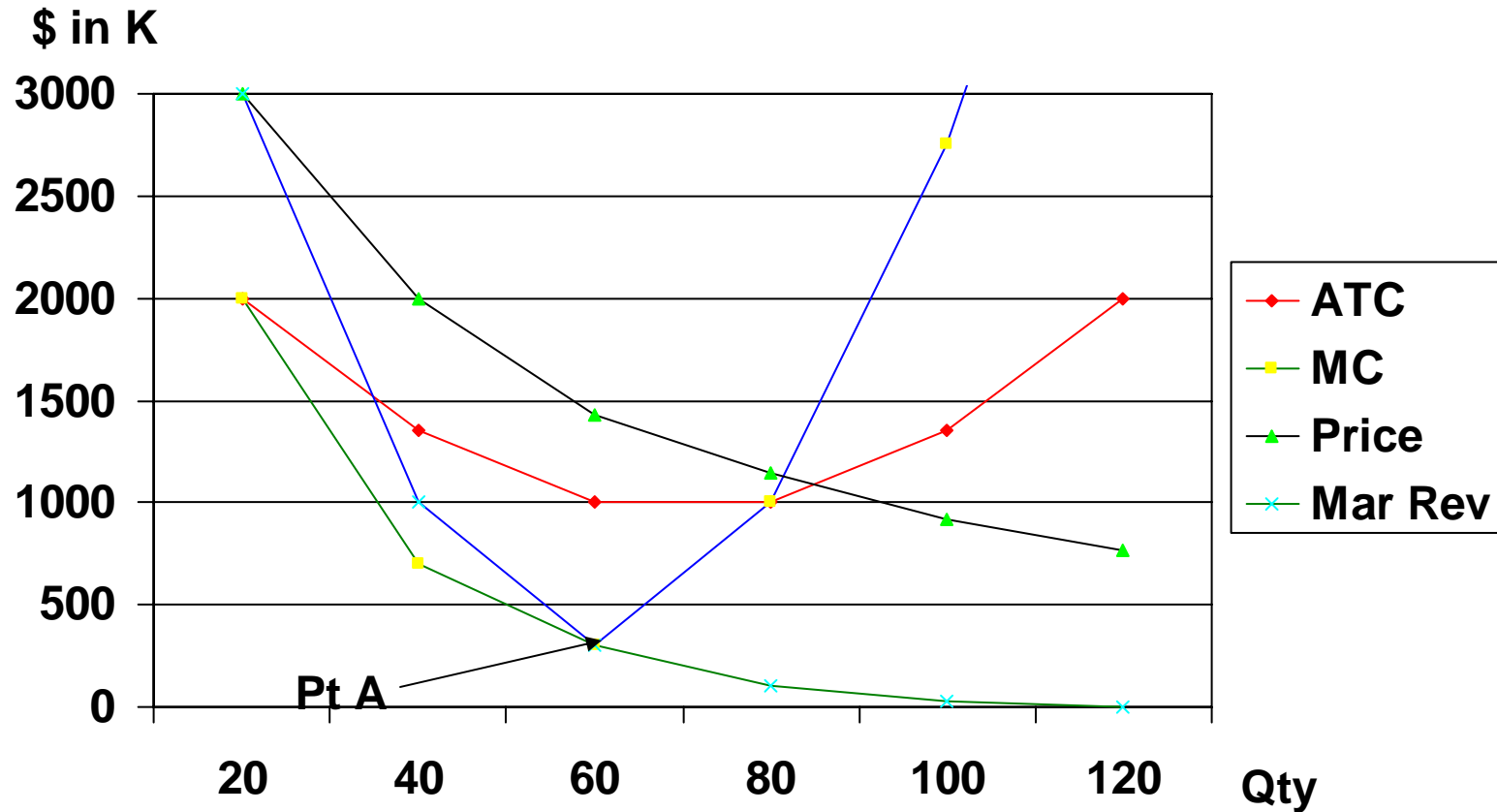
- Shape of Unit Cost Curves are:
  - A: Non-linear
  - B: U-shaped in Nature
- 3 Cost Curves for Economists
  - Average Fixed: Downward Slope with Spikes
  - Average Variable: U-Shaped as Qty Varies
  - Average Total: U-shaped as Qty Varies



# PRODUCTION OPTIONS



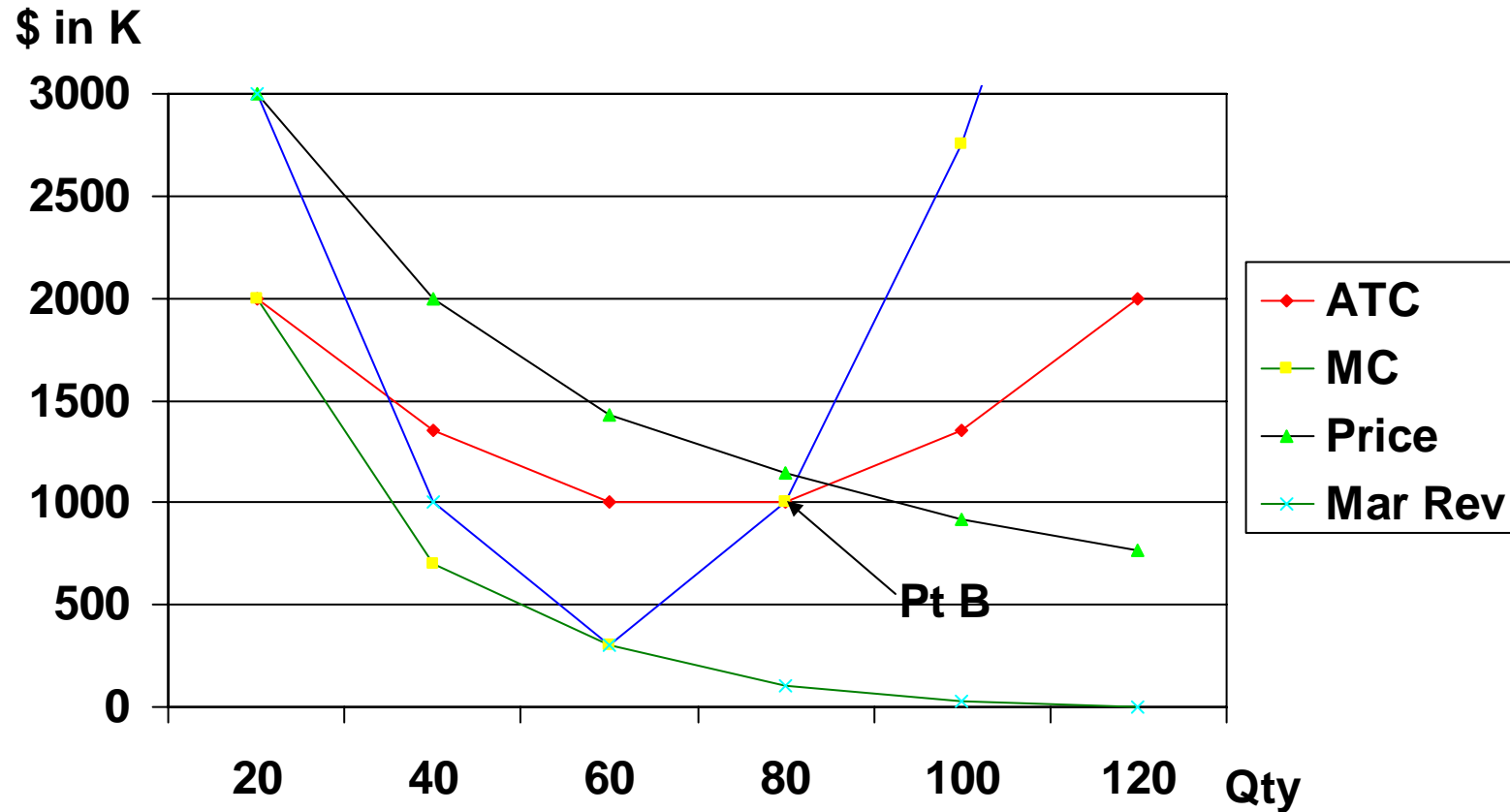
# MAXIMIZE PROFITS



# MAXIMIZE PROFITS RESULTS

- Total Revenue = Price X Qty
  - Maximize Profits Qty = 60
  - Total Revenue = \$1433K X 60 = \$85,980K
- Total Cost = Aver Total Cost X Qty
  - Total Cost = \$1000K X 60 = \$60,000K
- Profit = Total Revenue – Total Cost
  - \$85,980K - \$60,000K = \$25,980K (Profit)

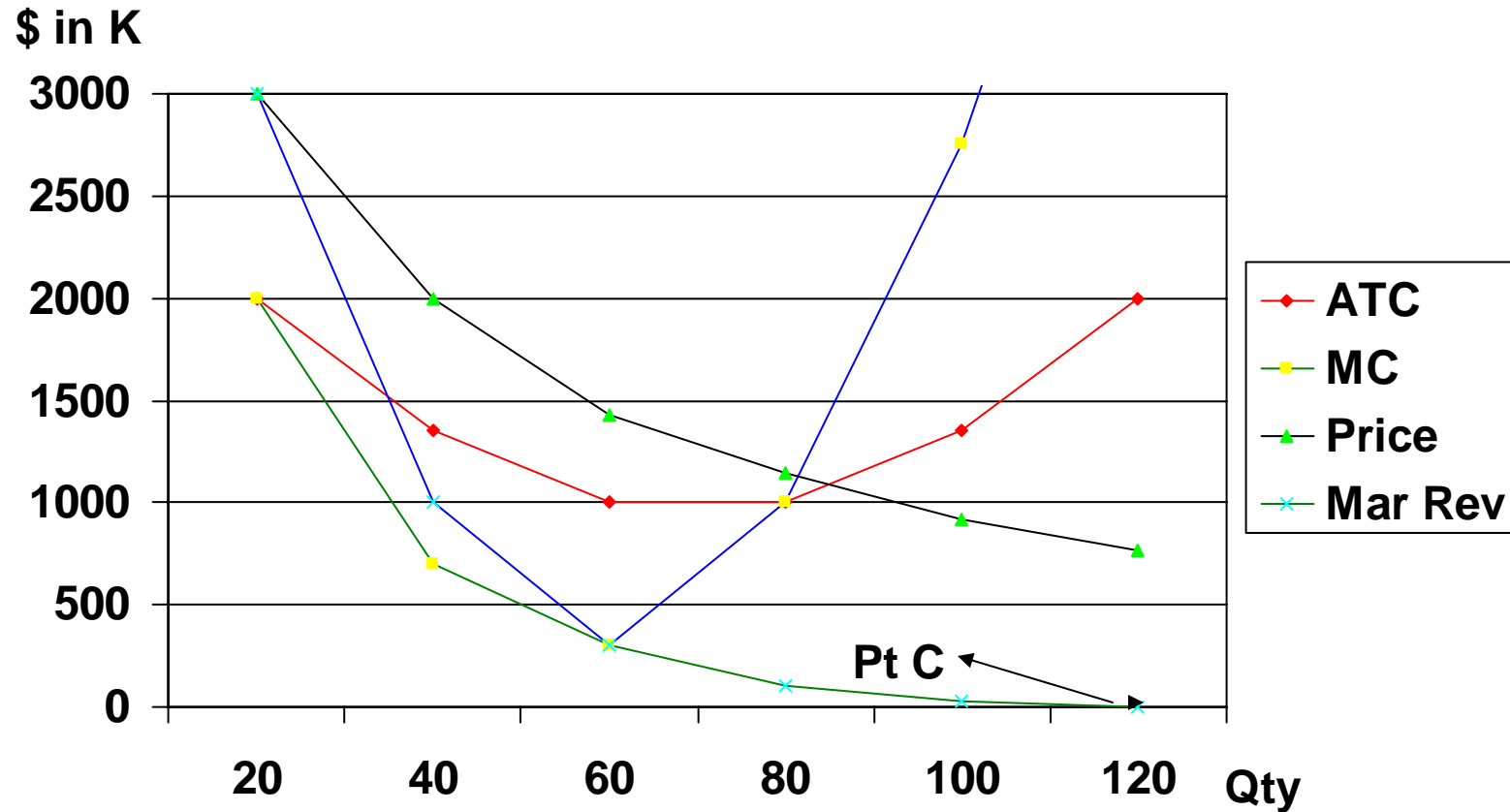
# MINIMIZE COST



# MINIMIZE COST RESULTS

- Total Revenue = Price X Qty
  - Minimize Cost Qty = 80
  - Total Revenue = \$1142.5K X 80 = \$91,400K
- Total Cost = Aver Total Cost X Qty
  - Total Cost = \$1000K X 80 = \$80,000K
- Profit = Total Revenue – Total Cost
  - \$91,400K - \$80,000K = \$21,400K (Profit)

# MAXIMIZE REVENUE



# MAXIMIZE REVENUE RESULTS

- Total Revenue = Price X Qty
  - Maximize Revenue Qty = 120
  - Total Revenue = \$767K X 120 = \$92,040K
- Total Cost = Aver Total Cost X Qty
  - Total Cost = \$2000K X 120 = \$240,000K
- Profit = Total Revenue – Total Cost
  - \$92,040K - \$240,000K = -\$147,960K (Loss)

# CONCLUSIONS ABOUT GOALS

- Maximize Sales Goal Rarely Good for Contractor and Ultimately Government Due to Probable Losses (Cost Overruns) Generated
- Presentation of a Model
- Process of Cost Estimate Development



# USES OF COST MODEL

- As Baseline for Future Analysis
  - Resources and Dollars Become EVMS BCWS
  - Variance Analyses Become Relevant to Expectations
- Adjustable for Future Cost Estimate Updates
  - Modify Output to Reality (Known Entities)
  - Modify Processes to Reality
  - Modify Resources to Reality
- As Assessment of Risk Mitigation Success or Failure

# VALUE OF EVMS TO COST ESTIMATING

- EVMS Baseline Comparison to Cost Estimate (Negotiated Price) During IBR is Critical
  - Variations Need to Be Identified and Justified
- EVMS Variance Analyses Identify Reasons for Output, Resource, Process and Rate Changes
- EVMS EAC Should Become Basis for Updated Cost Estimate

# MODEL AS AN ANALYSIS TOOL

- You must have Expectations
  - Cost Estimate Documents
  - EVMS Baseline Documents
- Measure output for reality
  - Quality (Getting What Expected)
  - Quantity (Both Amount Expected and When Scheduled)
- Search for Inconsistencies with Expectations
- Resolve inconsistencies (in this order)
  - Change Output Quality and Quantity Goals
  - Change Resource Mix and/or Processes
  - Change Theory—If and Only If Misapplied

# COST ESTIMATING PERSPECTIVES

- Education is Absolutely Essential
  - Where You Learn Theory
  - Basis for Accurate Analytical Conclusions
- Build Models Around Theory—Not Data
  - Only Theory Provides Relationships Among Output, Resources, and Processes
  - Violate Theory At Grave Risk of Severely Wrong Dollar Estimate Conclusions
- Cost Estimating is a Team Sport
  - Cost Estimator is **NOT** Abel to Know All
  - Cost Estimator Cannot **DO** All

# PERSPECTIVES—PAGE 2

- REMEMBER: Every Cost Estimate Is, By Its Very Nature of Prediction—**WRONG.**
- The Real Questions Are:
  - How Wrong Is It?
  - Is it Wrong In the Right Direction? (Too High versus Too Low)
  - Has it Been Translated Into the Budget Cycle?