

**31<sup>st</sup> Annual International Test and  
Evaluation Symposium:  
T&E to Achieve Better Buying Power  
6-9 October 2014**

**APPLIED COST ANALYSIS IN  
TEST AND EVALUATION (T&E)**

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# Theme: T&E to Achieve Better Buying Power



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# Applied Cost Analysis in Test and Evaluation

- This presentation demonstrates how the application of cost estimating and analysis varies in Program Management and T&E Events. The intent is to help bridge the gap between cost estimating requirements and skills needed at the Program Management Event and T&E Event levels.



# The One Thing to Take Away

## Think Through Implementation:

*Please consider concepts, taxonomy, policy, instructions, examples etc. to fill the gap between **Program Management Key Event** and **T&E Events**.*

## Ask:

How will this (i.e., concept, policy, requirement) work/show up on the ground/in the field level/at the project level/in a T&E event?



# Achieve Dominant Capabilities While Controlling Lifecycle Costs (BBP 3.0)

- Strengthen and expand “should cost” based cost management
- Build stronger partnerships between the acquisition, requirements, and intelligence communities
- Anticipate and plan for responsive and emerging threats
- Institutionalize stronger DoD level Long Range R&D Planning



# Applied Cost Analysis in T&E

## Program Management Events and T&E Events

Should cost is sprinkled throughout the 5000.2 Interim Guidance—to create a cost culture.

At the T&E Event level, test officers, engineers and budget analysts, contracting officers use varied costing methods to respond to PM and/or cost requests.



# 5000.2 Interim Guidance 2013

- Core Instruction
- 13 Enclosures
- ALL Enclosures have been Revised...
  - New Enclosures are highlighted in **bold red italics**
  - Old Enclosures with Major Revisions are highlighted in **bold blue** (some have different titles than the 2008 version)
- 150 Pages

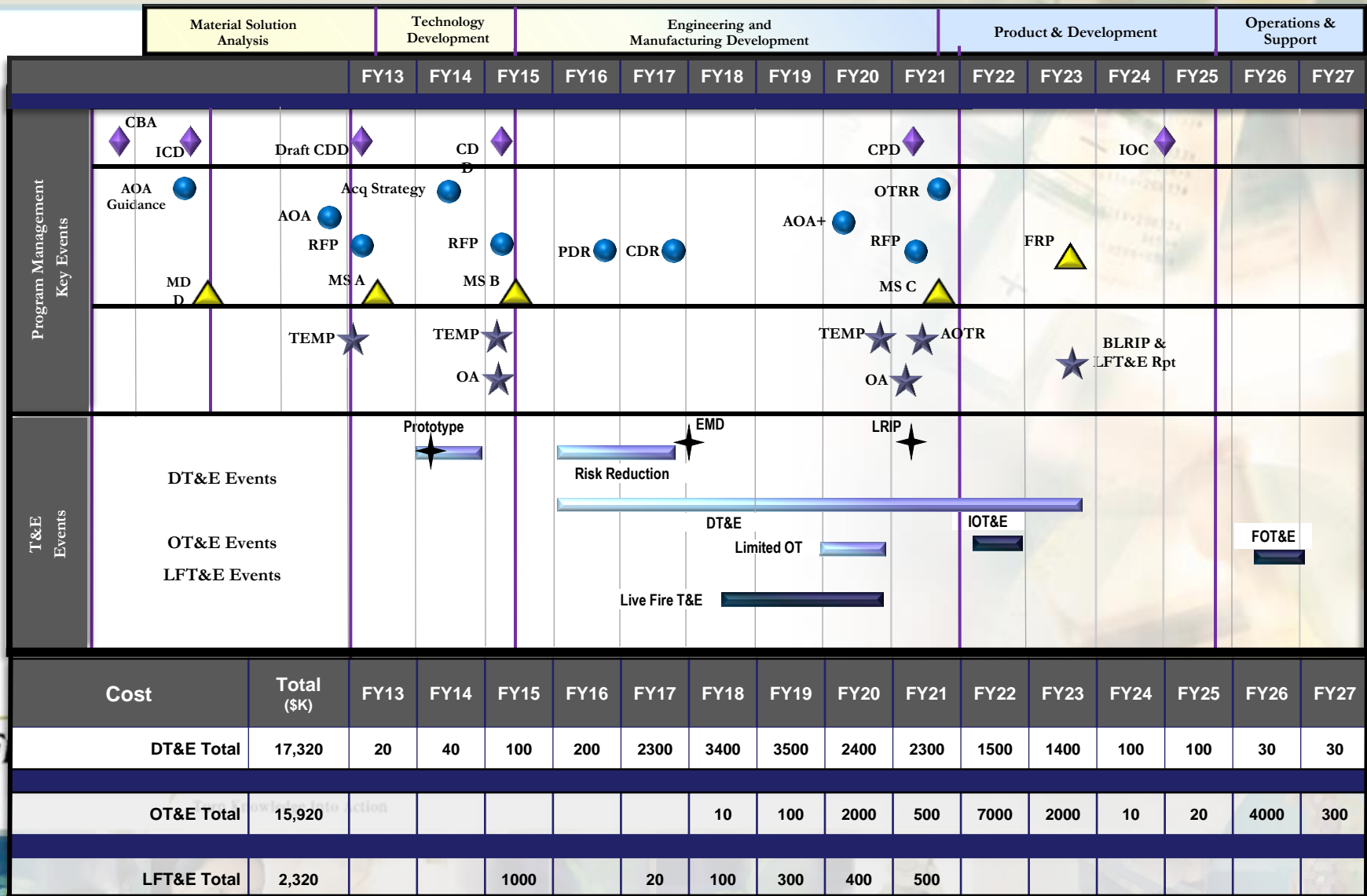
## Core Instruction - Operation of the Defense Acquisition System

### Enclosures

1. Acquisition Program Categories and Compliance Requirements
2. Program Management
3. Systems Engineering
4. *Developmental Test and Evaluation (DT&E)*
5. Operational and Live Fire Test and Evaluation
6. *Life-Cycle Sustainment Planning*
7. Human Systems Integration (HSI)
8. *Affordability Analysis and Investment Constraints*
9. *Analysis of Alternatives*
10. Cost Estimating and Reporting
11. Requirements Applicable to All Programs Containing Information Technology (IT)
12. Defense Business Systems (DBS)
13. *Rapid Acquisition of Urgent Needs*



# Cost Analysis in Test and Evaluation





# Level II T&E Functional Required Courses

As of **1 October 2014** the requirement includes continuous learning modules:

- [CLE 035](#) Introduction to Probability and Statistics
- [CLM 013](#) Work-Breakdown Structure
- [CLM 016](#) Cost Estimating



# Level II T&E Education Requirements

As of **1 October 2014** the requirement includes:

Baccalaureate degree of higher (any field of study)

**A total of 24 semester hours or equivalent in technical or scientific courses such as mathematics (e.g., calculus, probability, statistics), physical sciences (e.g., chemistry, biology, physics), psychology, operations research/systems analysis, engineering, computer science, and information technology.**



# Level III T&E Functional Required Courses

As of **1 October 2014** the requirement includes continuous learning modules:

[CLB 008](#) Program Execution

[CLV 016](#) Introduction to Earned Value Management



# Analytics is defined as the scientific process of transforming data into insight for making better decisions<sup>1</sup>.

WHAT HAPPENED?	WHAT'S HAPPENING?	WHAT WILL HAPPEN?
Univariate Analysis	Bivariate Analysis	Multivariate Analysis
Descriptive Statistics and Inferential Statistics	Correlation Linear Regression Descriptive Statistics and Inferential Statistics	(Predictive Analytics) Multiple Regression Descriptive Statistics and Inferential Statistics
<p>Ex: Why was <u>one ship</u> having a high number of maintenance actions with <u>one source code</u>?</p> <p><i>Consideration: Once you add categorical variable, you really have shifted to bi-variable.</i></p>	<p>Ex: Within a ship class (same ship design), why is one ship having parts issue <u>associated</u> with one source code higher than other ships in the same class?</p>	<p>Ex: Which equipment <u>will lead</u> to customer engineering solution?</p>



# What is Cost Analysis?

Cost analysis, used to develop cost estimates for such things as hardware systems, automated information systems, civil projects, manpower, and training, can be defined as

- the effort to develop, analyze, and document cost estimates with analytical approaches and techniques;
- the process of analyzing, interpreting, and estimating the incremental and total resources required to support past, present, and future systems—an integral step in selecting alternatives; and
- a tool for evaluating resource requirements at key milestones and decision points in the acquisition process.



# What is Cost Estimating?

- Cost estimating involves collecting and analyzing historical data and applying quantitative models, techniques, tools, and databases to predict a program's future cost. More simply, cost estimating combines science and art to predict the future cost of something based on known historical data that are adjusted to reflect new materials, technology, software languages, and development teams.
- Use/combine concepts from such accounting, budgeting, computer science, economics, engineering, mathematics, and statistics and should even employ concepts from marketing and public affairs.



# GAO Cost Estimating and Assessment Guide Overview<sup>1</sup>

## Initiation and research

Your audience, what you are estimating, and why you are estimating it are of the utmost importance

## Assessment

Cost assessment steps are iterative and can be accomplished in varying order or concurrently

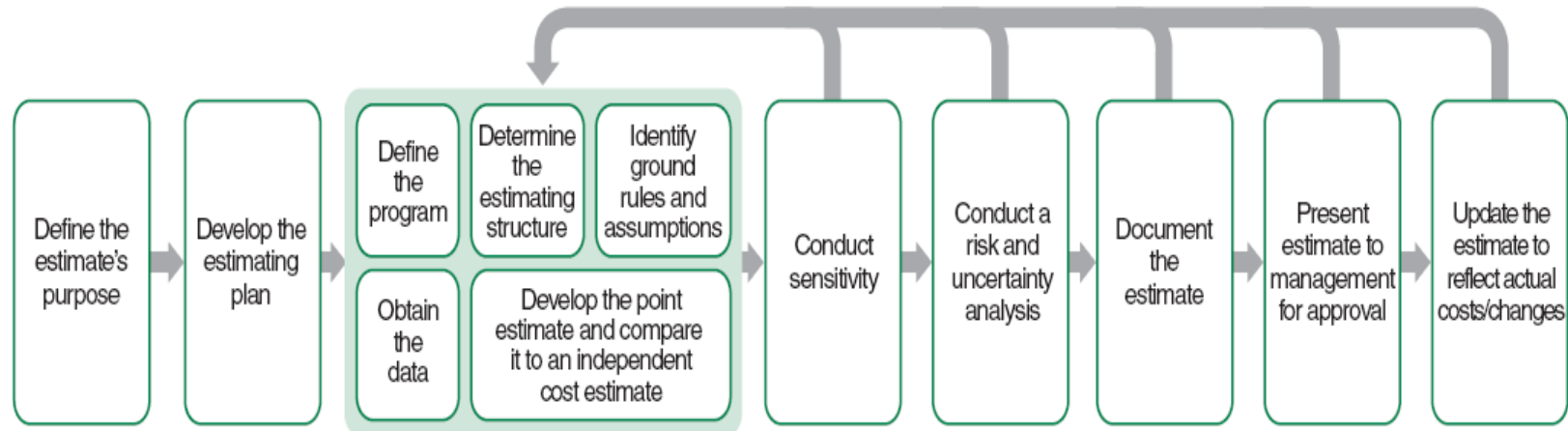
## Analysis

The confidence in the point or range of the estimate is crucial to the decision maker

## Presentation

Documentation and presentation make or break a cost estimating decision outcome

Analysis, presentation, and updating the estimate steps can lead to repeating previous assessment steps



Source: GAO.

# Cost Estimating Process

1. **Definition and Planning (Requirements)**
2. **Data Collection/Analysis/Normalization**
3. **Estimate Formulation**
4. **Risk Analysis**
5. **Final Documentation/Presentation**





# GAO Guide Step 5: Identify Ground Rules & Assumptions

## Ground Rules & Assumptions (GR&As) Introduction<sup>1</sup>

- Because cost estimates are based on limited information, they are bound by various constraints or assumptions
- **Ground Rules**
  - Global ground rules represent a common set of agreed-upon estimating standards that provide guidance and minimize conflicts in definitions
  - Technical baseline requirements represent ground rules
  - Each program has its own set of ground rules
- **Assumptions**
  - Element-specific assumptions are made in the absence of firm ground rules
    - **They represent judgments about past, present or future conditions**
    - **To avoid optimistic assumptions, judgments should be sought from experienced technical staff and vetted through multiple perspectives**
    - **All assumptions should document the associated rationale, historical data, and consequences if the assumption fails to hold**
  - Assumptions must clearly identify any factors that impact a program's cost, schedule or technical status
    - **Well-supported assumptions include documentation on sources, weaknesses, and/or risks**
    - **Solid assumptions are measureable, specific and validated by historical data**

# GAO Guide Step 2: Develop the Estimating Plan

## Cost Estimating Plan Best Practices<sup>1</sup>

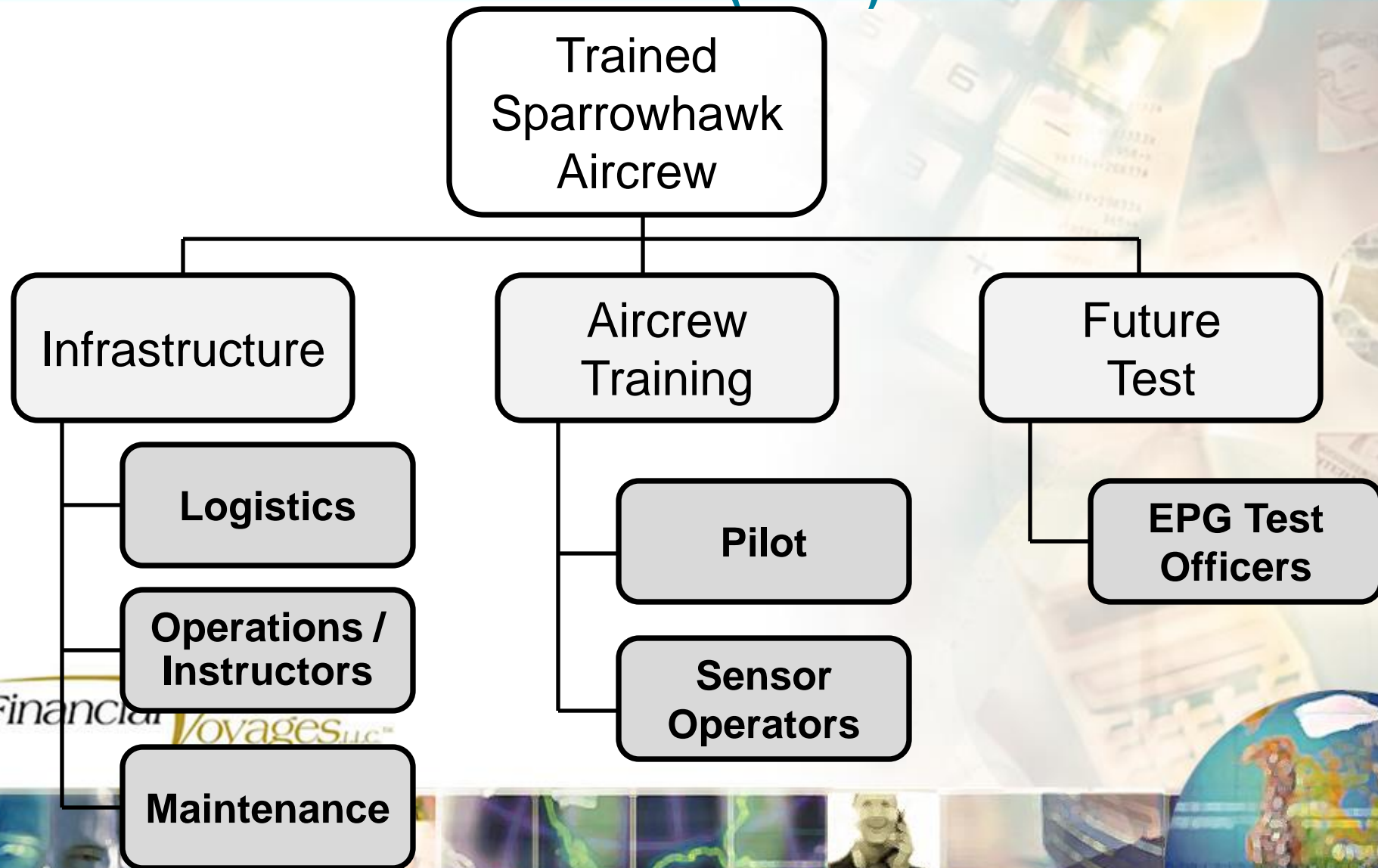
- The estimating team's composition is commensurate with the assignment
- The team has the proper number and mix of resources
- Team members are from a centralized cost estimating organization
- The team includes experienced and trained cost analysts in the program's major technical areas
- Team members' responsibilities are clearly defined
- Team members' experience, qualifications, certifications, and training are identified
- A master schedule with a written study plan has been developed
- The team has adequate time to collect data for, create, and update the cost estimate *(developing an LCCE from scratch typically takes up to 6 months from the time a firm program baseline has been established)*
- The team has access to the necessary subject matter experts

# GAO Guide Step 3: Define the Program Cost Estimating Baseline Document (CEBD) Introduction<sup>1</sup>

- The purpose of this step is to identify and summarize the program's purpose, its system and performance characteristics, and all system configurations in a technical baseline description document
- At DHS, the technical baseline description document is referred to as the **Cost Estimating Baseline Document or CEBD**
- The CEBD provides in a single document a common definition of the program
  - Includes a detailed technical, program and schedule description of the system
  - From this description, all LCCEs are derived (i.e. program and independent cost estimates)
- The CEBD should provide sufficient detail to enable a credible cost estimate
  - The amount of information gathered for the CEBD directly affects the overall quality of the estimate
  - Less information means more assumptions must be made, which increases risk associated with the estimate
- **Program Offices are responsible for developing and maintaining the technical baseline**

# Sparrowhawk Training Program (Example Only)

## Work Breakdown Structure (WBS)



# Sparrowhawk Training Program Assumptions (Example Only)

- **Assigned Instructors (Officers and Enlisted) 3 year rotation (PCS costs/2 sets)**
- **3 - EPG Test Officers per training session / 1 Pilot Training (GS-13), 2 Sensor Operator training (GS-12)**
  - EPG TO will not receive flight training (6 annually)
  - EPG TO will receive simulator training (6 annually)
- **6 classes per year – 3 day recovery between sessions**
- **Food & Lodging will be commercially provided**
- **Sensor operators do not fly – no flight or simulator time**
- **Students keep courseware upon graduation**
- **24 pilot and 24 sensor operators trained per year**
- **No cars for trainees (Luke AFB Garrison covers local transport - \$25K annual LCC cost not program cost)**
- **BY08 funded fully and program concludes in FY13**

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# Bottom Line Presentation (*Example Only*)

Six year Total: \$16.424M

BY08	FY09	FY10	FY11	FY12	FY13
\$2.6M	\$2.672M	\$2.711M	\$2.764M	\$2.811M	\$2.854M

Then year weighted inflation calculated using rates from:

<http://www.asafm.army.mil/offices/office.aspx?officecode=1400>

The FY 15 Joint Inflation Calculator. Used the DOD inflations since it is a Air Force Test.



# Cost Estimating Techniques (*Example Only*)

- **Best Business Practices**
  - Historical Data
  - Analogy
- **Subject Matter Expertise**
  - Expert Opinion
  - Consensus



# Ground Rules (*Example Only*)

- Six classes each year for 8 weeks with 4 pilots and 4 sensor operators (24 each per year)
- Six year estimate required
- Two UAVs
- EPG Test Officers (TO) get course work and simulator time, but not flight time.
- Training schedule eight hour days, five days a week





# Assumptions Continued 1:

- Test officer would use a GSA vehicle instead of a rental car to travel to Luke AFB.
- Cost of GSA is \$260 a month and \$0.18/miles
- Used Google Maps to find that miles from SV to Luke AFB is 210, 420 round trip.
- Assume all civilian Test officers
- Assumption that cost to be included for PCS is per permanent staff member per year



# Assumptions Continued 2:

- Test officers are observing one class per year
- Test officers are local to EPG Ft Huachuca and travelling to Luke AFB
- We assume class is 8 weeks and will not be extended if the 8 weeks does not contain 40 days
- Assume block leave for Christmas and Fourth of July
- Assume all civilian Test officers
- Assumption that cost to be included for PCS is per permanent staff member per year



# WBS Top level (

- 1.0 EPG Test Officer
- 2.0 Fixed Costs
- 3.0 Aircraft Costs
- 4.0 Student Costs



# WBS 1.0 EPG Test Officers

1.1 – Three TOs one course per year

1.2 – Simulator

1.3- Course Work

1.4 - TDY

1.4.1 – per diem

1.4.2 – GSA

1.4.3 – Mileage

1.4.4 – Non mileage



# WBS 2.0 Fixed Costs

2.1 Training Facility

2.2 PCS Costs Two officers and four enlisted

2.3 Salaries Two O4s, Two E6s, Two E5s



# WBS 3.0 Aircraft Costs

- 3.1 Contractor Logistic Support
- 3.2 Petroleum Oil and Lubricants
- 3.3 Consumables
- 3.4 Repairable

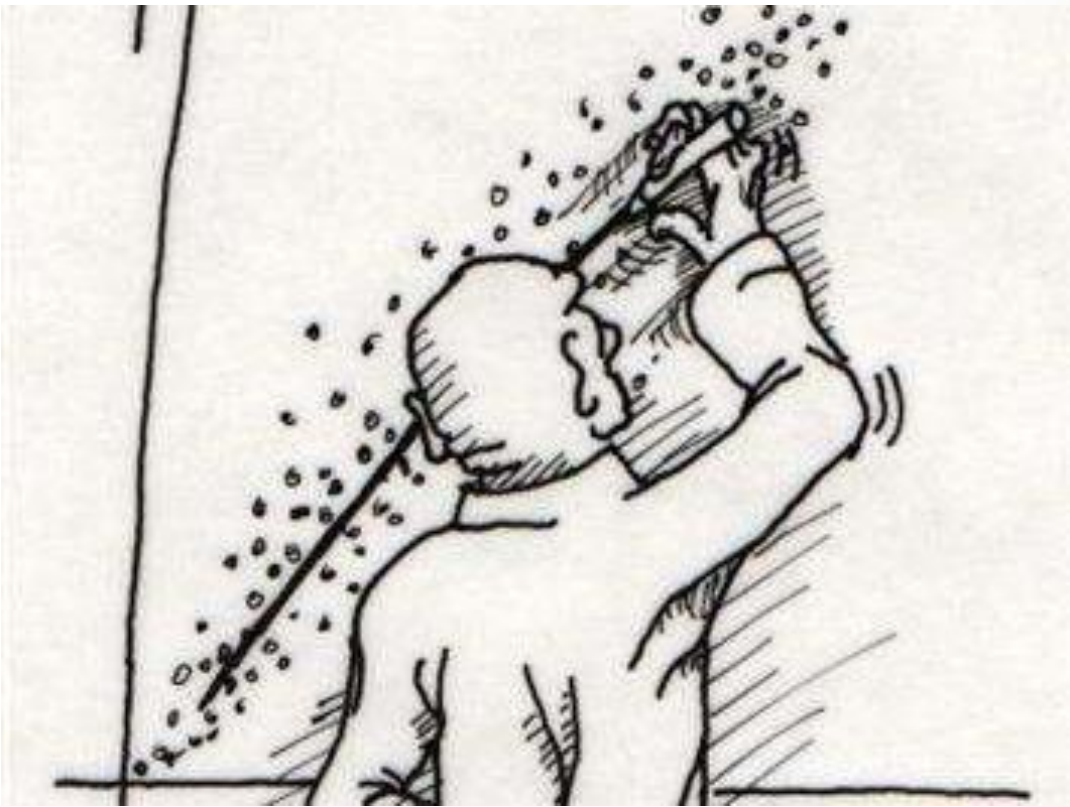


# WBS 4.0 Student Cost

- 4.1 TDY
- 4.2 Courseware
- 4.3 Simulator
- 4.4 Student Salary



# Cost Estimating Relationships (CERS)



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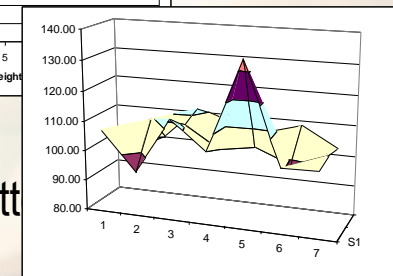
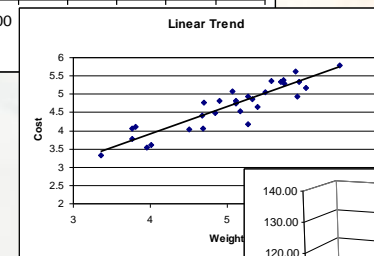
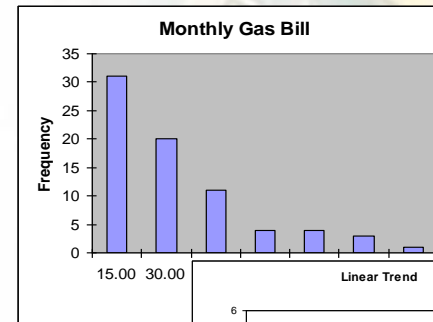




# GAO Guide Step 6: Obtain the Data

## Data Analysis Overview<sup>1</sup>

- **Data analysis** is the first analytical step taken after obtaining and normalizing a set of data
- Types of data:
  - **Univariate:** single variable, such as cost data for a single element
  - **Bivariate:** one independent variable and one dependent variable (i.e.  $y$  is a function of  $x$ )
  - **Time Series:** generally a bivariate data set with time as the independent variable
  - **Multivariate:** several independent variables and one dependent variable (i.e.,  $y$  is a function of  $x_1$ ,  $x_2$  and  $x_3$ )
- Regardless of data type, graphical displays of the data (e.g., histograms, scatter plots) should be used to visualize the data
- Additionally, descriptive and inferential statistics should be calculated



# GAO Guide Step 11: Present Estimate to Management

## Example LCCE Presentation to Management Outline

1. Purpose and Scope of the Cost Estimate
2. Program Team Composition & Cost Team Composition
3. Program Overview
  - a) Quad Chart: Program, Project Summary, Milestones and Capability Gaps
  - b) System Description
  - c) Program Schedule
4. Life Cycle Cost Estimate Status
5. Cost Estimating Approach and Results
  - a) Ground Rules and Assumptions (GR&A)
  - b) Estimating Methodology
  - c) Life Cycle Cost Estimate [Point Estimate and Risk-Adjusted Estimate]
6. Annual Costs and Budget
7. Affordability
8. Identification and Analysis of High Dollar Cost Items
9. Cost-Related Risks
10. Cost-Related Issues



# Summary Point for Applied Cost Analysis in T&E

1. Collaborated Requirements / Baseline
2. Ground Rules and Assumptions (GR&A)
3. Work Breakdown Structure
4. Cost Estimate Relationships (CERS)
5. Presentation Skills



# For More Information...

Financial Voyages LLC is a DAU Certified Equivalent Education Provider offering DAWIA Certification Courses.

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