



*STAT T&E COE: Scientia Prudentia et Valor*

# Demand Signals for T&E Education and Training

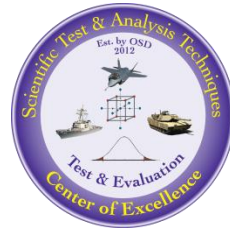
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Director

Scientific Test and Evaluation Techniques  
Center of Excellence



# Disclaimer



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The views expressed in this presentation are those of the speaker and do not reflect the official policy or position of the US Air Force or the Department of Defense.



# Training vs Education

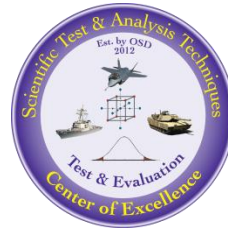


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- ‘Know How’ verses ‘Know Why’
- Training is undertaken in the hopes of gaining a specific skill.
- Education is undertaken in the hopes of gaining knowledge that, in our case, can then be applied.
- Training has its roots in the guild system while education’s origins lie in universities.
- Within T&E there is a need for BOTH!



# DAWIA T&E Requirements

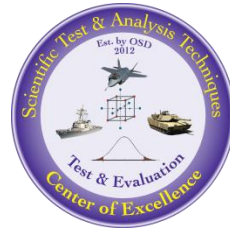


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Type		Requirements
Acquisition Training		DAU courses
Functional Training		DAU courses
Education		Associates Degree; 24 semester hours in technical or scientific courses; BS or MS in technical or scientific field for levels I,II, and III, respectively
Experience		1 year T&E; 2 years T&E; 4 years T&E experience for levels I,II, and III, respectively



# Types and Providers of Education and Training for T&E Professionals

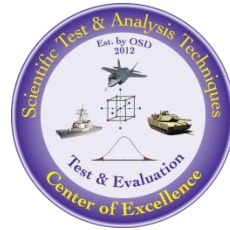


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Type		Provider
Acquisition Training		DAU
Functional Training		DAU, ITEA certification, contractors, others
Education		Universities, others
Experience		????



# Assessment of Training



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- Test professionals plan, perform, and manage T&E tasks in support of acquisition.
- What do we do well?
- What don't we do well?



# Better Buying Power 3.0 DRAFT

## Achieving Dominant Capabilities through Technical Excellence and Innovation

### Achieve Affordable Programs

- Continue to set and enforce affordability caps

### Achieve Dominant Capabilities While Controlling Lifecycle Costs

- 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

### Incentivize Productivity in Industry and Government

- Align profitability more tightly with Department goals
- Employ appropriate contract types, but increase the use of incentive type contracts
- Expand the superior supplier incentive program across DoD
- Increase effective use of Performance-Based Logistics
- Remove barriers to commercial technology utilization
- Improve the return on investment in DoD laboratories
- Increase the productivity of IRAD and CR&D

### Incentivize Innovation in Industry and Government

- Increase the use of prototyping and experimentation
- Emphasize technology insertion and refresh in program planning
- Use Modular Open Systems Architecture to stimulate innovation
- Increase the return on Small Business Innovation Research (SBIR)
- Provide draft technical requirements to industry early and involve industry in funded concept definition to support requirements definition
- Provide clear "best value" definitions so industry can propose and DoD can choose wisely

### Eliminate Unproductive Processes and Bureaucracy

- Emphasize Acquisition Executive, Program Executive Officer and Program Manager responsibility, authority, and accountability
- Reduce cycle times while ensuring sound investments
- Streamline documentation requirements and staff reviews

### Promote Effective Competition

- Create and maintain competitive environments
- Improve technology search and outreach in global markets

### Improve Tradecraft in Acquisition of Services

- Increase small business participation, including more effective use of market research
- Strengthen contract management outside the normal acquisition chain
- Improve requirements definition
- Improve the effectiveness and productivity of contracted engineering and technical services

### Improve the Professionalism of the Total Acquisition Workforce

- Establish higher standards for key leadership positions
- Establish stronger professional qualification requirements for all acquisition specialties
- Strengthen organic engineering capabilities
- Ensure the DoD leadership for development programs is technically qualified to manage R&D activities
- Improve our leaders' ability to understand and mitigate technical risk
- Increase DoD support for Science, Technology, Engineering and Mathematics (STEM) education

**Continue Strengthening Our Culture of:  
Cost Consciousness, Professionalism, and Technical Excellence**





# Contemporary Sources of T&E Training and Education Demands



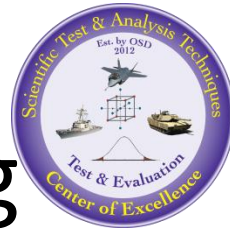
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- 1998- Nat'l Research Council "Statistics, Testing, & Defense Acquisition" cites **need for state-of-the-art** methods
- 2009- Weapon Sys Acq Reform Act: **Establish DASD(DT&E)** office
- 2009- Service Op Test Agencies **memo to employ Design of Exp'ts**
- 2010- DOT&E memo **advocates for use** of Design of Experiments
- 2011-Memo from OSD/AT&L amplifies 5000.02 reliability requirements **to include reliability growth and reporting measures for all major acquisitions.**
- 2012- DASD(DT&E) STAT Plan signed by component T&E executives
- 2012- DOT&E TEMP Guidebook Callouts memo for information assurance, design of experiments and reliability growth.
- 2013- DOT&E Best Practices memo **details statistical methods**
- 2013- **USD(AT&L)** ITEA article states **need to "bring the data"**
- 2013- Interim 5000.02 **"The PM will... use scientific test and analysis techniques..."**





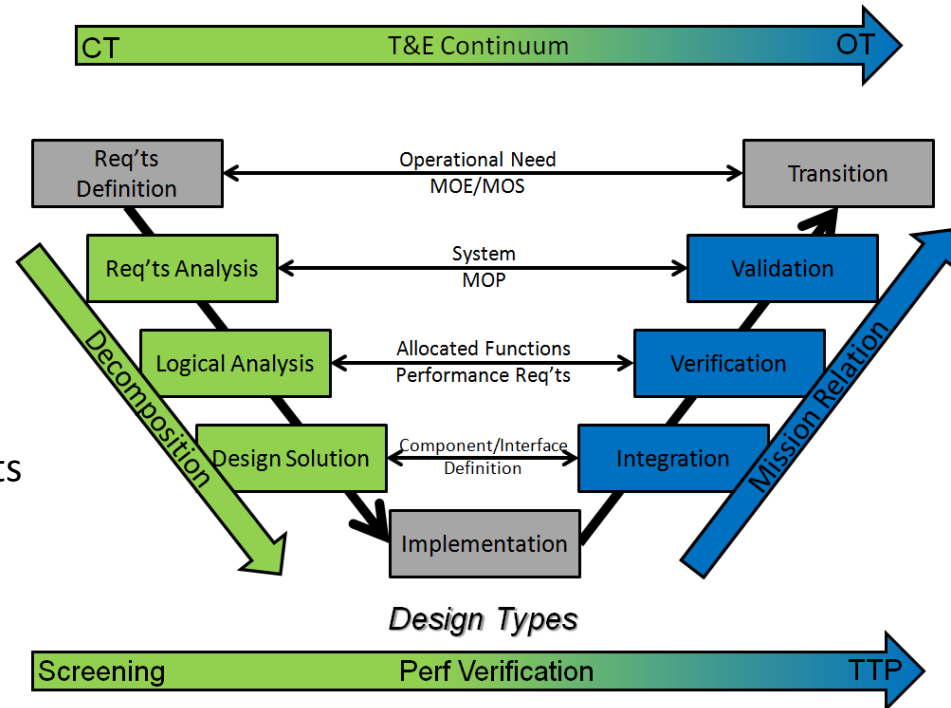
# Decomposition and Mission Relation for Test Planning



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## Process Principles

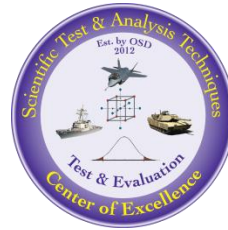
- Decompose **system components**
  - Defines low level testable elements
  - Screen factors early in DT
  - Develop models in DT (not just point check)
- Decompose **mission segments**
  - Assign mission-related (derived) requirements
  - Include significant DT factors
- Tailor test space for OT
  - Critical operational regions or DT risk areas
  - OT events can verify DT model predictions



**Decomposition** helps define DT scope and allows assignment of **mission related requirements** for OT



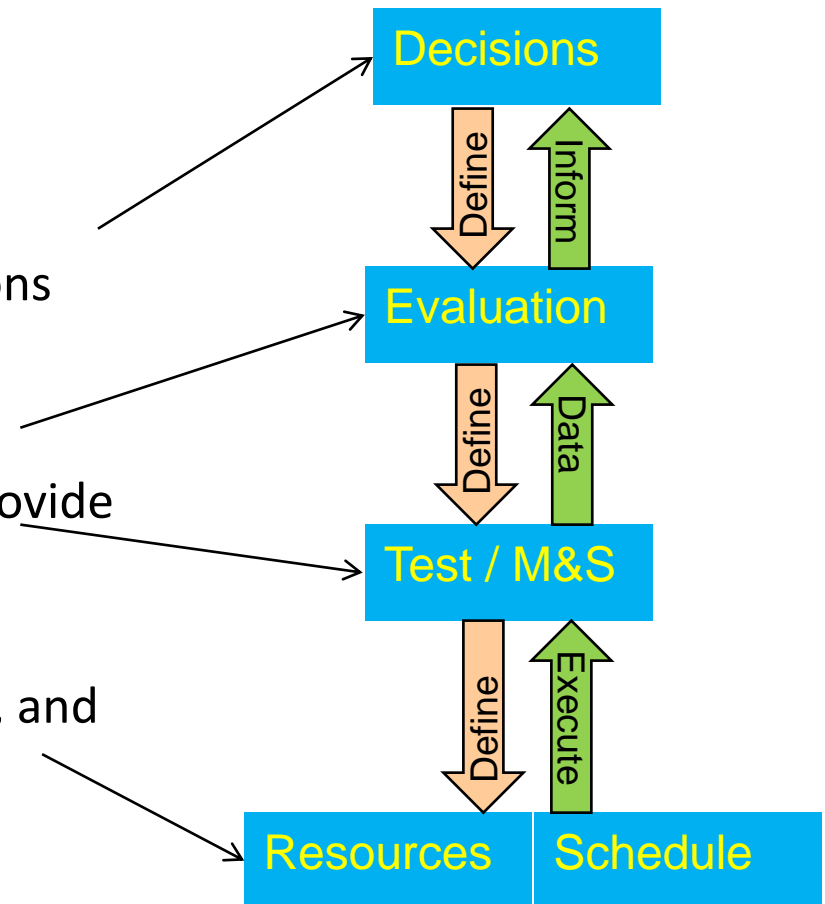
# Shift Left Implementation: DT&E Strategy



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Articulate a logical *evaluation* strategy that informs decisions

- How acquisition, programmatic, technical and operational decisions will be **informed** by evaluation
- How system will be **evaluated**
- How test and M&S events will provide **data** for evaluation
- What **resources** are required to execute test, conduct evaluation, and inform decisions



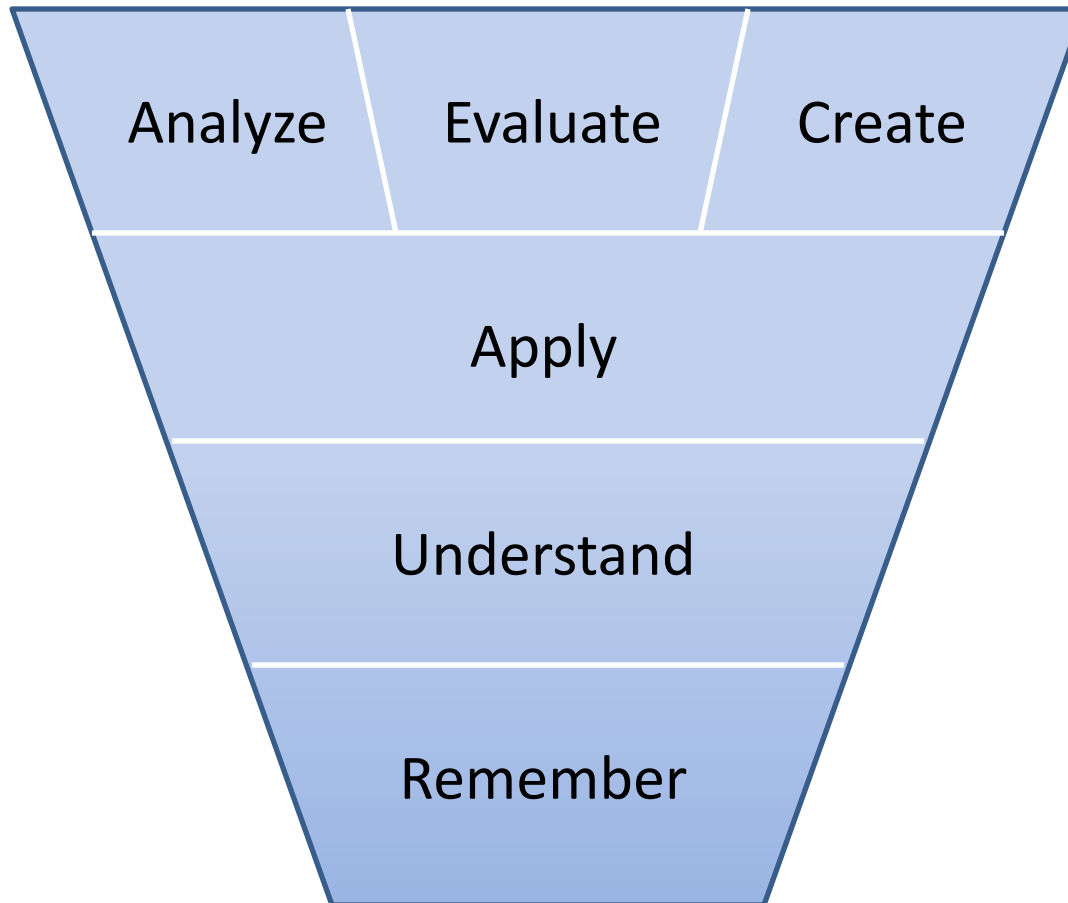
DT&E story thread: decision – evaluation– test & resources



# How do we measure Education and Training: Bloom's Taxonomy



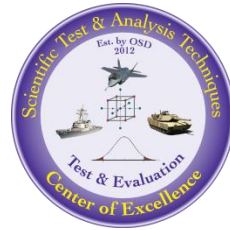
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Skills in the cognitive domain revolve around knowledge, comprehension, and critical thinking on a particular topic. Traditional education tends to emphasize the skills in this domain, particularly the lower-order objectives.



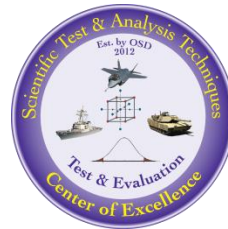
# Assessment of Training



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- Test professionals plan, perform, and manage T&E tasks in support of acquisition.
- What do we do well?
- What don't we do well?

Focus on scientific test and analysis techniques!!



# What is STAT?

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Scientific Test and Analysis Techniques (STAT) are the scientific and statistical methods and processes used to enable the development of efficient, rigorous test strategies that will yield defensible results.

The results of the **repeated use** of STAT is a more progressive sequential testing approach that carefully **leverages past test** information, along with **informing** the systems engineering process.

## STAT Tools

- Design of Experiments
- Quasi-Experimental Designs
- Natural Experiments
- Hypothesis Testing
- Regression Analysis
- Exploratory Data Analysis
- Operating Characteristic Curves
- Optimization
- Empirical Modeling
- Reliability & Reliability Growth
- Observational Studies
- Surveys



# STAT Frame of Reference



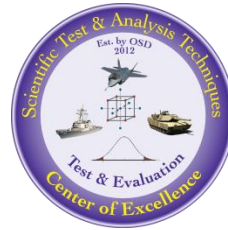
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“Have a clear idea *in advance* of exactly *what* is to be studied, *how* the data are to be collected, and at least a qualitative understanding of how these data are to be *analyzed*.”







Montgomery *Design and Analysis of Experiments* 8<sup>th</sup> Ed.



# STAT Assessment of Training



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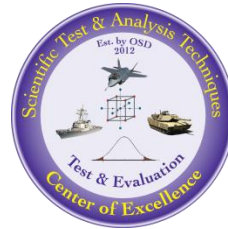
- Operational Test Agencies 
- Acquisition Staffs 
- Program Executive Offices / Program Mgrs 
- Program T&E personnel 
- Ranges/ Labs/ Field Supporting Activities 
- Contractor Support 

Note: These are assessments from the limited interactions of the speaker

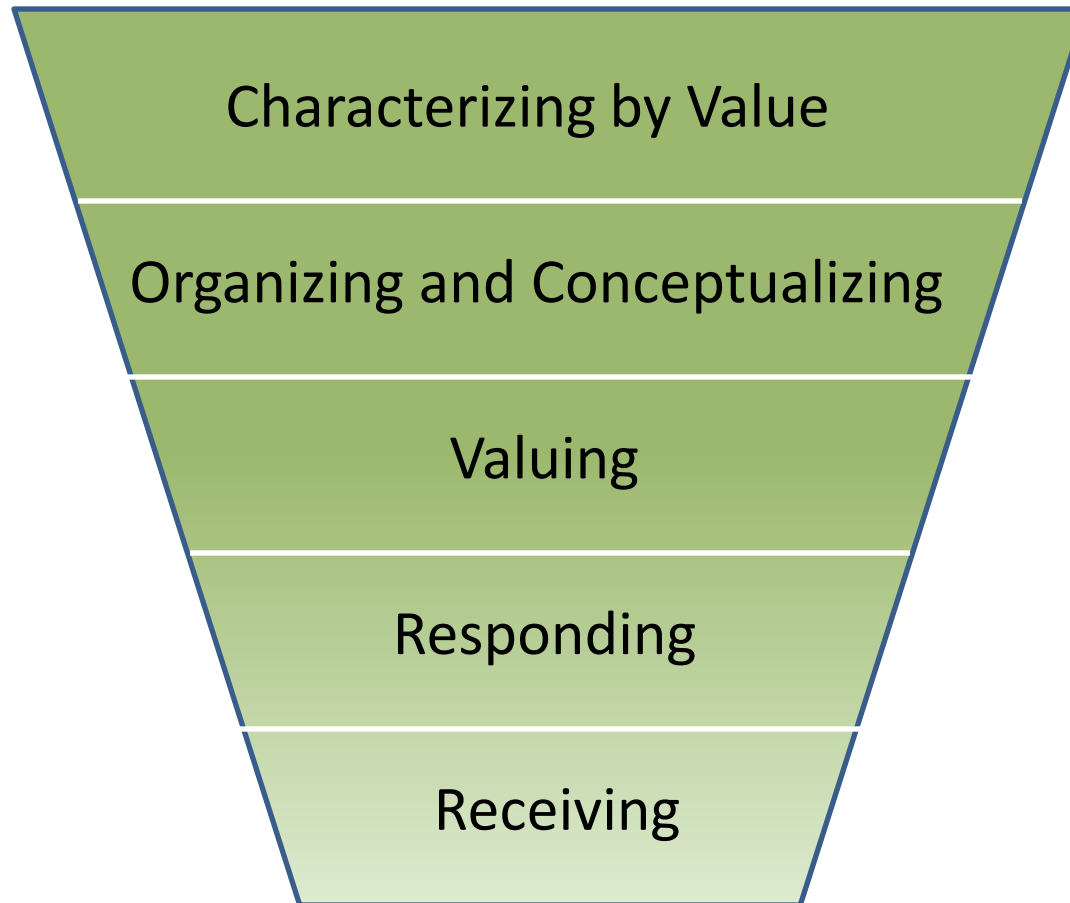




# Bloom's Taxonomy: Affective Domain



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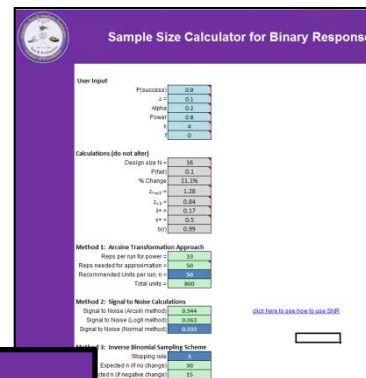
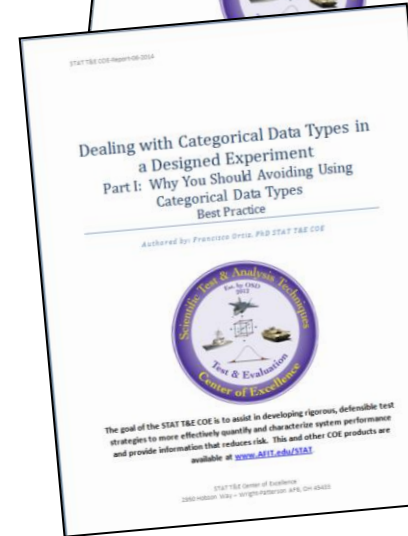
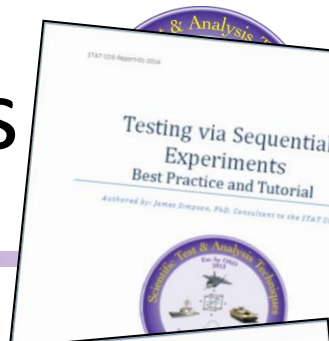
There is a need to **CHANGE THE CULTURE** not just provide the knowledge and skills



# Practitioner-Focused Products

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- Guide to Developing an Effective STAT Strategy
- Best Practices & Case Studies
  - Use of the Binomial Nomograph for Test and Evaluation Planning
  - Controlling Conditions is Key for Meaningful Operational Test Results
  - Best practices for highly effective test design; A beginners guide
  - Combinatorial Test Methods and Tools
  - Benefits of using Continuous versus Categorical Variables (Part 1&2)
  - The Logic of Statistical Hypothesis Testing
  - Reliability Test Planning for Mean Time Between Failures
  - Statistical Rigor in T&E
  - Defining Practical Test Objectives
  - Fixed, random, and mixed effects models; When and how to use them.
  - Understanding Requirements: They Are Our Foundation



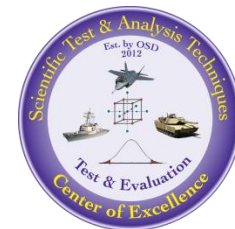
Available at [www.AFIT.edu/STAT](http://www.AFIT.edu/STAT)



# Summary

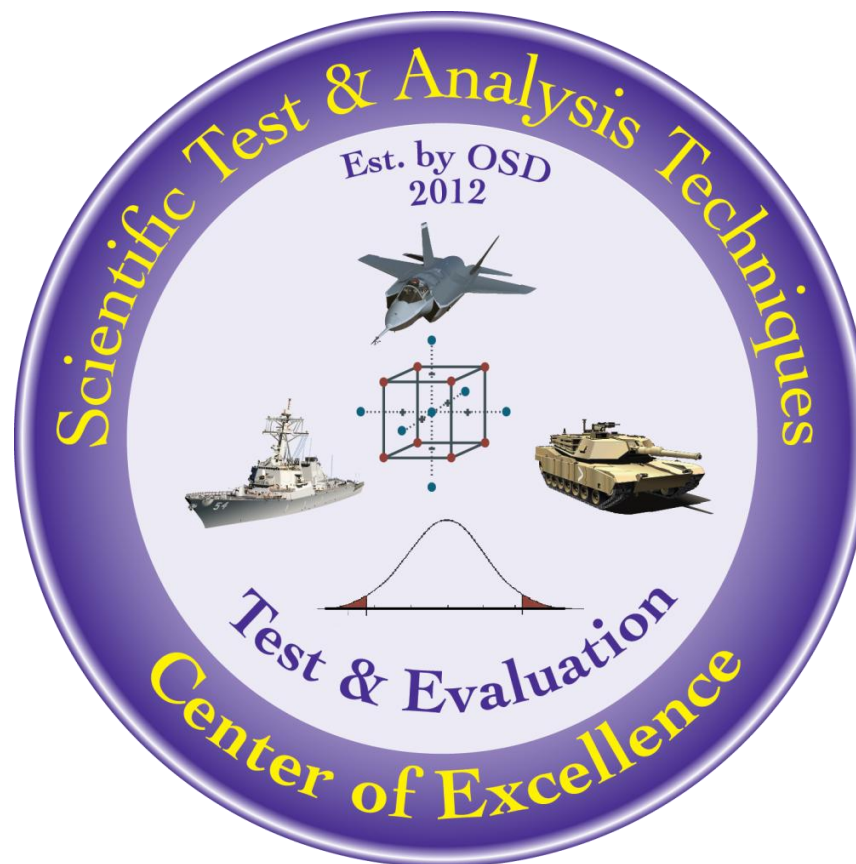
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- There are several initiatives to improving testing that create education and training demands.
- Over the past several years there have been many demands for more **STAT emphasis** from both AT&L and DOT&E.
- **Leadership** education and training must be emphasized more for **STAT**.
- An integrated approach across T&E and acquisition professionals is needed.



# Questions?

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[www.afit.edu/STAT](http://www.afit.edu/STAT)

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