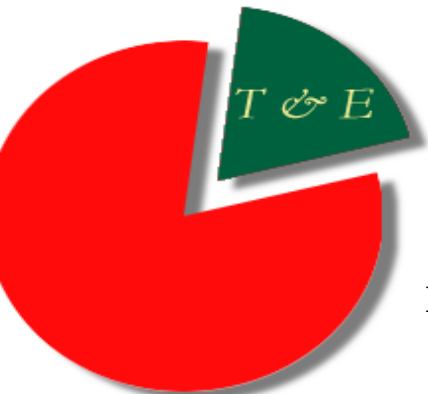


# A UNIFIED FRAMEWORK FOR TESTING AND EVALUATION

## Second Conference on the Economics of Test and Evaluation

**Atlanta, Georgia  
November 1999**

Martha Krug Nelson, Ph.D.  
Associate Professor and Chair  
Department of Business Administration  
Franklin and Marshall College  
Lancaster, Pennsylvania  
M\_Nelson@acad.fandm.edu



MK NELSON

November 1999

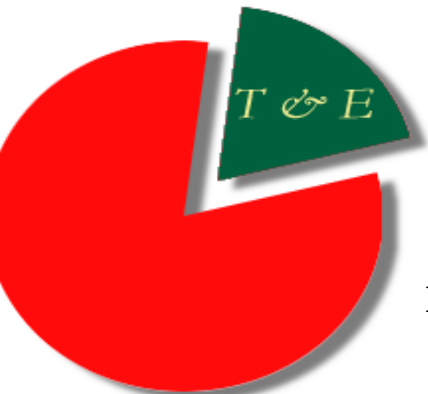
# Industry Adopted Customer /User Focus

## Factors in User Satisfaction

Quality

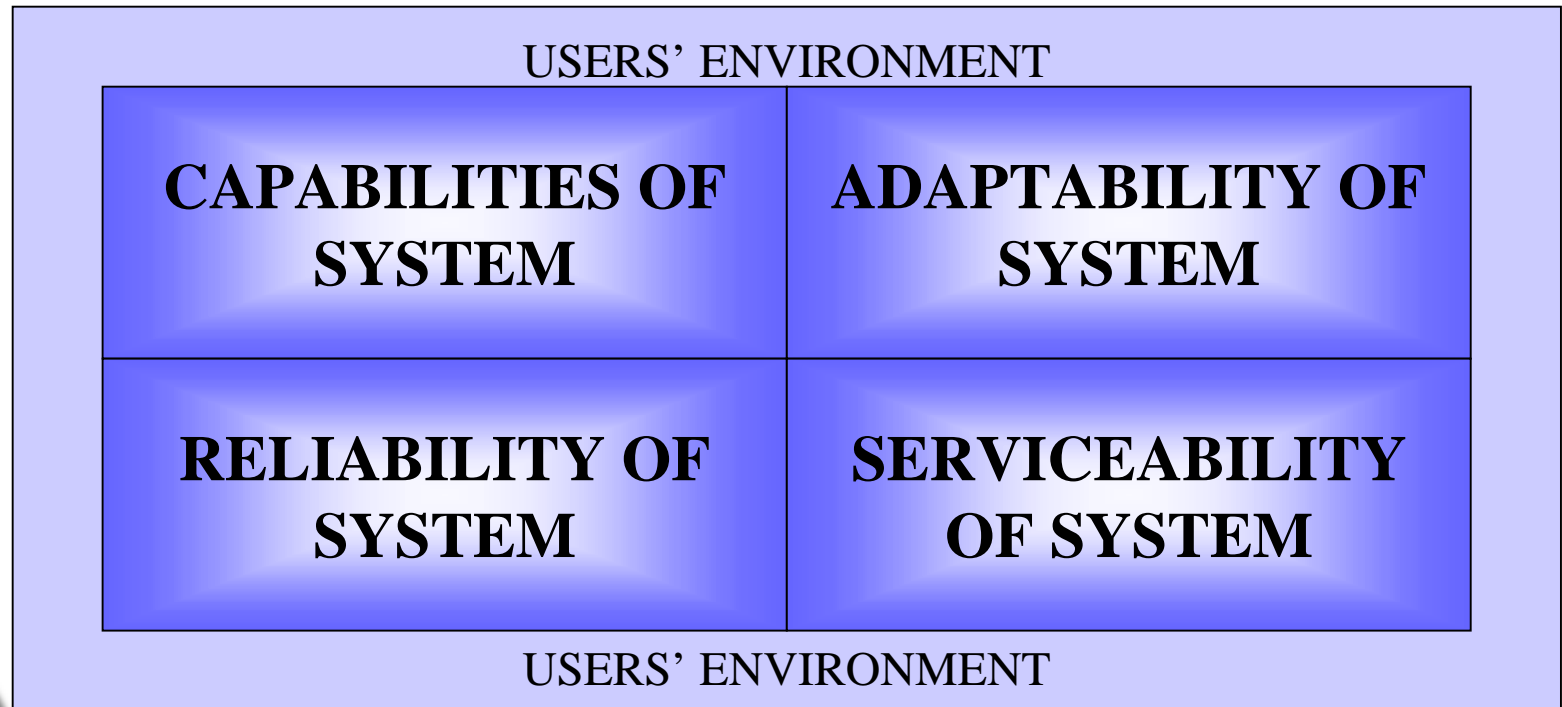
Cost

Timeliness in production/delivery



# Dimensions of Quality

[User-Focus]



# Goal

## Optimum Level of Quality

- Consider trade-offs in quality and costs.
- Consider costs of controlling for quality vs. costs of failure to control for quality.



# Life-Cycle Costs

## User Emphasis

Purchasing

**Test & Evaluation**

Operating

Maintaining

Disposal

## Producer Emphasis

Research & Development

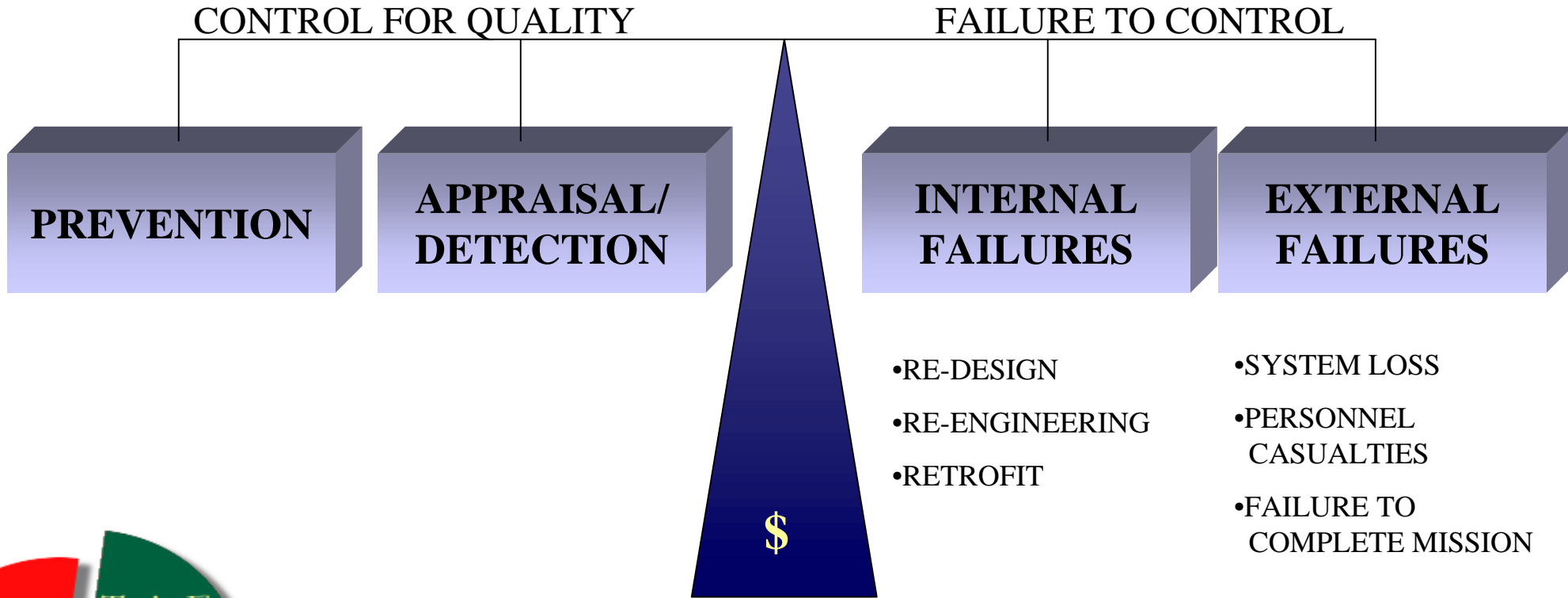
Planning/Design

**Test & Evaluation**

Product Logistics



# Quality Costs



# Costs of Controlling for Quality

## Prevention

Designing and engineering activities to increase quality of product to consumer

## Appraisal

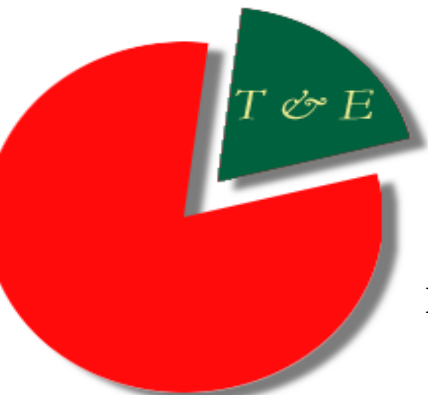
Inspection and detection activities to address:

Does product conform to specifications?

Does product meet users' needs?

Includes Test and Evaluation conducted

- on materials, components, subsystems, and system
- during and after production
- at sites of manufacturer, user, and independent tester/evaluator



# Measures of Quality

## Conformance

Does system meet specifications?

## Fitness

Does system perform intended functions? Is it able to perform tasks required to complete mission?

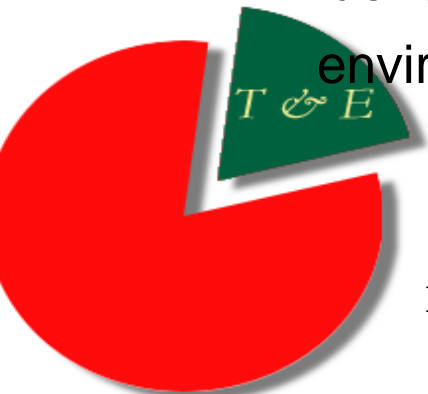
CAPABILITIES | ADAPTABILITY | RELIABILITY | SERVICEABILITY



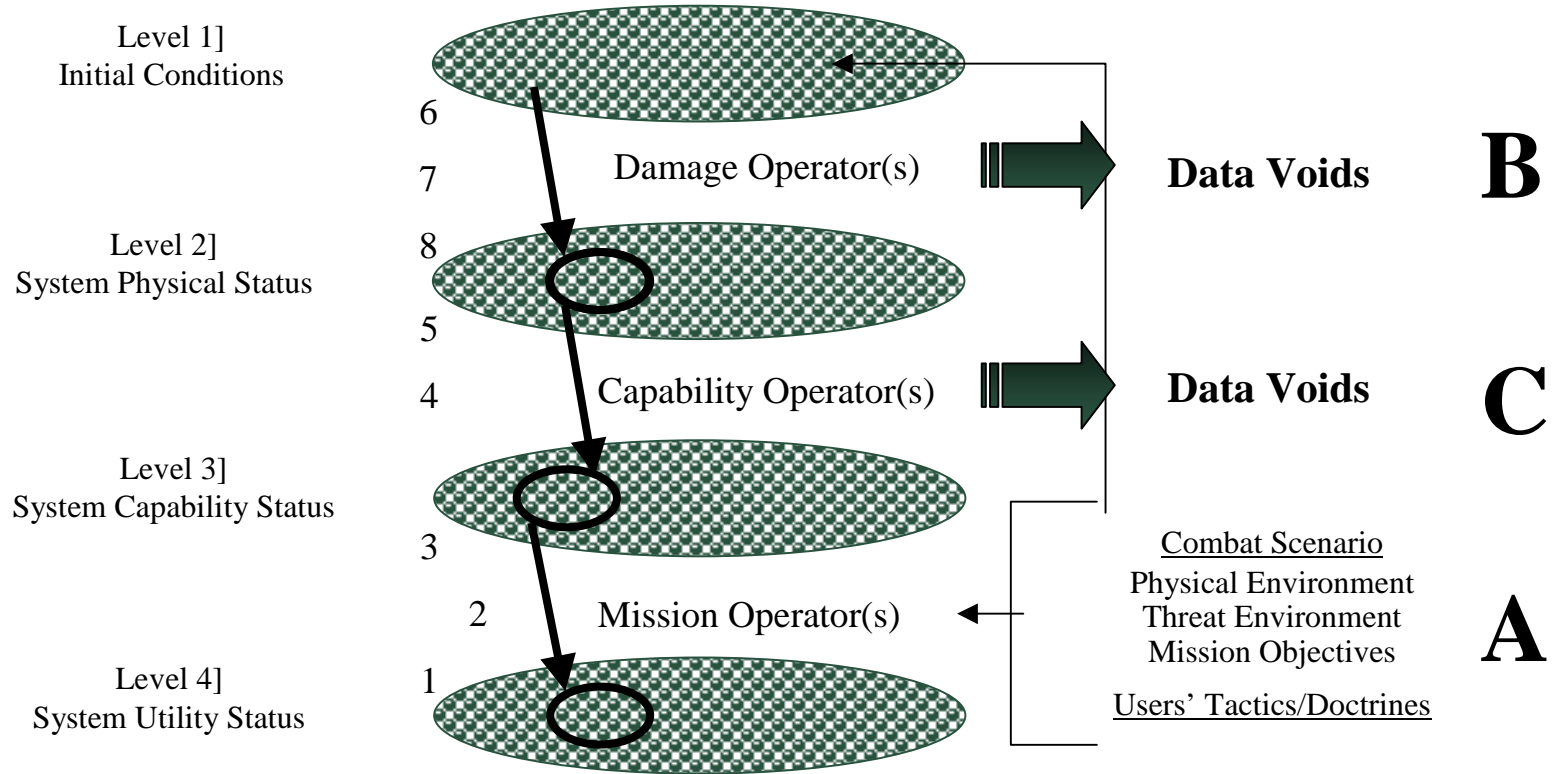


# Increase Quality of Product

- Identify the tasks that the system must perform to complete its mission and understand how users plan to use system.
- Identify the multiple dimensions of the users' environment and their effect on users' tasks and mission success.
- Link the mission-relevant (relevant to identified tasks) capabilities of the system to the design and engineering of the system.
- Design T&E to assess the ability of the system to retain its identified mission-relevant capabilities in the users' environment.



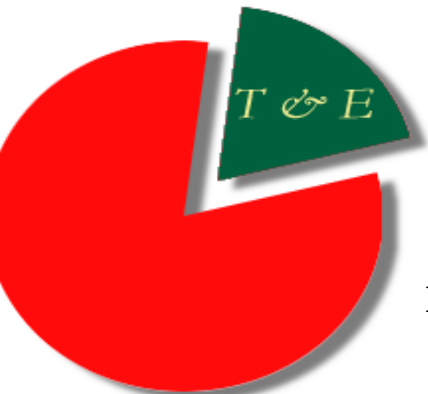
# Taxonomy Framework



○ = Subspace of vectors that map to a “success subspace” at the next level

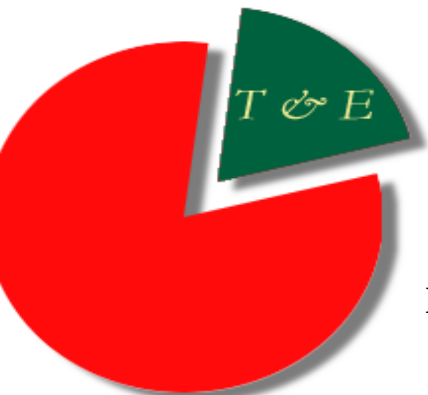
## Activities

1. Define system utility status
2. Develop mission operator(s)
3. Define system capability status
4. Develop capability operator(s)
5. Define system physical status
6. Define initial conditions
7. Develop damage operator(s)
8. Define system physical status
9. Compare system physical status in activity #5 to status in #8

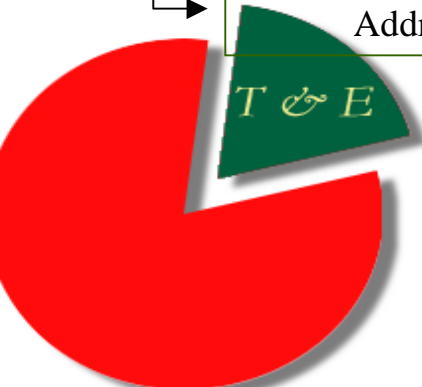
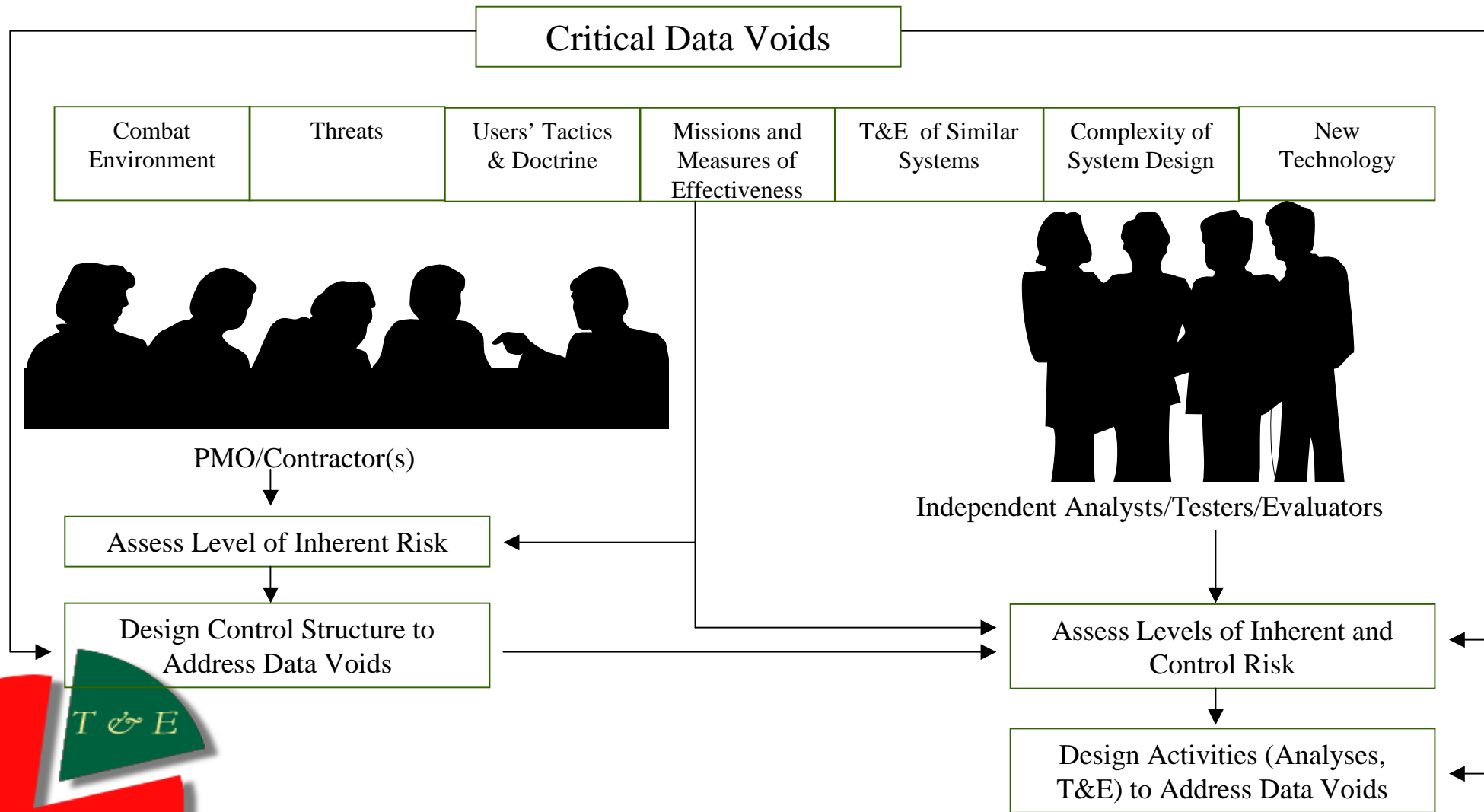


# Cost-effective Test and Evaluation

- Prioritize data voids: identify critical data requirements.
- Design alternative *T&E* plans to obtain critical data within specified budget range.
- Compare alternative *T&E* plans on bases of CAIV principles:
  - ◆ Capability of each plan to provide critical data.
  - ◆ Cost to accomplish each plan.
  - ◆ Uncertainties associated with each plan's capacity to provide the critical data within the time constraints of the decision process at the identified cost.



# Cost-effective Test and Evaluation



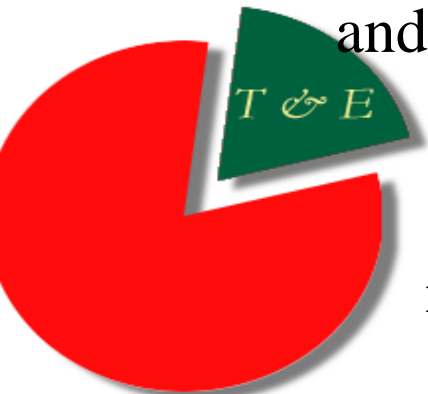
# Increasing Cost-effectiveness of Test and Evaluation

1. Facilitate discussion early in acquisition process among all principal players (PMO, contractor, tester, analyst, evaluator, etc.) to plan cost-effective T&E.
2. Identify and prioritize data voids for T&E to ensure limited funds are used effectively.
3. Consider all characteristics (e.g., timing, costs) of alternative activities (e.g., M&S, analysis, T&E) in addressing data voids.
4. Consider alternative designs of specific activity.

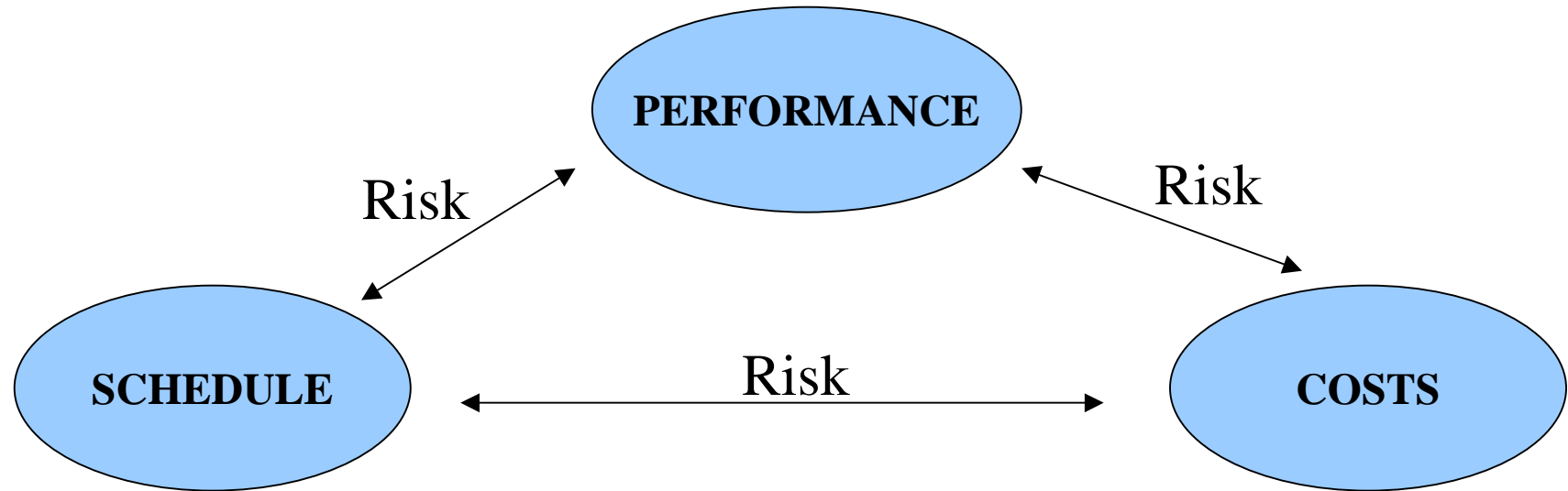


# Increasing Cost-effectiveness of Test and Evaluation

5. Encourage development and VV&A of M&S tools; integrate efforts of modelers and testers.
6. Consider control structure of PMO/contractor(s) in planning independent T&E.
7. Compile database relevant to outcomes of independent T&E, including costs, discoveries, results of discoveries (e.g. retrofits, modifications in design); define procedures for database submissions to ensure comparability/ consistency across systems and periods.



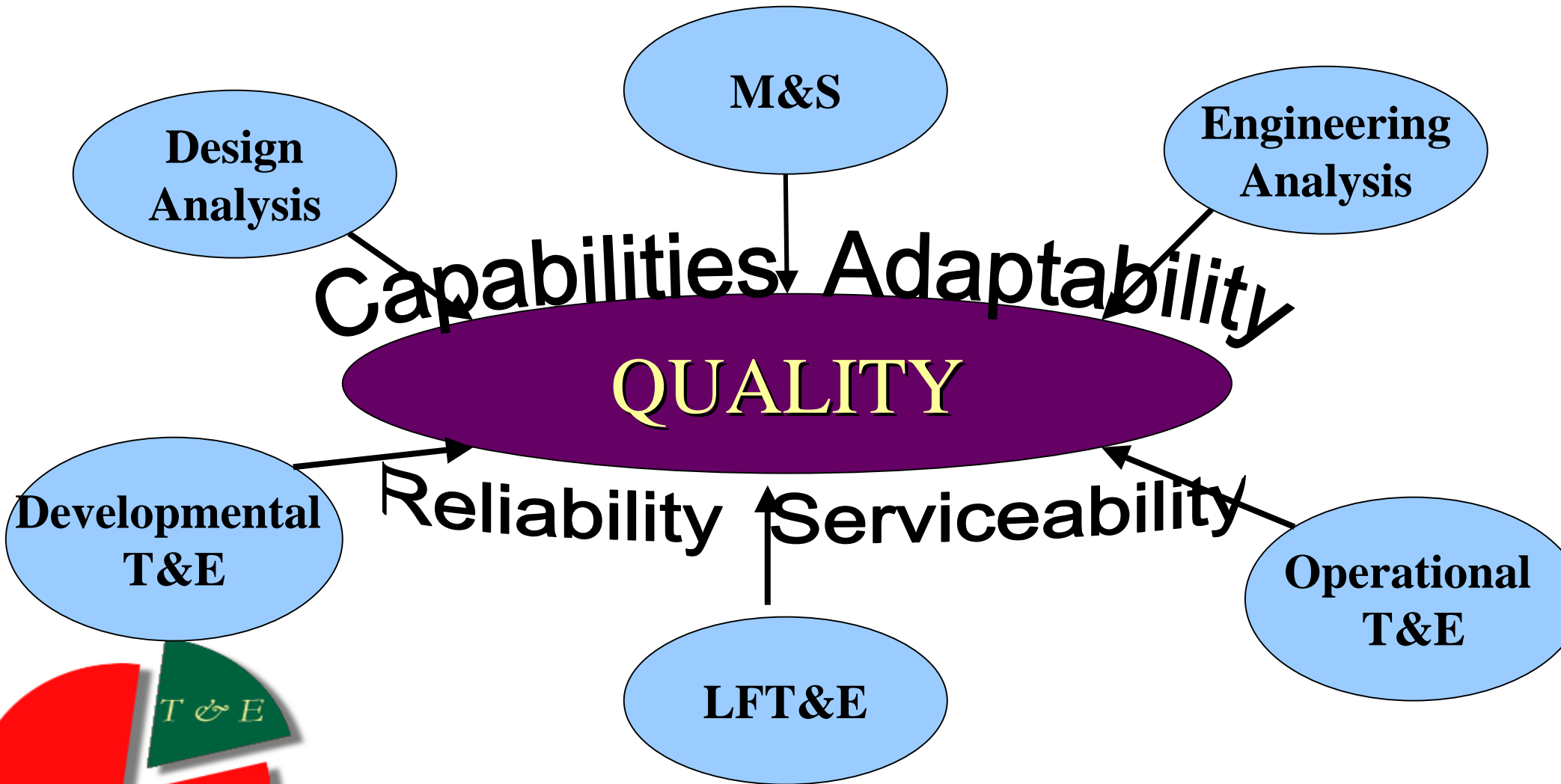
# Cost as an Independent Variable (CAIV)



Core of CAIV Methodology: Balance Mission Needs (Performance) against Available Resources (Costs) Considering Schedule and Risks



# Cost-effective Control for Quality





# A Unified Framework for Test and Evaluation

Mr. Jack Sheehan

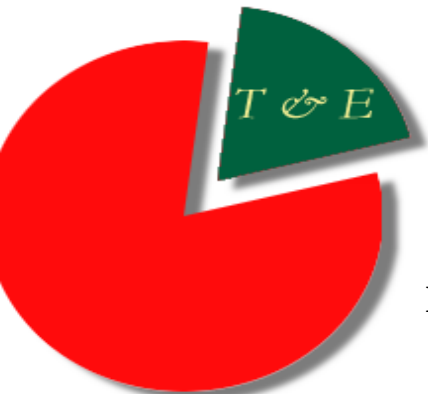
Defense Modeling and Simulation Office

Alexandria, VA

Dr. Paul H. Deitz

U.S. Army Materiel Systems Analysis Activity

Aberdeen Proving Ground, MD



# A Unified Framework for Test and Evaluation

Mr. William Hacker

Applied Research Associates, Inc.

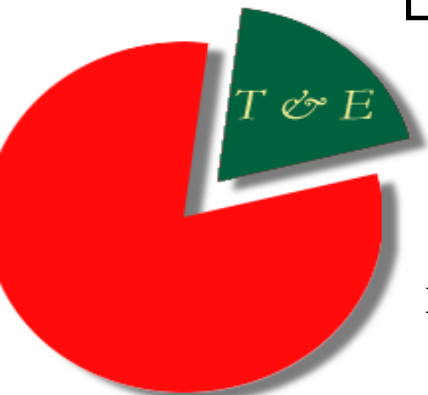
Albuquerque, NM

Dr. Ronald R. Luman

Johns Hopkins University

Applied Physics Laboratory

Laurel, MD



MK NELSON