

# **Integration of Modeling and Simulation Into the Test and Evaluation Process**

Michael J. Leite, PE

M&S Project Manager, SAIC. and

T&E Community Coordinator, DoD M&S  
CO

DISTRIBUTION STATEMENT A: Approved for public  
release; distribution is unlimited.

Contract: GS09K99BHD0010; DoD Case 08-S-0203

# Why we are here . . .

- To Explore the utilization of modeling and simulation to support test and evaluation.

# Outline . . .

- Introduction
- Processes
- M&S Activities for T&E Support
- M&S Integration
- Case Study
- Conclusions

# Introduction

- Acquisitions are Based on Requirements
- Test & Evaluation Verifies Attainment
- Modeling and Simulation used for Design and Development
- T&E has Historically Avoided M&S
- System Size and T&E Cost Now Require M&S

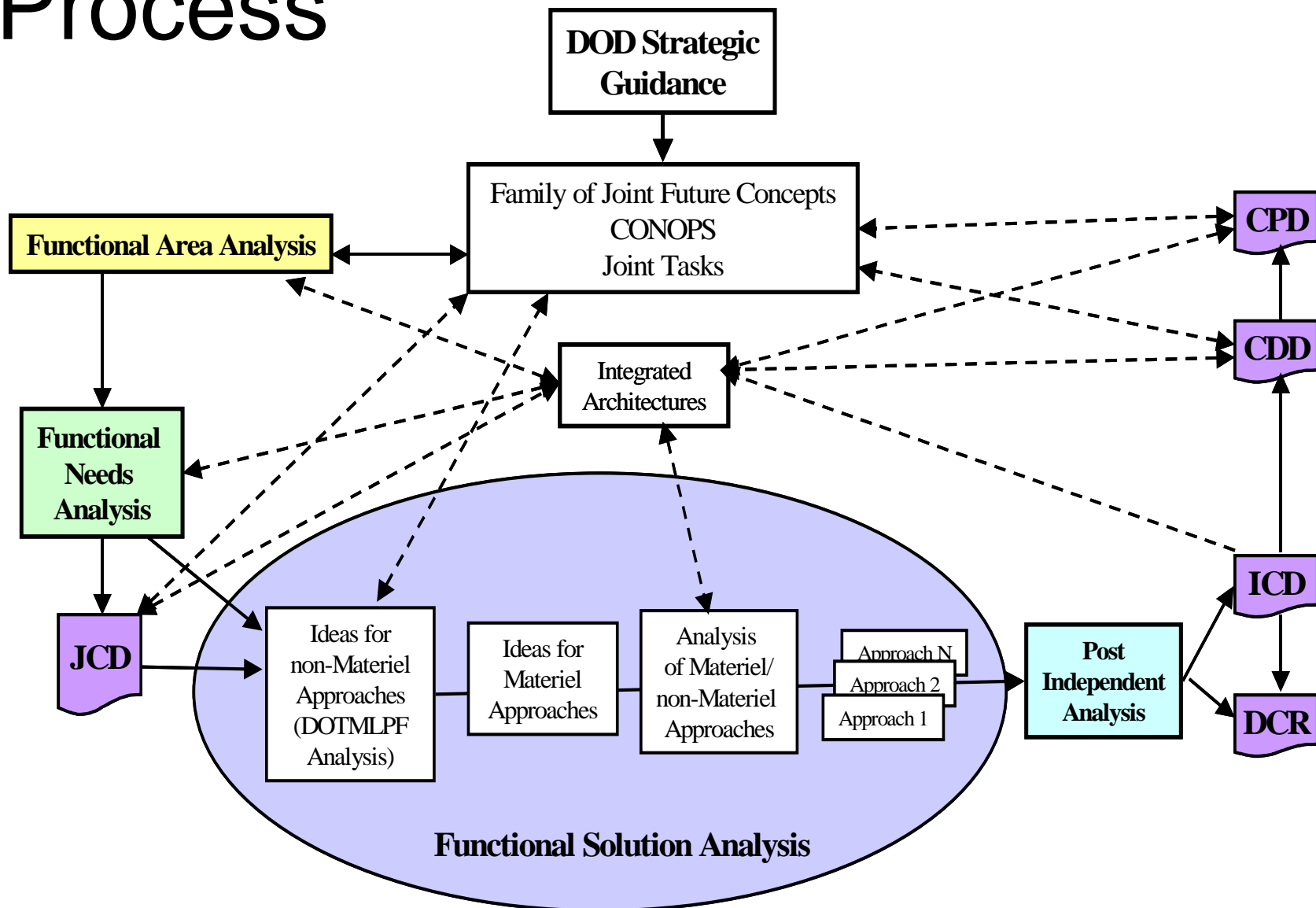
# Processes . . .

- Requirements
  - Must have: Performance, Criterion & Metric
  - JCIDS Process
- Acquisition
  - DoDD 5000.1 and DoDI 5000.2
- Systems Engineering
  - Defense Acquisition University
- Test and Evaluation
  - Developmental, Operational & Live Fire

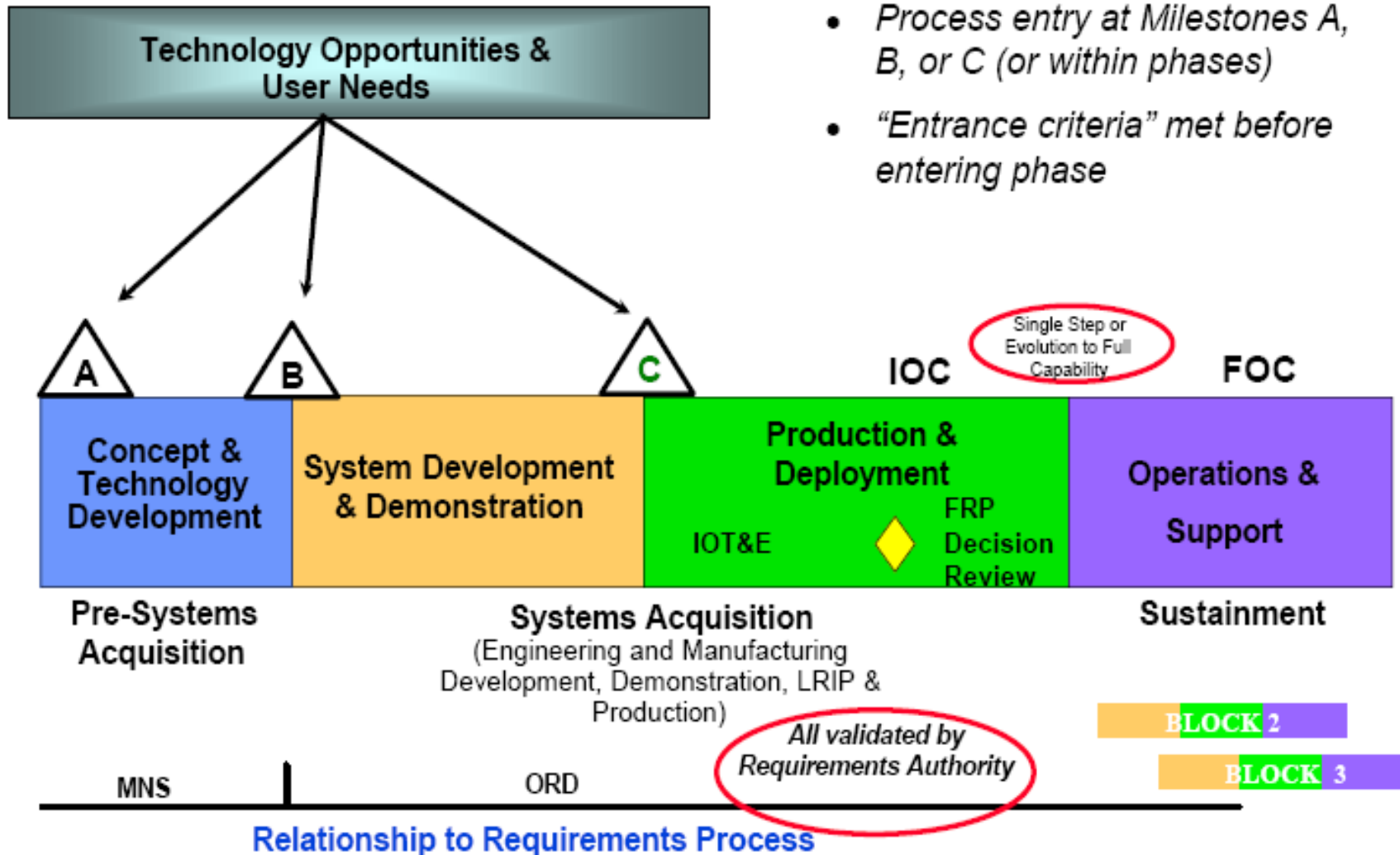
# Requirements Process

- What is a Requirement?
  - The machine will produce cap screws conforming to the dimensions for ANSI/ASME Class 2A threads [**PERFORMANCE**]
  - at a production rate of 10,000 per hour [**CRITERION**] and
  - with a defect rate of not more than one per 1,000 units [**CRITERION**]
  - as measured by an opto-electronic counter and with dimensions being verified by automated high-speed photo imaging. [**METRIC**]
- Valid Requirements are Testable

# Requirements--The JCIDS Process

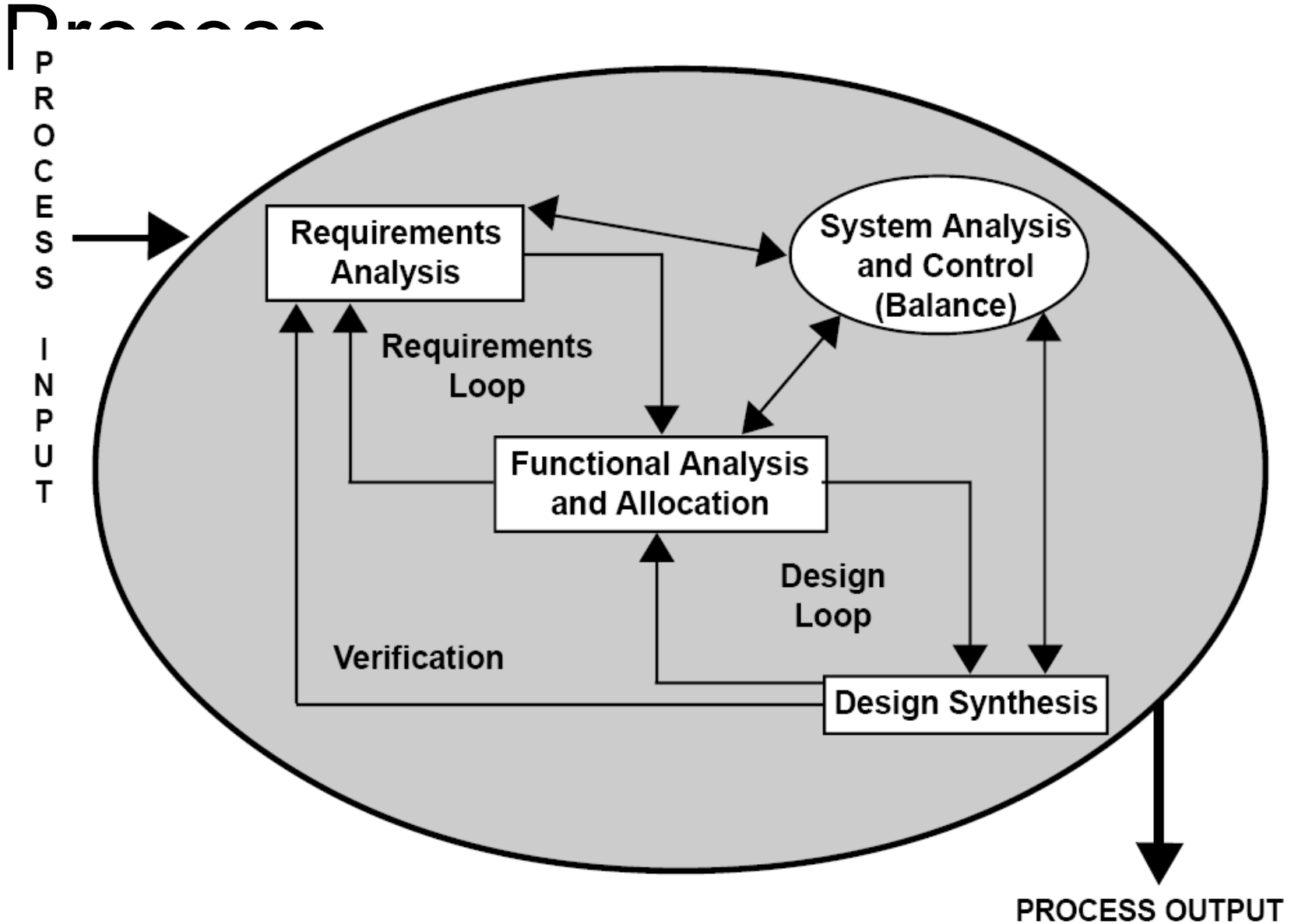


# The Acquisition Process

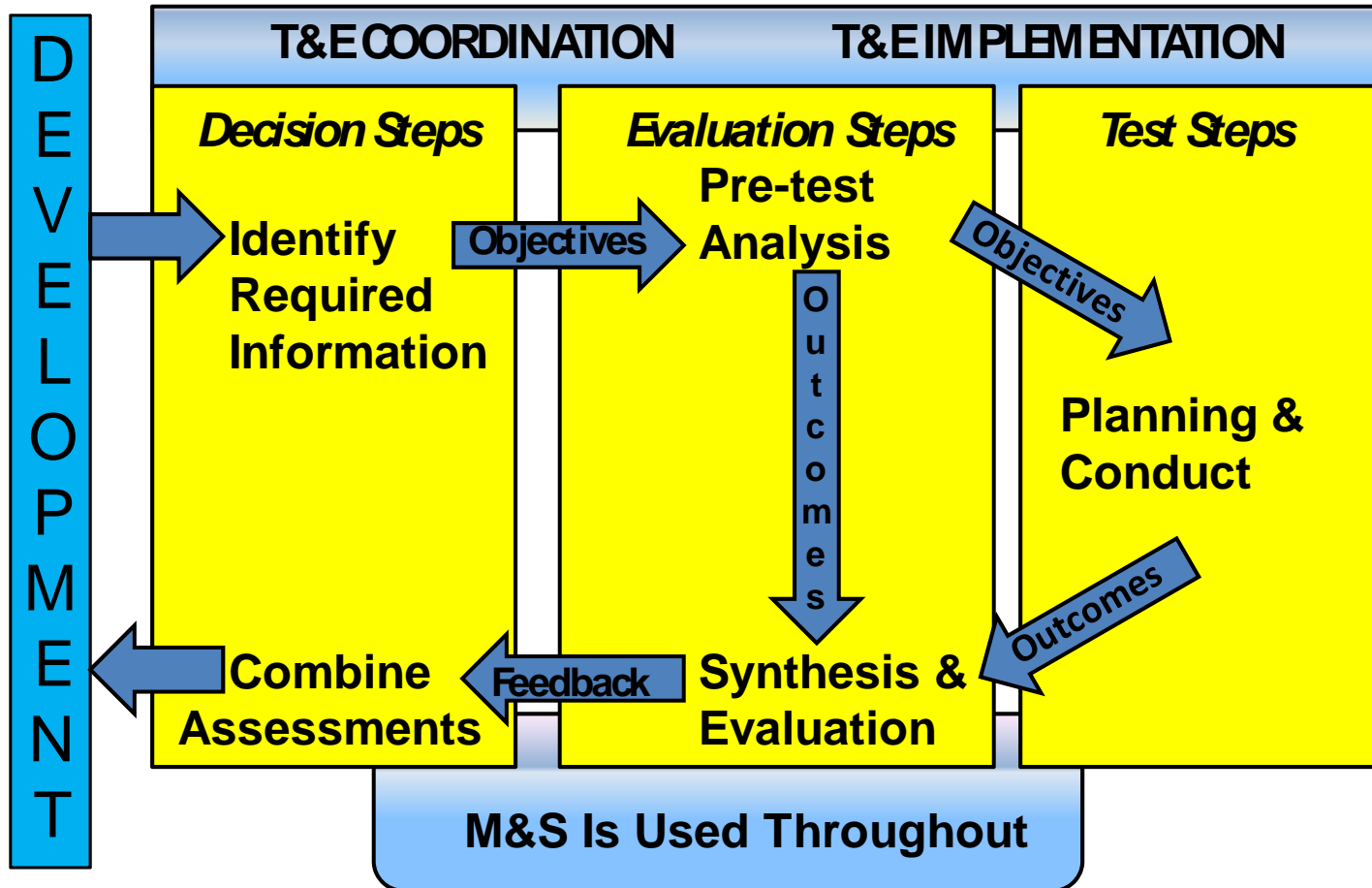


- Process entry at Milestones A, B, or C (or within phases)
- "Entrance criteria" met before entering phase

# The System Engineering



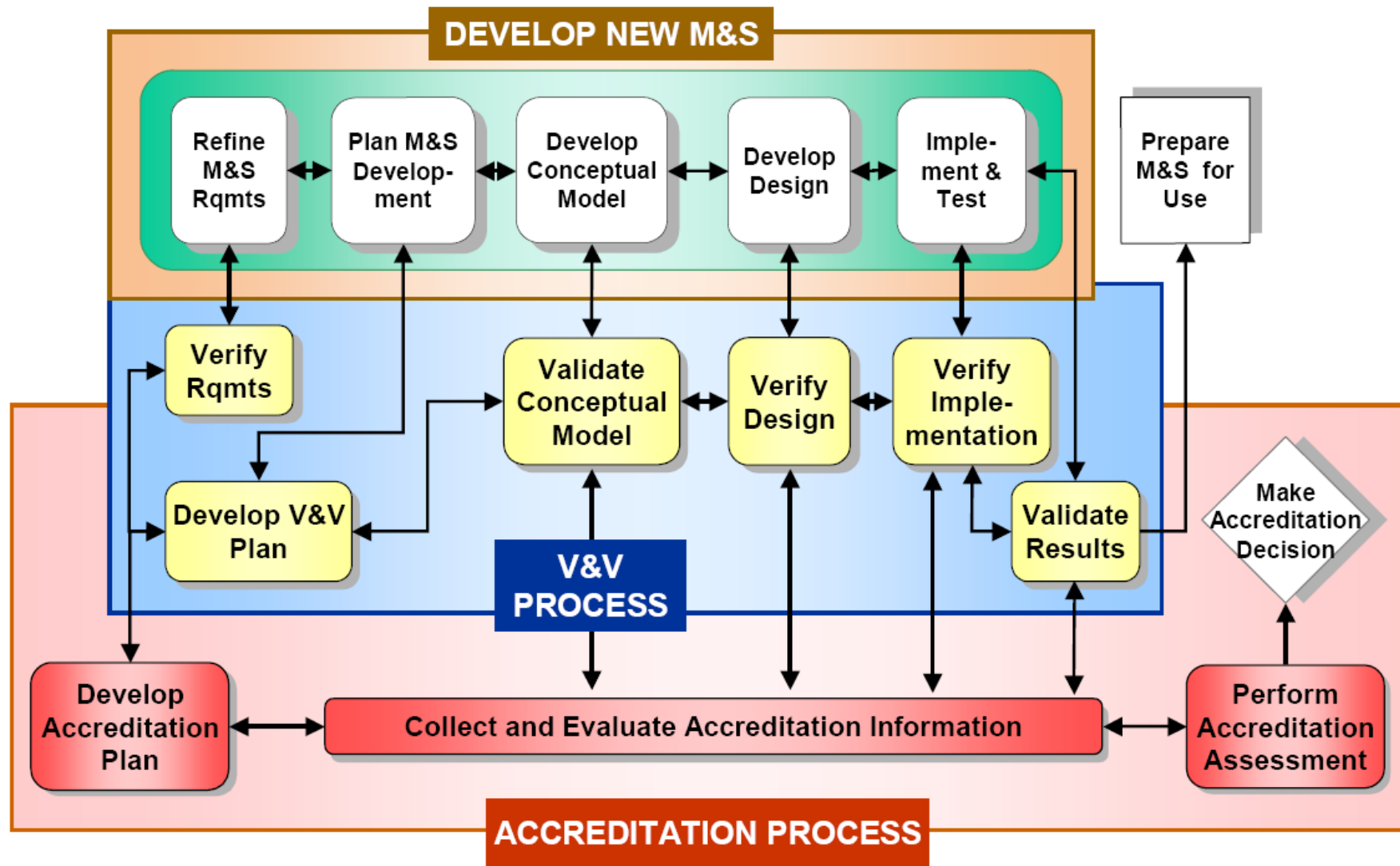
# Test & Evaluation Process



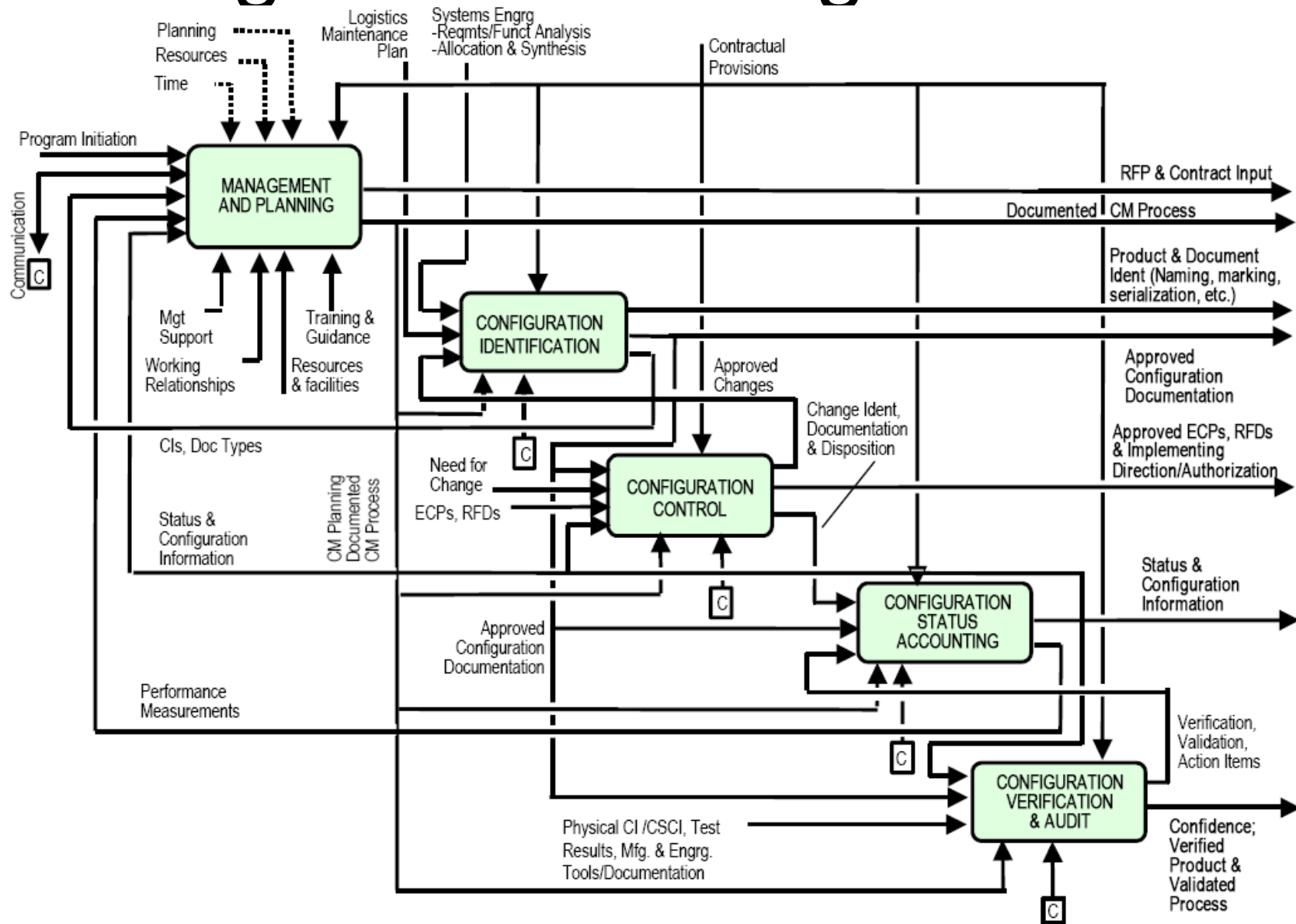
# M&S Integration Elements

- Model and Simulation Selection
- Configuration Management
- Verification, Validation and Accreditation

# M&S Selection & Employment



# Configuration Management



# Verification, Validation & Accreditation

- Essential for Credibility of Results
- Provides Traceability for Requirements
- Follow Standard Process and Documentation
  - *DoDI 5000.61*
  - *VV&A Recommended Practices Guide (RPG)*
  - *New Military Standard—Documentation of VV&A*

# M&S in Test & Evaluation

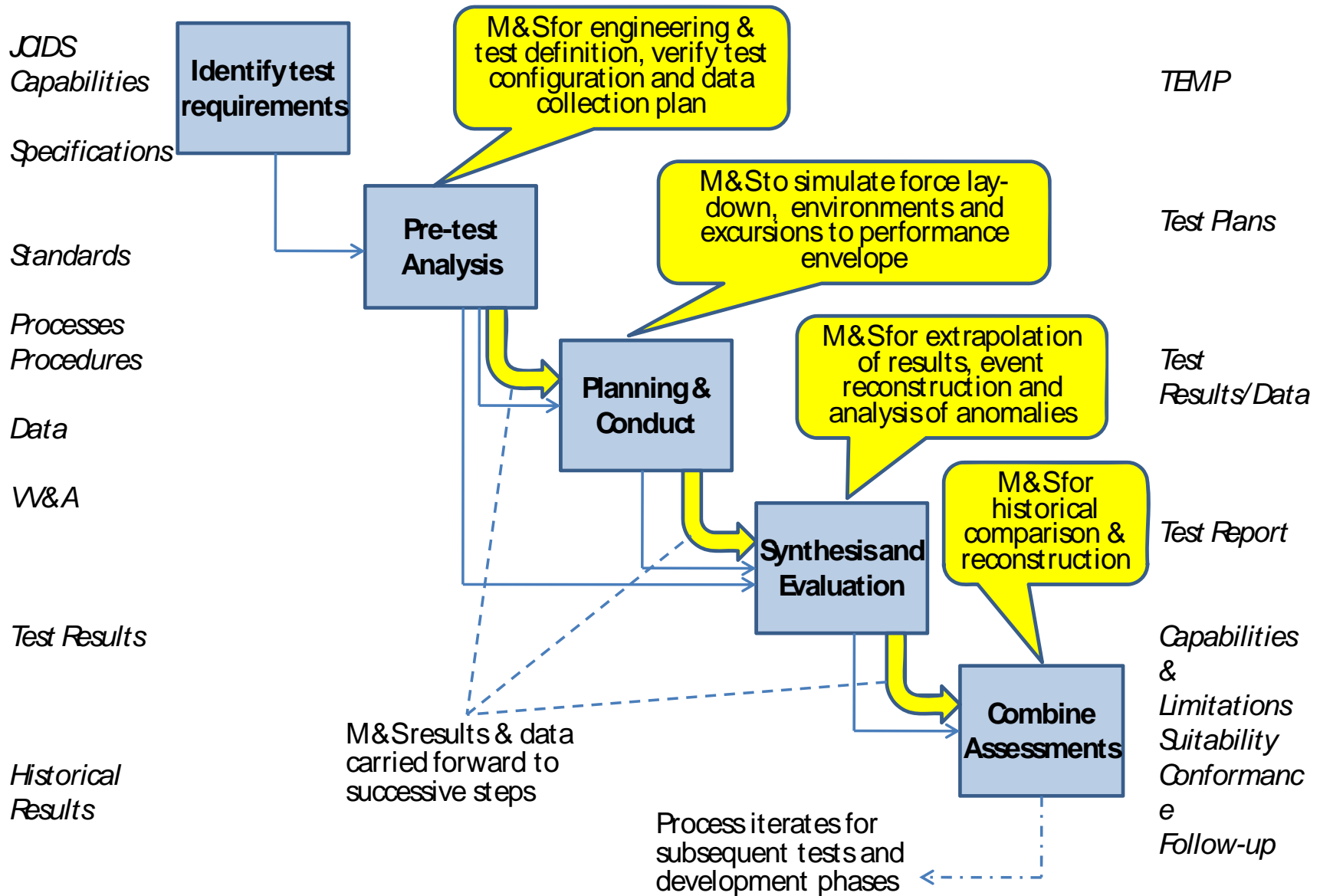
- Assessment of system performance in environments that cannot be replicated in live (or field) tests
- Assessment of system performance with units or forces that cannot be made available in a field environment
- Extrapolation of small scale test results to the prediction of system performance
- Validation of a proposed test configuration
- Verification of a data collection plan
- Validation of live test results
- Reconstruction and analysis of test anomalies

# M&S in Test & Evaluation

## Inputs

## Process

## Outputs



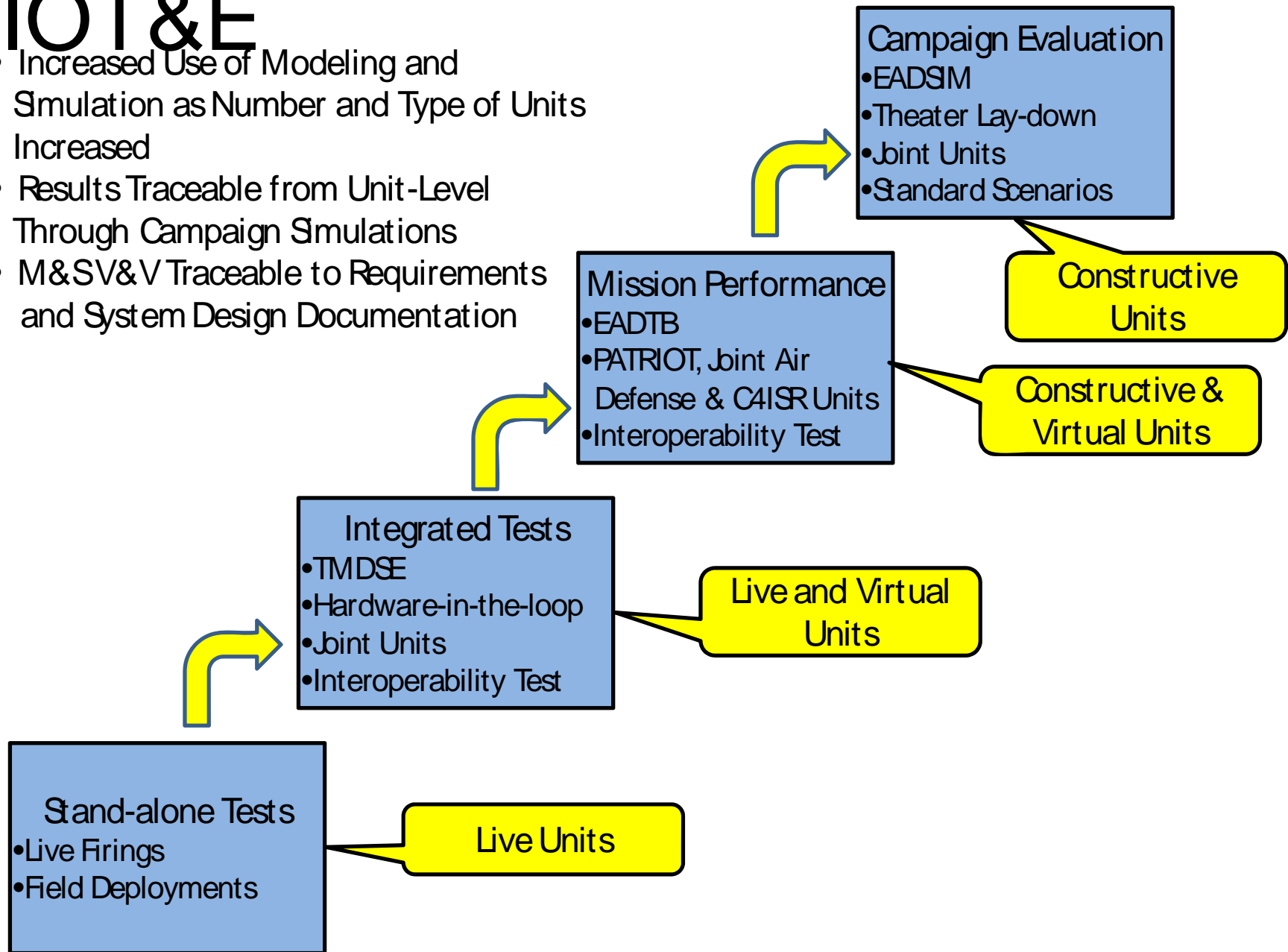
# Case Study—PATRIOT PAC-3 IOT&E

- M&S Required for T&E
  - Full Field Lay-down Not possible
  - Required Targets & Interceptors too Costly
  - Selected Requirements Only Testable with M&S
- Multi-level M&S Approach Selected
  - Tie Engineering-level & Field Tests to
    - Hardware-in-the-loop
    - Engagement Simulations
    - Theater Simulations
  - Integration of Live-Virtual-Constructive Tests

# Case Study—PATRIOT PAC-3

## IOT&E

- Increased Use of Modeling and Simulation as Number and Type of Units Increased
- Results Traceable from Unit-Level Through Campaign Simulations
- M&SV&V Traceable to Requirements and System Design Documentation



# Conclusions

- T&E Commences at Start of Project.
- T&E is Part of the Systems Engineering Process
- Modeling and Simulation Adds Value to T&E
  - Assessment in environments that cannot be replicated in live (or field) tests
  - Assessment with units or forces that cannot be made available
  - Extrapolation of small scale test results to system performance prediction
  - Validation of test configurations
  - Verification of a data collection plans
  - Validation of test results
  - Reconstruction and analysis of test anomalies
- Recognize M&S Limitations in Support of T&E