Mission-Based T&E Strategy

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Outline

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- MBT&E Framework
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MBT&E Introduction

Mission-Based Test and Evaluation

is a methodology that focuses T&E on the mission task **capabilities** provided to the warfighter. It provides a framework and procedure to:

- **link capabilities to the attributes** of the materiel system-of-systems;
- develop evaluation measures that **assess capabilities and attributes**;
- and link the evaluation measures to all **available data sources**.

MBT&E Top Goals

- Show impact of materiel system strengths/weaknesses on the operational capabilities and limitations.
  - Validate system performance in context of mission task capabilities.
  - T&E aligned with Systems Engineering products.
- Complete feedback loop to Capability-Based Analysis.
  - Evaluation results focused on how system performance (current focus) supports the capability needs identified by the combat developer's capability-based analysis (CBA). Answers the "so what" question.
  - Align T&E strategy with CBA and DoDAF products.
- Integrate DT and OT and make use of all available data.
  - T&E conditions determined by the mission context and applied to all data sources (contractor test, M&S, DT, and OT).
  - Allows for appropriate and synergistic mix of data (developmental and operational) to support the evaluation.

MBT&E & SE Aligned Goals

From NDIA SE Division Task Group Report

July 2006

- Execute SE and scope T&E efforts earlier in the acquisition cycle based on mission task capabilities.
  - Addresses:
    - "Insufficient systems engineering applied early in the program life cycle…"
    - "Requirements not always well-managed, including the effective translation from capabilities statements into executable requirements…"
  - By: Focusing on mission task capabilities as the starting point.

- Enable robust SE and T&E strategy development for Joint networked SoS and a common environment for collaborative effort between capabilities developer, materiel developer and T&E.
  - Addresses: "Collaborative environments, including SE tools, are inadequate to effectively execute SE at the joint capability, SoS and system levels."
  - By: Using a framework that links all components of the SoS to the mission capability and uses a common definition of terms.

MBT&E Background

- Dec 07: Study group was formed.
  - Participants included: ATEC, ARL, AMSAA and DOT&E (JTEM). Consensus: T&E focused on the mission tasks is correct path ahead.

Presented preliminary design.
- **Go ahead with detailed design**.

- Feb 08: Mission-Based T&E Strategy Summit (Panel Review).

Presented draft 80% design for review/comment.

- May 08: Briefed process for review/comment.
  - Additional participants included TRADOC, ASA(ALT), DUSA-TEO, JCS, COMOPTEVFOR and MCOTEA.
- Briefed OSD RAM Initiatives Working Group #3, 18 Jun 08.

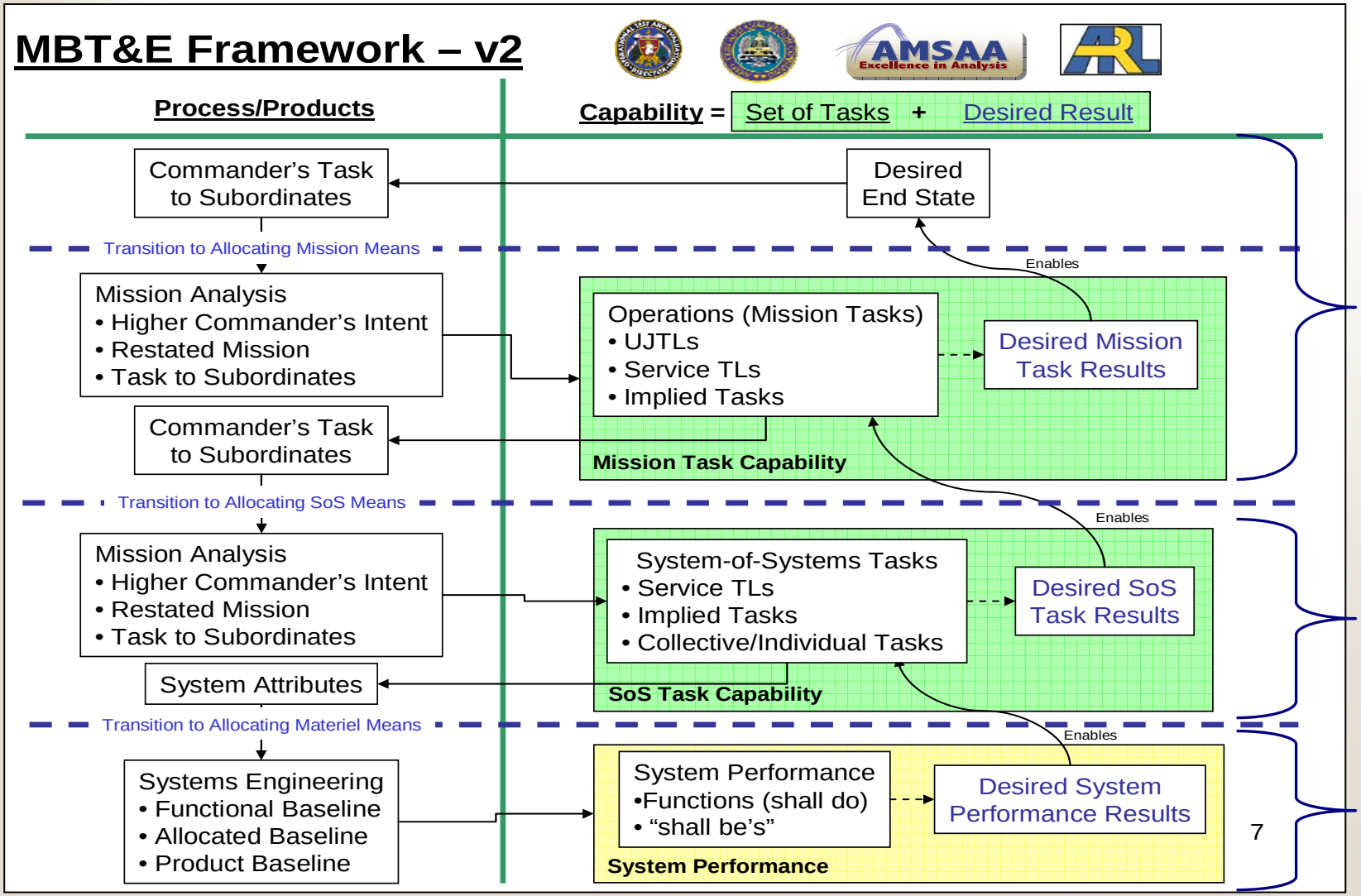
Presented final 80% design.
- **Go ahead with coordination.**
- **Go ahead with pilot projects**

- Aug 08: Held second MBT&E Strategy Summit,
  - Additional participants included JFCOM, DUSD(AT&L), and AFOTEC.
- Briefed ASA(ALT), 21 Aug 08.
- Briefed RDECOM, 18 Sep 08.
- Briefed HQDA DCS G-3/5/7, 22 Sep 08.

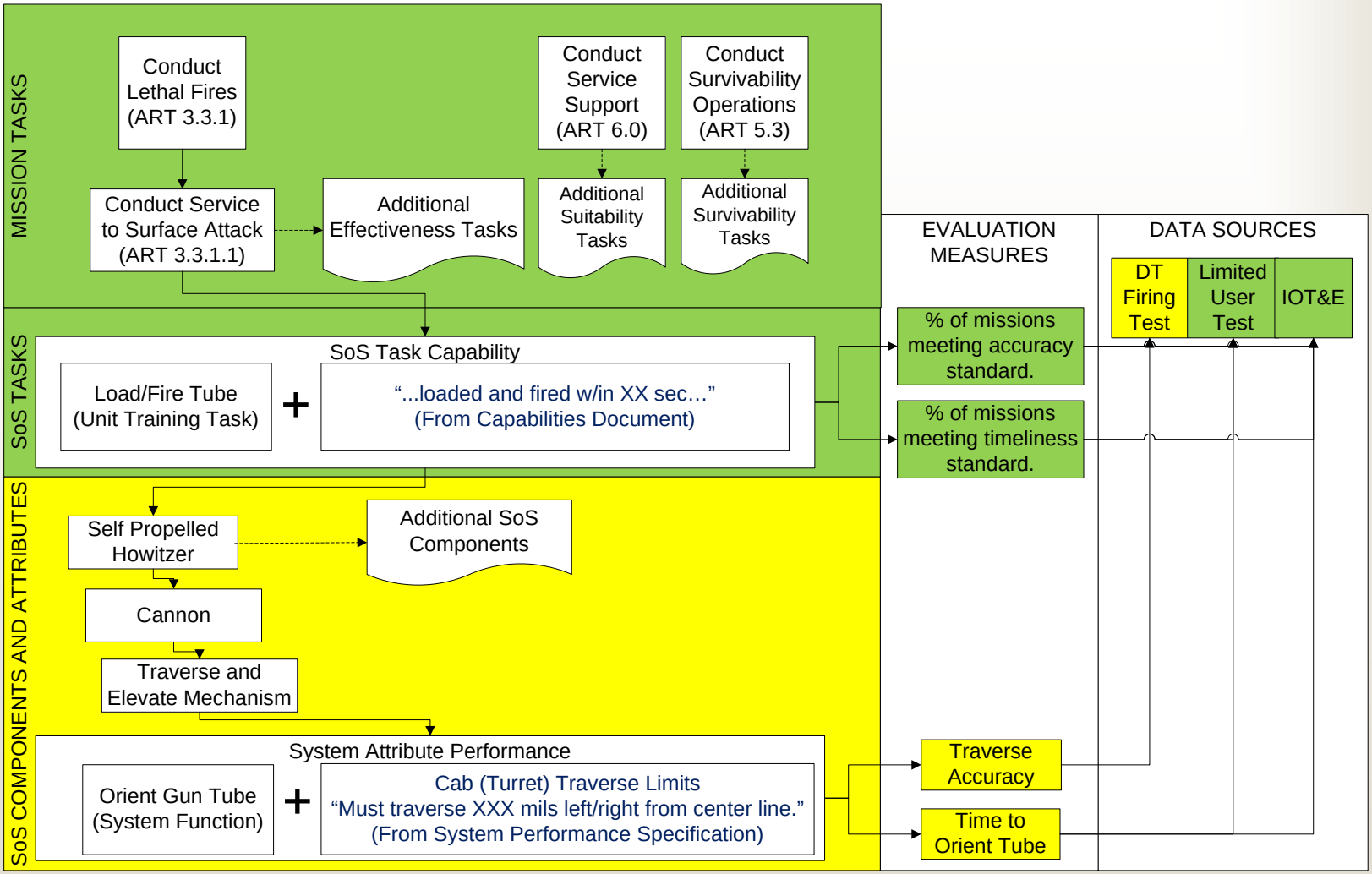
MBT&E Requirements

- **Address initiatives in Section 231 Report.**
- **Address initiatives in DOT&E/OUSD(AT&L) *T&E Policy Revisions* memorandum, 22 Dec 07.**
- **Address initiatives in DOT&E/DUSD(A&T) *Reliability Improvement Working Group* memorandum, 15 Feb 08.**
- **Address goals, strategies and initiatives in DUSA-TEO Strategic Plan, 2007.**
- **In addition, addressing T&E and SE capability needs.**
  - **System of Systems engineering and evaluation.**

MBT&E Framework



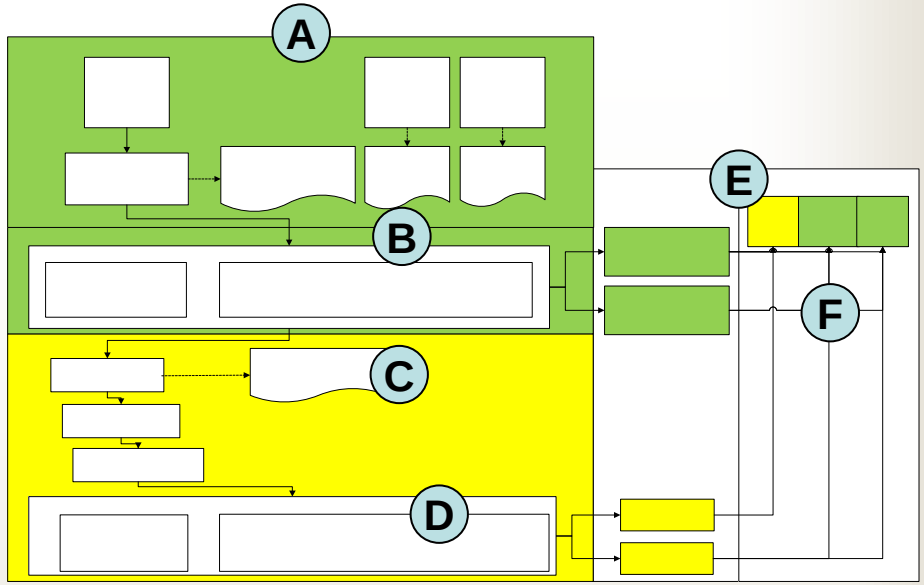
MBT&E Framework Thread Example



Functional Decomposition Linked to Task Capability

Capability and Performance Linked to Integrated T&E

MBT&E Framework Thread Link Back to Goals



- **A** Report effectiveness, suitability and survivability based on capability.
- **B** Measure mission capability and operational support.
- **C** Supports Joint networked system-of-systems T&E.
- **D** System strengths/weaknesses impact on operational capabilities.
- **E** Best use of M&S identified by assessing conditions needed and possible to test.
- **F** Integrated T&E through…
  - Operational context from task capability applied to DT conditions;
  - Integrated use of contractor, developmental and operational test; and
  - System function impact on task measured in OT.

MBT&E Process Overview

- Steps divided into 5 major purpose areas.
- Process is iterative supporting acquisition life-cycle.

- 1 Pre-step to understand the program context.

UNDERSTAND THE MISSION	• 4 steps to understand the military operations, tasks, task capabilities and mission context.
UNDERSTAND THE SYSTEM	• 2 steps to understand the components and attributes of the materiel system-of-systems.

- 1 additional step to understand the mission and system linkages.

DESIGN THE TEST AND EVALUATION	• 7 steps to design the T&E given the mission and system understanding.
DETERMINE THE RESULTS	• 3 steps to generate, collect, analyze, and evaluate the data.
REPORT THE RESULTS	• 1 step to format and report the results.

Mission-Based Systems Engineering

- Effective systems engineering expands requirements analysis into the mission context.

- Mission-based approach can lead the way to research, develop, test and verify mission capabilities.
  - Goal is robust application for SoS, commercial-off-the-shelf intensive systems, and recapitalized systems.

MBSE Example

HMMWV Upgrades

Understand the mission

- Mission: to provide a light tactical wheeled vehicle for command and control, troop and light cargo transportation, special purpose shelter carrier, ambulance, towed weapons prime mover, and special weapons platform throughout all areas of the battlefield or mission area.

- Initial needs: durable, mobile, reliable, utility vehicle to keep up with tanks.

- Evolving needs due to change in conditions and technology:
  - Added mission equipment:
    - Expand vehicle capacity
    - Add communications and weapons systems
    - 1.5 ton payload
  - New environments (changes in threat and terrain):
    - Protect Soldiers through use of additional armor
  - Obsolescence avoidance:
    - Replace obsolete hardware and software

1. U.S. Army Training And Doctrine Command Tactical Wheeled Vehicle Modernization. Operational Requirements Document, ORD for the HMMWV, 2004

Example of mission tasks:

HMMWV carrier

ART 1.1.3 Conduct Tactical Recon

1 ART 1.3.3.1 Conduct Zone Recon
2 ART 1.3.3.2 Conduct Area Recon
3 ART 1.3.3.3 Conduct Reconnaissance In Force
4 ART 1.3.3.4 Conduct Route Reconnaissance
5 ART 1.3.3.5 Conduct Reconnaissance Patrol
6 ART 1.3.4 Conduct Surveillance
7 ART 2.2.2 Conduct Actions On Contact
8 ART 2.2.3 Employ Combat Patrols
9 ART 2.2.4 Conduct Counter-ambush actions
10 ART 2.2.5 Exploit Terrain Expedite Tactical Movements
11 ART 2.2.6 Cross Danger Area
12 ART 2.2.7 Linkup Other Tactical Forces
13 ART 2.2.9 Conduct Relief In Place
14 ART 2.2.10 Navigate From Point to Point
15 ART 2.2.11 Conduct Survivability Move
16 ART 2.2.12 Negotiate Tactical Area Ops
17 ART 2.3.2 Conduct Admin Movement
18 ART 2.3.3 Conduct Tactical Road March
19 ART 2.3.4 Conduct Approach March
20 ART 2.4.1 Conduct Lethal Direct Fire Against Surface Target
21 ART 2.4.2 Conduct Non-lethal Direct Fire Against Surface Target
22 ART 2.5.2 Occupy Attack Position
23 ART 2.5.3 Establish Battle Position
24 ART 3.2 Detect Locate Surface Targets
25 ART 4.3.4 Employ Combined Arms Air Defense
26 ART 5.3.1.6 React Enemy Direct Fire
27 ART 5.3.1.7 React Enemy Indirect Fire
28 ART 5.3.1.8 React Enemy Aerial Attack
29 ART 5.3.2.1.3 Warn Personnel Of Contaminated Area
30 ART 5.3.2.1.4 Report NBC Hazards Throughout Area Ops
31 ART 5.3.5.1 Provide Screen
32 ART 5.3.5.2 Conduct Guard Operations
33 ART 5.3.5.3 Conduct Cover Operations

ART 5.3.5.4 Conduct Area Security Operations

34 ART 5.3.5.4.1 Conduct Rear Area Base Security Ops
35 ART 5.3.5.4.2 Conduct Convoy Security Operations
36 ART 5.3.5.4.3 Conduct Route Security Operations
37 ART 5.3.5.5.4 Establish Observation Posts
38 ART 5.3.6.1 Provide Protective Service Selected Individuals
39 ART 6.5.2 Provide Medical Evac
40 ART 7.2.5 Disseminate Info Other Organizations
41 ART 7.5.2 Conduct Rehearsals
42 ART 7.8.3 Maintain Continuity Command Control

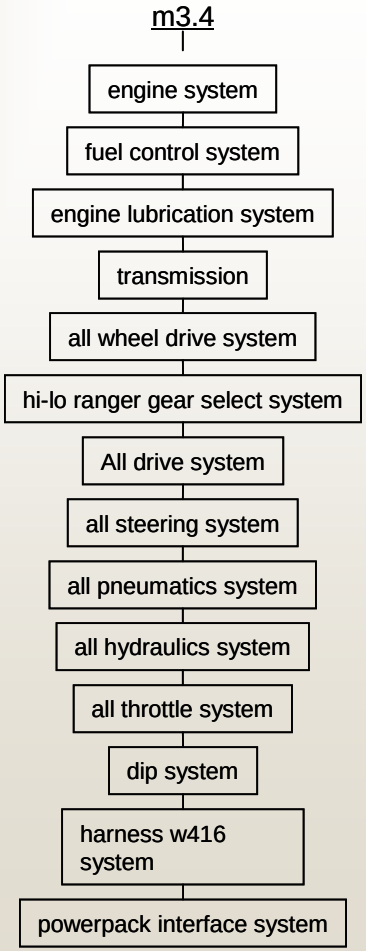
Tasks based on mission profile.

MBSE Example

HMMWV Upgrades

Understand the System

System Components Modeled



System Functions Modeled

- m_1 Reduced Maximum Speed
  - $m_{1.1}$ Reduced Maximum Speed 0-10%
  - $m_{1.2}$ Reduced Maximum Speed 10-50%
  - $m_{1.3}$ Reduced Maximum Speed 50-100%
- m_2 Reduced Maneuverability
  - $m_{2.1}$ Reduced Acceleration
  - $m_{2.2}$ Reduced Steering
  - $m_{2.3}$ Reduced Braking
  - $m_{2.4}$ Reduced Visibility
- m_3 Stop After T Minutes
  - $m_{3.3}$ Stop After 5-10 Minutes
  - $m_{3.4}$ Stop After 0-5 Minutes
- f_3 Degraded Initial Rate of Fire of Main
- f_4 Degraded Subsequent Rate of Fire of Main
- f_7 Total Loss of Firepower Main
- x_3 Lost LOS Voice
- x_4 Lost Non-LOS Data (ex. SATCOM)
- x_7 Lost External Communications
  - $x_{7.1}$ Lost Encryption Capability
  - $x_{7.2}$ Lost Channel/Frequency Selection Capability

MBT&E/MBSE Road Ahead

- Working group will continue to develop/refine MBT&E process through demonstration and coordination.
  - Execution of pilot projects.
  - Incorporation of lessons learned.
  - Papers/presentations at major symposia.
  - Coordinate with similar efforts.

- 3 Major additional tasks:
  - **Coordinate with Materiel Developer**
  - Coordinate with Capabilities Developer
  - Document Baseline MBT&E Process

Coordinate with Materiel Developer

Overall Purpose: To align MBT&E with **systems engineering** (SE) process.

Goals (Products):

- Description of products available from SE.
- Description of MBT&E modifications necessary to align MBT&E with SE.

Responsibilities:

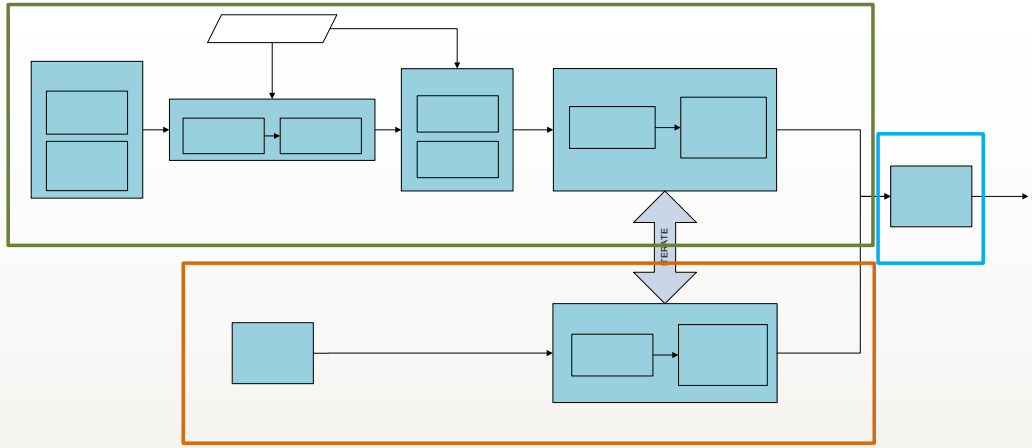
- AEC will lead.
- Primary support from PMs (through participation in pilot projects), DUSD(AT&L) and ASA(ALT).
- Other agencies support.

Schedule:

- September/October: Introduce to PMs through focused AST training sessions.
- Early November: Detailed interchanges at MBT&E WG.
- February: Report modifications to MBT&E process at MBT&E Summit #3.

MBT&E and SE

Mission-Based T&E



Understand the Mission

Systems Engineering

Requirements Analysis
- Missions and Environments
- Functional Requirements
- Define Performance Requirements

Functional Analysis
- Decompose to lower level Functions
- Allocate Performance
- Define Functional Interfaces

Synthesis
- Transform Architectures
- Define Alternative System Concepts
- Define Physical Interfaces
- Define Alternative Products & Process

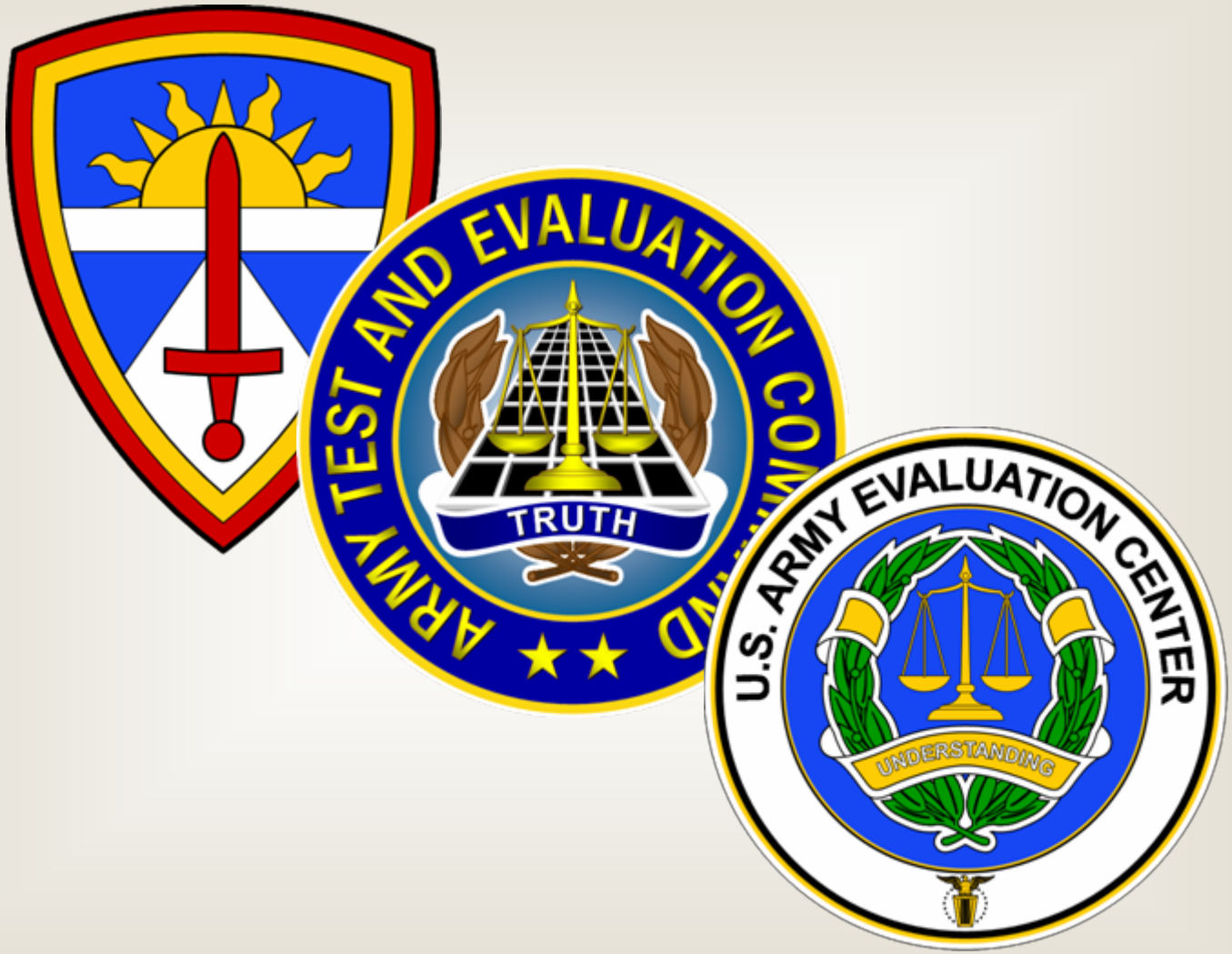
Understand the System

(2) Define Mission Context

Determine

Summary

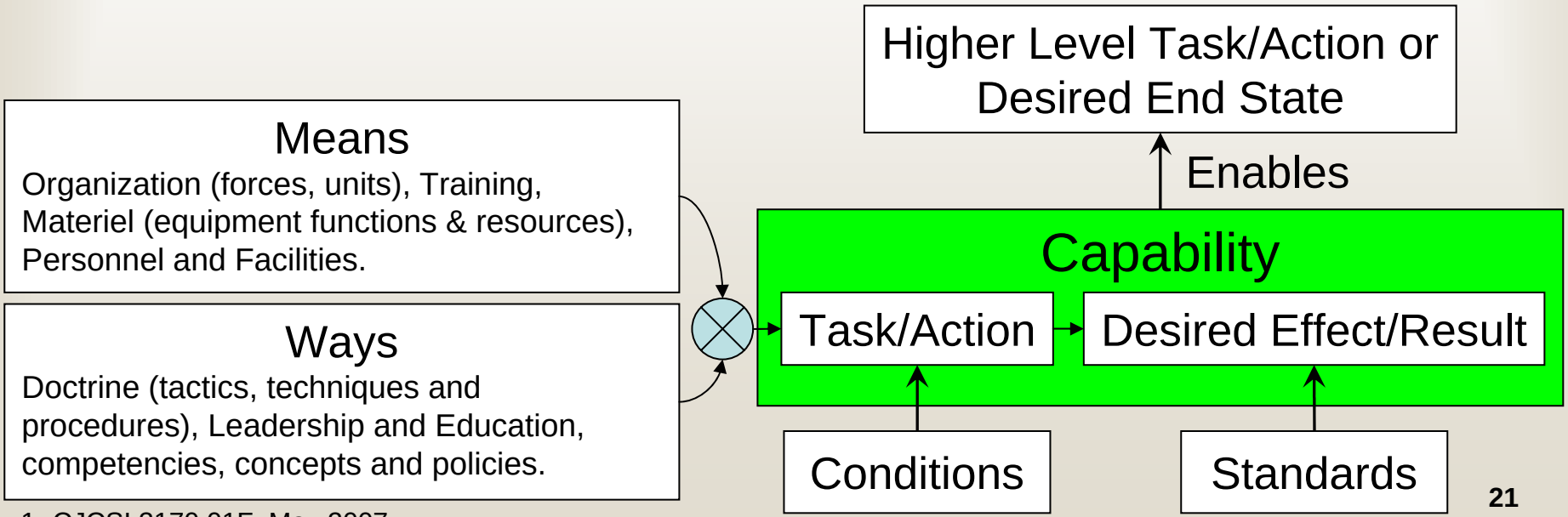
- MBT&E provides a way to link task capabilities to SoS components and functions to test and evaluation.
- SE is an essential element of system development. Mission-based SE considers the system functional requirements that provide the operational capability anticipated by the user.
- Synchronization of MBT&E and SE will provide the common framework needed to create a collaborative environment between the capabilities developer, materiel developer, and T&E.


ARMY TEST AND EVALUATION COMMAND
TRUTH
U.S. ARMY EVALUATION CENTER
UNDERSTANDING

Framework - Capability

Capability[1] – The ability to achieve a desired effect [or result, outcome, or consequence of a task[2]] …

- under specified standards and conditions
- through a combination of means and ways
- to perform a set of [higher level] tasks.



1. CJCSI 3170.01F, May 2007
2. Taken from JP 1-02, Mar 2007, definition of effect.

MBT&E Accomplishments Demonstration

- Pilot Projects Initiated.
  - 11 projects identified. Examples:
    - Aviation: Joint Cargo Aircraft + Joint Air-to-Ground Missile
    - Combat Support: Joint Light Tactical Vehicle
    - Net Fires: M109 Family of Vehicles + IAMD SoS
    - C3: WIN-T Inc 3
    - Intel: DCGS-A
    - Close Combat: Sub-combat Weapon, Counter Defilade Target Engagement (XM25)

- Focus of the Pilot Projects.
  - Validate process (usability, quality and workload).
  - Develop AST tools and training plans.
  - Solicit AST feedback for improvements.

Early Results and Feedback:
- **Process steps can be executed with current personnel skill set.**
- **Improvements in tools (templates, M&S, training, etc.) and wider community participation will increase efficiency.**

DCGS-A – Distributed Common Ground System – Army
IAMD SoS – Integrated Air and Missile Defense System of Systems

SE Policy February 2004[1]

- Systems Engineering (SE) All programs … shall apply a robust SE approach that balances **total system performance** and total ownership costs within the **family-of-systems, system-of-systems context**.
- Programs shall develop a Systems Engineering Plan (SEP) for Milestone Decision Authority (MDA) approval in conjunction with each Milestone review, and **integrated with the Acquisition Strategy**.
- DoDI 5000.2 requires a SEP for all programs

MBT&E and SE synchronized with the acquisition strategy and documented in SEP.

1. Reference?

SEP elements

- **Requirements development and management***
- Project technical planning
- Project technical monitoring and control
- **Integrated project and team management**
- **Measurement and analysis**
- Configuration management
- Risk management
- Solicitation and contract monitoring
- Transition to operations and support
- **Product validation**
- **Product verification**
- **Product integration**

*** Areas shared with MBT&E**