Evaluating the Mission – Translating System Performance to Unit Capabilities

NDIA National Test & Evaluation Conference

Atlantic City, NJ
Agenda

• Purpose
• Background
• MBT&E Fundamentals
• SE Approach
• Example
• Summary
Purpose

- Identify a Systems Engineering Approach that may be useful in translating system performance to unit capabilities
- Present a methodology that integrates the test & evaluation function with requirements analysis and materiel development
Background

• Some factors driving MBT&E:
  – McQueary-Young Memo (Dec 2007)
  – Section 231 Report (July 2007)
  – CJCSI 3170.01F JCIDS Process

• ATEC, MCOTEA, COMOPTEVFOR and AFOTEC developing approaches
  – Similarities in the Mission Task identification and decomposition process
  – Key differences are in the complexity of the evaluation methodology

• Integrated Testing (DT & OT) provides a continuum of knowledge throughout System development
Integrated Test Approach

Knowledge

Planning Ktr Test DT DT/OT OT/DT OT (Capstone Test)

Subsystem Attributes

System Attributes (KPPs)

System Performance

Limited Mission Performance

Mission Measures Integration Assessment

Testing Over Time

System Maturation
MBT&E Fundamentals

- In order to gather data that accurately answer the Critical Operational Issues (COI) and illustrate capabilities and limitations of the system, the test process must begin and end with a paradigm that ties system Attributes to operational tasks or missions at the unit level.

- Mission Based Test & Evaluation (MBT&E) represents a thought process to guide the evaluators in developing the T&E strategy
  - Must take advantage of work done before by other agents in the Acquisition process
  - Understanding the documented missions for the System vice recreating mission and task analysis

- Definitions (For the purpose of this brief)
  - **Effectiveness** – Capability of the Unit to accomplish the Mission
  - **Suitability** – Factors that Impact the Unit’s Mission Capability
SE Approach

- What Mission Tasks was the System developed to perform?
- What System Functions are required to perform those Tasks?
- What Attributes, defined in the CDD and delivered in the System, enable the function?
- Which measures in the Evaluation Matrix were identified in the JCIDS process that convinced leadership to develop the System?
JCIDS Gap Analysis Process

1. Strategic Policy Guidance
2. Capstone Concept for Joint Operations
3. Joint Operating Concepts (JOC)
4. Joint Functional Concepts (JFC)
5. Joint Integrating Concepts (JIC)
6. Integrated Architectures (IA)

- FAA Functional Area Analysis
- FNA Functional Needs Analysis
- DOTMLPF Analysis
- Will Material Changes Solve deficiency?
- Ideas For Material Approaches
- Analysis of Material Approaches
- Alternative
- Alternative
- Recommend DOTMLPF changes to solve deficiency (CJCSI 3180)

- Will Integrated DOTL PF changes solve deficiency?

Evaluating the Mission
March 2009
FAA & FNA JCIDS Analysis

**FAA**
- Joint Concepts
- Threat & Environment
- Military Objectives

Required Joint Capabilities

**FNA**

Current & Programmed Joint Capabilities

Required Capability Gaps

Attributes of Solutions to Gap

MOE

Strategy-to-Task

Gap Analysis

Provides the Foundation for the Functional Solutions Analysis (FSA) & Ultimately, the ICD

March 2009

Evaluating the Mission
Mission Task Hierarchy

Joint Operations

War (MCO)

MOOTW w/ Force

MOOTW w/o Force

Activity Model

Deter/Engage

Seize Initiative

Decisive Operations

Transition

Joint Functional Concepts

C2

BA

Force Appl

Protection

Logistics

NCW

Joint Tasks

Task 1

Task 2

Task 3

Task 12

Task 13

Task 14

Task 26

Task 27

Task 28

Task 38

Task 39

Task 40

Task 35

Task 36

Task 37

Task 54

Task 55

Task 56

Task 57

Task 79

Task 9

Task 18

Task 33
MBT&E Planning Process

- Four Basic Elements:
  - Mission analysis (Critical Operational Issue (COI) definition)
  - System performance measures (attribute traceability to functions)
  - Operating conditions (test scenario/environment description)
  - Test variables (controlled and uncontrolled)
- These items form the basis for the Scope of Test and resource requirement estimates that are included in the TEMP
MBT&E Process Responsibilities

Mission-Based Test & Evaluation Systems Engineering Process Context

- **Mission Area**
  - FAA/NAPA/FAA provide gap analysis
  - EAF ICD & TWV documents capability gap
  - COE & OOMB documents primary mission threads

- **Mission Tasks**
  - FAA/NAPA/FAA identify mission tasks
  - Mission threads, tasks define critical operational issues (COI)

- **System Functions**
  - Payload
  - Protection
  - Performance (mobility & transportability)
  - Suitability
  - CDD documents threshold functionality
  - System variants define sub-issues

- **System Attributes**
  - Evaluation matrix by vehicle category
  - Developmental tests evaluate attributes and critical technical parameters

- **System Design**
  - P-Spec documents system threshold attributes
  - Functionalized baselines document system variant designs
  - Contractor sub-component tests
  - Variant designs

Responsibilities:
- **Combat Developer Responsibility**
- **Materiel Developer Responsibility**
- **System Evaluator Responsibility**
Gap 1: Conduct Fire and Maneuver

- **EO Gap 1 Description:** The EAF combat elements cannot move rapidly & safely as a cohesive force while executing deep operational maneuver

- **EAF must be able to:** Conduct/support extended ops w/ armor
  - **Move light armor by air:** Employ, via air, the light armor elements of EAF to achieve positional advantage; 110nm in 8 hrs (TH), 6 hrs (Obj)
  - **Breach obstacles, manmade and natural:** Combat element must maneuver through or around any obstruction designed or employed to disrupt, fix, turn or block movement without delaying the force longer than 1 hr (TH), .5 hr (Obj).
  - **Protect the force from the lethal effects of kinetic energy weapons systems:** Detect & protect the force against blast, flame, thermal, fragmentation and ballistic effects by equipping 75% of the force (TH); equipping & training 100% of the force (Obj).
  - **Provide Combat ID:** Attain an accurate characterization of detected objects – friend, enemy, neutral - in the battlespace by employing Active Recognition and Tracking Systems and Passive Tracking Systems in 100% of the force (TH & Obj).

- **Characteristics of the Gap**
  - No capability to reposition light armor by air
  - Lack of mobility for vertical lift forces
  - Weight of inherent protection for combat systems adversely impacts EAF mobility
  - Unacceptable limitations in the EAF’s combat forces’ ability to detect/detonate explosive obstacles
  - Lack of active recognition and active tracking systems for employment with assault, CS or CSS elements of the EAF
Example Mission Task (COI)

*Issue: Move Light Infantry (Airborne/Air assault) via ground.*

- (Sub-Issue) The JLTV Payload Category B Vehicle will support…(based on unit T/E)
  - Payload Characteristics
    - Transport 9-man team
      - P-Spec Attributes
  - Performance Characteristics
    - Air Transport
      - P-Spec Attributes
    - Mobility
      - P-Spec Attributes
  - Protection Characteristics
    - Ballistic Survivability
      - P-Spec Attributes
    - IA
      - P-Spec Attributes
  - Suitability Characteristics
    - Availability
      - P-Spec Attributes
    - Safety
      - P-Spec Attributes

- (Sub-Issue) the JLTV Payload Category C Vehicle will support…(based on unit T/E)
  - Payload Characteristics
    - Transport Unit Shelters
      - P-Spec Attributes
  - Performance Characteristics
    - Air Transport
      - P-Spec Attributes
    - Mobility
      - P-Spec Attributes
  - Protection Characteristics
    - Ballistic Survivability
      - P-Spec Attributes
    - IA
      - P-Spec Attributes
  - Suitability Characteristics
    - Availability
      - P-Spec Attributes
    - Safety
      - P-Spec Attributes
### Mission Evaluation

#### Sub-Configurations (Variant) Matrix

<table>
<thead>
<tr>
<th>Performance</th>
<th>C2OTM</th>
<th>AMB</th>
<th>HVI Guns</th>
<th>Utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 man C2 suite</td>
<td>3 man 2 x liter</td>
<td>4 plus Gunner speed range acceleration braking etc.</td>
<td>2 man cargo etc.</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Protection</th>
<th>Ballistics</th>
<th>Ballistics</th>
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<tr>
<td>CBRNE etc.</td>
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<td>CBRNE etc.</td>
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<th>Transportability</th>
<th>CH 47/53</th>
<th>CH 47/53</th>
<th>CH 47/53</th>
<th>CH 47/53</th>
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<td>1 x IAT C130</td>
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<td>1 x IAT C130</td>
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<thead>
<tr>
<th>Suitability</th>
<th>Availability</th>
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<td>Safety etc.</td>
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</tbody>
</table>

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### Mission-Based COICs
- Move Light Infantry (Airborne/Air assault) via ground
  - Payload Category B Attributes
  - Payload Category A Attributes
    (Category mix based on Unit T/E)
- Move Combat Support forces via ground
- Etc.

### Mission-Based ROIs
- Add other Mission Tasks only as necessary based on planned tests (e.g., C2)

### Risk Analysis for TD Phase
- Vehicle capabilities indicate potential to meet COI/ROI
- Vehicle limitations indicate risk area to meeting COI/ROI
**Task:** What are the lethality capabilities and limitations of the EFSS when performing suppression missions?

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<th>Attributes</th>
<th>Result</th>
<th>Mission Measures</th>
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<tbody>
<tr>
<td>First Rd Response</td>
<td>X</td>
<td>28 sec</td>
</tr>
<tr>
<td>Max ROF</td>
<td>X</td>
<td>5.1 rds/min</td>
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<tr>
<td>Deflection</td>
<td>X</td>
<td>0.65 m</td>
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<tr>
<td></td>
<td></td>
<td>• #Successes/#Total Missions</td>
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<tr>
<td>CEP</td>
<td></td>
<td>• Operator Opinion</td>
</tr>
<tr>
<td>Range CEP</td>
<td>X</td>
<td>0.58 m</td>
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<tr>
<td>Max Range</td>
<td>X</td>
<td>6.5 km</td>
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<td></td>
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<td>• SME Evaluation</td>
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**Testing Over Time**

*DT, DT/OT, OT/DT, OT (Capstone Test)*
Conceptual Evaluation Process (Table Version)

1. Test Results

2. System Capability Evaluation (by Category)

3. Technology Risk Assessment

4. Mission Capability Assessment

5. Mission Assessment

(Evaluating the Mission)
System Capability Evaluation Table (Each Category by Vendor)

- Use Measure results to evaluate Attributes and support COI Evaluation as Met, Partially Met, or Not Met
- Overall System Assessment based on weighted COI “performance”

| INTEGRATED SYSTEM EVALUATION - Category A by Vendor |
|-----------------|-----------------|-----------------|
|                | Vendor 1 | Vendor 2 | Vendor 3 |
| Overall Assessment | Measures | Measures | Measures |
| COI Assessment Attribute | Measures | Measures | Measures |
| A-1 (Partially Met) | M-1 (Met) | A-1 | A-1 |
| M-3 (Met) | A-3 | M-3 |
| A-2 (Met) | M-5 | A-4 | A-4 |
| M-7 | M-8 | M-34 |
| M-10 | M-9 | M-36 |
| A-4 | M-10 | M-39 |
| A-4 (Met) | M-34 | M-36 |
| A-4 (Met) | M-36 | M-39 |
| A-8 (Met) | M-50 | A-8 | A-8 |
| A-9 | M-60 | A-9 | M-60 |
| A-10 | M-61 | A-10 | M-61 |
| A-12 | M-62 | A-12 | M-62 |
| A-13 | M-63 | A-13 | M-63 |

Carry etc.
Payload etc.
Sustain etc.
Survive etc.
Not Ready etc.
### Mission Capability Evaluation Table

- COIs assessment (previous table) feeds Mission Capability Evaluation
- Evaluate COIs in the context of supporting individual Mission Capabilities (limit missions to most critical/probable?)
- Across all participating variants, evaluate impact on each Mission Capability as Met, Partially Met, or Not Met

#### MISSIONS

<table>
<thead>
<tr>
<th>Overall Variant Assessment</th>
<th>General Purpose</th>
<th>Inf Carrier (Army)</th>
<th>Infantry Carrier (USMC)</th>
<th>C2OTM</th>
<th>Hvy Guns Carrier</th>
<th>Close Combat Wpns Carrier</th>
<th>Utility</th>
<th>Ambulance</th>
<th>Shelter Carrier</th>
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**MSN 1 (Conduct Mounted Movement to Contact) (Met, Partially Met, Not Met)**

**Evaluating the Mission**

March 2009
Summary (1 of 2)

• Significant analysis is conducted in the requirements development process
  – Mission Tasks, Gaps and MOEs identified
  – Alternatives selected based on performance against thresholds

• Relationship between Mission Tasks and System Functions established in JCIDS analysis is maintained during the SE decomposition
  – Mission Profile analysis is key to evaluating Suitability characteristics

• Test develops system knowledge over time
  – All phases of test support evaluation of system “maturity”
  – Operational Test evaluates the effect of the System on the Unit Mission performance
Summary (2 of 2)

• Fiscal and schedule realities typically drive testing to focus on COIs and KPPs
  – System evaluation focuses on Gap Missions and System Functions/Attributes that support mission effectiveness
  – Evaluate Critical Tasks and Issues to identify risk and scope of unknown performance
• Potentially, test results would be used to validate early M&S assumptions and analysis
• Did the system deliver the expected capability?
QUESTIONS
**Mission Profile – Operational Context**

**Operational Context**
- MPCs arrive in theater aboard MPF shipping; move ship to shore at SPOD or via connector (e.g., LCAC).
- Support infantry battalion with three variants:
  - Support infantry battalion across ROMO
    - Offensive Ops: patrolling, movement in support of maneuver, urban ops
    - Defensive Ops: patrolling, support by fire positions
    - Stability: patrolling, security ops, QRF, checkpoints, convoy security

**Summary**
- MCO oriented on forces initially; then control of key areas (APODs / SPODs / Forward Bases / Key Cities) and routes between those areas.
- Both IrW scenarios oriented on control of key areas / routes and restoring host nation capability.
- Even during MCO, large % of operations = stability operations.
- Stability operations drives larger % of on-road; wider variety of mission use.
By Category

By Vendor

- Assess the risk consequence and probability to effectively support the designated missions capabilities.