Developmental Test and Evaluation

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Agenda

- **Office of The DASD(DT&E)**
  - Mission, Roles, and Responsibilities
  - Differences between DT and OT

- **Miscellaneous Technical Areas**
  - Developmental Evaluation Framework
  - Design of Experiments
  - Design for Reliability and Reliability Growth
  - Cybersecurity T&E

- **Emerging Areas**
  - Frontiers of T&E
  - DT&E / TRMC Initiatives
**DT&E Mission:** Improve acquisition outcomes by advancing the DT&E “state of the practice,” engaging acquisition programs to position them for success, and by executing Title 10 oversight responsibilities.
## Differences between DT and OT

<table>
<thead>
<tr>
<th>Tests</th>
<th>DT&amp;E</th>
<th>OT&amp;E</th>
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</thead>
<tbody>
<tr>
<td>• Prototypes of systems, subsystems, and components</td>
<td>• Units equipped with production representative systems</td>
<td>• SoS or system-level Open Air Range</td>
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<tr>
<td>• M&amp;S, HITL, ISTF, Open Air Range</td>
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<thead>
<tr>
<th>Evaluates</th>
<th>DT&amp;E</th>
<th>OT&amp;E</th>
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<tbody>
<tr>
<td>• Performance and Interoperability</td>
<td>• Operational Effectiveness</td>
<td>• Operational Suitability</td>
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<tr>
<td>• Reliability and Maintainability</td>
<td>• Operational Suitability</td>
<td>• Survivability</td>
</tr>
<tr>
<td>• Cybersecurity Posture</td>
<td>• Operational Suitability</td>
<td>• Test Adequacy</td>
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<td>• KPP/KSA Compliance</td>
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<table>
<thead>
<tr>
<th>Informs</th>
<th>DT&amp;E</th>
<th>OT&amp;E</th>
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<tbody>
<tr>
<td>• Design improvements</td>
<td>• Improvements to TTPs and Training</td>
<td>• Combat Readiness</td>
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<tr>
<td>• Production readiness</td>
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<table>
<thead>
<tr>
<th>Organized</th>
<th>DT&amp;E</th>
<th>OT&amp;E</th>
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<tr>
<td>• Controlled by the acquisition chain of command</td>
<td>• Independent of the acquisition chain of command</td>
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**DT (can be, but) is frequently not a good predictor of OT outcomes.**
Developmental Evaluation Framework
MQ-25A (Unmanned Carrier Aviation)

MQ-25A is a carrier-based unmanned aircraft that supports long-endurance, Intelligence, Surveillance, Reconnaissance (ISR) and aerial refueling.

### Evaluates:
- Performance
- Reliability & Maint.
- Interoperability
- Cybersecurity Posture

### Includes:
- CTR Testing
- Government DT
- Lab Testing
- Cat./Trap Testing
- Sea Trials

### Informs:
- Long Lead Item Procurement
- First Flight Readiness
- Carrier Suitability
- Initial Sea Trial Readiness
- Production Readiness
- Follow on Sea Trial Readiness
- OT&E Readiness

### System Capabilities

<table>
<thead>
<tr>
<th>Capability</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Airworthiness</td>
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<tr>
<td>Environmental</td>
<td></td>
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<tr>
<td>Survivability</td>
<td></td>
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<tr>
<td>Interoperability</td>
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<tr>
<td>Cybersecurity</td>
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</table>

### System Requirements / Measures

<table>
<thead>
<tr>
<th>Development/ Evaluation</th>
<th>Operational/ Environmental</th>
<th>Technical/ Functional</th>
<th>Performance</th>
<th>Reliability</th>
<th>Interoperability</th>
<th>Cybersecurity</th>
<th>Other</th>
</tr>
</thead>
</table>

### Data Sources

- Test, M&S events

### Distribution Statement A: Approved for public release; distribution is unlimited. Cleared 17 –S-1321
Design of Experiments and the STAT COE

- Space-Based Infrared System Program, High Component
- Military GPS User Equipment (MGUE)
- Next Gen Operational Control System (OCX)
- GPS Gen 3
- Enhanced Polar System
- JSPOC

- Armored Multipurpose Vehicle
- Stryker ECP
- Joint Light Tactical Vehicle

- Combat Rescue Helicopter
- KC-46 Tanker Modernization
- Next Generation Trainer

- Logistics Modernization Program
- Air Force Integrated Personnel and Pay System
- Space Fence
- Air and Space Operations Center - Weapon System initiative 10.2
- DDG-51 Flight III Guided Missile Destroyer
- LHA-R Amphibious Assault Ship (Flight 0/1)
- Ship to Shore Connector
- Next Generation Enterprise Network
- CVN-78
- P-8
- Next Generation Jammer
- GATOR

- Joint Strike Fighter

The STAT T&E COE resides at the Air Force Institute of Technology (AFIT), Wright-Patterson AFB, Dayton, OH

- Indirect Fire Protection Capability Increment 2 – Intercept
- Common Infrared Countermeasures
- Integrated Air and Missile Defense

Army  Air Force  Navy
Design for Reliability

- GEIA-STD-009, Contract Language Promoting RAM Best Practices
- AMSAA Program Scorecard to Assess Reliability Program Plan
- DFR improves product quality and reliability
- DFR Reduces Lifecycle Costs

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Reliability Growth Planning

The most critical step ...  
- Designing for Reliability -
Assessing Reliability Maturity

AMSAA Maturity Projection Model (Infinite Case)
Expected (smooth) VS Observed (pts) Number of B-modes

\( \mu(t) = \left( \frac{\lambda_B}{\beta} \right) \ln(1 + \beta \cdot t) \)

Figure 1. Expected No. Modes.

AMSAA Maturity Projection Model
Estimated Percent Surface of B-mode Initial Failure Rate

\( \theta(t) = \frac{\beta \cdot t}{1 + \beta \cdot t} \)

Figure 2. Percent \( \lambda_B \) Observed.

AMSAA Maturity Projection Model
Estimates for the Expected Rate of Occurrence of B-modes

\( h(t) = \left( \frac{\lambda_B}{1 + \beta \cdot t} \right) \)

Figure 3. ROC of New Modes.

AMSAA Maturity Projection Model
MTBF Projections

\( M(t) = \left[ \lambda_A + (1 - \mu_d) \cdot \left( \lambda_B - h(t) \right) + h(t) \right]^{-1} \)

Figure 4. Reliability Growth.
Cybersecurity T&E

- **Requirements**
  - January 2017, cybersec in SS KPP

- **Policy**
  - January 2017 - DODI 5000.01

- **Guidance**
  - July 2015 – DoD Cybersecurity T&E Guidebook
  - September 2015 – DoD PM’s Cybersecurity Guidebook
  - January 2017 – Cyber Survivability Implementation Guide
  - February 2017 – Defense Acquisition Guidebook

- **Training**
  - Defense Acquisition University
  - Cyber Tabletop Events
  - Cross-Service Working Groups

- **Investments**
  - T&E infrastructure
  - Manning for cyber test teams
  - Cybersec evaluations of Major Defense Programs
Previous Offset Strategies

First Offset Strategy. Emphasis on nuclear deterrence to avoid the large increase in defense expenditures necessary to conventionally deter Warsaw Pact forces during the 1950s.

Second Offset Strategy. Emphasized: Intelligence, Surveillance, and Reconnaissance (ISR) platforms; Precision-Guided Weapons; Stealth Technology; and the expansion of space’s role in military communications and navigation.

These Offset Strategy’s technologies continue to enable U.S. global precision strike today.
A Third Offset Strategy

• **Autonomous Learning Systems**
  – Delegating decisions to machines in applications that require faster-than-human reaction times
  – Cyber Defense, Electronic Warfare, Missile Defense

• **Human-Machine Collaborative Decision Making**
  – Exploiting advantages better and faster human decisions
  – “Human strategic guidance combined with the tactical acuity of a computer”

• **Assisted Human Operations**
  – Helping humans perform better in combat

• **Advanced Manned-Unmanned System Operations**
  – Employing innovative cooperative operations
  – “Smart swarm” operations and tactics

• **Network-enable, autonomous weapons hardened to operate in a future Cyber/EW Environment**
  – Allowing for cooperative weapon concepts in communications-denied environments
1. Improve TRMC/DT&E collaboration
2. Emphasize Shift Left
3. Institutionalize the Developmental Evaluation Framework
4. Implement the TEMP at MS A
5. Advocate for the T&E Workforce
6. Improve support to PMs and Chief Developmental Testers
7. Improve reliability T&E
8. Improve cybersecurity T&E
9. Improve interoperability T&E
10. Improve hypersonics infrastructure
11. Incorporate big data/knowledge management into T&E
12. Understand/improve T&E of autonomous systems
13. Improve Mission Context in DT
Questions?