Video - T&E supports readiness ...
Test ... it’s not a four letter word.

NDIA Brief
Presented by Mr. Robert Miele
1 March 2017
AGENDA

• Why Do We Test?
• TRL vs. Test
• How Consumer Reports Tests Vehicles
• Army Capability Gaps
• Questions We Answer
• Design of Experiments
• COTs/NDI = No Test
• Test Examples
• Where Do We Test
• Summary
Why Do We Test?

- Verify Safety
- Minimize Design Risks
- Validate Requirements
- Performance Specs
- Ensure System can be used in realistic Operational environment
- Inform Decision Makers
## Technology Readiness Levels and T&E

<table>
<thead>
<tr>
<th>TRL</th>
<th>TRL Description</th>
<th>Decision</th>
<th>Phase</th>
<th>DT</th>
<th>OT</th>
<th>ATEC Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Actual system proven through successful mission operations.</td>
<td>O&amp;S</td>
<td>PVT/ FAT/ LAT Surveillance</td>
<td>FOT</td>
<td>OFER*, SC*, Position Memo*</td>
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<tr>
<td>8</td>
<td>Actual system completed and qualified through test and demonstration.</td>
<td>FRP/ FD</td>
<td>P&amp;D</td>
<td>PQT/ SQT LFT</td>
<td>IOT</td>
<td>OER, SC, Position Memo</td>
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<tr>
<td>7</td>
<td>System prototype demonstration in an operational environment.</td>
<td>MS C</td>
<td>TMRR</td>
<td>TFT Comp. Proto.</td>
<td>EUT</td>
<td>OMAR, SC*</td>
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<tr>
<td>6</td>
<td>System/ subsystem model or prototype demonstration in a relevant environment.</td>
<td>MS B</td>
<td>EMD</td>
<td>EDT/ SDT</td>
<td>LUT</td>
<td>OMAR, SC*</td>
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<tr>
<td>5</td>
<td>Component and/or breadboard validation in relevant environment.</td>
<td>TMRR</td>
<td>MS A</td>
<td>Market Research TFT</td>
<td></td>
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<tr>
<td>4</td>
<td>Component and/or breadboard validation in laboratory environment.</td>
<td>MSA</td>
<td></td>
<td></td>
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<td>3</td>
<td>Analytical and experimental critical function and/or characteristic proof of concept.</td>
<td>MSA</td>
<td></td>
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<tr>
<td>2</td>
<td>Technology concept and/or application formulated.</td>
<td>MSA</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1</td>
<td>Basic principles observed and reported.</td>
<td>MSA</td>
<td></td>
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</tbody>
</table>

DT verifies functional requirements. OT validates operational need.
How Consumer Reports Test Vehicles*

Vehicle Testing
- ~60 vehicles/year
- ~900K miles
- 2K break-in miles over several weeks
- 50 instrumented tests including:
  - Acceleration
  - Transmission
  - Routine/Emergency Braking
  - Routine/Emergency Handling
  - Fuel Economy
  - Headlights
  - Safety
  - Off-Road Capability
  - Tire Testing

Consumer Reports Vehicle Test Facility
- 327 Acres + local roads
  - 4,400' main straight
  - 3500' handling course
  - Accident Avoidance Course
  - 33 degree rock hill
  - Brake Test facility (wet & dry)
- Staff Includes:
  - Engineers
  - Editors
  - Statisticians
  - Technicians
  - Photographers/videographers
  - Support staff
- $2.1M buying vehicles

TRL 9 Items tested by unbiased organization to provide consumer information on units intended environment

* http://www.consumerreports.org/cars-how-consumer-reports-tests-cars/
Army Capability Gaps - Requirements

**/★★

AROC Review Board (ARB)

★★★★

Strategic Portfolio Analysis Review (SPAR)
25 Years Ahead
18 Portfolios
All Army Systems

★★★★

Army Requirements Oversight Council (AROC)

1-5 Years

Gain concurrence on future portfolio objectives / priorities
Major Questions We Answer

**IS IT EFFECTIVE**
Does it do what is needed . . .

**IS IT SUITABLE & SAFE**
Can Soldiers safely Operate and Train with the system and use it in the intended environment . . .

**IS IT SURVIVABLE**
Is it survivable against the known threats that it is meant to defeat or deter . . .
How Requirements Drive Test

Requirements
• Autonomous: Mountainous Terrain
• Reliability: 10K MTBF
• Temperature Range: -25 to 120°F

Test Design

COA 1
• 10K miles on flat paved roads

COA 2
• 10K miles on flat paved roads
• Hot and Cold Test Chambers
• One test vehicle

COA 3
• 10K miles on flat paved roads
• 10K miles on Mountainous roads
• Temperate, desert & Cold Natural environments
• 3 test vehicles
• Demonstrate reliability at 85% confidence level

DOE provides:
• the most powerful allocation of test resources for a given number of tests
• a scientific, structured, objective way to plan tests
• an approach to integrated test
• a structured, mathematical analysis for summarizing test results
• enables defensible conclusions about system performance
COTS/ NDI ≠ No Testing

Pickup was designed for on & off-road operation ...
Radio kit was designed for operation ...
Both were independently tested ...

Radio kit Installed ...

What is your level of confidence with ...
- Off-road radio operation?
- Off-road radio kit durability?
- Operator safety?

COTS/ NDI may not be designed for intended Military environments and operations.

Testing will reduce program risk and increase confidence in operational effectiveness, operational suitability, survivability, and user safety.
Brake Test Example
Family of Medium Tactical Vehicles
Hidden Failure Modes!

- Testing based on perceived worst case scenario (combat load and OMS/MP)

- Missed catastrophic failure mode that occurs when empty at highway speeds

Testing needs to be optimized to establish the systems performance envelope
Summary

• Strong Systems Engineering (SE) and analysis processes can improve system performance.
  o Requirements analysis
  o System design and development
  o Environment, Safety, & Occupational Health

• Utilize ATEC expertise to support and inform SE processes.
  o Requirements refinement
  o Testability
  o Corrective action assessments

• Utilize ATEC capabilities and resources
  o Early Soldier involvement during Field tests in realistic environments

“Testing the right system, the first time, saves time and money.”