

Enhancing Test and Evaluation (T&E) for Joint Warfighting

Providing the Tools for Testing in a Joint Operational Environment

A key DoD tenet for the transformation of our military forces is strengthening our joint warfighting capabilities. Typical of the increasing emphasis on joint warfighting is the development of the Joint Capabilities Integration and Development System (JCIDS). JCIDS will be the process to identify joint warfighting capability gaps and, where material solutions are warranted, the weapon system developments to fill these gaps. The result will be defining weapon system capabilities in terms of their contribution to joint warfighting. Weapon systems are to be “born joint”, fully integrated and interoperable with joint forces and operational concepts. This evolving approach will necessitate some changes in the way we conduct T&E.

Developing and fielding joint force capabilities requires adequate, realistic test and evaluation in a joint operational context. The T&E community must adjust test methods and develop the necessary test systems and tools to evaluate these joint capabilities. Currently, T&E focuses primarily on testing a single weapon system operating within the context of a single military service. From a resource perspective, an adequate capability to conduct operational testing in a joint environment will consist of several components:

- The optimal use of live forces to evaluate systems and systems-of-systems in a joint operational environment. Assembling the necessary joint forces for testing will always be a challenge. One way to meet this challenge is a greater use of Guard and Reserve forces in joint test events to enable us to “test like we fight”. Another way is to use, where appropriate, joint training exercises such as those conducted by the Joint National Training Capability (JNTC).
- The use of common or interoperable test instrumentation. Wherever possible, future instrumentation must enable testing in a joint environment by being “interoperable” or common among the test, training, and experimentation communities and among Service facilities.
- The use of a persistent T&E networking infrastructure that links live systems with distributed virtual and constructive models and simulations. Live systems operating in live environments will remain the core of operational testing. However, a networked joint mission environment will enable the selective use of virtual and constructive models and simulations to augment the live test environment. A key tenet of this infrastructure is persistence so that it is readily available.
- The use of suitable models and simulations to enhance operational testing. To be of value, modeling and simulation representations of threats, environments, and systems must be readily available and effectively verified, validated, and accredited for use in operational testing.

Enhanced Partnerships with the Training Community

DOT&E continues to expand its relationship with U.S. Joint Forces Command (JFCOM). The past year has seen several significant areas of collaboration which include:

- Co-development of requirements for test and training ranges and facilities to support joint training, joint testing, and experimentation.
- Coordination of test and training range improvements needed to support joint training, joint testing, and experimentation.
- Cooperative planning for future joint exercises and experiments and execution of current events to ensure optimum utilization of existing capability.

DOT&E collaborated with JFCOM during the past year in examining common infrastructure approaches to meet the needs of both testing and training. Additionally, DOT&E continues to examine, in partnership with JFCOM, approaches to leveraging JNTC training events as venues to conduct T&E. This effort offers opportunities to significantly enhance the realism of the joint operational test environment while taking maximum advantage of available live forces for testing purposes. DOT&E continues to make major strides toward test and training range integration and interoperability.

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T&E Resources and Facilities Challenges

The primary challenge regarding T&E resources will be to ensure T&E capabilities meet the demands of new warfighting technologies and evolving operational concepts. Adequate test capabilities must be in place, ready to test new systems throughout their development cycle. A number of test capability shortfalls limit the ability to conduct complete and adequate test and evaluation across a variety of warfare areas.

AIR WARFARE

T&E capability challenges in the area of air warfare include:

- Developing more effective threat simulators for missile warning and infrared missile countermeasures testing. Current methods for testing aircraft countermeasures against modern, seeker-aided surface-to-air threats are not adequate.
- Developing adequate and sufficient full-scale aerial targets. The Services have not yet agreed on an approach for replacing the dwindling inventory of QF-4 full-scale aerial targets. Current full scale targets do not satisfy future operational test and evaluation requirements for threat signature and performance.
- Developing adequate mobile ground targets. Adequately testing manned and un-manned aircraft in land attack mission areas requires high fidelity, remote-controlled surface targets, both expendable and reusable.
- Developing a capability to adequately test sensor-to-shooter networks. To adequately test networked sensors, command and control systems, and weapons, test ranges require upgrades that provide for improved on-range and off-range control, high-bandwidth data transfer, secure communications, and electromagnetic spectrum clearance.

LAND WARFARE

T&E capability challenges in the area of land warfare include:

- Developing Real-Time Casualty Assessment Instrumentation (RTCA). The Army's current RTCA has a number of significant shortcomings including spectrum encroachment, encryption vulnerability, and range and engagement fidelity limitations. Current RTCA cannot replicate the full range of combat interactions to include air-to-ground and ground-to-air engagements.
- Developing instrumentation for beyond line-of-sight engagements. Current testing of ground-to-air and ground-to-ground beyond-line-of-site weapons at standoff ranges is a challenge for existing tracking and data collection systems. Ranges require upgrades and investment in new technologies to provide extended range exercise control.
- Developing a more robust Intelligence, Surveillance, and Reconnaissance (ISR) T&E capability. Network-centric operations and the increasing capability and complexity of ISR systems requires a more complex and integrated test environment with improved multi-spectral threat signatures.
- Developing adequate Military Operations in Urban Terrain (MOUT) test facilities. Current MOUT facilities are not adequately instrumented for T&E. Additionally, existing MOUT facilities lack size and diversity in urban terrain.
- Developing adequate Electronic Warfare environments for T&E. Network-centric operations increase the potential vulnerability of systems to electronic warfare threats. The test infrastructure to evaluate these vulnerabilities is not adequate and open-air jamming restrictions make it very difficult to conduct testing near major population centers. T&E of network radios and GPS systems is conducted with synthetic jamming, but there is no synthetic capability for testing radios operating above 250 MHz.
- Developing adequate mobile targets with common control systems to increase both efficiency and flexibility. A common set of targets that can be controlled on any test range or training range does not exist.

NAVAL WARFARE

T&E capability challenges in the area of naval warfare include:

- Developing upgrades to littoral/shallow water T&E capabilities. The Navy lacks the capability to conduct instrumented, distributed littoral/shallow surface and underwater T&E over large, operationally realistic areas.
- Developing upgrades to existing self defense test ship capabilities will be essential to testing the air defense effectiveness of integrated ship combat systems. This T&E capability is essential to at least seven major acquisition programs.

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- Developing signature measurement test capabilities to keep pace with system developments. Acoustic, radio frequency, and infrared signature measurement capabilities for naval systems require upgrades to meet the testing requirements of new ships in development.
- Developing adequate supersonic sea skimming threat targets. The navy faces a critical shortage of supersonic sea-skimming missile targets.
- Developing adequate multiple small craft test capabilities. The Navy lacks the ability to adequately test sensor and weapon systems against groups of small craft representing today's littoral threat.

CHEMICAL AND BIOLOGICAL DEFENSE

T&E capability challenges in the area of chemical and biological defense systems include:

- Developing adequate and sufficient chambers to support live agent testing. There are insufficient chambers to accommodate complete end-to-end testing of the detection systems currently under development.
- Developing adequate and sufficient chemical and biological simulants and dispersion models. Current threat simulants and predictive dispersion models are not threat representative.
- Developing adequate and sufficient referee systems. Current referee systems used to establish ground truth during testing lack mobility, are unacceptably slow in data reduction and presentation, or cannot keep pace with the current test load.

OTHER RESOURCE ISSUES

Closure of NASA Wind Tunnels

In the spring of 2003, the National Aeronautics and Space Administration (NASA) inactivated three subsonic wind tunnels at the Ames Research Center in California. Two of those tunnels, the 80 x 120-foot and 40 x 80-foot tunnels, are the world's largest wind tunnels. Together, they comprise the National Full-Scale Aerodynamic Complex (NFAC). The third tunnel is the 12-foot pressure wind tunnel.

Shortly after NASA inactivated the wind tunnels, DOT&E tasked the Institute for Defense Analyses (IDA) to conduct an assessment of the effect that the closure of those facilities would have on DoD and the supporting U.S. aerospace industry. The IDA study found that DoD would be adversely affected by the closure of the NFAC, and that the loss of the NFAC would be particularly detrimental to rotorcraft research and development. It would also eliminate the only wind tunnel in the United States capable of conducting full-scale testing of aircraft. The highest priority recommendation in the IDA study was that DoD take ownership of (or lease) the NFAC from NASA, assume operational responsibility for the facility, and upgrade it to meet the current and future needs of the Department.

The DoD response to date has been an effort to identify the cost of assuming ownership and operation of the NFAC from NASA, as well as the extent of DoD's need for the type of large and full-scale subsonic wind tunnel testing that can only be conducted in this facility. With that information, senior managers in DoD can weigh the costs and benefits of taking control of the facility and decide whether or not to arrange to transfer the facility from NASA to DoD.

Range Encroachment

Encroachment refers to the cumulative result of outside influences that inhibit normal military testing and training. It includes urban sprawl near military areas; loss of frequency spectrum; restrictions on using land, air, and sea space; and migration of endangered species to ranges. A steady increase in encroachment has serious consequences and threatens the use of DoD's test and training ranges.

Of the eight-provisions in the legislative package (submitted to the Congress by the Administration in FY02), five have been passed. Congress has yet to act on the three remaining proposals in the Readiness and Range Preservation Initiative. The three provisions, resubmitted in FY04, reaffirm the principle that military land, marine areas, and airspace exist to ensure military preparedness while ensuring that DoD remains fully committed to its stewardship responsibilities. These three proposals remain essential to the Readiness and Range Preservation Initiative.

Equally important Readiness and Range Preservation Initiative are the outreach efforts with other government agencies, local communities, and non-government organizations in which DoD is engaged. These efforts are strategically focused within DoD but enacted to suit the unique needs of each test or training range within the local area and community. This

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has led to valuable partnerships, allowing us to work together to address encroachment issues to the mutual benefit of diverse interests.

DOT&E T&E RESOUC E PROGRAMS

Central Test and Evaluation Investment Program (CTEIP)

CTEIP is an OSD-managed program established to develop T&E capabilities normally considered beyond a single Service's area of responsibility. Its objectives include applying state-of-the-art technology to correct deficiencies in T&E capabilities and improving the efficiency of the test process; improving interoperability and interconnectivity among test facilities and ranges; developing, validating, and integrating modeling and simulation with open-air testing; and developing mobile test instrumentation as an alternative to fixed facilities.

One portion of CTEIP, the Resource Enhancement Project (REP), provides quick-reaction, near-term solutions to test shortfalls in support of ongoing operational test programs. REP funding is appropriate when the timeframe from the definition of need through critical test dates does not allow sufficient time in the budget cycle to fund the required capability through normal Service processes.

Currently, CTEIP has over 50 ongoing projects with total funding budgeted at \$388 million over the next three years. DOT&E is taking the initiative to make T&E instrumentation and capabilities being developed under CTEIP available to the training and experimentation communities. We are doing this in collaboration with the Office of the Under Secretary of Defense for Personnel and Readiness and JFCOM. Three of these projects are:

- Test and Training Enabling Architecture (TENA). This project is developing and validating a common architecture and requisite software to integrate testing, training, simulation, and high-performance computing technologies, distributed across many facilities.
- Enhanced Range Application Program (EnRAP). While primarily aimed at improving the accuracy of Time-Space-Position Information by means of an advanced GPS receiver and inertial measurement unit, EnRAP will also improve interoperability by using TENA-compliant interfaces to enhance the ability of test ranges and facilities to draw upon the test resources of other test and training ranges and facilities.
- Advanced Range Telemetry (ARTM). ARTM is focused on developing technology that allows aeronautical telemetry used in testing to more efficiently use the available radio frequency spectrum.

Test and Evaluation/Science and Technology (T&E/S&T)

The T&E/S&T Program transitions technologies from the labs to the T&E community so that test capabilities can keep pace with evolving weapons technology. The Test Technology Area Plan, updated in September 2004, details the overall program. In summary, we continued to address test issues in five critical areas during FY04:

- Hypersonic Test. Develops technologies needed to test air-breathing systems at or above Mach 5. These technologies will support National Aerospace Initiative demonstration schedules and future hypersonic system needs.
- Spectrum Efficient Technology. Develops technologies to better use current telemetry spectrum. Also explores issues related to future use of the Super High Frequency band for telemetry.
- Multi-Spectral Test. Develops technologies needed to test multi- and hyper-spectral sensors and seekers. These technologies will provide realistic multi-spectral simulation of battlefield systems in all types of environments and weather conditions.
- Embedded Instrumentation. Develops technologies for smaller instrumentation suites that don't adversely impact systems under test while providing data in support of continuous T&E.
- Directed Energy. Develops technologies needed to assess High Energy Laser and High Power Microwave performance and target interaction to support testing of directed energy weapons.

Threat Systems

DOT&E uses Defense Intelligence Agency (DIA) assets to provide test resource analyses on the availability, capabilities, and limitations of threat representations used for T&E. These DIA assets manage the Threat Simulation

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Investment program which sponsors investments toward applying technology and innovations to solve threat representation shortfalls. Through this effort, DOT&E is investing in projects to provide realistic, threat-representative targets and to provide enhanced threat representations for T&E. Projects of particular interest are:

- **Targets**
 - Full-Scale Aerial Targets. The Target Management Initiative (TMI) program funded upgrades to improve low altitude target control and more precise vector miss distance end game scoring to support future missile testing.
 - Sub-scale Aerial Targets. The TMI conducted studies to define modifications required to the existing sub-scale target drone inventory to better represent the current and emerging threat. In addition, the TMI funded multiple projects to provide low altitude target control, surface target scoring, and sub-scale target signature augmentation.
 - Anti-ship cruise missile. A project studied the performance and feasibility of two candidate target systems to address supersonic naval missile threats. Wind tunnel testing on both candidate systems commenced in FY03.
 - Diesel-electric submarine target. The Mobile Acoustic Source project develops a mobile diesel electric submarine simulator with highly robust acoustic and dynamic characteristics for use in high-risk, open-ocean, and shallow water environments.
- **Threat Simulators**
 - Multi-spectral test capabilities. The infrared/ultra-violet end-to-end test requirement study will develop a tri-Service functional design requirement for threat simulators that support testing of aircraft missile warning and infrared countermeasures systems.
 - New threat simulators to evaluate wireless networks for their vulnerability to jamming during unmanned air vehicle operations, to replicate different air-to-air infrared threats for directed countermeasure T&E, and to evaluate missile plumes for more realism in testing missile warning systems and directed infrared countermeasure programs.

International Programs.

DOT&E continues to work with the international T&E community through its International Test and Evaluation Program. The program provides reciprocal access to the test and evaluation resources of the United States and its allies through cooperative agreements. The agreements provide for the cooperative sharing of the cost of testing and the ability to exchange or “loan” equipment between countries. The agreements also allow for “familiarization visits” to foreign ranges, which allows testers and program managers to explore unique capabilities or assets, and provides preferred rates to customers that utilize the agreements.

In FY04, DOT&E concluded negotiations and finalized a cooperative agreement with the Netherlands. With the addition of the Netherlands, there are now four IT&E cooperative agreements in place (Canada, France, Australia, and the Netherlands). In FY05, DOT&E expects to complete negotiations with the United Kingdom, making the British the fifth ally to sign a cooperative T&E agreement with the United States. Over the past two years, besides providing U.S. program managers access to the test capabilities and technologies of our foreign allies, the agreements have also provided over \$25 million in revenues to U.S. ranges.

A recent test activity administered through the Canada-U.S. cooperative agreement was the quick reaction testing of various weapon systems mounted on a Stryker platform to support operations in the Middle East. Since no Strykers were available to perform the tests, nearly-equivalent Light Armored Vehicle/Cougar vehicles were loaned by Canada. The results of this test will provide the basis for retrofitting Stryker vehicles with appropriate weaponry for immediate use.

