

# SYSTEMS AND TEST RESOURCES

## Overview

This past year, the DoD T&E community has continued its efforts to refine the T&E infrastructure for the future. This T&E infrastructure must be both efficient in its use of available resources and adaptive to the test needs of advanced technology weapon systems and transformational joint warfighting concepts.

### **TRANSFORMING T&E TO MEET FUTURE CHALLENGES**

Establishing an effective strategic planning process for T&E resources is an important first step in ensuring the prerequisite T&E capabilities are in place to support the acquisition of transformational warfighting systems. Such a process will help focus scarce T&E investment resources towards the most critical needs. A long-term, comprehensive plan that identifies and addresses future needs is essential to true transformation of T&E capabilities. The recent establishment of the DoD Test and Resource Management Center (DTRMC) is a step toward this end.

The National Defense Authorization Act for FY03 called for the establishment of DTRMC. The DTRMC reports directly to the Under Secretary of Defense for Acquisition, Technology, and Logistics and has the following responsibilities: review and provide oversight of DoD budgets for T&E facilities and resources; biennially, prepare a strategic plan for DoD T&E resources; certify proposed budgets for T&E activities; and administer the Central Test and Evaluation Investment Program (CTEIP) and the Test and Evaluation/Science and Technology (T&E/S&T) Program. The DTRMC has two major interrelated functions, to develop and maintain a strategic plan for T&E and to certify the adequacy of T&E resources.

Congressional direction requires a strategic plan every two years that covers the next ten-year period. The plan is to be based on a comprehensive review of DoD T&E requirements and the adequacy of T&E facilities and resources to meet these requirements. DoD will use the DOT&E annual report, the DoD Science and Technology strategic plan, Service planning documents, and task forces comprised of Service/Agency acquisition and T&E staffs. The plan will include the following:

- An assessment of DoD T&E requirements for the period covered by the plan that identifies performance measures associated with the successful achievement of T&E objectives, assesses the T&E facilities and resources needed to meet such requirements and satisfy such performance measures, and assesses the current state of DoD T&E facilities and resources.
- An itemization of acquisitions, upgrades, and improvements necessary to ensure that DoD T&E facilities and resources are adequate to meet such requirements and satisfy such performance measures. This itemization will include an assessment of the budgetary resources necessary to implement such acquisitions, upgrades, and improvements.

Although the first T&E strategic plan prepared by interim personnel will not be a comprehensive strategic plan, subsequent plans will provide the necessary level of detail to guide DoD's T&E resource investment decisions.

The long-term goal of budget certification is to assess how well the budgeted resources comply with the strategic plan. The FY05 budget certification will be limited to complying with the congressional direction to reverse the trend of increasing test costs to customers of the Major Range and Test Facility Base (MRTFB). The objective is to charge customers only for direct test costs. The certification will also assess progress towards satisfying needs identified in the FY03 Test Resource Master Plan (TRMP) prepared by the Services.

In October 2002 at the direction of the Secretary of Defense, DOT&E led a study to identify future T&E infrastructure investments required to adequately test weapon systems both currently under development and likely to emerge from new technologies. In preparing that study, DOT&E conducted workshops to identify needed T&E capabilities that ensure adequate and affordable testing into the future. The product of this effort was a draft T&E Modernization Plan. This plan was subsequently integrated with the existing Service TRMP as a baseline for the development by the DTRMC of the DoD T&E Strategic Plan.

# SYSTEMS AND TEST RESOURCES

The modernization planning effort noted that existing T&E capabilities would not be adequate to support future weapon system development and identified a number of T&E capability shortfalls. Among others, shortfalls were identified in the following areas:

- Interoperable test and training ranges.
- Common joint test instrumentation.
- Interoperability testing - Upgraded distributed test beds and increased emphasis on testing of system-of-systems and command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) capabilities are needed.
- Size of test ranges - Current T&E ranges are not large enough to test the greater reach of weapon systems under development. The maneuver areas used to test new joint operational concepts also require expanded range space.
- Test facilities for urban warfare.
- Shallow water (littoral) test capability.
- Space range - A T&E capability to test space systems in orbit is needed.
- Wind tunnels - Future aircraft will encounter technical challenges that require improved wind tunnel test capability.
- Threat representation - Realistic threat representations for all warfare areas, to include improved targets are needed.
- Capability to test hypersonic systems throughout their flight regimes.
- Capabilities for testing directed energy weapons.
- Test data management, processing, and analysis.

One of the principal requirements for the transformed military is that it must be a cohesive joint force. From inception, weapon systems must be developed and tested in a joint context, not in the “Service-centric” manner of the past. Over the past year, a number of steps have been taken to improve the links between T&E and the joint operational community. DOT&E is closely following the development of the Joint National Training Capability (JNTC). Testing, training, and experimentation all share some common requirements, to include the need for a robust simulated combat environment, accurate instrumentation to determine “ground truth,” and similar analytic approaches to understanding what took place and why. The approach JNTC is taking to link training ranges and training capabilities in a persistent distributed network should also be adapted for T&E.

DOT&E continues to develop a relationship with U.S. Joint Forces Command (JFCOM). During the past year there was a major expansion of the Memorandum of Agreement (MOA) between the two organizations. Among the expanded activities will be:

- Development of requirements for test and training ranges and facilities to support joint training and experimentation.
- Coordination of test and training range improvements needed to support joint training and experimentation.

## SYSTEMS AND TEST RESOURCES

- Planning for future joint exercises and experiments and execution of current events to ensure optimum utilization of existing capability.
- Reviewing, shaping, and scoping Joint T&E (JT&E) nominations to focus the initiatives on solving joint warfighting deficiencies in tactics, techniques, and procedures.

JFCOM and DOT&E personnel are engaged in re-engineering JT&E and future partnerships.

DOT&E continues to make major strides towards test and training range integration and interoperability. DOT&E leveraged the JFCOM Joint Combat Identification Exercise in August to demonstrate a prototype of the Test and Training Enabling Architecture (TENA). TENA is a set of architectures designed to enable interoperability among various range facilities, instrumentation, and simulations in a quick, cost-efficient manner. Currently, range systems tend to be non-interoperable, “stovepipe” systems. Validation of TENA as the JNTC architecture is planned for January 2004 in a Western Range Complex Training Event.

The process of thoroughly examining and restructuring T&E policies, processes, and capabilities in order to ensure DoD meets the challenges of transforming the U.S. military is vital. DoD must keep what works, discard what does not, and remain flexible in adapting to new requirements. There must be a corporate approach to policies, processes, and investment priorities in order to accomplish this.

DoD is transforming to meet the dynamic operational requirements of the war on terrorism and future high-technology conflict. This transformation is not limited to new hardware and technological innovation. It also involves transforming T&E capabilities. The future T&E infrastructure should comprise a comprehensive suite of joint, interoperable capabilities that provide a spectrum of opportunities to test new technologies, improved platforms, and innovative tactics and training methods.

# SYSTEMS AND TEST RESOURCES

## Issues in the T&E Infrastructure

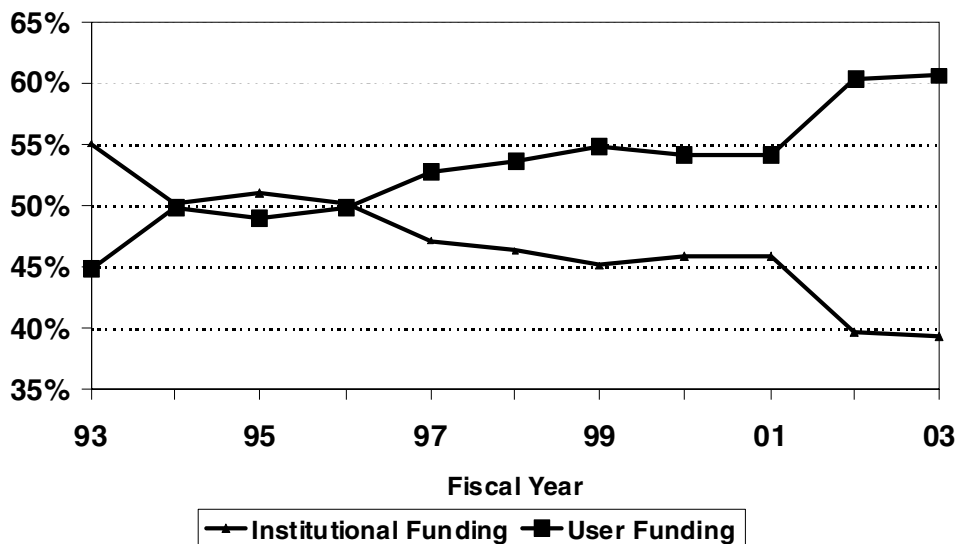
### CONSISTENCY OF FUNDING AND CHARGE POLICIES.

The costs borne by the test customer at different ranges influences the adequacy of testing. DoD policy calls for customers to pay for the direct costs associated with testing while the range or center parent organization pays for sustaining the test facility's availability. DoD implemented this uniform-charge policy to ensure that decisions about where and when to test would be based on program technical requirements rather than differences in cost.

Recently, the DoD Inspector General examined MRTFB funding and concluded that ranges were not funded in a uniform and consistent manner. As a result, DoD lacks the comparable budget data needed to make informed decisions about the funding levels necessary to adequately maintain test facilities. Furthermore, Program Managers may lack the relevant information necessary to make informed test decisions for their programs.

Between FY93 and FY03, the portion of MRTFB funding borne by test customers increased from 45 percent to over 60 percent. This shift resulted from the failure of institutional funding for the MRTFB to compete successfully with other demands in the Service programming and budgeting processes. This shift in costs to the customers may contribute to a reduction in developmental testing.

Percent of Total Test Funding



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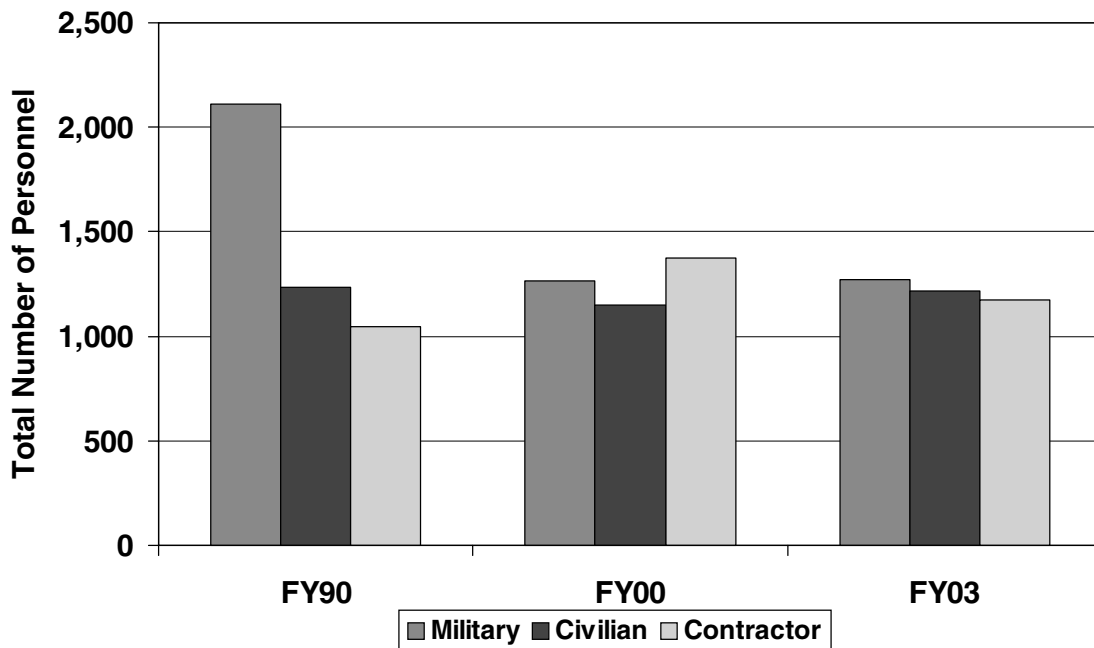
Congress addressed the funding policy in the FY03 Defense Authorization, noting that there had been a significant shift in cost to users over the past decade. Congress directed that this trend be reversed by FY06, and specified the categories of cost that should be paid by users and the funding that should be included in the institutional operating budgets for the MRTFB. The DTRMC is evaluating the extent to which the additional costs to users are consistent with the categories directed by Congress. Those that are not consistent will be corrected by FY06.

### UNDERMANNED OPERATIONAL TEST AGENCIES (OTA)

The adequacy of the OTA workforce to deal effectively with its workload has been of considerable concern since 1999 when a demographic analysis revealed a steady decline in both military and government civilian personnel since 1990. From 1990 through 1999, the military component of the OTA workforce declined by 38 percent, while the government

# SYSTEMS AND TEST RESOURCES

civilian component declined by 8 percent. The combined military-civilian decrease was 28 percent. While this decline has leveled off in the last several years, increasing demands on the OTA workforce indicate that the current manning levels and workforce composition may be inadequate to meet future operational testing needs.



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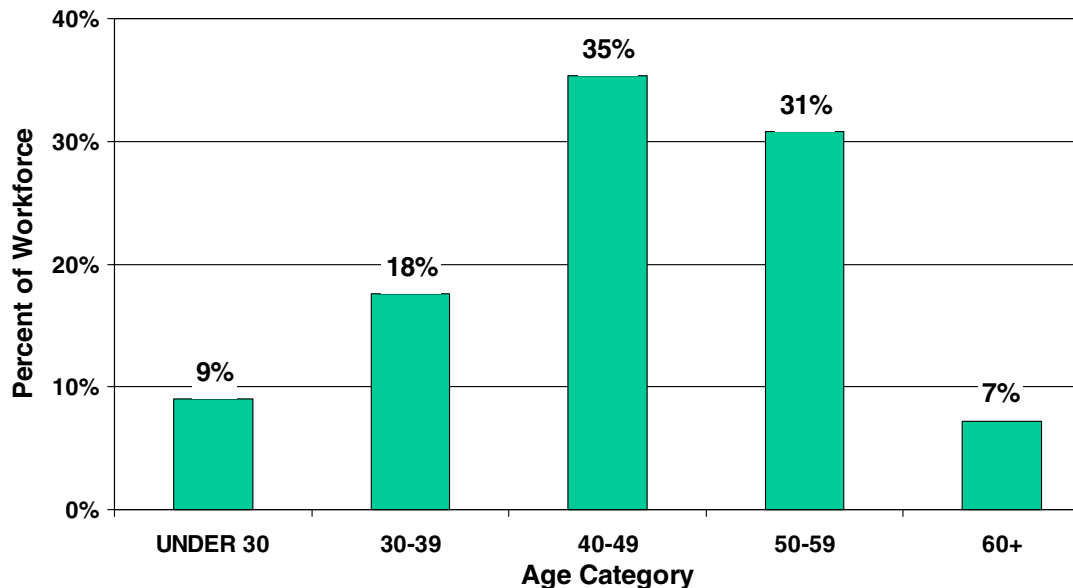
Proper sizing and composition of the OTA workforce is critical to the successful testing of weapon systems at a time when workload is increasing due to the confluence of several factors, such as evolutionary acquisition practices, early involvement in the system development process, the Integrated Product Team (IPT) approach to system development, increased complexity of the weapon system development and testing process, and increase of emphasis on joint interoperability tests.

The introduction of the evolutionary acquisition strategy resulted in a significant increase in workload for the test community. In the traditional development process, program activity rose as the program proceeded from concept development to full-scale development and operational testing, and then ebbed as the program transitioned to production and deployment. The evolutionary acquisition process serves to keep the programs continuously “active” at (or near) peak activity levels for prolonged periods as successive increments are developed and tested.

Emphasis on early involvement in the development process by the operational test community, in order to influence the design of systems early in the development process, has also added to the workload. This approach requires that OT&E personnel be active participants in acquisition programs from their inception.

In addition, the acquisition community has adopted an IPT approach that requires OT&E personnel to participate in team meetings regularly throughout the acquisition process. Only by being actively involved in these IPTs on a regular basis can OT&E representatives be effective in influencing design and testing issues.

# SYSTEMS AND TEST RESOURCES



*Only about 9 percent of the MRTFB workforce are under 30 years of age, and only 27 percent are under 40, clearly illustrating the fact that younger professionals are not being infused into the workforce.*

Finally, the increased complexity of the weapon system development and testing process brought about by such factors as the emphasis on interoperability and joint architectures also added to the workload. Individual systems are also more complex and difficult to test, largely due to being increasingly software intensive.

Another concern is the aging of the OTA civilian workforce. Presently, over 90 percent of that workforce are older than 40 years of age and nearly 60 percent are older than 50, reflecting the minimal infusion of young technical professionals. It is estimated that within five years 40 percent of the GS-7 to GS-15 civilian workforce will be retirement-eligible. However, the number of civilian personnel (Engineers and Professional) in DoD has increased, both in absolute terms and as a percentage of the civilian workforce. Timely action is needed to ensure that the civilian workforce at the OTAs is maintained.

Diminished military presence in the OTA workforce must also be addressed. This component of the OT&E workforce is essential for interacting with operational forces during the planning and conduct of operational testing, as well as during the development process.

## **THE MRTFB WORKFORCE**

The MRTFB workforce, both civilian and military, has also declined since 1990. Although the rate of decline has decreased during the last several years, the civilian portion of the T&E workforce located at MRTFB installations is now approximately 35 percent less and the military component about 49 percent less than in 1990. Overcoming these losses will necessitate additional investment in training of our T&E workforce, streamlining T&E business processes, and modernizing test procedures and technologies.

The insufficient number of personnel at test sites limits the flexibility of facility managers and reduces the capacity of facilities to meet the needs of their customers. Range Commanders are faced with the need to hire more contractor personnel for core T&E expertise. Although quantifying future workloads is difficult, the T&E community is likely to face an increase in demand over the next ten years. Simultaneous implementation of several generations of technology will drive future workload increases for the T&E workforce. Improvements to existing systems must continue to be made as long as our warfighters depend on them. The development and testing of the next generation of systems will significantly increase the workload.

# SYSTEMS AND TEST RESOURCES

As the MRTFB government workforce grows smaller, its civilian component has grown in seniority. Action must be taken to introduce new professionals into the workforce, particularly in the science and engineering disciplines. Only about 7 percent of the MRTFB workforce (excluding the Base Operation Support and other non-T&E personnel part of the overall MRTFB workforce) are under 30 years of age, and only 22 percent are under 40, again illustrating the fact that new professionals are not being infused into the workforce. Approximately 43 percent of this workforce are over 50 and are approaching retirement.

DoD must continue to aggressively experiment with and develop new approaches to workforce management, recruiting, and retention if DoD is to succeed in attracting newer, technologically-current cadre of T&E professionals.

## **CLOSURE OF NASA WIND TUNNELS**

Historically, DoD and the National Aeronautics and Space Administration (NASA) have operated complementary wind tunnel test facilities in the United States. Under this arrangement, DoD has relied on NASA facilities for specific types of testing during the development of aerospace systems. Due to increased pressure on its budget, NASA has decided to implement a full-cost recovery policy at many of its major test facilities. NASA's test facilities are now expected to recover from their customers the full costs of operations, including overhead and general and administrative costs. As a result, a number of unique national facilities that have limited but critical workload are now scheduled for closure.

Of immediate concern is NASA's closure of the largest wind tunnels in the world, the 80 x 120-foot and the 40 x 80-foot tunnels at the Ames Research Center in California. These wind tunnels are unique in that they are used to test very large-scale models and full-scale aircraft. They have been important to the development of rotorcraft, the development of Vertical/Short Take-off and Landing aircraft, the testing of high-lift transport and commercial aircraft, and the development of very large ducted and unducted fan propulsion systems. NASA is also closing the 12-foot Pressure Tunnel at the Ames Research Center. This facility is important in the design of aircraft in certain critical flight regimes. NASA ceased to operate these three tunnels in FY03. If insufficient contracts for their use are let in FY04, these tunnels will be closed permanently. In the interim, NASA has already announced that it is terminating the contractor personnel who operate these tunnels while reassigning an equal number of its own personnel.

While the possible closures of NASA's unique subsonic wind tunnels pose the most immediate threat to DoD ability to test and field new systems, there is a larger problem in that NASA's full-cost recovery policy applies to all of its test facilities. If other test facilities do not generate enough business to cover their costs, NASA will close them as well. This includes transonic, supersonic, and hypersonic wind tunnels and propulsion facilities, as well as specialized facilities for acoustic testing, spin testing, flutter testing, and icing testing. DOT&E will continue to work on this issue to reduce the risk to DoD aerospace acquisition programs.

## **INADEQUATE AERIAL TARGETS AND SELF DEFENSE TEST SHIP (SDTS)**

DOT&E is concerned about the availability, reliability, and overall threat fidelity of DoD aerial targets. Over the past year, testing has been delayed or not completed due to the absence or unreliability of the available aerial targets. Furthermore, the venerable QF-4 drone will reach the end of its useful life as a target in 2010, yet no funding has been identified by the Services to replace this target and satisfy a tri-Service T&E requirement. In addition, there are emerging threats for which no adequate targets currently exist. No funding has been identified to develop or acquire adequate targets to represent these threats. As a result, the performance gap between the threats and the targets available to represent them during operational testing is growing larger. DoD's capability to conduct OT&E under realistic threat conditions depends upon this trend being reversed.

Safe, operationally realistic testing of Navy short-range air defense systems requires an unmanned, remotely controlled SDTS. The SDTS used for the past 10 years is beyond repair and a replacement hull awaits conversion to an SDTS. The SDTS is a critical T&E asset for the operational testing of the Ship Self Defense System Mark 2, the Rolling Airframe Missile, the Evolved Seasparrow Missile, LPD 17, Littoral Combat System, DD(X), and CVN 21. As a matter of priority, the Navy needs to resource the SDTS and install the relevant air defense systems for testing.

## **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 air, land, and sea space; and

# SYSTEMS AND TEST RESOURCES

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.

Last year, the Administration submitted to Congress an eight-provision legislative package, the Readiness and Range Preservation Initiative. Congress enacted three of those provisions as part of the National Defense Authorization Act for FY03. Two of the enacted provisions allow DoD range installations to cooperate more effectively with state and local governments, as well as private entities. One plans for the growth of surrounding test and training ranges by allowing compatible land use that preserves habitat for imperiled species and the other ensures developments are compatible with test and training activities. Under the third provision, the Congress provided DoD with a regulatory exemption under the Migratory Bird Treaty Act (MBTA) for the incidental taking of migratory birds during military readiness activities. This action by the Congress provided welcome relief to serious readiness concerns raised by recent judicial extensions of the MBTA.

Last year, Congress did not act on the other five legislative provisions in the Readiness and Range Preservation Initiative. These five proposals remain essential to range sustainment. The five provisions, resubmitted in FY03, 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. The remaining provisions are:

- **Endangered Species Act.** Authorize use of Integrated Natural Resources Management Plans in appropriate circumstances as a substitute for critical habitat designations.
- **Marine Mammal Protection Act.** Reform obsolete and unscientific elements of the Act, such as the definition of "harassment," and add a national security exemption to the statute.
- **Clean Air Act.** Modestly extend the allowable time for military readiness activities such as beddown of new weapons systems to comply with the Act. Also, provide additional flexibility by ensuring emissions from military training and testing are consistent with state implementation plans under the Clean Air Act.
- **Resource Conservation and Recovery Act (RECRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).** Limit regulation of munitions use on operational ranges under the CERCLA and the RECRA if those munitions and their associated constituents remain there, and only while the range remains operational.

This year's legislative proposals also include some clarifications and modifications based on events since 2002. Of the five, the Endangered Species Act and the Clean Air Act provisions are unchanged.

## RADIO FREQUENCY SPECTRUM

The testing of modern defense systems relies heavily on the use of the radio frequency (RF) spectrum. RF telemetry systems are used to track test participants, control targets, ensure public safety, and transmit instrumentation data. Technology advances being incorporated into weapon designs require higher telemetry data rates and, consequently, substantially more spectrum. DOT&E has sponsored a number of initiatives to ensure that currently available spectrum is used as efficiently as possible and that additional spectrum is made available to support testing. Equipment to support a waveform that is twice as efficient as the legacy telemetry waveform is now operational, while development of an even more efficient waveform is continuing. DOT&E is also investigating the application of modern communications networking techniques to telemetry. Additionally, the Inter-range Frequency Deconfliction System has been developed to coordinate the use of spectrum among the test ranges.

More efficient use of currently available frequency spectrum is only a partial solution to the problem. To support future weapons development, additional RF spectrum will be needed, as well as updating instrumentation, telemetry, and tracking systems. In order to ensure that these needs are satisfied and acknowledged internationally, DOT&E has worked to ensure that an initiative to identify additional spectrum to support aeronautical flight test telemetry was placed on the agenda of the 2007 World Radiocommunication Conference (WRC). As a result of these efforts, and with the support of DoD, other government departments, and industry, this agenda item was confirmed at the 2003 WRC as an item for the 2007 WRC. DOT&E has also sponsored an investigation into the use of telemetry at higher frequencies than are currently used.

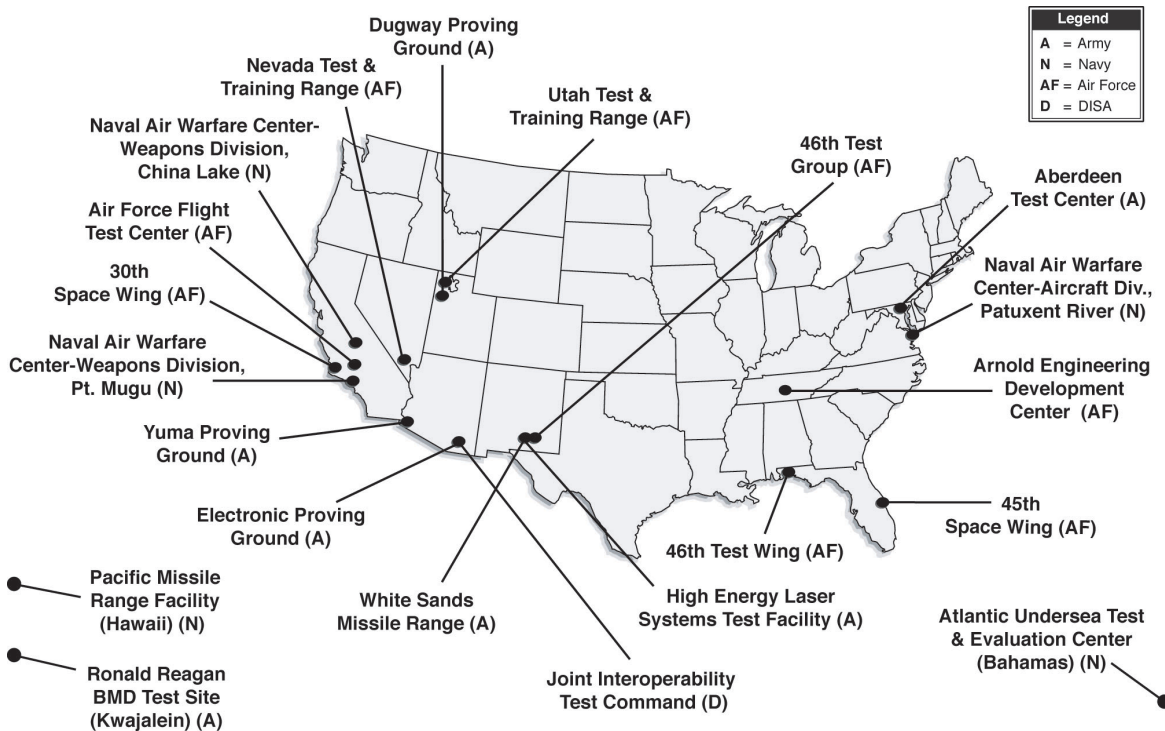


# SYSTEMS AND TEST RESOURCES

## Progress in the Last Year

### THE MRTFB CONTINUES TO SUPPORT MOST DEVELOPMENTAL TESTING

Most developmental testing within DoD is conducted at MRTFB locations. These sites, operated by 30,000 military, civilian government, and contractor personnel, range from wind tunnels and electronics integration test facilities to DoD's largest open-air, land, and sea test ranges. The function of the test infrastructure remained relatively unchanged since the MRTFB's founding in 1974: "The MRTFB is a national asset that shall be sized, operated, and maintained primarily for DoD T&E support missions."<sup>1</sup> While these major test facilities and ranges provide the majority of the developmental test capabilities we need today, there is a continuous need for investment. Funds must be available for upgrades to existing capabilities and for the introduction of new capabilities to test future weapon systems.



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### T&E INVESTMENT PROGRAMS ARE IMPROVING AND EXTENDING CURRENT CAPABILITIES

Sustaining current capabilities and improving test technology are the focus of existing T&E investment programs. The Service and Defense Agency investment and modernization (I&M) programs along with the OSD Central Test and Evaluation Investment Program (CTEIP) program upgrade existing capabilities, but have inadequate resources to develop the new capabilities required by emerging weapons technologies. Several of the Service ranges have identified a significant list of unfunded requirements needed in order to fully test upcoming systems.

I&M programs fund modernization of existing test facilities and the acquisition of new capabilities to meet test needs. Each Military Service pursues an I&M strategy that often focuses on test assets that are Service-unique with little multi-Service utility. Service I&M funding has been relatively constant in recent years.

<sup>1</sup>DoD Directive 3200.11, "Major Range and Test Facility Base (MRTFB)," May 1, 2002.

## SYSTEMS AND TEST RESOURCES

In FY03, the Army I&M program completed at Kwajalein Atoll the remote operation of instrumentation, radar modernization, and the Range Safety Control Center upgrade. These projects will reduce on-island staffing and inter-island transportation and should improve data management and mission response times. Dugway Proving Ground has initiated a Joint Test Infrastructure project by using a DoD-wide chemical-biological (CB) testing infrastructure survey to provide a roadmap for undertaking tasks within the CB area. Projects at White Sands Missile Ranges are investigating the options for replacing film with high-speed digital imaging, thereby reducing the time and expense of processing film, while reducing test turn-around time.

In FY03, the Navy's I&M program completed the upgrade program for its FPS-16 radars at Naval Air Warfare Center Weapons Division locations and the installation of the manned Flight Simulator at the Naval Air Warfare Center Aircraft Division. The Navy completed the first two phases of the Off-board Advanced System Stimulus (OASYS) at the Atlantic Undersea Test and Evaluation Center (AUTEC). The first phase provided for integrated test and evaluation of undersea warfare combat and sensor systems in a dynamic multi-mission environment. Phase two, using the AUTEC Sonobuoy Simulation/Stimulation System, provides the capability to test and validate performance of Navy multi-mission platforms, systems, and vehicles. Phase 3 will focus on the AUTEC Mine Field Proxy System.

The Air Force's I&M investments completed in FY03 include the Electronic Combat Integrated Test facility and the Global Air Traffic Management Test Facility at Edwards Air Force Base (AFB), California. The Air Force Electronic Warfare Evaluation System completed various simulator threat upgrades, including integrated air defense, and hardware-in-the-loop upgrades. The Air Force completed an upgrade of the High Speed Test Track facility at Holloman AFB, New Mexico. It conducted a hypersonic test, wherein the test sled obtained a velocity of 9,465 feet per second (or 6,553 miles per hour) in delivering a 192-pound payload into a target. Other Air Force I&M projects underway include the Open-Air hardware-in-the-loop facility, which includes a 300-foot, free-standing platform, with a 3-axis flight motion simulator and a Multispectral Missile Engagement Hardware-in-the-Loop Simulator, including a multi-channel infrared projector with the ability to simulate extended targets and flares at the 46th Test Wing. The major I&M project at Arnold Engineering and Development Center (AEDC), Tennessee, are the Propulsion Wind Tunnel (PWT) upgrades. These upgrades have the potential of reducing (by at least 30 percent) the cost of testing in the wind tunnels at AEDC.

The Missile Defense Agency (MDA) uses MRTFB facilities and is funding upgrades at the Pacific Missile Range Facility, Ronald Reagan Ballistic Missile Defense Test Site, Wake Island, and White Sands Missile Range. In addition, MDA is funding test activity at Kodiak, Vandenberg AFB, and Holloman AFB. MDA is also developing a test infrastructure for a wide range of airborne sensor programs, including the High-Altitude Observatory II Aircraft and the Wide-body Airborne Sensor Platform using a DC-10 aircraft. Also, MDA is investing in the Mobile Extended Range Telemetry and Safety System, a standard integrated system that collects telemetry and provides flight safety over the extended Pacific range of interest to MDA.

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 improve 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 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.

One of the key elements of CTEIP is its partnership with the Services. CTEIP develops and demonstrates new test capabilities, which allows the Services to focus on the procurement and sustainability of critical resources. Such partnering enables CTEIP to exploit breakthrough technologies that create realistic test conditions required to evaluate and enhance the development of next generation warfighting systems.

# SYSTEMS AND TEST RESOURCES

New test capabilities being developed by CTEIP include:

- **Spectral Efficient Technology Development.** The Advanced Range Telemetry project has developed a spectral-efficient technology that improves the reliability, utility, and availability of aeronautical telemetry spectrum for use in T&E.
- **Signature Characterization Capability.** The Tri-Service Signature Measurement and Database System project developed an instrumentation capability that characterized the detailed spatial, spectral, and temporal signatures of aircraft, missiles, ground vehicles, ships, undersea vehicles, and their countermeasures in realistic environments.
- **Test and Training Enabling Architecture.** The Foundation Initiative 2010 project is developing and validating the TENA to enable cost-effective interoperability among ranges, facilities, and simulations to support testing weapon systems and training warfighters.
- **High-Intensity RF Sources for Aircraft Vulnerability Testing.** The Electromagnetic Environmental Effects Generating System project is developing a test capability for use in the Air Combat Environment Test and Evaluation Facility, Patuxent River, Maryland, that will assess the actual performance of a full-scale, fixed- or rotary-winged aircraft completely immersed in a high-intensity RF environment.
- **Realistic Live Fire Testing.** The Weapon Set-to-Hit Threat Target, developed under the REP, will provide an unmanned, reusable, cost-effective target for conducting set-to-hit testing of Mark 54, Mark 48 Advanced Capability, and future torpedoes.
- **CB Test Instrumentation.** The Biological Warfare Referee Instrumentation Towers project, being conducted under the REP, is providing mobile instrumentation for ground truth measurement for operational test and evaluation, exercise support, and training activities at operationally realistic test and training sites. The Contamination Avoidance Detector Test Suite will develop a suite of new test methodology and instrumentation to dynamically challenge and evaluate current and developmental CB detector systems over the entire range of expected conditions of use.
- **Time Space Position Information Instrumentation.** The Enhanced Range Application Program will develop the next-generation range data system that will address major deficiencies in current systems, including incompatibility of range data and acquisition reduction systems, inefficient use of radio frequency spectrum, and inadequate interoperability.

The T&E/S&T Program develops or adapts emerging technologies for test applications in order to enable test technologies to pace evolving weapons technology. T&E/S&T investments will transition to test capability investment programs to support emerging weapon system development. The Test Technology Area Plan, a detailed roadmap for the overall T&E/S&T program, was published in July 2003.

The T&E/S&T efforts underway during FY03 continue to address technological issues in three critical areas:

- **Hypersonic Test.** The objective in this area is to develop technologies that can provide the ability to adequately test and evaluate vehicles, propulsion systems, and integrated systems at or above Mach 5 to meet National Aerospace Initiative demonstration schedules and future hypersonic systems T&E needs.
- **Spectrum Efficient Technology.** The objective in this area is to develop technologies that increase usage efficiency in current spectrum allocations and investigate technical and economic challenges related to future usage of an augmented Super High Frequency telemetry band.
- **Multi-Spectral Test.** The objective in this area is to make technologies available for test and evaluation of sensor probability of target detection, multi-spectral data extraction, and mission scenario analysis. Model data

# SYSTEMS AND TEST RESOURCES

produced from this focus area will augment open-air and facility-based testing with real-time, realistic multi-spectral simulation and stimulation of systems and battlefield personnel in all types of environments including water, desert, forest, rural, and urban terrains under varying meteorological conditions.

In addition, DoD initiated efforts in two new focus areas:

- **Embedded Instrumentation.** The objective is to enable development of non-intrusive embedded instrumentation technologies that provide performance data in support of continuous T&E and life-cycle data requirements.
- **Directed Energy.** The objective is to develop the test technologies required to create a Directed Energy T&E infrastructure capable of supporting future systems test requirements.

## DOT&E ACTIVITIES CONTINUE TO CONTRIBUTE TO THE TRANSFORMATION OF T&E

DOT&E's Threat System Office (TSO) provides test resource analyses on the availability, capabilities, and limitations of threat representations used for T&E. In addition, the TSO advises DOT&E on the adequacy of service-funded threat system investments that support weapon system acquisition and T&E.

Through the TSO, DOT&E is investing in projects to enhance threat representation in T&E. Projects of particular interest are:

- **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.
- **Real-Time Casualty Assessments (RTCA) Instrumentation.** The infrared Man-Portable Air Defense Systems Methodology Assessment project integrates the existing infrared missile fly-out model at the Threat-Signal-Processor-in-the-Loop facility with a fuse model and an Army Material System Analysis Agency approved model for damage assessment. Overall, this simulation addresses the need for an RTCA tool to provide adequate operational testing of Army aviation systems.

Additionally, through TSO, DOT&E is sponsoring a number of threat target projects to provide realistic, threat-representative targets for test and evaluation. Projects of particular interest are:

- **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.
- **Anti-ship cruise missile.** A project studied the performance and feasibility of two candidate target systems (Hawk missile mated with Tomahawk and Standard Missile mated with Tomahawk) that could possibly meet the Threat "D" target requirement. Wind tunnel testing on both candidate systems proceeded in FY03.
- **Sub-scale aerial targets.** Numerous projects are currently active that seek to improve the flexibility and economy of the sub-scale aerial target inventory.

DOT&E's Center for Countermeasures provides independent precision guided weapon (PGW) countermeasures/counter-countermeasures (CM/CCM) analysis, testing, and evaluation for the entire DoD community, supported by a knowledge base of over 500 developmental and operational tests of U.S. and foreign PGWs and CM systems. Over the past year, CCM tested, analyzed, or otherwise supported over 30 U.S. and foreign PGW systems or components in a countermeasure environment, as well as other countermeasure and threat warning systems.

To improve the DoD's business practices, DOT&E has been contributing to the success of the Business Initiative Council (BIC)'s T&E Process Functional Board initiatives. The BIC's mission is to improve the efficiency of DoD business

# SYSTEMS AND TEST RESOURCES

operations by identifying and implementing business initiatives that create savings to be reallocated to higher priority efforts. Among the T&E process initiatives being pursued are:

- **Common Flight Clearance Process.** This initiative is to develop and implement a Common Flight Clearance Process by incorporating the latest Information Technology advancements to reduce clearance turnaround time.
- **Common Range Scheduling Tool.** This initiative is to develop and implement a web-based schedule display tool capable of integrating and displaying schedule information that will enhance coordination and communications across multiple sites.
- **Embedded Instrumentation (EI) for Diagnostics, Prognostics, Testing and Training.** This initiative resulted in DoD regulatory guidance to ensure that EI is included in system trade-off studies and design analyses.
- **Common Test and Training Range Architecture Policy.** This initiative is to establish or change appropriate DoD Policies/Directives so that test and training range systems will comply with the TENA where it makes technical and fiscal sense. Potential benefits are a significant increase in test and training system interoperability, a capability to efficiently design and execute multi-range test and training events, a decrease in costs to conduct testing and training, and easy reuse of test and training software.
- **Test and Evaluation Master Plan (TEMP) Preparation and Approval Process Improvement.** This is a new initiative to examine the TEMP preparation and approval process and to recommend improvements.

DOT&E continues to work with the international T&E community and has developed new Test and Evaluation Program Cooperation Agreements with Canada, France, and Australia. These agreements include a “Reciprocal Use of Test Facilities” clause that allows access to ranges and facilities at direct cost, and a “Cooperative Test and Evaluation” clause that allows for cooperative activities where the cost of testing is shared.

The Canada/U.S. Test and Evaluation Program (CANUSTEP), the longest standing of these agreements, was renegotiated and signed in September 2002. The original CANUSTEP agreement was signed in 1993. CANUSTEP served as the model for the agreements with France and Australia. It is anticipated that these agreements will open the doors for U.S. ranges by establishing new international customers. Areas of cooperation also include the exchange of test technologies, information and data exchanges, and project equipment transfers. DoD is currently negotiating similar agreements with the Netherlands and the United Kingdom.

Another international program for DOT&E focuses on International Test Operation Procedures. This program is managed by an International T&E Steering Committee and results in mutually agreed upon, technical test procedures. By using these test procedures, partner nations can accept each other’s testing without need to retest, thereby reducing acquisition costs. This program continues to grow, with procedures for several new technical areas currently being developed.

DOT&E also publishes biennially an International Test Facilities and Ranges Capability Summary. The 2001 edition included input from eleven nations. Two additional nations have been invited to contribute to the 2003 edition.

