DOT&E STRATEGY IMPLENTATION PLAN

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DOT&E Strategy Implementation Plan (I-Plan)

In April 2023, DOT&E – in coordination with USD(R&E), USD(A&S), and the Military Service Secretaries – published a DOT&E Strategy Implementation Plan (I-Plan) to collaboratively and cooperatively transform the DoD T&E infrastructure, tools, processes, and workforce in response to emerging changes in acquisition, technology, and warfighting. DOT&E's Strategy I-Plan is built on five strategic pillars and twelve lines of efforts summarized below.
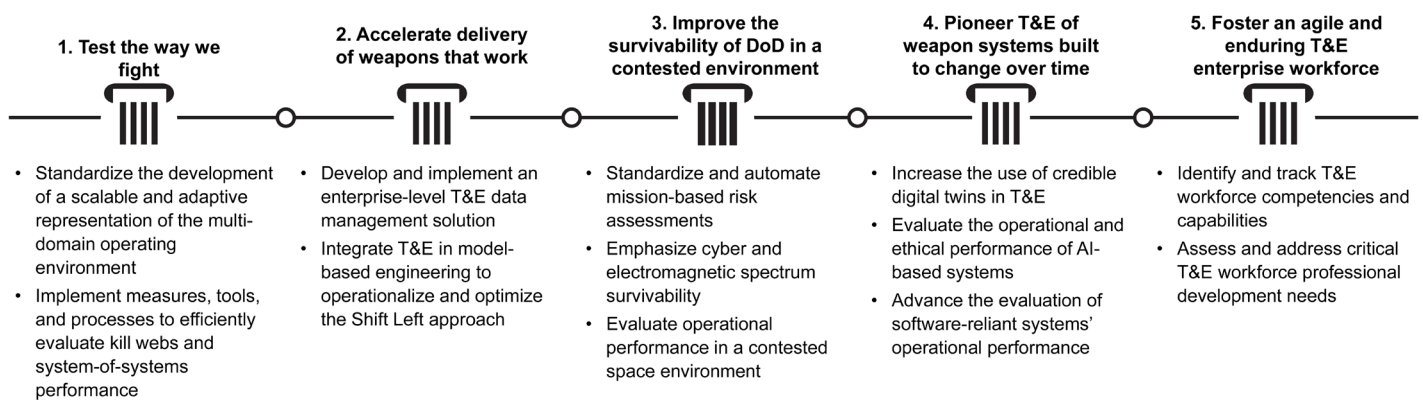
1. Test the way we fight	2. Accelerate delivery of weapons that work	3. Improve the survivability of DoD in a contested environment	4. Pioneer T&E of weapon systems built to change over time	5. Foster an agile and enduring T&E enterprise workforce
• Standardize the development of a scalable and adaptive representation of the multi-domain operating environment • Implement measures, tools, and processes to efficiently evaluate kill webs and system-of-systems performance	• Develop and implement an enterprise-level T&E data management solution • Integrate T&E in model-based engineering to operationalize and optimize the Shift Left approach	• Standardize and automate mission-based risk assessments • Emphasize cyber and electromagnetic spectrum survivability • Evaluate operational performance in a contested space environment	• Increase the use of credible digital twins in T&E • Evaluate the operational and ethical performance of AI-based systems • Advance the evaluation of software-reliant systems' operational performance	• Identify and track T&E workforce competencies and capabilities • Assess and address critical T&E workforce professional development needs

Table 1. DOT&E Strategy I-Plan Desired End States

Pillars	Desired End States
1. Test the way we fight	• Accurate representation of the joint, multi-domain operating environment in test (and training) • Established processes, resources, and capabilities to evaluate joint warfighting capabilities and mission threads
2. Accelerate the delivery of weapons that work	• Near real-time test data analysis and assessments • Discoverable, accessible, and secure T&E data repositories • Established tools and processes to "shift left" and optimize integrated T&E • Digital documentation and tracking of T&E strategies, data, and plans
3. Improve DoD survivability in contested environments	• Minimized mission-critical vulnerabilities and maximized defense in a contested environment • Efficient mission-based risk assessments and full-spectrum survivability T&E
4. Pioneer T&E of weapon systems built to change over time	• Standardized and increased use of credible digital tools in T&E • Adequate assessment of operational and ethical performance of artificial intelligence (AI)-enabled systems • Established processes and capabilities to enable dynamic testing and monitoring of programs throughout operations and sustainment
5. Foster an agile and enduring T&E enterprise workforce	• Highly skilled T&E workforce prepared to meet the toughest challenges • Effective continuous learning program and a robust recruitment/retention plan

As documented in the DOT&E Strategy I-Plan, DOT&E recognizes the critical role of T&E within the wider DoD enterprise including acquisition, requirements, warfighting, and intelligence communities. DOT&E also recognizes the critical role of industry, academia, federally funded research and development centers, university-affiliated research centers, and international partners to help DoD accelerate innovation and support the delivery of the world's most capable warfighting capability at the speed of need. To align this T&E enterprise against common objectives, the DOT&E Strategy I-Plan identifies the desired end state for each of the five pillars, as summarized in Table 1. DOT&E looks forward to continuing collaboration with the T&E enterprise to refine and accomplish the T&E initiatives listed for each of the five strategic pillars.

Pillar 1 – Test the Way We Fight

Pillar 1 is designed to architect T&E around validated joint force mission threads and kill webs (including multiple systems under test) to demonstrate their agility and responsiveness in multi-domain operations and facilitate accurate assessments of operational effectiveness, suitability, survivability, and lethality.

The T&E community can support the measurement of the operational performance of such mission threads and kill webs by establishing:

• An accurate representation of the joint, multi-domain operating environment in test (and training).

• Processes and capabilities to evaluate joint warfighting concepts, capabilities, and mission threads (e.g., kill webs, system-of-systems performance) effectively and efficiently.

DOT&E contributed to the Pillar 1 end state in FY24 as follows:

• Initiated a T&E Capabilities and Requirements Assessment Process that expands on the "range of the future" analysis discussed in the FY23 Annual Report and standardizes how DOT&E identifies, prioritizes, and coordinates mitigation of the OT&E and LFT&E range capability needs across the T&E infrastructure enterprise.

• Advanced the development of a T&E Capabilities and Requirements Dashboard prototype designed to display current capabilities, and to identify, prioritize, and digitally track the status of current

and emerging OT&E and LFT&E range capability, capacity, and availability gaps.

- Collaborated with T&E enterprise stakeholders across the OSD to establish responsibilities to ensure that OT&E and LFT&E are representative of key real-world mission threads.

- Developed a joint test concept roadmap that identifies milestones and goals to implement changes to the T&E of joint operations.

- Delivered electromagnetic spectrum (EMS) passive detection hardware-in-the-loop (HWIL) and software-in-the-loop (SWIL) capabilities to the Naval Air Warfare Center Weapons Division and completed unclassified system integration. The classified system integration is pending authorization to operate.

- Upgraded EMS facilities with a Reconfigurable Signal-Injection Missile Simulation (RSIMS) HWIL simulator for an advanced electro-optical (EO) and infrared (IR) sensors-guided threat and delivered the RSIMS HWIL design for a second advanced EO/IR-guided threat to Naval Surface Warfare Center Crane Division.

- Provided funding to the Naval Surface Warfare Center Dahlgren Division to upgrade their Aerial High-Powered Radio Frequency/Microwave Instrumentation measurement system.

- Acquired the High-Powered Microwave (HPM) Beam Evaluation Tool (HBET) to utilize at Kirtland AFB for HPM testing.

Pillar 2 – Accelerate the Delivery of Weapons that Work

Pillar 2 is designed to accelerate acquisition and T&E by adopting digital technologies and workflows to speed up the delivery of capabilities to the warfighter. The T&E community can implement faster, simple, data-driven T&E methods by:

- Developing, implementing, and enabling an enterprise-level T&E data management and automated analysis solution (e.g., T&E data standards, data stores, knowledge management tools, automated data fusion and analytic tools to expedite data collection, data analysis, and reporting).

- Using advanced statistical methods to support the development and sustainment of a well-structured approach that rigorously codifies how system behavior can be inferred from a collection of evidence (i.e., live data collected on the system as it matures across the acquisition life cycle, and modeling and simulation [M&S] results).

- Leveraging digital engineering and implementing efficient digital representations of T&E strategies and plans that trace back to the technical and operational requirements.

DOT&E contributed to the Pillar 2 end state in FY24 as follows:

- Developed an Integrated Decision Support Key (IDSK) architecture and tools that utilize data to support the acquisition decision-making process for operational testing (OT) and live fire testing (LFT). This includes a tool to capture metadata and a tool to port data from DOT&E-approved TEMPs into the IDSK tool.

- Partnered with several Service T&E representatives, operational test agencies (OTAs), and field activities to support federated data concept developments, such as cloud services and data mesh architectures that will be leveraged by programs to increase the speed of system analysis and evaluation.

- Designed and developed a platform to automate test data analysis that enhances speed, analysis reproducibility, and error reduction; while supporting complex, multi-tiered analysis targeting high-level effects of multi-domain mission threads and kill webs.

- Developed a software application that adapts test designs based on real-time data collected during testing, enabling robust T&E by focusing on system performance, increasing the understanding of system effectiveness and suitability.

- Stood up a DOT&E cloud environment to support development of capabilities that can generate insights into OT/LFT. The environment enables the application of artificial intelligence (AI) and machine learning (ML), data analytics, and data management to meet emergent testing

needs. Within this cloud environment, DOT&E is investigating the secure and reliable applications of large language models and generative AI technologies to accelerate operational effectiveness, suitability, and survivability evaluations.

Pillar 3 – Improve DoD Survivability in Contested Environments

Pillar 3 is designed to enable dynamic assessments and improvements of a system's ability to effectively operate and survive in a hostile full-spectrum threat environment while maintaining mission effectiveness. The T&E community can assist in minimizing mission-critical vulnerabilities and maximizing defenses against full-spectrum threats by:

- Standardizing and automating mission-based risk assessments to optimize the evaluation of kinetic and non-kinetic threats, and their combined effects. These risk assessments include efficient: (1) characterization of system designs, (2) identification and prioritization of vulnerabilities, (3) identification of potential attack conditions, and (4) evaluation of threats effects on the mission.

- Providing automated and integrated processes, tools, and representative threats scenarios with emphasis on cyber and EMS survivability.

- Enabling adequate evaluation of operational performance in a contested space environment by delivering: (1) space environment modeling, system modeling, and analytic tools; (2) space T&E process, policy, and guidance; and (3) space test infrastructure to support subsystems ground-testing or testing space systems and combined effects at scale.

DOT&E contributed to the Pillar 3 end state in FY24 as follows:

- Expanded the development of an M&S framework concept for evaluating vulnerability to both kinetic and non-kinetic threats and launched a limited pilot. This framework combines engineering methodologies and M&S tools to assess a warfighting system's performance and survivability in a contested environment. Ongoing development includes expanded M&S integration, Application Programming Interface (API) coding, and user interface development on both classified and unclassified networks.

- Enhanced the Cyber Operations Lethality and Effectiveness (COLE) Joint Munitions Effectiveness Manual capability for cyber vulnerability and resiliency assessments. COLE now supports models such as Cameo Enterprise Architecture files for interoperability with current model-based systems engineering initiatives and is compatible with the USD(R&E)-directed ontology for attacks in cyber risk assessment frameworks, allowing integration into other M&S frameworks. Additional details on the COLE tool can be found in the Joint Technical Coordinating Group for Munitions Effectiveness article of this Annual Report.

- Established a mission-based risk assessment methodology to evaluate methods for identifying and defending the scope of OT&E and LFT&E required to adequately test a system in both kinetic and non-kinetic contested environments. DOT&E initiated partnerships to develop guidance on the methodology and conduct proof-of-concept pilots.

- Developed a cloud-based digital ecosystem with AI-enhanced tools for identifying and tracking tailored threat intelligence to incorporate into operational testing and inform future T&E investments and threat shortfalls. DOT&E completed a beta capability for unclassified data discovery using ML and retrieval-augmented generation. This capability provides document summarization, context-rich question-and-answer capability, and semantic searching. Future plans include utilizing a robust data collection source, ensuring scalability and adaptability requirements from various data sources, and implementing multi-layer security for handling classified documents.

- Delivered 40 new threat models (hardware and software), 5 new National Air and Space Intelligence Center CHIMERA models and major updates, and 4 new Missile and Space Intelligence Center threat software asset management HWIL

models to various T&E locations (laboratories, facilities, and ranges).

- Conducted a space requirements study to address uplink survivability and anti-jamming concerns, with gap analysis and solutions analysis teams working with Space Force and intelligence communities.

Pillar 4 – Pioneer T&E of Weapon Systems Built to Change Over Time

Pillar 4 is designed to respond to new warfighting capabilities that will be upgraded and changed throughout the life cycle. This includes aircraft mission systems, AI and ML, test automation, and digital engineering. These systems will require new tools and processes to evaluate their performance as they adapt to changing conditions. The T&E community may evolve its processes by:

- Increasing the use of credible digital twins in T&E by: (1) developing a methodology to describe the effective use of T&E digital twins and the associated verification, validation, and accreditation process; and (2) developing and standardizing an architecture for calibrating models based on real, operational data.

- Advancing the research and capabilities including the definition of criteria, methodologies, and metrics for assessing operational and ethical performance of AI-based systems and various aspects of AI and ML technologies.

- Advancing the evaluation of software-reliant systems' operational performance including, but not limited to: (1) software pipelines and factories; (2) software bill of materials monitoring and management to reduce supply chain risk; (3) capability to collect software effectiveness and suitability data from automated testing; and (4) tools and processes to effectively evaluate interoperability and other performance metrics as DoD systems continuously change over time.

DOT&E contributed to the Pillar 4 end state in FY24 as follows:

- Hosted a digital twin workshop and assessed the technological and organizational maturity of model-based systems engineering and digital twins through detailed frameworks and cost-benefit analyses.

- Developed natural language processing-based system to extract vulnerabilities from a software bill of materials and link to known vulnerabilities and exploits to improve Red Team analysis of systems.

- Established the Centralized Capabilities Repository of Software for T&E teams to discover, access, and compare software testing tools. This software provides support in shifting OT&E data collection to left and right to provide continuous insight into software systems' ongoing effectiveness, suitability, and survivability.

- Integrated research into practice using a T&E harness, a collaborative software platform serving as a hub for AI T&E. This research developed use case examples that run through the T&E process, capturing their unique nuances. This approach allows for testing various processes and requirements, aiming to accelerate the transition of cutting-edge research into practical tools for educating and training the T&E community.

- Finalized DoD policy for publication, including policies on T&E for software-intensive systems, software-embedded systems, AI-enabled systems, and autonomous systems to enable continuous and responsible performance evaluation of these capabilities as they change during operational use.

- Hosted the OT&E of Autonomous and AI Systems Trust Workshop to capture DoD OT&E experiences, challenges, and potential solutions while focusing the discussion on warfighter trust and responsible AI OT&E metrics generation and collection.

Pillar 5 – Foster an Agile and Enduring T&E Enterprise Workforce

Pillar 5 is designed to respond to the evolving nature of T&E necessitating a thorough review and refinement of the T&E workforce competencies and the development of continuous learning opportunities for T&E professionals to attract, hire, and retain top talent. The T&E enterprise will better track and manage the T&E workforce's overall readiness in

real-time and deliver improved talent management initiatives by sharing DoD's best practices and establishing and maintaining:

- The appropriate infrastructure to inform the DoD efforts to identify and track the status of required T&E skillsets.

- An effective continuous learning program and robust recruitment and retention plan to prepare the T&E workforce for the emerging challenges.

DOT&E contributed to the Pillar 5 end state in FY24 as follows:

- Launched "learning journeys" that combine classroom, peer, and on-the-job training to enhance action officer (AO) proficiency in key areas. Following a workforce needs analysis, DOT&E updated its competency model to outline the essential knowledge, skills, and abilities required for future success. This competency-based approach enables strategic planning for critical skills and supports targeted training and development.

- Revised, executed, and improved the annual DOT&E AO course, integrating the updated competency model into a refreshed curriculum. The course covered over 40 modules with topics including DOT&E's mission and role in the acquisition process, TEMP and TES oversight, test planning and execution, T&E of software and AI, and technical writing and reporting. Attendees engaged in use cases, scenario-based exercises, T&E community-wide networking opportunities, and panel discussions, ensuring a steady talent pipeline for future T&E expertise. For the first time this year we had attendees from the United Kingdom and Australia attend the course in an effort to strengthen the partnerships between the three countries.

- Expanded the Pathfinder Internship Program to address the demand for certified cyber and software T&E talent. The 2024 summer internship – a collaboration between DOT&E and the Army's Program Executive Office for Simulation, Training, and Instrumentation – involved 45 students from over 22 universities. This six-week program combined rigorous technical training with

engaging activities, resulting in an increased talent pipeline.

- Initiated a partnership with the Defense Human Resources Activity's Advanced Distributed Learning team, to leverage the Enterprise Digital Learning Modernization program and establish a dedicated digital learning management system for DOT&E. This system will offer easy access to curated learning resources aligned with DOT&E's competency needs. By integrating training into DOT&E's workflow, this approach ensures content is available on-demand, minimizing disruptions and enhancing efficiency.