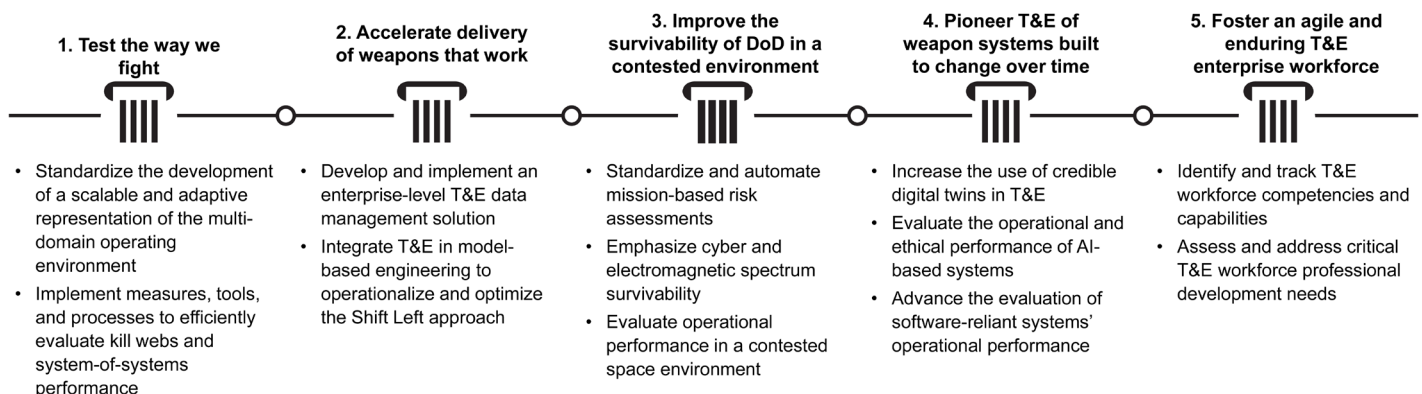# DOT&E STRATEGY IMPLENTATION PLAN

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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 5 strategic pillars and 12 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 collaborating with the T&E enterprise to refine and accomplish the T&E initiatives listed for each of the 5 strategic pillars.

Pillar 1 – Test the Way We Fight

Pillar 1 – "Test the way we fight" – is designed to architect T&E around validated joint force mission threads and kill webs (including multiple systems under test) to demonstrate their operational effectiveness, suitability, survivability, lethality, agility, and responsiveness in multi-domain operations.

Measuring the operational performance of such mission threads and kill webs may be advanced 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.

To contribute to the Pillar 1 end-state, in FY23, DOT&E:

• Initiated a "range of the future" analysis, which is intended to inform the OT&E and LFT&E range capability needs of the future based on known and emerging technology and threat trends and gaps.

• Supported the development of a prototype for the range capabilities dashboard that will identify, prioritize, and digitally track the status of current and emerging OT&E and LFT&E range capability, capacity, and availability shortfalls.

• Developed a preliminary concept for a data-backed, all-domain modeling and simulation (M&S) environment to integrate with live, multi-

domain operational testing, and maintained an M&S for T&E working group.

- Demonstrated there is value to be added using model-based engineering for intelligence analytical activities to interoperate with the acquisition community's digital transition.

- Developed a joint test concept determining the preliminary plan for what needs to be changed, including policy, tools, and training, and how to ensure timely and rigorous T&E of joint operations.

Pillar 2 – Accelerate the Delivery of Weapons that Work

Pillar 2 – "Accelerate the delivery of weapons that work" – is designed to accelerate acquisition and T&E by adopting digital technologies and workflows to speed up the delivery of capabilities to the warfighter. T&E workload and process optimization that enables data-driven T&E at scale and machine speed may be accomplished 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, and 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 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.

To contribute to the Pillar 2 end-state, in FY23, DOT&E:

- Prototyped a software application to optimize test sizing in a dynamic way using modern statistical inference methods to enable adaptive, integrated testing including the ability that is fully informed

by prior live data and digital tool results as T&E is conducted across the acquisition life cycle.

- Developed examples of model-based T&E Master Plans to enable more adaptive and dynamic development, review and approval of such critical acquisition decision artifacts using SysML, and Structured Query Language relational databases.

- Supported the development of a prototype of a smart word processing and content management application intended to expedite the development and review of acquisition program (model-based) documents including the Test and Evaluation Master Plans and system performance reports that are native to Microsoft Word.

- Initiated the development of an enterprise-level automated data analysis suite for the T&E community implementing modern quantitative and computing methods to remix live data collected with M&S, and physics to create "digital arenas" for gleaning the emergent high-level mission effects characteristic of complex multi-domain scenarios and future joint warfighting concepts.

- Initiated analysis campaigns that characterize the high-level effects of specific multi-domain mission threads.

Pillar 3 – Improve DoD Survivability in Contested Environments

Pillar 3 – "Improve DoD survivability in contested environments" – is designed to enable dynamic assessments and improvements of system's ability to effectively operate and survive in a hostile full spectrum threat environment while maintaining mission effectiveness. Minimizing mission-critical vulnerabilities and maximizing defenses against full spectrum threats may be enhanced by:

- Standardizing and automating mission-based assessments to optimize the evaluation of kinetic and non-kinetic threats, and their combined effects. This includes 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 electromagnetic spectrum (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 testing space systems or subsystems ground-testing and combined effects at scale.

To contribute to the Pillar 3 end-state, in FY23, DOT&E:

- Conducted a full spectrum survivability and lethality proof-of-concept tool based on an envisioned cloud-hosted, full-spectrum threat effects as-a-service architecture. The proof of concept is designed to standardize inputs and outputs both within and across kinetic and non-kinetic threat effects to enable the evaluation of survivability and lethality in multi-domain operations to include throughout operations and sustainment.

- At the request of Deputy Secretary of Defense, hosted a DoD Cyber Survivability Human-Centered Design Study Group that published a report in June 2023. The report summarized key DoD cyber survivability challenges and four proposed courses of action to improve the DoD's warfighting survivability posture in contested cyberspace. The courses of action include: (1) integrate cyber survivability across a system's life cycle, including the operations and sustainment phases, (2) cultivate responsive cyber-focused industrial support, (3) conduct mission-based system of systems tests and exercises, and (4) go beyond cyber compliance to operational performance. The DoD is standing up cross-DoD working groups to support the planning and execution of these actions.

- Partnered with the Test Resource Management Center to provide the Cyberspace Live-Fire Evaluation Framework. This quantification framework is a collection of software, test data and automated tools constructed to rapidly test and analyze cyber capability under different environments.

- Supported the development of automated tools necessary to accurately evaluate the ability to detect and recover from cyber threats.

- Leveraged AI Natural Language Processing to support the development of a prototype tool that automatically extracts and properly formats a system's software data for vulnerability analysis.

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

Pillar 4 – "Pioneer T&E of weapon systems built to change over time" – is designed to respond to new warfighting capabilities that will be upgraded and changed throughout the life cycle. This includes things like aircraft mission systems, AI and machine learning (ML), test automation, and digital engineering requiring the development of tools and processes to determine the uniquely contextual operational and responsible performance of these capabilities, especially as they change during real operational use. 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/ML technologies.

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

To contribute to the Pillar 4 end-state, in FY23, DOT&E:

- Initiated a pilot to support the development of an architecture for calibrating digital twins based on real, operational data.

- Conducted a pilot using AI/ML to glean differences between digital twins and the physical systems they represent.

- Completed a literature review on the current state of T&E of AI-based systems, discovering that industry and academia have been focused on collecting data to train algorithms and produce models. While numerous tools exist for model monitoring and drift detection, adversarial attacks, hyperparameter optimization, reproducibility, explainability, labeling and annotation, model evaluations, and privacy, there is still an insufficient amount of information to adequately evaluate the operational and ethical performance of AI-enabled and autonomous systems as a T&E enterprise.

- Developed a "best practices" guide to T&E of AI-enabled systems. Completed AI T&E research projects covering: intellectual property implications, using model-based engineering for test case generation, and design of experiments of AI-enabled systems; methods for assessing adversarial effects in computer vision applications; and hierarchical scoring for operational missions.

- Sponsored the development of a prototype application in coordination with DoD CIO and USD(R&E) that measures the maturity of a software factory and helps T&E practitioners understand the effectiveness and overall security of the software factory.

- Investigated the effectiveness rates of static and dynamic code analysis tools and how they can be leveraged for test design.

- Developed a pathfinder effort for model-based testing, demonstrating that a system model can automatically generate and simulate test cases within the model. This capability, if leveraged correctly, may accelerate T&E capabilities through automated test generation and execution.

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

Pillar 5 – "Foster an agile and enduring T&E enterprise workforce" – 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. 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.

To contribute to the Pillar 5 end-state, in FY23, DOT&E:

- Enhanced the DOT&E Action Officer (AO) professional development program by redesigning its annual AO course to provide AOs and the larger T&E enterprise with interactive and relevant case simulations that moved beyond traditional lecture-based methods. The course was based on highly interactive, human-centered design learning principles, and engaged attendees in scenario-based exercises, panel discussions, cohort collaboration, and teambuilding while also ensuring a standardized and effective learning experience for new DOT&E AOs and participants from the Service operational test agencies.

- Developed new training materials to respond to emerging changes in DOT&E policy and guidance. Tangentially, coordinated with the Defense Acquisition University and their Software T&E Credential and Cyber T&E Credential teams to support and accelerate the development of their courseware to offset training gaps in software and cyber OT&E and LFT&E training.

- Executed a Learning Needs Assessment of the DOT&E workforce to identify and evaluate T&E campaign of learning and course curriculum to meet future workforce demands. This included

updates to the DOT&E competency model to account for changing job demands in response to a continuously changing and dynamic operating environment and to mirror the Defense Acquisition University's T&E competency model to facilitate a "T&E Enterprise Mindset."

- Continued with the implementation of T&E collaboration and innovation partnership to meet the congressional intent to address the unmet demand for qualified, certified cyber and software T&E talent. In partnership with the Army's Program Executive Office for Simulation, Training, and Instrumentation, DOT&E hosted the 2023 Summer Pathfinder Internship Program. A diverse class of 29 students from 11 universities across the country graduated from the program, resulting in 20 cyber experts poised to earn 20 Security+ certifications and 9 Certified Ethical Hacker certifications and join the T&E workforce. These internships resulted in prototype capabilities for close access teams, adversarial social media tactics, techniques, and procedures, and new command and control techniques for network protocols. All projects ended in a state where DoD cyber Red Teams can mature the prototypes.