FY 2019 Annual Report

The most powerful element of our national defense is the warfighter. Our highly skilled, intelligent, and inventive soldiers, sailors, airmen, and marines keep our Nation safe and strong.

As I stated during my November 7, 2017, confirmation hearing, I know from personal experience that there are three imperatives in combat: believe in yourself, your fellow warriors, and your training; believe in your mission and commanders; and believe in your equipment and weapons. Operational and live fire test and evaluation (OT&E and LFT&E) allow warfighters to believe in their equipment, weapons, and training; we determine whether a system is combat-credible, operationally suitable, and survivable.

For the last 2 years, as the Director of Operational Test and Evaluation (DOT&E), I have focused on meeting the 2018 National Defense Strategy (NDS) mandate for greater lethality and readiness. From the DOT&E perspective, this means having the right assessment tools, infrastructure, and expertise and sufficient financial and human resources. As the NDS notes, "We cannot expect success fighting tomorrow's conflicts with yesterday's weapons or equipment. To address the scope and pace of our competitors' and adversaries' ambitions and capabilities, we must invest in modernization of key capabilities through sustained, predictable budgets."

Cybersecurity, test and evaluation (T&E) that represent realistic operational conditions, and testing and training for space-based systems remain my greatest challenges. While the operational test community has instituted some improvements in these areas, we still have much to do.

Equally important, we are seeking ways to improve efficacy and efficiency. As part of this effort, this year DOT&E will work with the developmental test community to chart a 5-year path to integrating operational testing with developmental testing. We also will continue to pursue complementary approaches to streamline T&E, when possible, while maintaining the comprehensiveness that helps to ensure warfighters receive the robust weapons, systems, and training they need to execute their missions and return safely. I will keep Congress informed as we craft the plan for the future of T&E. No change in policy or process will affect DOT&E's unique position as the sole independent source of authoritative OT&E data and findings.

CYBERSECURITY T&E

Cybersecurity presents enormous challenges for the DOD. Software and networks drive the Department's warfighting, training, and business capabilities. Almost every weapon in the warfighter's arsenal is software-defined, and we are likelier to "improve" system lethality by installing new software than by modifying hardware. As always, accurate, trusted, timely information is the discriminator on the battlefield, but now all of it – data, voice, video – traverses a digital medium of some kind.

This dependence on software and networks makes cybersecurity T&E absolutely essential: A system cannot be deemed combat-credible and survivable without understanding its cybersecurity posture. In response, DOT&E has improved the realism and relevance of cyber tests and assessments. DOT&E's Cybersecurity Assessment Program works with Combatant Commands and the Services to address their areas of greatest operational interest and impact. DOT&E provides subject matter experts to help cyber teams grow their capabilities, especially replication of advanced threats. Additionally, DOT&E analysis of data collected from observed cyber-attacks is used to augment detection and better understand mission effects.

DOT&E's structured yet flexible approach to tailoring operational tests and assessments is providing relevant, valuable cyber information. We repeatedly have identified cybersecurity threats and vulnerabilities as a major reason for determining a system was not survivable. However, overall, the DOD's ability to test and evaluate cybersecurity is not keeping pace with the extremely high volume of complex systems and the aggressiveness of adversary attacks. The DOD needs advanced cyber testing tools, as well as automation that alerts the warfighter of anomalous software behavior. Cybersecurity T&E must become more realistic, for instance testing a system's resilience by evaluating the operator's ability to fight through a cyber-attack and restore operational capability. For situations where a cybersecurity-induced failure would present physical danger to the operator or platform, the DOD must have a realistic modeling and simulation (M&S) environment that accurately replicates the effects of cybersecurity compromise and tests the operator's tactics, techniques, and procedures (TTPs).

We also need more efficient and effective methodologies for holistic T&E of large, complex platforms with many interdependent components and subsystems, such as the F-35 and CVN 78. Further, the supply chain cannot be exempt; its networks, tools, facilities, and software factories must undergo regular cybersecurity assessment and monitoring.

Most importantly, until automated anomalous software detection tools are developed, the DOD test community needs more personnel with deep cyber domain expertise. The competition for high-quality cyber testers is a national challenge and the DOD is losing out. To defend against the full spectrum of potential cyber threats, the DOD needs to begin a major initiative to harness the world-class cyber personnel resident in the U.S. academic and commercial sectors. Without substantial improvements in cybersecurity T&E, especially in the workforce, the DOD risks lowering overall force readiness and lethality.

T&E INNOVATION & IMPROVEMENT

Realism in T&E

The quality of OT&E and LFT&E depends substantially on the tools and infrastructure available. In particular, we cannot know a system's operational performance – lethality, survivability, suitability to mission – without running it through environments and scenarios that mirror what it would encounter during real-world use. For a combat system, this means putting it in the operator's hands, going against current and emerging threats, and pushing the system to its physical and cyber limits. In many cases, however, the DOD cannot meet these criteria; the threat is either not available in a realistic density or at all, or realistic field conditions and testing (open air, open water) aren't feasible.

Part of the solution to these limitations is high-fidelity, accredited emulation and M&S. Replicating threats and a system's operational profile via a digital environment can provide the information necessary for an accurate performance assessment, and can feed development and evaluation of TTPs and mission planning. The DOD already is successfully applying these types of technology to one of its most complex programs, the F-35. In FY19, F-35s flew 12 open-air trials at the Nevada Test and Training Range versus an array of radar signal emulators (RSEs). A reprogrammable open-loop emitter, the RSE pits aircraft against a wide variety of real adversary radar and integrated air defense system signals, including large, surface-to-air missile target engagement and acquisition radars. Without the RSEs, open-air sorties would not adequately represent the threat scenarios needed to properly evaluate the F-35.

Results from the RSE open-air trials are being used to verify, validate, and accredit a key – perhaps the DOD's most critical – M&S system, the Joint Simulation Environment (JSE). Scheduled to go live in summer 2020, the JSE will enable scenario-based T&E against modern threats in realistic densities. Within an all-digital environment that mimics the real world, warfighters will interact in real time with virtual entities. Due to the inherent limitations of open-air testing, the JSE will be the only venue available, other than actual combat against peer adversaries, to adequately evaluate the F-35.

In addition to accuracy, M&S can increase T&E efficiency. For example, the Environment-Centric Weapons Analysis Facility (ECWAF), a real-time undersea warfare environment simulation with the MK 48 torpedo as hardware-in-the-loop, potentially will allow the Navy to eliminate up to 50 percent of in-water live firings for that munition. Live T&E always draws significant resources – time, money, personnel, and materiel. Replacing even a fraction of live runs will conserve resources while still helping to ensure that the warfighter receives the capability needed.

Although M&S and emulation capabilities often are built with one particular program in mind, the acquisition and test communities must make sure these systems can grow to fit changing requirements and operational environments. To maximize our investment, M&S and emulators must be able to expand easily to accommodate additional platforms and new threats.

Preparing for Emerging Technologies

For T&E to be realistic and accurate, T&E tools and processes must keep pace with emerging technologies. Thanks to a Congressional plus-up of $150 Million in the FY19 Defense Appropriations Act, the DOD is making significant progress in modernizing T&E infrastructure. With these funds, the Department will be able to augment its ability to collect hypersonic flight test data by adding telemetry and optics instrumentation to unmanned aerial systems, and will improve atmospheric measurement and end-game scoring and weapons effects. To assess directed-energy weapons, the DOD is pursuing development of high-power microwave diagnostics and high-energy laser instrumentation and target and scoring boards, as well as M&S tools to estimate directed-energy weapons' damage effects and collateral effects.

To improve and accelerate the evaluation piece of OT&E, particularly of next-generation aircraft, the DOD is upgrading its Big Data analytics capability. Additionally, DOT&E and the Test Resource Management Center (TRMC) have invested in autonomous cyber-threat emulation (Red Team tools), expanded cyber operational testing, and funded more research into artificial intelligence and machine-learning test methodologies.

Space Testing and Training

Space is critical to the Nation's security, economic prosperity, and scientific knowledge – and is now unquestionably a warfighting domain. The DOD intends to invest at least $100 Billion in space systems over the next decade, and we are not alone. We therefore must thoroughly understand how our systems will perform in space, particularly when facing manmade threats. Yet, the DOD

currently has no real means to assess adequately the operational effectiveness, suitability, and survivability of space-based systems in a representative environment.

DOT&E, in conjunction with TRMC, is actively pursuing creation of such a capability. In keeping with the 2018 NDS commitment to "prioritize investments in resilience, reconstitution, and operations to assure our space capabilities," this enduring infrastructure would enable T&E of current and future DOD space systems via a space warfighting combined test force, a "National Space Test and Training Range," and ground-based space test facilities. The threat array would include cyber, directed-energy, kinetic and electronic-warfare threats, as well as natural hazards.

This multi-layered space T&E capability is key to the DOD's being able to demonstrate the true functionality, limitations, survivability, and employment considerations of space systems. It would enable validation of space-based warfighting TTPs, and development of multi-domain operating concepts. It also would provide more effective warfighter training, directly supporting the Secretary of Defense's call for greater force readiness.

FRAMING TEST & EVALUATION TO SUPPORT THE NATIONAL DEFENSE STRATEGY

Middle Tier of Acquisition (MTA)

DOT&E supports the MTA concept of faster acquisition and fielding in order to get capability to warfighters more quickly. Still, MTA programs must assess and demonstrate operational performance. Knowing whether a system is survivable and can fulfill the warfighter's need is fundamental. Therefore, in accordance with the law, MTA programs remain subject to DOT&E oversight, including LFT&E, cybersecurity testing, and formal initial operational test and evaluation.

The DOD is developing a new instruction that will require MTA strategies to include a test strategy; when an MTA program is selected for oversight, DOT&E will be the test strategy approval authority. An interim DOT&E policy, issued in October 2019, details expectations for testing, operational demonstrations, and reporting for MTA programs. For rapid prototyping initiatives, the test strategy should incorporate progressive operational and live-fire assessments of capabilities and limitations, based on data from incremental integrated test events during the prototype development program. For rapid fielding efforts, decisions should be based on integrated developmental and operational testing that demonstrates how the capability contributes to fulfilling the warfighter's mission or a concept of operations.

MTA operational demonstrations (ops demos) offer a unique opportunity to "fly before you buy" by involving the operational user before the initial production decision is made. DOT&E encourages tailoring MTA ops demos, and other OT&E, to enable rapid acquisition while maintaining acceptable risk to the warfighter.

Advancing T&E Efficiency and Efficacy

The test community holds a critical role in providing operationally relevant and effective combat capability to the warfighter. To ensure that we fulfill this mission and the NDS mandate to deliver more lethal and more resilient capabilities at the "speed of relevance," the operational test community is focusing on six principles.

Three of these principles emphasize collaborative involvement of the operational and live fire test communities throughout the entire acquisition life cycle. First, OT teams and actual operators must be engaged in a program from its very inception, helping to shape requirements definition, budgeting, contracting, and engineering. Applying the operational perspective at the earliest stages will generate the soundest overall program plan with the greatest likelihood for success. OT involvement must then shift to continuous, timely feedback to the program manager and all other stakeholders. OT will not be limited to a "final exam" or formal reports at fixed milestones; instead, to keep pace with today's rapid acquisition objectives, data collection and dissemination will be frequent and iterative. To get the best, most relevant information, the DOD must implement the third principle in this group: integrate and combine data collection and testing among the contractor, developmental, and operational test teams. These testing "silos" are artificial constructs. Rather, we should be open to utilizing any test event at any point in a program to provide the information any of these three communities may need.

The remaining three principles collectively focus on tailoring testing to each program. Test teams will have the flexibility to adjust as needed in order to help field capability as rapidly as possible. This may include modifying and streamlining processes, products, and requirements in advance – or even after testing has commenced. We must be adaptive, taking advantage of what we learn during the testing process. As an example, in FY19 DOT&E approved elimination of 29 F-35 test missions (more than 200 sorties) because enough data had already been collected or the test outcome was obvious.

Implementing these principles will produce actionable information earlier in, and regularly throughout, the acquisition process. By doing so, we will be able to mitigate program risk, enable sound decisions by the acquisition community, and give the commander and the warfighter a full understanding of what capability they have and how best to use it.

CONCLUSION

As I enter my third year in this position, I remain honored and proud to serve with the operational and live fire test and evaluation community to support our warfighters. We provide the unvarnished truth to the Congress and DOD leaders so that our lawmakers and the Department can ensure that those who put their lives on the line for the Nation have what they need.

In keeping with operational security practices, this report does not contain certain details regarding system performance. As always, my staff and I stand ready to answer questions and to provide more information to members of Congress and their staff in the appropriate setting. I look forward to working with the dedicated women and men of the House and Senate in 2020.

Robert F. Behler
Director