Warfighter Readiness Level (WRL)

A Critical Addition to Expand the Transition Maturity Framework (TMaF)

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Introduction

In the rapidly evolving landscape of military technology, strategic and systematic engagement with Warfighters is crucial for the successful design and development of advanced capabilities to field at the speed of relevance. Deploying new capabilities that the Warfighter is unable or unwilling to employ highlights a breakdown in communication and coordination among the Science and Technology (S&T), Research & Development (R&D), procurement, requirements, and the Warfighter teams. Such failures within the acquisition ecosystem, often stemming from shortcomings in one or more areas of Doctrine, Organization, Training, Materiel, Leadership and education, Personnel, Facilities, and Policy (DOTMLPF-P), result in wasted resources and undermine the effectiveness of fielded solutions.

Persistent engagement between S&T and R&D teams with the Warfighter during Test & Evaluation (T&E) events ensures new technologies align with the practical needs and preferences of those on the front lines as well as being technically robust enough for transitioning to procurement and fielding. By involving Warfighters in the process, the development team ensures that the technologies are user-friendly, mission-relevant, and readily embraced by those who will employ them in critical military operations. This collaborative approach enhances the likelihood of operational success and maximizes the return on investment in defense innovations.

To bridge the gap between technological development and operational employment, this paper introduces the concept of a Warfighter Readiness Level (WRL) framework. For the WRL framework, a Warfighter may be considered a member of the Armed Forces who responsible for conducting operations and is affiliated with a Combatant Command (CCMD) and/or a Service presenting forces to the CCMD. Warfighters with relevant input range from the "boots on the ground" tactical level junior officer and enlisted corps to the operational mid-grade service members, and all the way up through senior leaders in strategic roles.

WRL is designed to complement and strengthen the existing Transition Maturity Framework (TMaF)[1], which consists of the following elements: Technology Readiness Level (TRL), Transition Confidence Level (TCL), Manufacturing Readiness Level (MRL), and Requirements Readiness Level (RRL). The TMaF provides a structured approach to transitioning technologies from the Research, Development, Test & Evaluation (RDT&E) funding phases into procurement, The WRL element adds a critical dimension by focusing on Warfighter engagement and readiness to enable adoption and acceptance. The WRL incorporates DOTMLPF-P

[1] Zides, D., Youngbull, T., Darling, R., Verich, M., Faucher, N., Kirshenbaum, K., Warda, D., Murphy, C., Kiviat, B., & Tedder, L. (2024, November 1). *Transition Maturity Framework (TMaF): A Framework to Guide New Technologies Transitioning to Department of Defense (DOD) Acquisition Programs*. The MITRE Corporation. DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited.

considerations defined in the Joint Capabilities Integration and Development System (JCIDS) manual[2]. By systematically categorizing and assessing the stages of employment interest and willingness—from initial identification to full implementation, WRL ensures that emerging technologies meet the strategic and tactical needs of military personnel.

This structured approach not only facilitates smoother transitions from R&D to fielding but also addresses a key gap in the TMaF: the human and operational dimensions of technology adoption. By embedding Warfighter perspectives into the development lifecycle, WRL fosters greater confidence among Warfighters in adopting new capabilities, ultimately enhancing mission effectiveness, operational readiness, and the overall impact of defense innovations.

Current Challenges Assessing a Technology's Warfighter Readiness Maturity

The maturation and transition of advanced technologies face several significant challenges for acceptance and use (adoption) by the Warfighter. One primary issue is the disconnect between technological advancements and the practical needs and preferences of the end-users, the Warfighters themselves. Often, technologies are developed in isolation, apart from those who will ultimately employ them, leading to solutions that may be technically sound but lack relevance or usability in real-world scenarios. In fact, GAO report GAO-25-107003, *DOD Acquisition Reform: Military Departments Should Take Steps to Facilitate Speed and Innovation*, concluded the Army, Navy, and Air Force, "[S]hould revise [their] acquisition policies and relevant guidance to reflect leading practices that facilitate speed and innovation, using continuous iterative cycles that ensure the design meets user needs, the development of a minimum viable product, and the optimization of processes to produce further iterations."[3]

For example, without collecting feedback to ensure a design meets Warfighter needs, the safety, ruggedization, and mobility/transportation solution opportunities could go unattended. This can also lead to missed opportunities for standardization and interoperability across joint and coalition forces – increasing acquisition, logistics, and sustainment costs. So, to illustrate, a cutting-edge energy storage system may meet technical specifications but fail to account for ergonomics/portability or ease of use in austere environments, limiting its operational value because the Warfighter may not be *willing* to employ the capability.

Additionally, the complexity and rapid pace of technological innovation can outstrip the ability of military procurement processes to adapt, resulting in delays and inefficiencies in fielding new capabilities. For instance, while a technology may be ready for deployment, the lack of training infrastructure or policy alignment can stall its integration into operations because the Warfighter may not be *able* to employ the capability. Furthermore, ensuring that Warfighters are adequately trained and motivated to adopt these new technologies requires a deep understanding of their operational environment and constraints. Without addressing these challenges, the potential benefits of advanced technologies may remain unrealized, underscoring the need for a

[2] Defense Acquisition University. (2021, October). *Manual for the operation of the Joint Capabilities Integration and Development System (JCIDS)*. https://www.dau.edu/sites/default/files/2024-01/Manual%20-%20JCIDS%20Oct%202021.pdf
[3] U.S. Government Accountability Office. (2024). *DOD acquisition reform: Military departments should take steps to facilitate speed and innovation* (GAO-25-107003). https://files.gao.gov/reports/GAO-25-107003/index.html

framework like the WRL to guide alignment of technological development with Warfighter readiness and willingness to employ capabilities.

Defining Warfighter Readiness Level (WRL)

The WRL framework is designed to systematically integrate and account for Warfighter input throughout the RDT&E maturation lifecycle, ensuring that new capabilities are not only technically viable, affordable, and produceable, but also operationally relevant and embraced by end-users. This framework establishes strategic points within the technology development process, spanning from applied research (Budget Activity Code (BAC) 6.2) to operational system development (BAC 6.7) - where Warfighters actively participate in co-developing the capability. At each stage, critical WRL-related activities are executed to assess and refine the alignment of the technology with operational needs. These activities include workshops, simulations, and field trials where Warfighters provide feedback and insights, addressing the pivotal question: "Can you see a world where you would be *willing to employ* this technology/capability in an operational environment in support of critical mission requirements?" and “Is it compatible with the other kit you will be using?” By embedding Warfighter perspectives and knowledge at these key junctures, the WRL framework ensures that the evolving technology remains focused on practical application and mission success, ultimately enhancing the likelihood of its adoption and effective use in the field.

What WRL is Not

WRL is uniquely focused on Warfighter engagement and should not be conflated with other elements of the TMaF, such as the RRL. While elements like TRL, RRL, TCL, and MRL within TMaF concentrate on the broader transition of technologies from R&D into procurement, WRL specifically tailors its focus to actively involve Warfighters in the co-development process, make sure their feedback in incorporated moving forward, and ensuring that emerging capabilities are not only technically sound but also align with the real-life operational needs and preferences of the Warfighters.

Unlike RRL, which assesses the maturity of requirements alignment to enable a project to transition into a program office, WRL extends its focus to the goal of securing the Warfighter's willingness to employ an acquired and fielded capability. It integrates early considerations of DOTMLPF-P. WRL complements, rather than duplicates, the technical assessments or procedural elements of TMaF by addressing the human and operational dimensions of technology adoption. This distinction underscores WRL's unique role in bridging the gap between technological innovation and practical application, ensuring that end-users are willing and prepared to employ these capabilities in real-world scenarios.

The WRL Framework

WRL Scale Descriptions, Critical Activities, and Outputs

The WRL framework consists of nine levels, each representing a stage in the technology's alignment with Warfighter readiness and willingness to employ. Below is a detailed description

of each WRL level, including critical assessments, actionable activities, and outcomes to move up / mature through the levels. Please note that the WRL framework was initially designed to support operational energy technologies, so DOD Service Energy Offices (SEOs) are identified as critical stakeholders. This may/may not be the case for all DOD R&D efforts (i.e., tailor project efforts accordingly):

WRL 1 introduces Warfighters to the technology concept, raising awareness and aligning it with operational needs. Initial discussions and briefings gauge interest and ensure alignment with current and future operational concepts. Critical *activities include conducting briefings, aligning technology development with DOD innovation investments, and exploring how the technology fits within operational concepts*. The output is the observation of basic requirements and the raising of initial awareness.

WRL 2 validates initial requirements and assesses the technology's fit within command structures and roles. Stakeholder engagement begins, and support is demonstrated through letters of endorsement. *Activities include engaging Warfighters in discussions about the technology's implications for Doctrine and Organization, validating requirements curated during RRL research, and securing letters of support and points of contact* (POCs) from Combatant Commands (CCMDs) and, in the case of the operational energy mission area, the SEOs. The output is the identification of initial requirements and the securing of stakeholder backing.

WRL 3 focuses on T&E events where Warfighters engage with the developing capability to validate requirements and provide feedback for training development. *Activities include conducting T&E activities (e.g., lab testing, M&S, demonstrations, wargaming, experiments, low-fidelity exercises) with Warfighter observation and participation, developing training programs for familiarization, and assessing the technology's fit within organizational structures* while making necessary adjustments. The output is the refinement of requirements based on Warfighter consultation and the development of training programs.

WRL 4 emphasizes Warfighter’s leadership advocacy and endorsement based on the feedback collected during WRL 3 T&E activities. Leaders are trained to advocate for the technology, and adjustments are made to align with organizational structures. *Activities include training leaders to understand and advocate for the technology, securing endorsements from key leadership, CCMDs, and SEOs, and conducting lab and field tests* to gather feedback for validation. The output is leadership endorsement and organizational alignment.

WRL 5 involves policy development and field demonstrations. Policies and procedures are developed to support the technology's integration, and field demonstrations under operational conditions validate the technology's fit within doctrine and TTPs. *Activities include conducting field testing and exercises, capturing and analyzing feedback to inform policy and training development, and involving Warfighters in shaping policies* to ensure practicality and acceptance. This shaping includes deployment, employment, and disposition policies as well as the affiliated initial design and development of the Mission Essential Task List (METL) inputs. The output is the development of policies, initial training packages, and the capture of field-testing event feedback to support acquisition decision-making.

WRL 6 focuses on activities needed to prepare for adoption and training development leveraging advanced concepts and prototypes. The technology is initially prototyped for adoption across relevant units, with continuous adaptation and support to address emerging challenges. *Activities include developing and maturing training packages in collaboration with CCMDs, SEOs, and educational institutions, establishing a support system for troubleshooting, and ensuring infrastructure is in place* to support widespread use. The output is the establishment of training programs and infrastructure to support widespread use.

WRL 7 prioritizes operational trials and commitment to advocate for project authorization and funding in the POM (Program Objective Memorandum). Limited operational trials are conducted, with Warfighters providing feedback on usability and effectiveness. *Activities include organizing system prototyping and pilot project trials, securing funding commitments for full-scale deployment, and documenting feedback to refine the technology and improve training TTPs*. The output is the validation of requirements through operational trials and the commitment of funding for full-scale deployment.

WRL 8 focuses on training and Warfighter integration. Training programs are developed to ensure Warfighters are proficient with the technology, and Warfighter input is integrated into the design process to refine usability and effectiveness. *Activities include conducting training sessions, including Warfighters on the development team, and conducting exercises and transition events to explore the technology's capabilities*. The output is the completion of training, and the refinement of the technology based on Warfighter feedback.

WRL 9 ensures deployment and cultural integration. The technology is fully fielded into operational units and has become an integral part of military culture. *Activities include gathering Warfighter endorsements, reviewing and updating DOTMLPF-P, and establishing a support system for continuous adaptation*. The output is the full integration of the technology into military operations, ensuring it is operationally effective and embraced by Warfighters.

Figure 1 below visually represents the WRL framework, highlighting its alignment with the TMaF and illustrating the structured progression from basic research to full operational deployment. This visual provides a clear overview of how WRL integrates Warfighter engagement at each stage to ensure technology readiness and operational relevance.

WRL Level	Title	Description
9	**Deployment and Cultural Integration**	The project is fielded to operational units and becomes an integral part of the military culture. Warfighters endorse its use, and it is fully embedded in Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, Facilities, and Policy (DOTMLPF-P). This ensures the technology is fully embraced and operationally effective.
8	**Training and Warfighter Integration**	Training programs are developed to familiarize warfighters with the technology. Projects with a warfighter on the development team progress quicker, as they provide input from the end-user perspective during the design phase. This ensures warfighters have the necessary skills and knowledge to effectively use the technology.
7	**Operational Trials and Commitment to POM**	The technology is deployed in limited operational trials, with warfighters providing feedback on usability and effectiveness. Money is allocated to purchase the project at scale, supporting the warfighter's ability to execute the mission. This involves warfighters in the evaluation process to ensure the technology meets their needs.
6	**Adoption/Training Development**	The technology is adopted across relevant units, with continuous adaptation and support to address emerging challenges. Project developers coordinate with educational institutions to develop and mature training packages, ranging from "on the job training" to curriculum development for new career fields. This ensures the necessary infrastructure and training are in place to support widespread use.
5	**Policy Development and Field Demonstration**	Policies and procedures are developed to support the technology's integration, with warfighters involved in shaping guidelines and training. This shaping includes deployment, employment, and disposition policies as well as the affiliated initial design and development of the Mission Essential Task List (METL) inputs. The project is inserted into a collective training event under operational conditions to understand its fit within doctrine and Tactics, Techniques, Procedures (TTPs). Feedback is captured for senior leaders making acquisition decisions.
4	**Leadership, Advocacy, and Endorsement**	Leadership and education efforts focus on building advocacy among key personnel. Leaders are trained to understand and communicate the technology's benefits. This is a critical step to transition from a science and technology project to a program of record, indicating support by end-users for adoption and purchase at scale.
3	**Test & Evaluation (T&E) Participation**	The technology is assessed for its fit within existing organizational structures, with adjustments made to align with current processes. Tests allow developers to gather diagnostic data, with warfighter participation critical for replicating realistic conditions and offering operationally informed feedback.
2	**Initial Engagement**	Warfighter consultation and validate end user requirements. Warfighters engage in discussions about the technology's implications for Doctrine and Organization. Service labs and industry must gain support from Combatant Commands (CCMDs) and/or Service Energy Offices (SEOs), demonstrated by a letter of support. This assesses how the technology fits within existing command structures and roles.
1	**Awareness and Alignment with Requirements**	Warfighters are introduced to the technology concept, with initial discussions and briefings raising awareness and gauging interest. DOD innovation investments are aligned with warfighter needs, ensuring the technology aligns with current and future operational concepts. This could be a "technology pull" if the Warfighter has an existing requirement the technology solves or could be a "technology push" if there is not a codified, existing requirement.

Figure 1: The Warfighter Readiness Level (WRL) Framework

This WRL framework outlines the progressive integration of technology into military operations, starting from initial awareness and alignment with Warfighter requirements (Level 1) to full deployment and cultural integration (Level 9). At the foundational levels, Warfighters are introduced to the concept, validating its alignment with operational needs and engaging in discussions about its implications for doctrine and organizational structures (Levels 1-2). As the technology matures, it undergoes increasingly rigorous testing and evaluation, with warfighter participation ensuring operational relevance and diagnostic refinement (Level 3). Advocacy from leadership and policy development follow, enabling field demonstrations and shaping guidelines for integration into training and operational frameworks (Levels 4-5). Adoption across units and the development of comprehensive training programs mark the transition to widespread use, supported by operational trials and funding commitments for scaled deployment (Levels 6-7). Finally, training programs are institutionalized, and the technology becomes embedded in military culture, fully integrated into DOTMLPF-P, ensuring its operational effectiveness and enduring value to warfighters (Levels 8-9).

Additionally, as depicted below in Figure 2, each WRL level includes a set of critical actionable activities that define the systematic steps necessary for progression to the next level. These activities should be incorporated into the S&T team’s project planning to ensure effective

scheduling and resourcing for each event (especially if a Warfighter is going to be asked to take time away from conducting military operations to provide feedback on the developing capability.

WRL Level	Title	Critical Activities
9	**Deployment and Cultural Integration**	• Conduct comprehensive training sessions to ensure warfighters are fully proficient with the technology. • Gather and document warfighter endorsements and testimonials to support cultural integration. • Review and update DOTMLPF-P to reflect the technology's integration.
8	**Training and Warfighter Integration**	• Develop training programs and workshops to familiarize warfighters with the technology. • Include warfighters on the development team to provide input from the end-user perspective. • Conduct exercises and transition events to explore the technology's capabilities and gather feedback. • Leverage OSD Warfighter Touchpoint Tool for collecting feedback at demos/experiments/exercises (https://warfighterfirst.org/)
7	**Operational Trials and Commitment to POM**	• Organize system prototyping and pilot project trials with warfighters to gather feedback on usability, training, and effectiveness. • Secure funding commitments for full-scale deployment by demonstrating value and impact. • Document and analyze feedback to refine the technology, improve training TTP's and ensure it meets operational needs. • Leverage OSD Warfighter Touchpoint Tool for collecting feedback at demos/experiments/exercises (https://warfighterfirst.org/)
6	**Adoption/Training Development**	• Develop, mature, and distribute detailed training packages in collaboration with CCMDs, SEOs, and educational institutions. • Establish a support system for continuous adaptation and troubleshooting to address emerging challenges. • Ensure infrastructure is in place to support widespread use, including facilities and logistics. Leverage OSD Warfighter Touchpoint Tool for collecting feedback at demos/experiments/exercises (https://warfighterfirst.org/)
5	**Policy Development and Field Demonstration**	• Involve warfighters in shaping policies and procedures to ensure practicality and acceptance. • Conduct field testing and exercises under operational conditions to validate the technology's fit within doctrine. • Capture and analyze feedback from demonstrations to inform policy & training development and support acquisition decision-making in concert with CCMD and SEO POCs. • Leverage OSD Warfighter Touchpoint Tool for collecting feedback at demos/experiments/exercises (https://warfighterfirst.org/)
4	**Leadership, Advocacy, and Endorsement**	• Train leaders to understand and advocate for the technology, emphasizing its benefits and applications based on WRL 3 feedback. • Secure endorsements from key leadership, CCMDs, and SEOs to support transition to a program of record. • Develop communication materials to effectively convey the technology's value to users and stakeholders. Leverage OSD Warfighter Touchpoint Tool for collecting feedback at the demos/experiments/exercises (https://warfighterfirst.org/)
3	**Test & Evaluation (T&E) Participation**	• Conduct T&E activities (e.g., lab testing, M&S, demonstrations, wargaming, experiments) with Warfighter observation and participation. • Assess the technology's fit within existing organizational structures and make necessary adjustments. • Begin planning with CCMD and SEO POCs for integrating the technology into existing inventory and logistics systems. • Leverage OSD Warfighter Touchpoint Tool for collecting feedback at demos/experiments/exercises (https://warfighterfirst.org/)
2	**Initial Engagement**	• Engage warfighters in discussions about the technology's implications for Doctrine and Organization. • Validate requirements the S&T project team has curated during RRL research activities. • Secure letters of support and POCs from CCMDs and/or Service Energy Offices to demonstrate stakeholder backing. • Assess how the technology fits within existing command structures and roles.
1	**Awareness and Alignment with Requirements**	• Engage Warfighters from both the CCMDs and the Services' Supporting Commands to ensure joint mission execution and Organize/Train/Equip (O/T/E) presentation of forces perspectives. • Conduct initial briefings and discussions to raise awareness and gauge interest in the technology. • Align technology development with DOD innovation investments and warfighter needs. • Explore how the technology aligns with current and future operational concepts. • Leverage this information to conduct RRL research to identify initial requirements as possible.

Figure 2: WRL Critical Activities

Critical activities progress from validating requirements and assessing organizational fit through testing, leadership advocacy, policy development, training infrastructure, and operational trials, with the OSD Warfighter Touchpoint Tool serving as a vital mechanism to capture Warfighter feedback during T&E touchpoint events. These events can be completed, date-stamped, certified, and become part of the permanent program development record.

WRL Scale Alignment to Budget Activity Codes (BACs)

Aligning the WRL scale to Budget Activity Codes (BACs) provides a structured framework for integrating actionable Warfighter feedback throughout the technology development lifecycle. This alignment synchronizes capability maturation with funding phases, ensuring seamless transitions from research to operational deployment.

WRL	Budget Activity Code (BAC) Alignment
9	6.7 Operational System Development & 6.5 System Development and Demonstration
8	6.7 Operational System Development & 6.5 System Development and Demonstration
7	6.5 System Development and Demonstration & 6.4 Adv Component Dev and Prototypes
6	6.4 Adv Component Dev and Prototypes
5	6.4 Adv Component Dev and Prototypes & 6.3 Advanced Technology Development
4	6.3 Advanced Technology Development
3	6.3 Advanced Technology Development
2	6.2 Applied Research
1	6.2 Applied Research

Table 1: WRL Alignment to BACs

By mapping WRL stages to BACs, stakeholders can better coordinate resources, timelines, and decisions, optimizing resource allocation and enhancing transparency. This approach fosters a responsive development process, where advancements are refined based on operational needs, maximizing the effectiveness of defense investments (note: BAC 6.6 cuts across multiple WRLs in a background support role).

Leveraging Test & Evaluation (T&E) to Integrate the Warfighter Early

Traditionally, S&T and R&D teams have been hesitant to invite the Warfighter into the early stages of capability development, fearing that premature feedback might derail progress or expose technical uncertainties. However, leveraging T&E events as collaborative meeting grounds offers a powerful way to overcome this barrier and foster meaningful engagement. T&E events serve as critical touchpoints for S&T and R&D teams to work directly with the Warfighter, enabling the maturation of emerging capabilities and increasing the likelihood of successful transition from RDT&E and into procurement. Engaging Warfighters early in the development process to gather positive feedback on the potential impact of the technology not only helps build advocacy from leadership but also mitigates risks by aligning the innovation with operational needs – an approach that often becomes essential for successful transition during the later stages of the RDT&E process.

These events provide a unique opportunity for Warfighters to serve as both observers and participants, offering invaluable insights into operational needs, usability, and mission alignment. Without the active involvement and feedback of the Warfighter, there is a risk that new technologies may be fielded but ultimately rejected in mission operations due to gaps DOTMLPF-P considerations. By engaging the Warfighter early and often through T&E events, S&T and R&D teams can proactively address these challenges, ensuring that capabilities are not only technologically sound but also operationally viable and embraced by those who rely on them in the field. Table 2 summarizes Warfighter role in the early, middle, and later T&E phases.

T&E Phases of RDT&E Process	Warfighter Role Summary
Early T&E (e.g., Lab, M&S, and DT)	Warfighter's role is typically limited to providing requirements, operational context, or desired outcomes. Their involvement is more indirect.
Middle T&E (e.g., OT, Experimentation, Field Testing)	Warfighter becomes increasingly involved, using the technology in realistic scenarios and providing critical feedback to ensure it meets operational needs.
Later T&E (e.g., Exercises, Prototyping, Transition Events)	Warfighter plays a central role, operating the technology in simulated or real missions and driving the final integration into the force.

Table 2: Summary of Warfighter's Role in the T&E Phases of the RDT&E Process

Example: T&E Events in the Operational Energy Technology Domain

In the operational energy technology domain, T&E events span a range of activities that allow Warfighters to provide critical feedback at different stages of capability development.

During lab testing, S&T teams might evaluate advanced battery technologies or hybrid power systems in controlled environments to assess performance metrics such as energy density, recharge cycles, and durability. Warfighters can participate as observers, offering insights into practical concerns like portability, ease of use, and maintenance requirements in austere conditions.

In modeling and simulation (M&S), teams may use digital representations, digital twins, and virtual environments to analyze how energy solutions perform under simulated mission scenarios, such as powering forward operating bases or supporting dismounted operations. Warfighters can act as participants by validating assumptions and ensuring the models reflect real-world operational demands.

Finally, in experimentation, technologies like wearable energy-harvesting devices or microgrids can be deployed in field exercises, where Warfighters actively use the systems in realistic mission environments. Their feedback on reliability, integration with existing equipment, and overall mission impact helps refine the technology and address potential DOTMLPF-P gaps before transition to procurement. These examples illustrate how T&E events provide a collaborative platform for Warfighters and R&D teams to shape operational energy solutions that are both effective and mission ready.

Table 3 outlines R&D key T&E events and highlights the vital role of the Warfighter in shaping the future of defense innovation.

Test & Evaluation (T&E) Categories in R&D	T&E Category Goal for S&T Activities	Tactical Control (TACON) Office of Primary Resonsibility (OPR)	Key Warfighter T&E Observation and Participation Roles
Lab Testing	Evaluate the fundamental performance of a technology in a controlled environment. This is typically the first step in assessing feasibility and validating basic functionality.	**S&T Team** The S&T team retains control, as the testing is conducted in a lab setting under their direct supervision.	*Observe* lab testing (as applicable) and/or review test results. *Participate* by providing operational context and/or requirements.
Modeling and Simulation (M&S)	Use simulations to test the technology in mission-relevant virtual scenarios.	**S&T Team** The S&T team retains control, as M&S testing is conducted in a virtual environment under their direct supervision.	*Observe* M&S (as applicable) and/or review M&S results. *Participate* by providing operational insights to refine scenarios, simulation parameters, and validate results against real-world expectations.
Technology Demonstrations	Showcase the capabilities of a technology to stakeholders, including decision-makers, warfighters, and acquisition teams. Demonstrations are often used to build confidence and justify further investment.	**S&T Team (with Warfighter input)** The S&T team usually retains TACON, but Warfighters may participate to provide feedback and operational context.	*Observer or participant (tailor Warfighter role to meet goal of the demo)* ; provides operational insights and feedback to refine technology.
Experimentation	Explore new concepts, tactics, techniques, and procedures (TTPs) using advanced technologies. Experimentation helps identify how emerging capabilities can be integrated into the operational environment.	**Shared (S&T Team and Warfighter)** TACON may be shared between the S&T team and Warfighters, as experimentation often involves collaboration to test hypotheses and refine operational concepts.	*Combined observation and participation role* ; tests new technologies and helps develop operational concepts and tactics.
Exercises (field exercises and tabletop exercises)	Test the integration of advanced technologies within larger-scale military operations. Exercises simulate real-world scenarios to assess readiness and interoperability.	**Warfighter** The Warfighter typically has TACON during exercises, as the focus is on operational use and mission execution.	*Active participant* ; integrates technology into simulated missions and evaluates its impact on operational effectiveness.
Field Testing	Validate the technology's performance in an operationally relevant environment, bridging the gap between laboratory testing and full-scale deployment.	**S&T Team → Warfighter** Early field testing is often controlled by the S&T team, but TACON transitions to the Warfighter as the technology nears operational readiness.	*Combined observation and participation role* ; Early stages *observation* : Provides feedback on usability. Later stages *participation* : Operates the technology in real-world conditions.
Prototyping/Pilot Programs	Deploy limited quantities of a technology to operational units for evaluation and feedback. This helps refine the system and identify any remaining issues before full-scale production.	**Warfighter** The Warfighter typically has TACON during pilot programs, as they are the ones using the prototypes in real-world missions.	*Active participant* ; Operates prototypes in real missions; provides detailed feedback to refine design and functionality.
Wargaming	Simulate strategic and tactical scenarios to assess the impact of advanced technologies on decision-making, force structure, and mission outcomes.	**Shared (S&T Team and Warfighter)** Both the S&T team and Warfighters may share TACON, as wargaming involves collaboration to explore how technology influences operational planning.	*Combined observation and participation* in both strategic and tactical roles; evaluates how technology influences decision-making, force structure, and mission outcomes.
Transition Events	Facilitate the handoff of mature technologies from S&T teams to acquisition programs or operational units. These events often include demonstrations, briefings, and documentation.	**S&T Team → Warfighter** TACON begins with the S&T team but shifts to the warfighter or acquisition teams as the technology transitions to operational use.	*Active participant* ; receives the technology; provides final operational feedback and begins integration into regular use.

Table 3: Warfighter Observation and Participation Roles in R&D T&E Events

Integrating DOTMLPF-P Considerations into R&D T&E Activities

T&E events are not only critical for validating the technical performance of emerging capabilities but also for assessing their alignment with the broader DOTMLPF-P framework. By incorporating DOTMLPF-P considerations into T&E activities, S&T and R&D teams can ensure that new technologies are supported by the necessary processes, plans, and standards to enable successful fielding and employment. This approach reduces the risk of the Warfighter rejecting the capability due to gaps in readiness, usability, or mission alignment, while also enhancing the

likelihood of a smooth transition from RDT&E to procurement, procurement to fielding, and fielding to employment.

For example, the development of Mission Essential Task Lists (METLs), which outline warfighter training standards, can be integrated into T&E events to validate whether emerging capabilities enable Warfighters to perform mission-critical tasks effectively. Field experimentation provides an ideal venue for testing METLs under realistic conditions, allowing warfighters to assess whether the technology supports their operational needs and identify any gaps in training or usability. Similarly, Deployment and Employment Plans can be tested during logistics-focused T&E activities, where transportation requirements, equipment handoff procedures, and accountability processes are evaluated. Finally, Energy Supportability Analyses (ESAs) evaluations may be conducted to assess the energy requirements, consumption, and overall energy supportability of military systems, platforms, and/or operations. These events ensure that deployment plans are feasible, efficient, and aligned with operational timelines and resources.

Safety and disposal considerations are equally important in T&E. Safety Plans can be tested during lab evaluations, M&S, and field experimentation to identify risks and refine mitigation strategies. For example, testing the safety protocols for advanced operational energy systems, such as hybrid power solutions, ensures that Warfighters can handle and operate the technology safely in austere environments. Additionally, retrograde and destruction plans can be evaluated during end-of-life testing or post-mission exercises to validate the secure return or appropriate disposal of sensitive equipment. These assessments ensure compliance with security, hazardous waste, and logistical standards, reducing the risk of operational disruptions/vulnerabilities and risks to human health.

By integrating DOTMLPF-P considerations into T&E activities, S&T and R&D teams can proactively address challenges that extend beyond technical performance, ensuring that new capabilities are not only operationally viable but also supported by the necessary processes and infrastructure. Warfighter participation in these evaluations is essential, as their feedback helps refine plans and standards to meet real-world operational needs. This holistic approach to T&E ensures that emerging technologies are fielded with confidence, maximizing their effectiveness and relevance in mission operations.

WRL Use Case: Operational Energy-Innovation (OE-I)

To apply WRL to the Operational Energy-Innovation (OE-I) portfolio, the emphasis is on BAC 6.3 (Advanced Technology Development) through BAC 6.4 (Advanced Component Development and Demonstration). Projects in the OE-I portfolio focus on maturing to at least WRL 6, ensuring adoption and training development. As part of the OE-I Portfolio Evaluation Board (PEB) process, proposed projects should enter at WRL 3 or have a plan that shows rapid transition from WRL 2 to WRL 3 For example, an energy storage system designed for operational use would undergo T&E field demonstrations at WRL 5 to validate its fit within doctrine, followed by training development at WRL 6 to ensure Warfighters can effectively employ the technology.

Conclusion

Warfighter readiness equally benefits both the RDT&E community and the Warfighters themselves. For the RDT&E community, this joint effort yields accountable documentation, rapid technological advancements, and a crucial understanding of the Warfighter as both customer and end-user. This collaboration is equally essential for Warfighters; ensuring emerging technology meets their needs and is properly and methodically documented within military standards, policy, and instructions to ultimately increase the likelihood of successful adoption.

The WRL framework provides a critical addition to the TMaF, expanding upon elements such as TRL, RRL, TCL, and MRL by addressing the human and operational dimensions of technology adoption. By embedding Warfighter perspectives into the development process, WRL ensures technologies are operational relevant, effective, and culturally integrated into military operations to enhance the mission effectiveness, operational readiness, and overall impact of defense technology innovation Ultimately, WRL bridges the gap between technological innovation and practical application, ensuring Warfighters are motivated, trained, and prepared to employ advanced capabilities.

About the WRL Team

The WRL has been developed by a cross-functional team of senior experts in DOD S&T, R&D, acquisition, warfighting, requirements, T&E, and staffing. This diverse expertise ensures Warfighter engagement throughout the technology development lifecycle, integrating their perspectives to make emerging capabilities operationally relevant, user-friendly, and mission aligned. This approach reduces risk, improves efficiency, and ensures Warfighter readiness to employ advanced capabilities effectively.

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Appendix A: Acronyms

Acronym	Definition
BAC	Budget Activity Code
CCMD	Combatant Command
DOD	Department of Defense
DOTMLPF-P	Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, Facilities, and Policy
DT	Developmental Testing
METL	Mission Essential Task List
M&S	Modeling and Simulation
OE-I	Operational Energy-Innovation
OPR	Office of Primary Responsibility
OSD	Office of the Secretary of Defense
OT	Operational Testing
OTE	Organize, Train, Equip
PEB	Portfolio Evaluation Board
POC	Point of Contact
POM	Program Objective Memorandum
R&D	Research and Development
RRL	Requirements Readiness Level
S&T	Science and Technology
SEO	Service Energy Office
TACON	Tactical Control
T&E	Test and Evaluation
TCL	Transition Confidence Level
TRL	Technology Readiness Level
TTPs	Tactics, Techniques, Procedures
WRL	Warfighter Readiness Level

Appendix B: Additional Reading

[1] Zides, D., Youngbull, T., Darling, R., Verich, M., Faucher, N., Kirshenbaum, K., Warda, D., Murphy, C., Kiviat, B., & Tedder, L. (2024, November 1). *Transition Maturity Framework (TMaF): A Framework to Guide New Technologies Transitioning to Department of Defense (DOD) Acquisition Programs*. The MITRE Corporation. DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited.