A Practical Framework for Transitioning TECHNOLOGY TO THE WARFIGHTER

by **DEBRA ZIDES, NATALIE FAUCHER, TRICIA YOUNGBULL, ALEX COCCO,** and **RUTHANNE DARLING**

U.S. Army Paratroopers assigned to 2nd Battalion, 377th Parachute Field Artillery Regiment, 2nd Infantry Brigade Combat Team (Airborne), 11th Airborne Division, wait for CH-47 Chinook helicopters to arrive for an air assault gun raid at Donnelly Training Area, Alaska, July 22, 2025. Operating in the Arctic requires Soldiers to remain patient, prepared, and mission-ready in harsh and rapidly changing conditions.

Source: Photo by Correy Mathews
This image was cropped to show detail and was edited using multiple filters plus dodging and burning techniques.

Cutting-edge technologies are essential for addressing evolving threats and maintaining operational readiness. As a result, the military annually invests billions of dollars in emerging technology Research, Development, Test, and Evaluation (RDT&E). For instance, in its Fiscal Year (FY) 2026 base budget, the Pentagon requested ***$142 billion in RDT&E funds.*** When these investments translate to technological advantage in warfighting capability, the United States and its allies benefit from increased military assuredness and deterrence. But the path from an innovative idea to a fielded capability is strewn with obstacles.

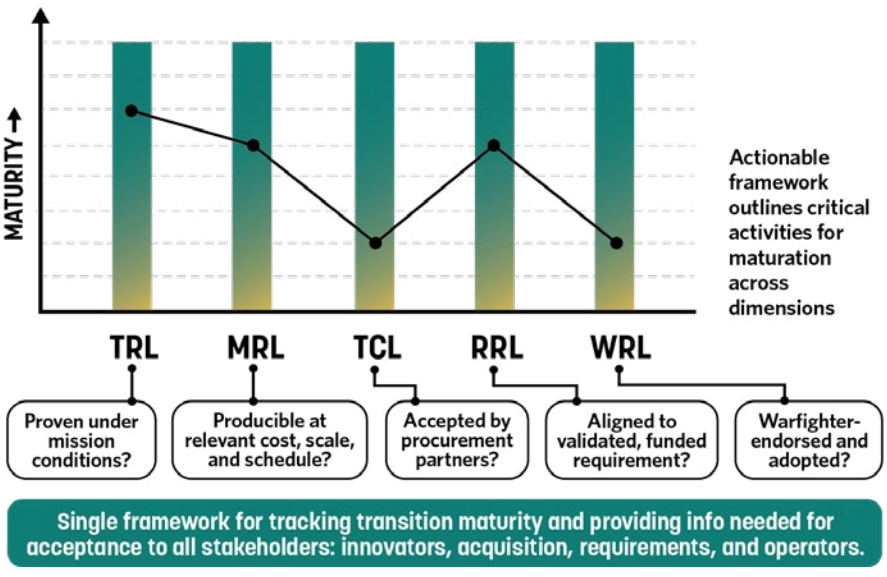
From Idea to Capability and the Valley of Death

A critical juncture in defense technology development emerges where the goal changes from demonstrating feasibility (proof of concept) to demonstrating producibility and mission relevance (minimum viable product/prototype aligned to a capability need). Navigating this transition and demonstrating technological maturity requires DoD domain knowledge often outside the strengths of a typical Science and Technology (S&T) project team (e.g., manufacturing, cost estimation, defense acquisition, requirements, and operator training). This knowledge gap creates barriers to technology adoption and increases the risk of falling into the "valley of death."

The Operational Energy Innovation Directorate (OE-I) in the Office of the Under Secretary of Defense for Acquisition and Sustainment developed the Transition Maturity Framework, or TMaF (Figure 1), to strategically manage technology transition.

The TMaF puts the Warfighter first. It is designed to support S&T teams and RDT&E program managers in delivering Warfighters superior technological capabilities. It helps S&T teams identify critical activities necessary to navigate their technologies past the valley of death. It provides program managers a framework for strategic project selection and execution management. Although initially developed by OE-I, the TMaF is readily tailored for use by other defense programs. Interested readers can find links to the TMaF and complementary tools at the end of the article.

Figure 1. Transition Maturity Framework (TMaF)



Note: MRL = Manufacturing Readiness Levels; RRL = Requirements Readiness Level; TCL = Transition Confidence Level; TRL = Technology Readiness Level; WRL = Warfighter Readiness Level

Source: The MITRE Corp. Reprinted with permission.

OE-I's Challenges

The OE-I Directorate was created in 2012 to transition operational energy capabilities to the Warfighter and is overseen by the Office of the Deputy Assistant Secretary of Defense for Energy, Resilience, and Optimization. OE-I manages two RDT&E funds (B.A. 6.3 and B.A. 6.4): the Operational Energy Capability Improvement and Prototyping Funds (OECIF and OEPF).

To mitigate transition risks, OE-I rigorously vets proposals via a Proposal Evaluation Board (PEB), proactively connects innovators with transition partners (e.g., Program Executive Offices [PEOs], industrial base collaborators, Service energy offices, and combatant commands) and tracks technology maturation during project execution.

By the end of 2022, however, OE-I recognized three persistent challenges to managing technology transition. First, OE-I found that existing "readiness levels" missed key determinants of transition success. For example, a technology at high TRL and MRL (technology and manufacturing readiness levels) could still lack alignment to a funded, validated requirement or could prove impractical for Warfighter use. In other words, a team could be developing a technology

for technology's sake rather than for a mission.

Second, OE-I realized that its project teams, typically led by technology innovators, lacked the information needed to develop and execute a strategic technology transition plan that demonstrates transition confidence and technical maturity to deliver a needed capability. These teams needed actionable activities to guide them toward successful transition. For example, which PEOs should they contact? How could they get in touch? What should they discuss once connected? OE-I needed resources and tools to empower innovators that deliver impactful capabilities to the Warfighter.

Finally, OE-I lacked an efficient, data-driven means of reporting technology maturation and mission impact to its leadership and Congress. The FY 2021 National Defense Authorization Act (NDAA, Sec. 324) added urgency to these challenges. It mandated OE-I to develop and utilize a tool that could (a) track technology maturation from applied research to transition to use and (b) provide information needed by all stakeholders for technology acceptance.

The Transition Maturity Framework

In early 2023, OE-I, in collaboration with MITRE, convened a multidisciplinary team of subject matter experts drawn from key stakeholder groups within the defense acquisition ecosystem: technology innovators, acquisition program managers, the requirements community, and operators (Warfighters and Warfighter-training specialists). They created the TMaF.

The TMaF integrates five readiness dimensions into a single framework designed to capture technology acceptance criteria across all acquisition stakeholders. Of the five TMaF readiness dimensions, three already existed: TRL, MRL, and Transition Confidence Level (TCL).

TRL, MRL, and TCL primarily account for the priorities of technology innovators and acquisition programs but do not fully capture the needs of the requirements community and operators. They leave open the possibility for S&T teams to lose sight of the Warfighters and their needs. To close this gap, the TMaF team created two additional readiness dimensions. First, the Requirements Readiness Level (RRL) measures a technological solution's alignment to a validated, funded requirement, i.e., to a Warfighter capability need. Requirements alignment alone, however, does not guarantee that a Warfighter is willing and able to employ a technology. Therefore, an operator-focused dimension, the Warfighter Readiness Level (WRL), was introduced.

WRL measures the extent a technology has been Warfighter-tested and adopted. It considers the technology's role in addressing capability gaps by evaluating solutions across **D**octrine, **O**rganization, **T**raining, **M**ateriel, **L**eadership and **E**ducation, **P**ersonnel, **F**acilities, and **P**olicy Analysis (DOTMLPF-P) to ensure use of the most effective and holistic approach. By complementing existing readiness dimensions with RRL and WRL, the TMaF ensures that OE-I S&T teams develop technologies the Warfighter wants and needs while resolving the transition measurement challenge posed to OE-I by the FY 2021 NDAA.

Beyond measurement and reporting, however, OE-I sought a tool that was actionable—i.e., that could provide its project teams with strategic technology transition guidance. To this end, for each readiness dimension and level, the TMaF concisely outlines critical activities needed for progress to the next level. For example, one of four critical activities to enable progress from WRL 5 to WRL 6 is to "involve warfighters in shaping policies and procedures to ensure practicality and acceptance." This example exhibits essential characteristics of TMaF critical activities. It indicates which stakeholders to engage ("warfighters"), when to engage them ("when shaping policies and procedures"), and the engagement's goal ("ensure practicality and acceptance").

The TMaF levels provide project teams with a set of transition milestones. Critical activities offer them a starting point to develop a plan to strategically address transition challenges as they move through those milestones. In this way, the TMaF gives OE-I the ability to efficiently provide each project team transition guidance tailored to their project's maturity. Executing critical activities helps a project team mature its technology while creating a record that allows effective program management and satisfies congressional reporting requirements.

The Transition Maturity Framework Rolls Out

Leading up to its FY 2025 call for proposals, OE-I integrated the TMaF into its proposal solicitation, selection, and execution management processes. It established minimum TMaF entry and exit levels and required that proposal teams complete a TMaF self-assessment with the

support of MITRE individualized training. Each proposal team was further required to summarize in its assessment a transition plan with a schedule and budget broken out by TMaF critical activities.

OE-I's PEB leveraged proposal teams' TMaF self-assessments and transition plans as weighted selection criteria. These transition maturity assessments offered OE-I leadership and the PEB data to validate projects' alignment to OECIF and OEPF budget activity requirements. Furthermore, the TMaF offered a standardized means to evaluate, balance, and monitor transition maturity across OE-I's portfolio. The first cohort of OE-I performers to use the TMaF is currently executing its projects and providing OE-I tranche leaders regular transition updates in terms of TMaF levels and critical activities.

OE-I is also partnered with the Noblis Corp. to further leverage data generated through the TMaF process. OE-I and the Noblis Corp. developed the "Operational Energy Management and Innovation (OMNI) tracking tool" to capture and catalog TMaF data generated over a project's life cycle. The OMNI platform securely provides DoD-wide, operational energy project information to key stakeholders. It is expected to be fully populated with current project data by the end of FY 2025.

Amidst publication of this article, OE-I was completing its initial TMaF rollout and had gathered feedback from project teams. While much of the feedback was positive, OE-I identified areas for improvement that are being evaluated and addressed. For example, a team developing a software-intensive capability noted that the traditional MRL methodology is incongruent with today's modern principles of agile software development. This made it difficult for the software team to assess its capability's production readiness and affordability. TMaF extensions to integrate existing software transition readiness practices are set for completion by the fall of 2025.

In addition to addressing user feedback, OE-I is proactively working with MITRE to develop a suite of complementary tools for further reducing transition barriers for technology innovators. The Tech2PEO tool, for instance, is designed to connect technology developers to relevant acquisition organizations by providing information and guidance on how to engage with PEOs.

Tech2PEO completed the minimum viable product stage and is moving toward the release of production version 1.0. The tool takes as user input a short description of the technology along with its corresponding TMaF assessment. It then searches multiple data sources to generate a curated list of PEO contacts and potential funding opportunities. Another complementary resource under development is the *OE-I Transition Playbook*, which is a concise reference for additional guidance to help OE-I project teams execute critical activities highlighted in the TMaF.

Further enhancements to the Tech2PEO tool and the *OE-I Playbook* will be rolled out in the fall of 2025. Also underway is initial development of AI-enabled resources intended to support OE-I project teams executing mission engineering and relevant requirements identification. These tools are unified in their intention to help innovators mature their technologies across TMaF dimensions.

Outlook and Future Opportunities

The TMaF provides innovators a tool for navigating the particularly fraught transition from laboratory-proven technology to a procured, Warfighter-adopted capability. For RDT&E portfolio managers, it enables standardized, systematic assessment of transition maturity across investments and project life cycles. And, to the defense acquisition ecosystem more broadly, the TMaF offers an efficient means of communicating technological maturity among stakeholders.

This last point is particularly relevant in the current, rapidly evolving defense acquisition environment. Congress' proposed Streamlining Procurement for Effective Execution and Delivery (SPEED) Act, for instance, would shorten the requirements creation process to as little as 90 days. In addition, a growing push, as described in a recent Government Accountability Office report, would move defense acquisition from a linear to an iterative acquisition process more akin to that of the commercial sector. These reforms require much more frequent communication among traditional defense acquisition stakeholders as well as new entrants that the reforms will attract. New entrants (e.g., nontraditional defense contractors, such as commercial technology startups) will benefit from

> "The **first cohort of OE-I performers to use the TMaF** is currently executing its projects and providing OE-I tranche leaders regular transition updates in terms of TMaF levels and critical activities."

the TMaF's strategic management capacity to help assess their defense market entry strategy. Tools that enhance communication efficiency like the TMaF will be critical to successful defense acquisition reform.

Beyond assisting development teams and facilitating communication among stakeholders, TMaF data represent a key resource to RDT&E portfolio managers and the broader defense acquisition ecosystem. It offers the opportunity for data-driven analysis of, for example, a program manager's return on investment (measured through TMaF levels); transition management at portfolio and project levels; and key determinants of transition success. These TMaF-enabled analytics inform decision-makers how to best invest in emerging technologies to ensure that Warfighters expediently receive the capabilities needed to provide military assuredness and deterrence.

Try the TMaF

Detailed information on the TMaF and links to complementary tools, including Tech2PEO, can be found on MITRE's Acquisition in the Digital Age (AiDA) site at https://aida.mitre.org/tmaf/. Try it out, and send feedback to tmaf@mitre.org!

> "[T]o the defense acquisition ecosystem more broadly, **the TMaF offers an efficient means of communicating technological maturity among stakeholders.**"

ZIDES is a principal program manager and agile acquisition expert at MITRE. A retired U.S. Air Force (USAF) lieutenant colonel acquisition officer, she served as deputy director of the USAF Life Cycle Management Center's acquisition excellence directorate and is a previous DAU guest lecturer. Zides holds a B.S. in Mechanical Engineering from Rensselaer Polytechnic Institute and M.S. degrees in Organizational Management and Military Operations from George Washington University and Air University, respectively.

FAUCHER is a principal economic and business analyst at MITRE. She is an expert in life cycle acquisition and cost analysis. Faucher has led enterprise and program-level analysis and planning, including cost estimation, risk analysis, analysis of alternatives, and business case analysis for DoD, NATO, and international and civil agencies. She holds a B.S. in Economics from Shepherd University and an M.S. in Information Technical Management from Brandeis University.

YOUNGBULL is a lead energy technologies engineer/scientist and manages MITRE's technology transition support for the operational energy-innovation directorate in the Office of the Under Secretary of Defense for Acquisition and Sustainment. Youngbull earned seven patents in her various industry positions focused on product development and manufacturing of photovoltaics, thermoelectrics, and integrated circuit packaging. She holds a B.S. and Ph.D. in Materials Science in Engineering from Ohio State University and the University of Washington, respectively.

COCCO is a MITRE lead energy technologies engineer contributing to techno-economic and supply chain analysis of defense critical energy technologies. Before joining MITRE, he worked at the U.S. Army Research Laboratory. Cocco holds a B.S. and Ph.D. in Mechanical Engineering from the University of Connecticut. He is currently an MBA candidate at the University of Maryland.

DARLING is the director of operational energy-innovation in the Office of the Deputy Assistant Secretary of Defense for Energy Resilience and Optimization. She manages the Operational Energy Capabilities Improvement and Prototyping Funds, overseeing more than $250 million in cutting-edge energy technology solutions. Darling holds a B.S. in Computer Science from the University of Massachusetts and an M.S .in Business Management from the University of Maryland.

The authors can be contacted at tmaf@mitre.org.

DAU Resources

- STM 1010: Introduction to DoD Science and Technology Management (Course)
- STM 2040: Technology Project Management (Course)
- STM 2050: Science and Technology Strategy (Course)
- STM 2060V: Technology Portfolio Management (Course)