SYM-AM-26-126

Excerpt from the Proceedings

of the

Twenty-Third Annual Acquisition Research Symposium and Innovation Summit

Thursday, May 7, 2026 Sessions
Volume II
"Accelerating Warfighting Capabilities"

A Review of DoW Systems Engineering Modernization Activity

Published: April 30, 2026

Prepared for the Naval Postgraduate School, Monterey, CA 93943.

The research presented in this report was supported by the Acquisition Research Program, Graduate School of Defense Management at the Naval Postgraduate School.

To request defense acquisition research, please contact:

Acquisition Research Program
Department of Defense Management
Naval Postgraduate School
E: arp@nps.edu
www.acquisitionresearch.net

Copies of Symposium Proceedings and Presentations; and Acquisition Sponsored Faculty and Student Research Reports and Posters may be printed from the **NPS Defense Acquisition & Innovation Repository** at **https://dair.nps.edu/**.

ACQUISITION RESEARCH PROGRAM
DEPARTMENT OF ACQUISITION, FINANCE, AND MANPOWER
NAVAL POSTGRADUATE SCHOOL

A Review of DoW Systems Engineering Modernization Activity

Dr. Kelly Alexander—Chief Systems Engineer | System Innovation, Contractor Support to OUSW(R&E) SE&A; kelly.d.alexander12.ctr@mail.mil

Ms. Monique Ofori—Systems Engineering Manager | SAIC, Contractor Support to OUSW(R&E) SE&A monique.f.ofori.ctr@mail.mil

Mr. Nicholas LeGrande—Systems Engineering Modernization Director, OUSW R&E SE&A; nicholas.j.legrand.civ@mail.mil]

Abstract

This paper provides a summary of Systems Engineering (SE) Modernization (SE MOD) published material over the past five years. The SE MOD effort began in 2021 with the intent of understanding the delay and accelerating the implementation of the digital transformation. The Office of the Under Secretary of War for Research and Engineering (OUSW[R&E]) and the Systems Engineering Research Center (SERC) collaborated on this effort that included workshops, one-on-one interviews, and SE surveys across government, industry, and academia. Each of the published reports or papers are summarized below along with a link to access the full report. (Note: Each of the summaries includes references to tables or cited material that can be found in the published report/paper).

SERC 1051 Program Managers Guide to Digital and Agile Systems Engineering Process Transformation

McDermott, T., & Benjamin, W. (2022). *Program managers guide to digital and agile systems engineering process transformation* (Report No. SERC-2022-TR-009). Systems Engineering Research Center. https://www.cto.mil/wp-content/uploads/2023/06/SERC-WRT-1051-2023.pdf

The Systems Engineering Research Center (SERC) conducted a sustained series of research tasks leading to codification of a framework and lessons learned for adoption of Digital Engineering (DE) and Model-Based Systems Engineering (MBSE). DE and MBSE are separate but jointly evolving strategies. DE is defined as “an integrated digital approach that uses authoritative sources of system data and models as a continuum across disciplines to support life-cycle activities from concept through disposal.” MBSE is defined as “the formalized application of modeling to support system requirements, design, analysis, verification and validation activities beginning in the conceptual design phase and continuing throughout development and later life cycle phases.” Successful adoption will thus be characterized by two general characteristics of the organization: *its ability to conduct systems engineering and related systems modeling, and its effectiveness at digital transformation*.

The SERC research on DE/MBSE adoption found many factors that must be addressed for organizations to achieve this transformation. Table 1 organizes the 12 most prominent factors in our research, organized across three categories: Organizational Design, Organizational Enablers/Barriers, and Organizational Change Management.

The team first conducted an enterprise analysis using interviews to identify what might result from future adoption of DE/MBSE (Section 2.1). Following that, the team used survey and literature reviews to broadly categorize DE/MBSE benefits and adoption factors (Section 2.2).

That study led to a causal analysis that selected primary measurable benefits and adoption factors, resulting in the model in Table 1 (Section 2.3). Finally, additional literature review and

interviews were used to conduct an initial validation of Table 1 (Section 2.4).

Systems Engineering Modernization Policy, Practice, and Workforce Roadmaps Lessons Learned and Adoption Framework

McDermott, T., Mesmer, B., & Ergin, N. (2023). *Systems engineering modernization policy, practice, and workforce roadmaps* (Report No. SERC-2023-TR-002). Systems Engineering Research Center. https://www.cto.mil/wp-content/uploads/2023/06/SERC-WRT-1058-2023.pdf

The SERC has analyzed through various surveys, interviews, and literature review the detailed benefits, enablers, barriers, change strategies, and lessons learned that are related to DE/MBSE adoption. As the SERC is a U.S. Department of Defense (DoD) funded research center, the central focus has been on the defense acquisition system and its related industrial base; however, the interviews, surveys, and literature analyses have been conducted broadly across government agencies, industry, and academia. This research conceptualized the changes to workforce and culture necessary to achieve the strategy. A number of qualitative characteristics of DE/MBSE adoption emerged from this study, which are listed in Table 2.

Table 2. Qualitative Statements of Organizational Adoption

- ✓ **Start with SE**: Good SE will enable success with MBSE; MBSE itself will not create value.
- ✓ **Multidisciplinary value:** Systems engineers work across disciplines; DE and MBSE must create added value across disciplines.
- ✓ **Digital literacy**: Experienced SEs may not be comfortable with DE; younger engineers may bring a digital culture with them. Create knowledge transfer between them.
- ✓ **Systems knowledge**: is a unique value of DE/MBSE. A good system model can create/maintain systems knowledge to improve awareness of other disciplinary engineers.
- ✓ **Model quality**: Models must demonstrably improve system understanding and decisions.
- ✓ **Model abstractions**: commensurate to the roles and uses of DE/MBSE. Models must communicate decisions at all levels.
- ✓ **Digital infrastructure**: will make finding and using data more efficient; everything will be on the desktop when needed.
- ✓ **Training**: must be commensurate to the roles and uses of DE/MBSE.
- ✓ **Leadership**: must clearly provide strategy and intent, investment and resources, and the messaging associated with the value of organizational change.
- ✓ **Communication and messaging**: must clearly articulate value to the workforce (benefits) and maintain awareness.
- ✓ **Continuous assessment**: of enterprise capabilities and maturity.
- ✓ **Automation**: of time-intensive tasks will improve value and adoption.
- ✓ **Digital collaboration platforms**: will improve cross-program and cross-disciplinary interaction.

The Supra-System Model

McDermott, T., Alexander, K., & Wallace, R. (2023). The supra-system model. *INSIGHT*, *26*(2), 15–21.

Abstract: This article presents an initial set of concepts resulting from research by the Office of the Under Secretary of Defense for Research and Engineering (OUSD[R&E]) and the

Systems Engineering Research Center (SERC) under an initiative called “Systems Engineering Modernization” (SEMOD). This article discusses the “Supra-system Model,” which evolved as a different view of SE life-cycle activities across the entire life of an engineered system. This view promotes SE as a continuous process that is (1) iterative across the full life of a system and (2) managed through a digital transformation centered on data and models. This article also discusses the value of “shared and authoritatively managed data and models” in the life cycle of future systems. These together present a modernized view of SE where “seamless and efficient transfer of data and models” will support practices that are “more agile and responsive to changing stakeholder needs.”

An Integration Framework for Digital Transformation of DoD Systems Engineering and Acquisition

Alexander, K., & McDermott, T. (2023, May 10–11). *An integration framework for digital transformation of DoD systems engineering and acquisition* [Paper presentation]. Twentieth Annual Acquisition Research Symposium, Monterey, CA, United States. https://dair.nps.edu/bitstream/123456789/4832/1/SYM-AM-23-063.pdf

Abstract: This paper presents the results of a Systems Engineering Research Center (SERC) research task entitled “Program Managers Guide to Digital and Agile Systems Engineering Process Transformation.” This research task supports a larger set of DoD activities being led by the OUSD(R&E) under the term “Systems Engineering Modernization” (SEMOD). The motivation for SEMOD stems from the need to integrate across independent guidance provided down to the DoD SE and acquisition communities related to Digital Engineering, Modular Open Systems Approach, Mission Engineering, and Software Engineering/Agile/DevOps across the multiple pathways of the Adaptive Acquisition Framework. The SERC/government research team found there is a lack of an integrated approach to implementation of SE Focus Areas that is creating a delay in full implementation of the Digital Transformation, which is necessary to ensure the relevant guidance, skills, and training are available to deliver a robust, disciplined approach to weapon systems acquisition.

A Modular Open Systems Approach (MOSA) to Enable Technology Transition

Alexander, K., Ofori, M., & Geier, N. (2025, May 7). *A modular open systems approach (MOSA) to enable technology transition* [Paper presentation]. Twenty-Second Annual Acquisition Research Symposium and Innovation Summit, Monterey, CA, United States. https://dair.nps.edu/handle/123456789/5395

Abstract: Technology Transition is referred to as the “valley of death” due to commonly experienced lack of successful transition to the next phase of system development. The high risk of technology development can cause a delay or cancellation that can be mitigated by Modular Open Systems Approaches (MOSA) principles. MOSA enables technology transition by providing a framework for integrating, upgrading, and replacing components with minimal disruption. By addressing these MOSA principles early in the development cycle, technology transition is more predictable and manageable:

1) Modular Architecture: Focuses on modularity offers plug-and-play capability, where system components adhere to defined standards and interfaces. Modularity also supports incremental upgrades, enabling individual modules to be updated or replaced as technology evolves and parallel development for specified (potentially high-risk) components.

2) Interface Management with Consensus-Based Open Standards: (a) Well-Defined Interfaces that rely on widely recognized, consensus-based open standards, ensuring that new technologies from different vendors integrate effectively, reducing development

and integration challenges. (b) Open Standards facilitate component reuse, which reduces integration time and can also reduce life-cycle costs by increased competition.

3) Enabling Environment that promotes Model-Based Systems Engineering (MBSE) tools processes with access to data to enhance interoperability and options in configuration.

Enabling SETR Modernization Across the Department of Defense (DoD)

Alexander, K., Ofori, M., & Geier, N. (2024, April 30). *Enabling systems engineering technical review (SETR) modernization across the Department of Defense (DoD)* [Paper presentation]. Twenty-First Annual Acquisition Research Symposium, Monterey, CA, United States. https://dair.nps.edu/bitstream/123456789/5112/1/SYM-AM-24-047.pdf

The current SE technical processes and the technical management process remain relevant at the macro level; however, there is a lack of guidance regarding the governance of shared data and models and an understanding of agile and continuous data and model development approaches and their impact on the SETR process. Continuation of document-centric methods will unnecessarily delay acquisition program decisions and impact the ability to implement future modifications and technology insertions. In addition, continuation of the current document-centric methods will not allow the integration of ongoing important initiatives, such as MOSA, software modernization, and Agile program development methods. This study will review the current SETR practices and how digital transformation can improve the process, resulting in better and more agile decision making. The intended outcomes/results of the study include guidance for implementing model-based SETR processes, exemplars for governance and oversight of model-based artifacts, recommended approach to Agile and continuous data and model development to support the SETR, model-based SEP/SETR processes that enable agile continuous data and model development and recommended SE digital artifacts usage and management.

Implementing a Modular Open Systems Approach in Department of Defense Programs

Office of the Under Secretary of Defense for Research and Engineering & Office of Systems Engineering and Architecture. (2025, February). *Implementing a modular open systems approach in Department of Defense programs*.https://www.cto.mil/wp-content/uploads/2025/02/MOSA-Implementation-Guide-v1.1_Public-Release.pdf

This guidebook provides the Department of Defense (DoD) community, including military services, civilians, and DoD support contractors with information to help ensure programs incorporate a modular open systems approach (MOSA) as part of the defense acquisition program life cycle. The intended audience includes decision makers, program management offices (PMOs), program managers (PMs), and program lead systems engineers responsible for implementing and evaluating MOSA in defense programs.

Although MOSA has long been incorporated into DoD programs, this guidebook describes statute and DoD policy that now impose requirements to use MOSA. This guidebook provides best practices for planning, implementing, and evaluating MOSA, including implementation principles, benefits, challenges, and suggestions based on experience from practitioners in the DoD and industry. It includes recommendations to consider when developing requests for proposals (RFPs) and evaluating planned approaches for implementing MOSA. The appendices provide supplemental information on the background efforts that have helped inform the DoD MOSA community.

Leveraging Modern Systems Engineering Principles to Enhance the Department of War Software Acquisition Pathway

Leveraging Modern Systems Engineering Principles to Enhance the Department of War

Software Acquisition Pathway: https://www.cto.mil/sea/mosa/

The Department of War (DoW) is at a pivotal moment in modernizing its software (SW) acquisition practices to meet the demands of an evolving threat landscape and the rapid speed of technology advancement. In March 2025, the Secretary of War (SECWAR) directed that software acquisition emphasize speed, flexibility, digital integration, and the rapid infusion of commercial innovation via the Software Acquisition pathway. The SECWAR released additional guidance regarding acquisition transformation and reforming the requirements generation process. In parallel, the Office of the Under Secretary of War for Research and Engineering (OUSW[R&E]) is leading Systems Engineering Modernization (SEMOD) to implement digital transformation across technical reviews and systems engineering (SE) process flows to support the acquisition decision process. Each of the SEMOD principles align with the SECWAR transformation initiatives by providing the methods to accelerate capabilities to the warfighter while also ensuring the ability to allow future upgrades. This paper provides considerations and metrics for integrating rigorous, modern SE principles into the Software Acquisition pathway, enabling rapid, iterative delivery of software capabilities for timely, data-driven acquisition decisions.

To successfully execute the Software Acquisition pathway, programs should adopt modern SE practices in both the Planning and Execution phases that align with the department's digital transformation initiatives. The OUSW(R&E)'s SE MOD effort provides the foundation for this transformation by integrating digital engineering, modular open systems approach (MOSA), mission engineering, and Agile Development, Security and Operations (DevSecOps) practices into program planning and execution. These practices are critical for maintaining authoritative digital models, enabling data-driven decisions and ensuring program teams can respond rapidly to evolving requirements without compromising cost, schedule, or performance. To enhance the execution of the Software Acquisition pathway and deliver timely, resilient, and upgradable capabilities to the warfighter, program managers (PMs) and chief systems engineers (CSEs) should consider these SE MOD principles when applying digital, iterative, and model-centric approaches.

Prepare and Develop the Workforce for a digital environment by adopting a "digital -first mindset."

- ✓ Modernize the Workflow to align with digital practices and tools.
- ✓ Implement MOSA principles to manage architecture that supports future upgrades, modifications and enables integration.
- ✓ Adopt Modern Design Practices (relying on Agile and Lean practices) to apply an iterative approach to design, test and incremental capability release that is informed by continuous user input.

The referenced documents above provide the necessary definitions, insights and recommendations that support a robust understanding of the role SE Modernization, digital transformation and MOSA have on DoW acquisition. The referenced material and additional SE MOD guidance is available at cto.mil.


Acquisition Research Program
Department of Acquisition, Finance, and Manpower
Naval Postgraduate School
555 Dyer Road, Ingersoll Hall
Monterey, CA 93943

www.acquisitionresearch.net