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# Enabling Systems Engineering Technical Review (SETR) Modernization Across the Department of Defense (DoD)

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## Abstract

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 Systems Engineering Technical Review (SETR) process. Continuation of status quo document-centric methods will unnecessarily delay acquisition program decisions and impact the ability to implement future modifications and technology insertions. Additionally, continuation of the current document-centric methods will not allow the integration of ongoing important initiatives, such as MOSA, SW Modernization and Agile program development methods. This study will review the current SETR practices and how the 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.

## Background: SERC SE Modernization Research Study Findings

In 2023, the Systems Engineering Research Center (SERC) completed a research study to support the Office of the Under Secretary of Defense for Research and Engineering (OUSD[R&E])’s investigation on how to modernize Department of Defense (DoD) Systems Engineering policy and practices, with an emphasis on equipping the workforce for the digital transformation (McDermott, 2023). The same year, *INCOSE Vision 2035* was released that discusses the increasing complexity of systems as the rationale for automated and efficient workflows and predicts that “by 2035, systems engineering will leverage the digital transformation in its tools and methods and will be largely model-based” (INCOSE, 2023).

Figure 1 identifies the primary findings of the SERC report. A key recommendation from SERC is that OSD must work to “achieve seamless and efficient data flows to improve acquisition decision, and further advises the DoD to modernize the current Systems Engineering Technical Review (SETR) processes so that acquisition programs can trace lifecycle workflows “from data to decision artifacts and from decision artifacts back to data” (McDermott, 2023). A critical aspect of SETR Modernization is to transition from the current document-centric to a model-centric approach that supports milestone decisions with authoritative sources of truth.



Figure 1. (Alexander & McDermott, 2023)

As a follow-on to the SERC study, the OUSD(R&E) is spearheading a study that will determine a recommended set of SETR processes and the associated digital artifacts to support a data-driven and model-based approach. The OUSD(R&E) is leveraging SERC ongoing research in Ontology, Agile Development, and model-based artifacts such as the SEP (Service level) and the TEMP (OSD DTEA-led). Additionally, ongoing forums and activities across the DoD are producing “emerging knowledge” to support transition to a digital environment. Emerging knowledge includes lessons learned and processes that are best practices and continue to mature before becoming official guidance. The government and industry led forums include the Digital Engineering Model and Simulation (DEMS) Community of Practice, Modular Open Systems Working Group (MOSWG), Software Modernization Working Group, OMG Model Based Acquisition Working Group, and R&M MBSE Working Group, where cross service and industry community of stakeholders share and discuss their current practices, challenges, and pain points.

These ongoing activities are progressing, but there is no overarching approach that the stakeholders can use to manage the digital environment and infrastructure required to transition



to the modern SETR. This study is focused on the following research questions: (1) How do we implement the digital transformation into the current systems engineering technical review (SETR) process? (2) What are the key artifacts that should be model-based? (3) How do we share and manage model-based artifacts and the associated data during the SETR process? Responses to these questions are aligned to the overall SE Modernization program, as discussed later in this paper.

## Objectives of SETR Modernization

The objective of the SETR Modernization research is to transition the current document-centric approach to a knowledge-based approach that relies on data and models to support better and more timely decisions along with a more efficient SE workflow. To make this happen, the DoD workforce will need the appropriate policy, guidance, and means to work in a digital environment. The outcomes of this research will rely on ongoing activities that are developing emerging content to support best practices and lessons learned and determine ways to successfully achieve this transition. Table 1 summarizes ongoing activities that are developing emerging content that is expected to provide input to the intended outcomes.

Table 1. Outcomes and Emerging Content Alignment

INTENDED OUTCOME	Ongoing Activities with Emerging Content
Guidance for implementing model-based SETR processes	SE Modernization Service Modernization/Transformation
Exemplars for governance and oversight of model-based artifacts	MBTEMP, MBSEP, OMG MBAcq WG, DEM&S COP
Recommended approach to Agile and continuous data and model development to support the SETR	MCDERMOTT Roadmap Research Activities
Recommended digital artifacts usage and management during the SETR	SERC Roadmap Research Activities, Service Use Cases, Industry Collaboration

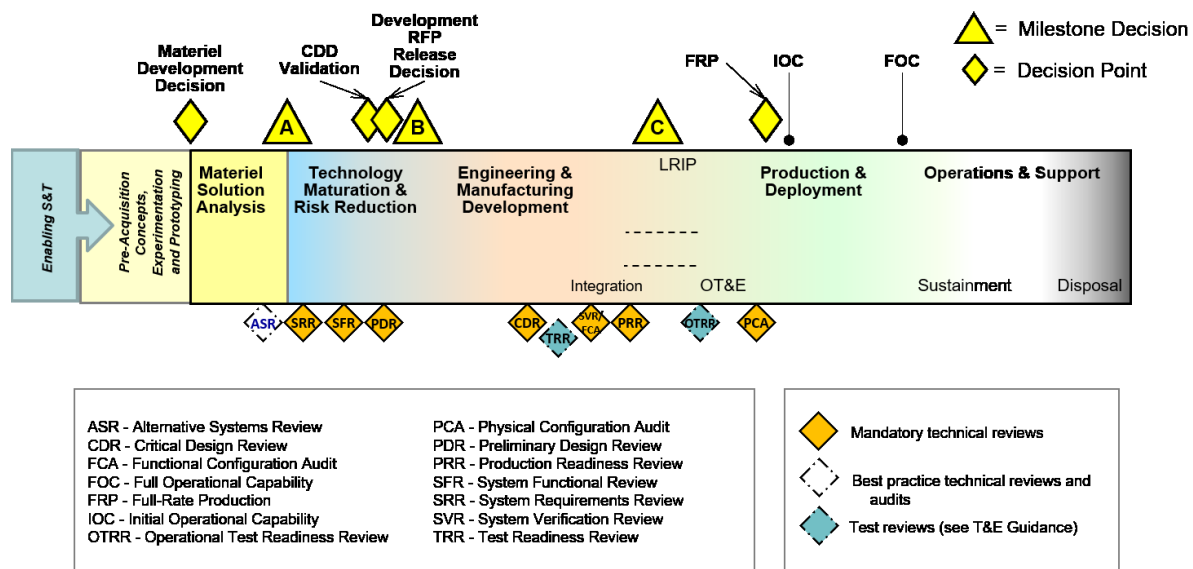
## The Traditional SETR Process

The current SETR process is governed separately by each of the DoD services. SETRs are tailored by the services to adapt to a specific solution, acquisition pathway, and other factors such as technical maturity and risk management. Each of the DoD services governs the current SETR process separately. SETRs provide independent forums designed to establish technical baselines, evaluate technical maturity, and assess technical risks. The services tailor SETRs to adapt to a specific solution, acquisition pathway, and other factors, such as technical maturity and risk management. The following graphic shows a potential sequence of SETR events (in the grey triangles) for a Major Capability Acquisition (MCA) as depicted in DoD 5000 ([www.dau.aaf.org](http://www.dau.aaf.org)). At each technical review, the PM will, to the extent practicable, use information from the digital authoritative source of truth to assess key risks, issues, opportunities, and mitigation plans to understand cost, schedule, and performance implications. At a minimum, DoD Major Defense Acquisition Programs (MDAP) must complete the following technical reviews and audits, unless waived through the Systems Engineering Plan (SEP) approval process: Systems Requirements Review (SRR; or Systems Functional Review [SFR]), Preliminary Design Review (PDR), Critical Design Review (CDR), Systems Verification Review (SVR; or Functional Configuration Audit [FCA]), Production Readiness Review (PRR), and Physical Configuration Audit (PCA).



Systems engineering decisions often rely on manually interpreting a wide range of separate data and analyses. One challenge is systems engineering's dependence on numerous data sources, static models, and document-centric decision artifacts to support decision-making across the systems engineering lifecycle (SELC). While tailoring of these documents is recommended, over 20 documents can be used to support the SRR. The study will consider a model-centric approach that leverages relevant data, information, and knowledge to visualize and communicate decision rationale to stakeholders during technical engineering reviews and milestone decisions. This will rely on understanding the key information that is essential to inform the decisions and enable programs to minimize redundancy and ambiguity.

A listing of the current major technical reviews across the acquisition lifecycle can be found in [DoDI 5000.88, Section 3.5a](#). Figure 2 shows a potential sequence of SETR events (in the orange triangles) for a Major Capability Acquisition as depicted in DoD 5000 ([www.dau.aaf.org](http://www.dau.aaf.org)).



Notes:  
 - Derived from DoDI 5000.85, Major Capability Acquisition Model

Figure 2. (DOD 5000)

For the purposes of this research, the following NAVAIR description of SETR will be used:

“The SETR events are designed to enable an independent assessment of the emerging design against the overall objective of promoting a well-managed development effort leading to a system that meets programmatic requirements while providing the system performance required supporting mission needs” (NAVAIR, 2015).

As the traditional SETR transitions, the SERC study concluded that the current systems engineering processes, while still valid, need to adapt to the digital transformation. The traditional document-centric methods are becoming a hindrance to efficient decision-making and the implementation of future modifications and technology insertions.

The lack of guidance on the governance of shared data and models, as well as the understanding of agile and continuous data and model development approaches, is impacting the SETR process. To fully leverage the benefits of digital transformation, it is crucial to



integrate important initiatives such as the Modular Open Systems Approach (MOSA), Software (SW) Modernization, and Agile program development methods. This integration will require a shift from document-centric methods to a more dynamic, data-centric approach that allows for continuous updates and real-time collaboration.

As data-driven methods and digital artifacts become more mature, there is a pressing need to update practices and methodology (SETR Workflow) to represent the digital transformation. This change will not only streamline the SETR process but also enhance the overall efficiency and effectiveness of systems engineering. OSD led SE Modernization effort will continue to emphasize the implementation of the DE transformation into SE practices and policies with the immediate focus on SETR Modernization.

## SE Modernization: Implementing Digital Transformation into SE Practices & Policy

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, MOSA, Mission Engineering, and Software Engineering/ Agile/DevOps across the multiple pathways of the Adaptive Acquisition Framework. The SERC/government research team found that 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 (Alexander & McDermott, 2023).

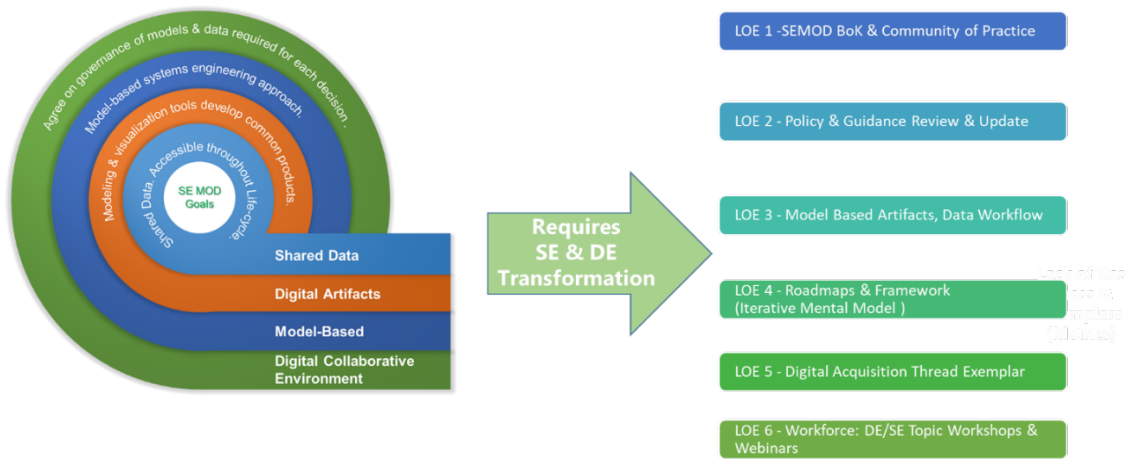


Figure 3.

The OSD led SE Modernization project established the high-level strategic goals shown in Figure 3 that shaped these follow-on efforts. Line of Effort (LOE) 3, “Model Based Artifacts and Digital/Data Workflow,” is most closely aligned with this study; however, the outcomes will also contribute to each of the other LOEs. As SE workflow and practices evolve, the intent is to share the emerging knowledge through webinars, conferences, and workshops.

“The vision of SE Modernization is to use data and models to create a more agile and responsive acquisition system that can quickly and effectively meet the needs of the warfighter” (SERC, 2022). With these goals in mind, SERC research recommended a new mental model for integrating SE, DE and Acquisition. “The value of SE Modernization will be realized in more seamless and efficient transfer of data and models from underlying performance drivers through models to decisions, as well as ease of drilling back down from decisions to data.” And, “New

SE lifecycle processes must evolve that address shared and authoritatively managed sets of digital data and models associated with the full lifecycle of the system itself, not just a single acquisition program lifecycle” (SERC, 2023).

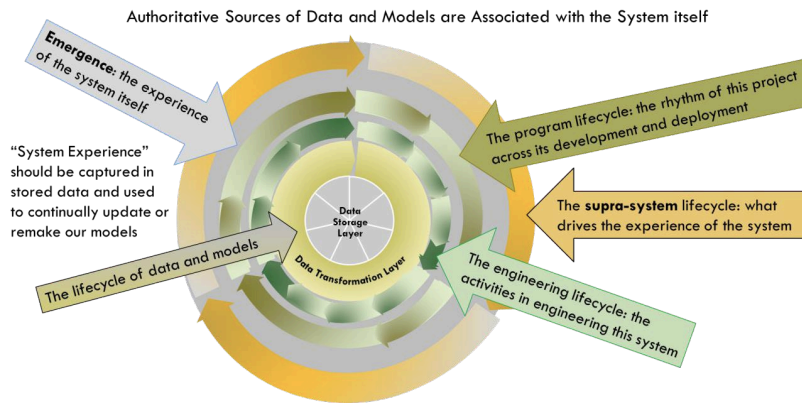


Figure 4. (McDermott, 2023)

Finally, the research found that a true representation of the model-based SE lifecycle is a complex integration of four distinct lifecycles (Figure 4):

1. **System Lifecycle:** This pertains to the lifecycle of the system itself, including any offspring it produces.
2. **Engineering Lifecycle:** This involves the processes conducted within the lifespan of the system from an engineering perspective.
3. **Program/Project Lifecycle:** This refers to the management and execution of programs or projects related to the system.
4. **Supra-System Lifecycle:** This reflects the experiences of the system in its operational context, particularly in relation to other systems it interacts with. A Supra-System is a larger system that integrates or contains other systems.

Each of these lifecycles is individually relevant and must evolve to address shared and authoritatively managed sets of digital data and models associated with the full lifecycle of the system itself, not just a single acquisition program lifecycle.

### Aligning Digital Transformation Principles to the SETR

Recognizing the Supra-System model and its complexity, the new SE lifecycle processes must evolve to address shared and authoritatively managed sets of digital data and models associated with the full lifecycle of the system itself, not just a single acquisition program lifecycle (McDermott, 2023). Each of the DoD Services are leveraging digital engineering by first transitioning to Model-Based Systems Engineering (MBSE) to develop and manage system design; however, these efforts are stove-piped and do not allow seamless transition of data and models throughout the lifecycle. As the Services shift from document-centric to data and knowledge-centric activities, the goal is to provide continuous access to authoritative data and models.



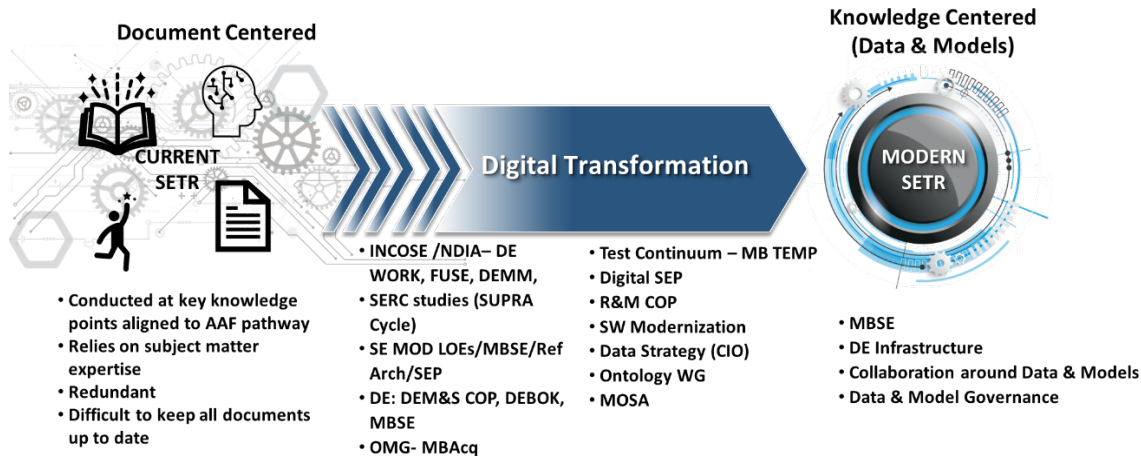


Figure 5.

In 2018, the OUSD R&E published the DE Strategy with the intent to “Formalize the development, integration, and use of models to inform enterprise and program decision-making.” The DE Strategy established five goals, with the first goal focused on establishing the formal planning, development, and use of models as an integral part of performing engineering activities as a continuum across the lifecycle. As Shown in Figure 5, multiple ongoing activities are developing methodology and practices that implement the DE Strategy. The DE strategy concluded that such ubiquitous use of models will result in a continuous end-to-end digital representation of the system of interest to support consistent analysis and decision making for programs and across the enterprise” (OUSD[R&E], 2018).

### Aligning Research Questions to Emerging Knowledge

With this goal in mind, the following is a discussion of each of the research questions and DE related activities that may contribute toward the DE Strategy goal. Answers to the following questions will provide OSD with information to support development of guidance to modernize the SETR process and artifacts.

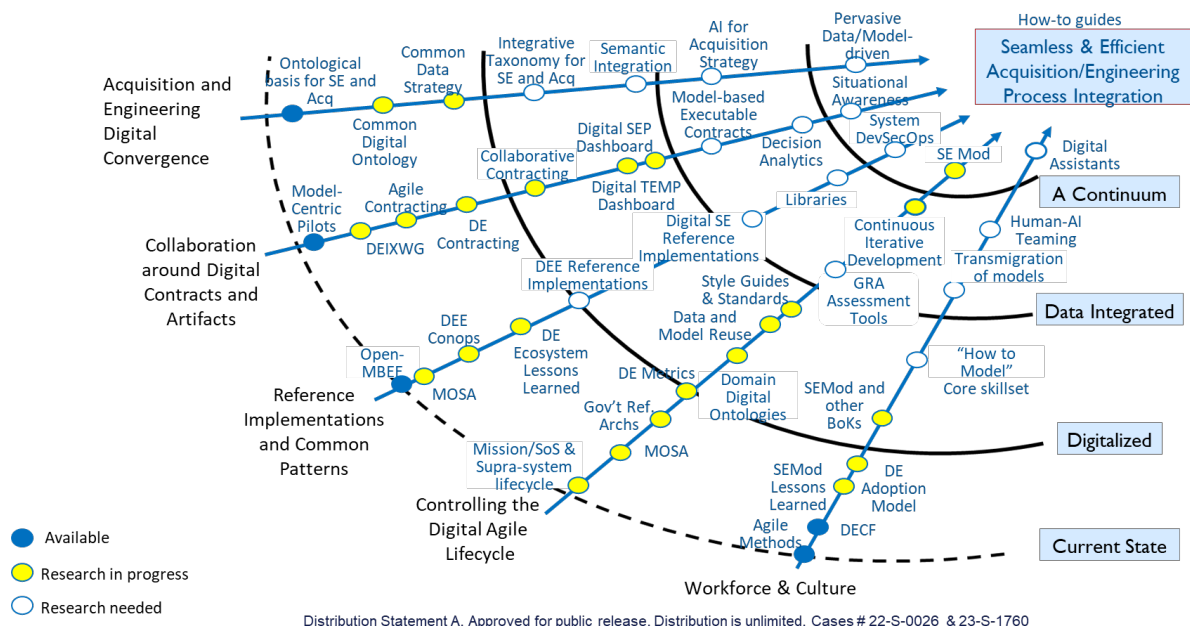
Question 1: How do we implement the digital transformation into the current SETR process?

Several activities are working toward this goal by developing enterprise level strategies that will provide their community of stakeholders with access to the tools necessary to establish model-based development processes. For example, in 2023, the Department of the Navy (DoN) Chief Engineer (CHENG) office and DON CIO collaborated to release a joint memo, *Department of Navy Enterprise Service Designation for Naval Integrated Modeling Environment (IME)*, to ensure Enterprise level resourcing to properly manage, sustain and evolve its capabilities to meet the Naval engineering workforce needs with a focus on systems modeling tools to support MBSE. While this is a major move in the right direction, the governance, processes, tools and resourcing to ensure the workforce has the level of needed skills continue to mature. Similar progress is being made in the other Services: In 2021, the Air Force established their Digital Transformation Strategy that is developing an integrated environment with authoritative sources of truth, while the under secretary of the Army plans to release an Army Digital Engineering Strategy memo this year. Each of these activities will contribute to understanding the SE transition to the digital transformation. The Services participate in the forums mentioned in this research to share best practices and lessons learned.

Questions 2 and 3 are combined for further discussion: What are the key artifacts that should be model-based? How do we share and manage model-based artifacts and the associated data during the SETR process?

As the Services and program leads continue maturing their processes and SE workflow in a digital environment, the answer to this question will become clear. SERC recommended the following roadmap (Figure 6) comprised of recent and ongoing research to build a body of knowledge and understand more digital artifacts and data. A full description of the roadmap is available in the SERC 2023 report (McDermott, 2023).

The answer is wrapped up in a more comprehensive discussion regarding the digital transformation that includes policy, infrastructure, and data governance. Many of the key elements required to make this happen are considered “emerging knowledge” that is useful but not authoritative. Communities of practice, bodies of knowledge, stakeholder conferences and other important forums are being used to share information. While not an exhaustive list, some of this emerging knowledge is included in the SE Modernization Roadmap (McDermott, 2023). The line of activities on the “Collaboration around Digital Contracts and Artifacts” and “Controlling the Digital Acquisition Lifecycle” will have tremendous benefit toward identifying and gaining understanding of managing and developing digital artifacts.



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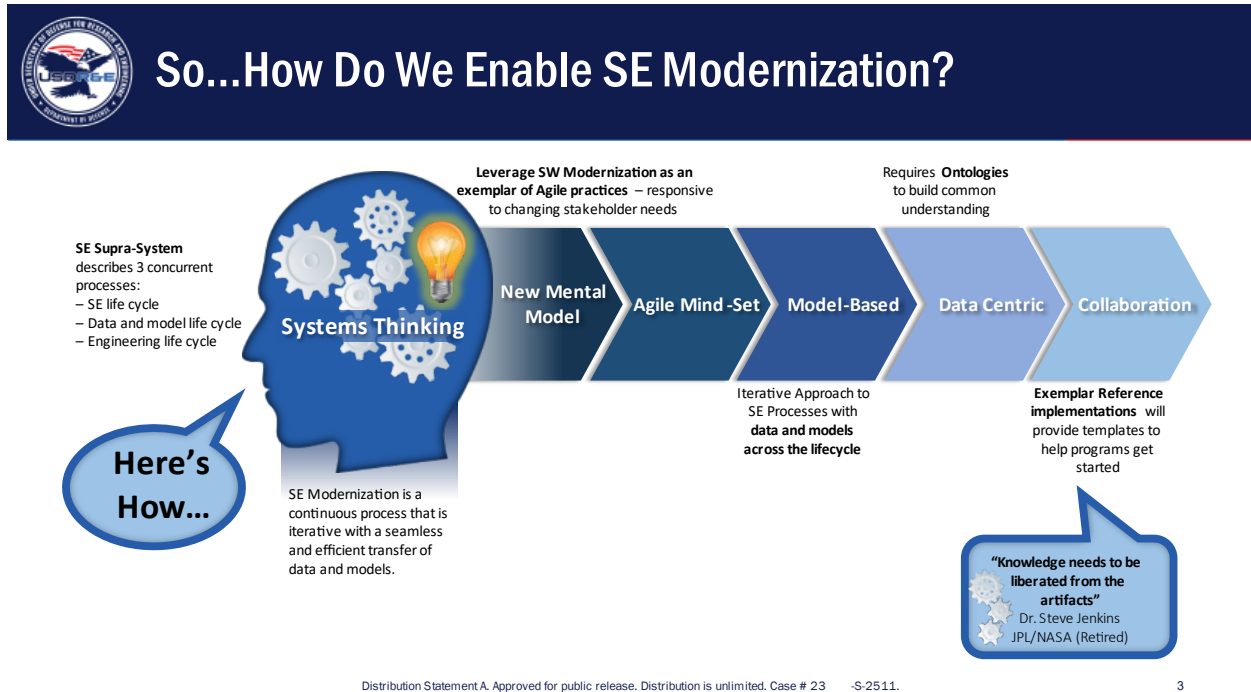
Figure 6. (McDermott, 2023)

### Conclusion and Next Steps

There is continuing urgency to mature approaches to manage and share data and models across the Supra-System lifecycle as defined in this research. The need to transition to a digital environment is included in the 2019 National Defense Authorization Act (NDAA 2019) that challenged the Services to ensure “access to digital technical data.” In 2020, the DoD released the Digital Data Strategy that highlighted “Enterprise-Wide Data Access and Availability” with the understanding that the DoD data must be made available for use by all authorized individuals and non-person entities through appropriate mechanisms” as one of eight guiding principles (DoD, 2020).



The digital transformation is a continuous process that requires constant learning, adaptation, and alignment with evolving technologies and business goals. As this study continues over the next 2 years, the reliance on data and model use will become the norm for system development across DoD acquisition. This study is one of many efforts that is working toward ensuring successful implementation of the digital transformation. The words of Dr. Roper from 2020 still ring true: “This “digital trinity” — digital engineering and management, agile software, and open architecture — is the true successor to stealth: the next big paradigm shift for military 2 tech dominance. Rather than just building better systems, it builds systems better — opening doors to faster design, seamless assembly, and easier upgrades” (Roper, 2020).



**Figure 7. (Alexander & McDermott, 2023)**

Finally, the SE Modernization effort has laid the framework for the DoD to meet the challenges involved in the digital transformation with respect to SETR and the overall SE role in system development. The key to SE Modernization (Figure 7) is reliant on (1) understanding the Supra System and the associated mental model and (2) developing an agile mindset that is based on model-based data-centric collaborations that enhance decision-making. The answer to the fundamental question – “How Do We Enable SE Modernization?” – is still evolving.

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