Systems Engineering Modernization

26th Annual National Defense Industrial Association Systems and Mission Engineering Conference

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(Contractor Support)
Ms. Nadine Geier
Director, SE Directorate Name
Office of Systems Engineering and Architecture
Office of the Under Secretary of Defense
for Research and Engineering
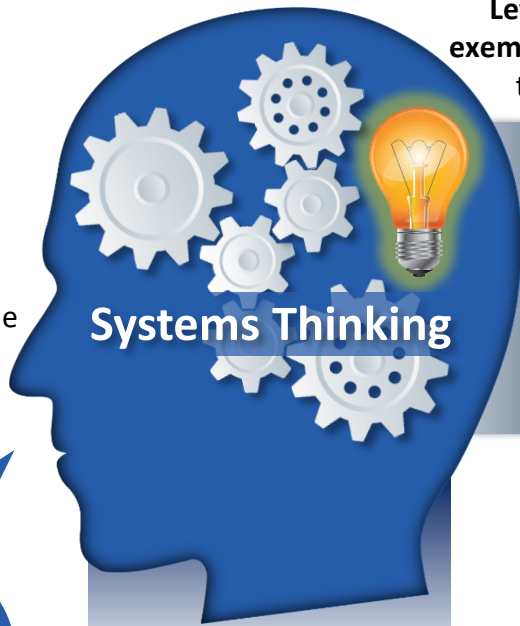
Norfolk, Virginia
October 2023

So...How Do We Enable SE Modernization?

Leverage SW Modernization as an exemplar of Agile practices – responsive to changing stakeholder needs

Requires **Ontologies** to build common understanding

SE Supra-System
describes 3 concurrent processes:
– SE life cycle
– Data and model life cycle
– Engineering life cycle

Systems Thinking

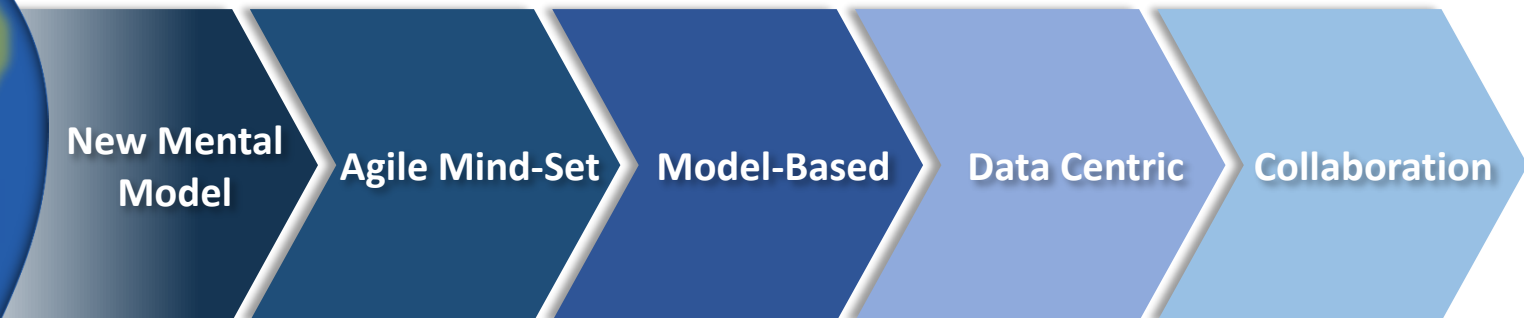**New Mental Model** | **Agile Mind-Set** | **Model-Based** | **Data Centric** | **Collaboration**

Here's How...

SE Modernization is a continuous process that is iterative with a seamless and efficient transfer of data and models.

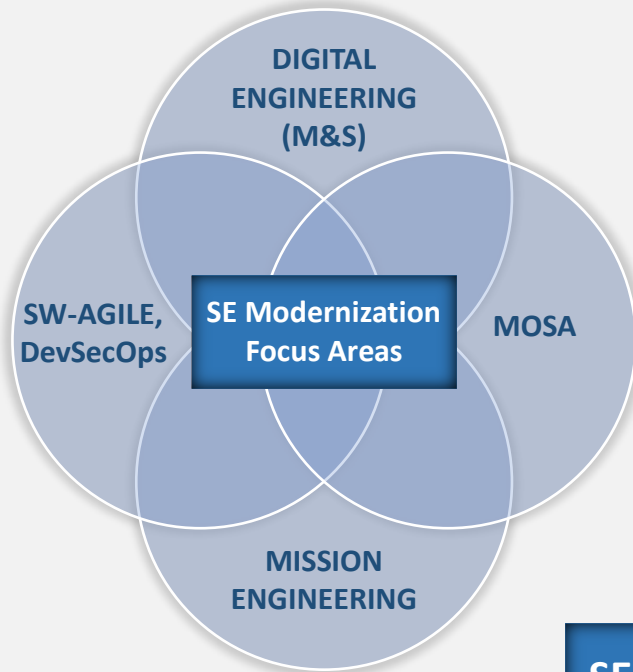Iterative Approach to SE Processes with **data and models across the lifecycle**

Exemplar Reference implementations will provide templates to help programs get started

"Knowledge needs to be liberated from the artifacts"
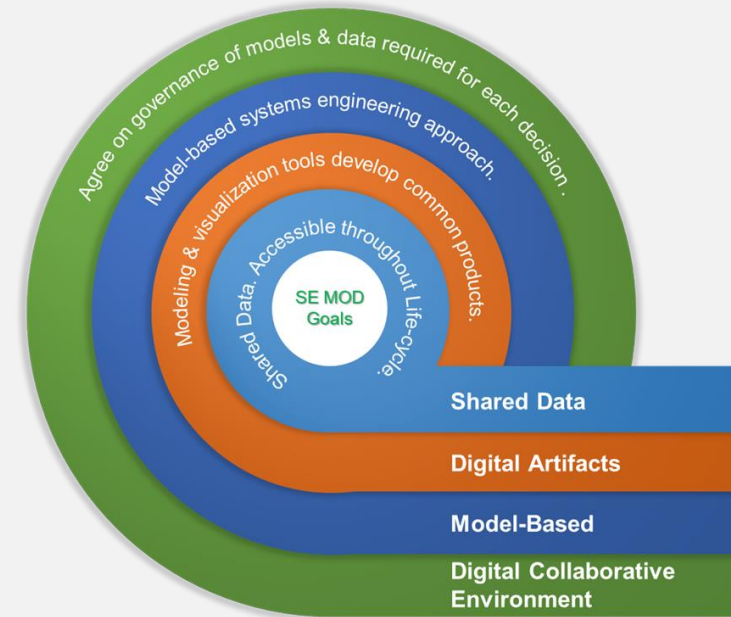Dr. Steve Jenkins
JPL/NASA (Retired)

Background

SE Modernization Focus Areas

- DIGITAL ENGINEERING (M&S)
- SW-AGILE, DevSecOps
- SE Modernization Focus Areas
- MOSA
- MISSION ENGINEERING

SE Modernization Goals

Agree on governance of models & data required for each decision.
Model-based systems engineering approach.
Modeling & visualization tools develop common products.
Shared Data, Accessible throughout Life-cycle.

SE MOD Goals

- Shared Data
- Digital Artifacts
- Model-Based
- Digital Collaborative Environment

SE Modernization Problem Statement

Challenge: DoD lacks an **integrated approach** to implementing a digital transformation, including digital practices, processes, and artifacts, within the systems engineering focus areas, which in turn delays the ability of programs to develop the processes, skills, and training required to deliver a robust, disciplined approach to weapon system acquisition.

SE Modernization Overview

SE Modernization Problem Statement

DoD lacks an **integrated approach** to implementing a digital transformation, including digital practices, processes, and artifacts, within the systems engineering focus areas, which in turn delays the ability of programs to develop the processes, skills, and training required to deliver a robust, disciplined approach to weapon system acquisition.

Cross-Cutting Key Enablers

Enabler	Description
Architecture	Modeling mission & platform levels, embracing reference architectures
Model-Based Systems Engineering (MBSE)	Enterprise-wide implementation; models as source of truth
SOS/Enterprise Collaboration & Data	Understand/assess cross-platform capabilities
Engineering Workflow	SE processes evolve to model based, including V&V, R&M
Workforce Training & Culture	A focused approach to workforce initiatives that enable culture change & skills gap

ENABLERS RESULTED FROM OUTREACH/INFORMATION SESSIONS

DIGITAL ENGINEERING (M&S)

SW-AGILE, DevSecOps

SE Modernization Focus Areas

MOSA

MISSION ENGINEERING
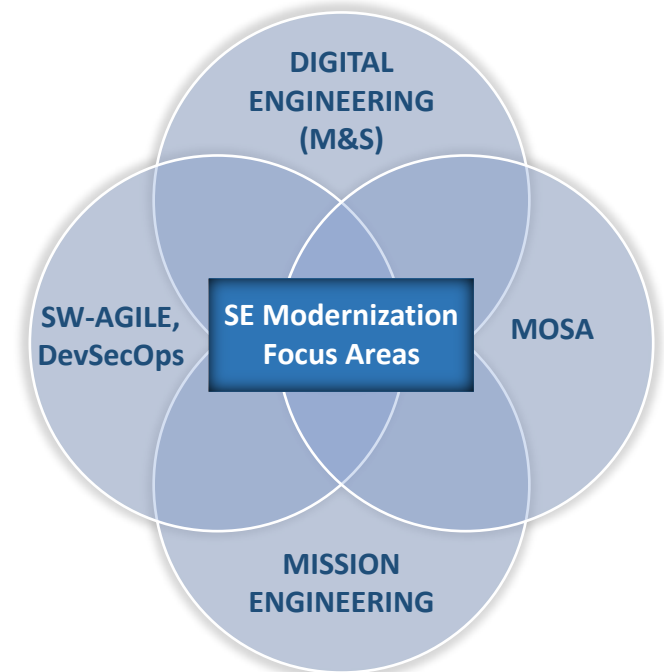
Collaborating with Government, Industry & Academia

- INCOSE
- National Defense Industrial Association
- Defense Acquisition University
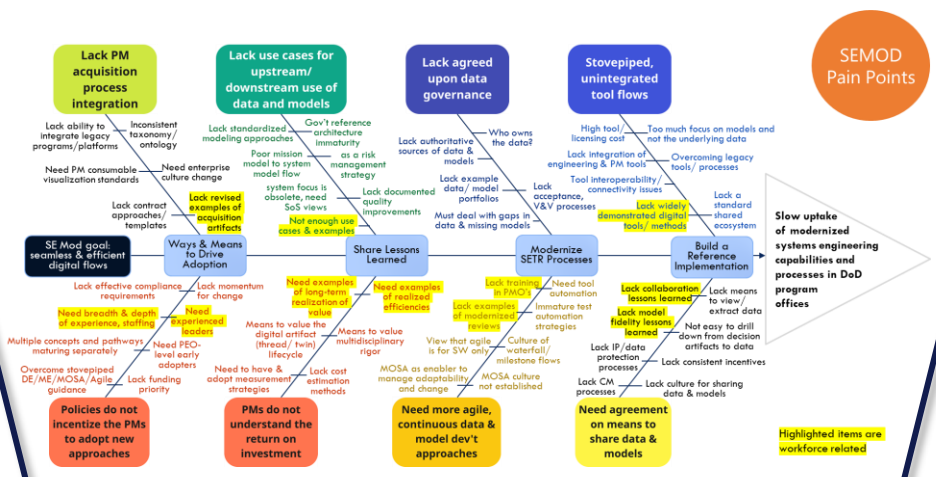- Systems Engineering Research Center

What?

We found the **SE Modernization Mental Model** for Digital Systems Engineering in a fully digital, iterative world that:

- System
- Engineering
- Data & Models

1. Converges 3 life cycles

2. Iterates a different order of **Build-Measure-Learn** for each acquisition pathway that relies on shared data

Why?
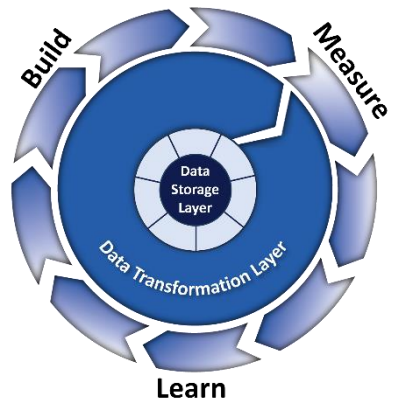
We captured a set of **interrelated issues / pain points / challenges** to implementation of this mental model

How?

We drafted **a roadmap of developmental needs** and recommendations to improve the uptake of modernized systems engineering
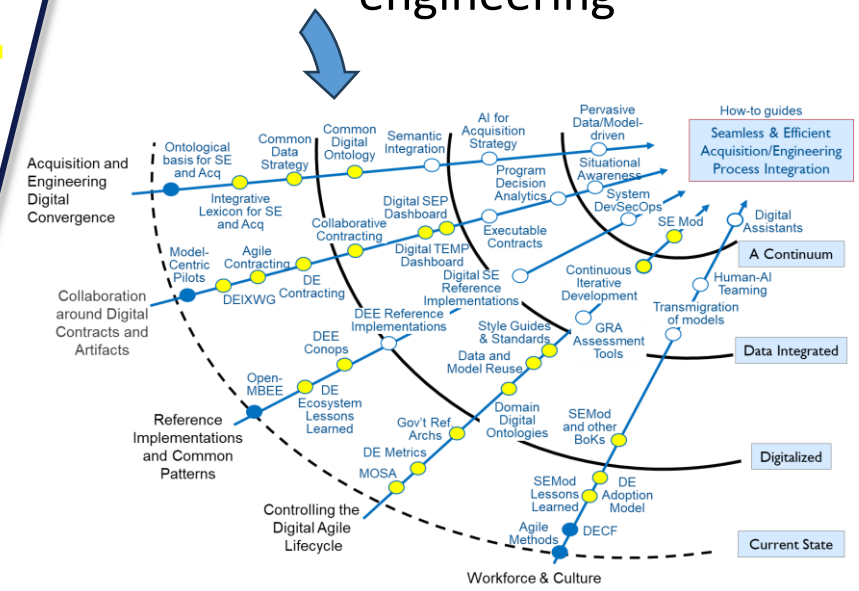
SE Modernization Mental Model
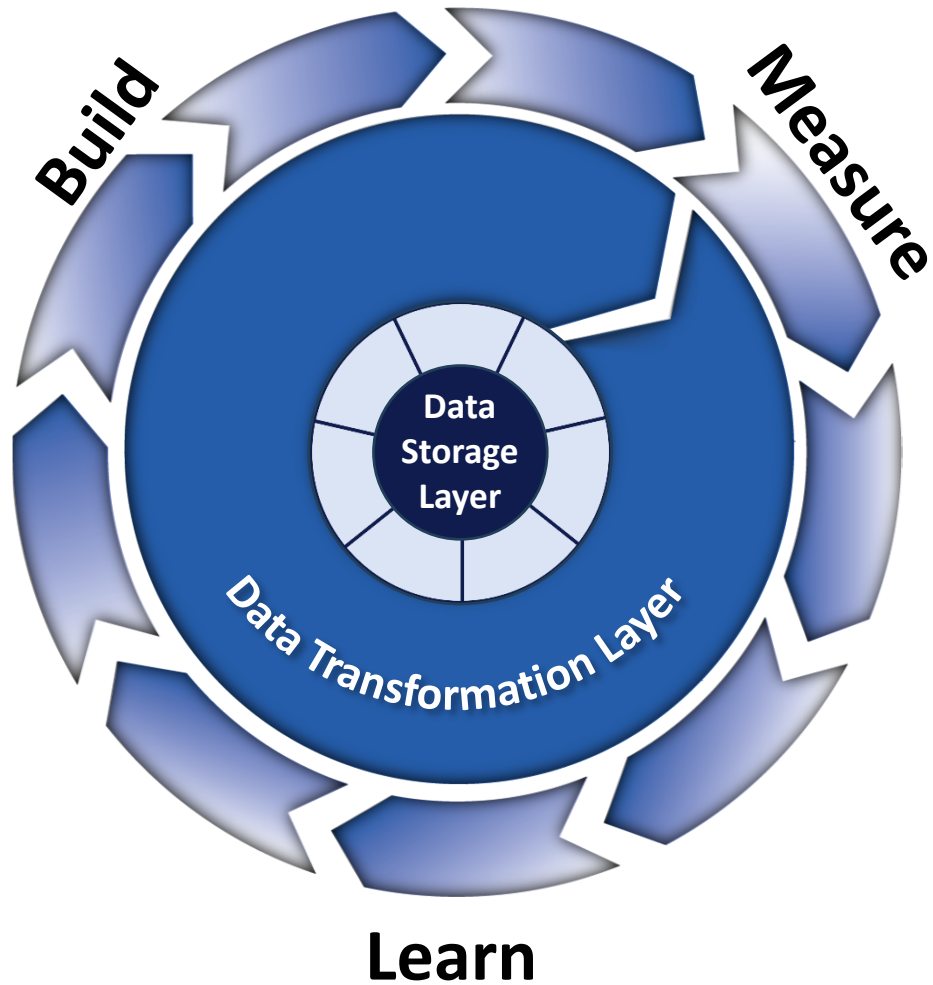
- Cyclic nature of modern SE

- Still milestone-based

- SE core principles in every Acquisition pathway

- Flexible system life cycle entry points:
  Learn-Build-Measure (MCA)
  Build-Measure-Learn (Mid-Tier, SW, UON)
  Measure-Learn-Build (Sustainment)

- Continuous Iterative Development processes (around the circle)

- Continuous Data Management and Transformation processes (at the core)

Interrelated Issues That Impact SE Modernization

Ways & Means To Accelerate Adoption
- Policy and Guidance Initiatives
- Exemplar Implementations

Share Lessons Learned
- Data & Models Throughout the Life Cycle

Modernized SETR Processes
- Data Governance to Support Decisions
- Agile Continuous Model Development

Build Reference Implementations
- Uninterrupted Tool Flow
- Model Usage/Governance

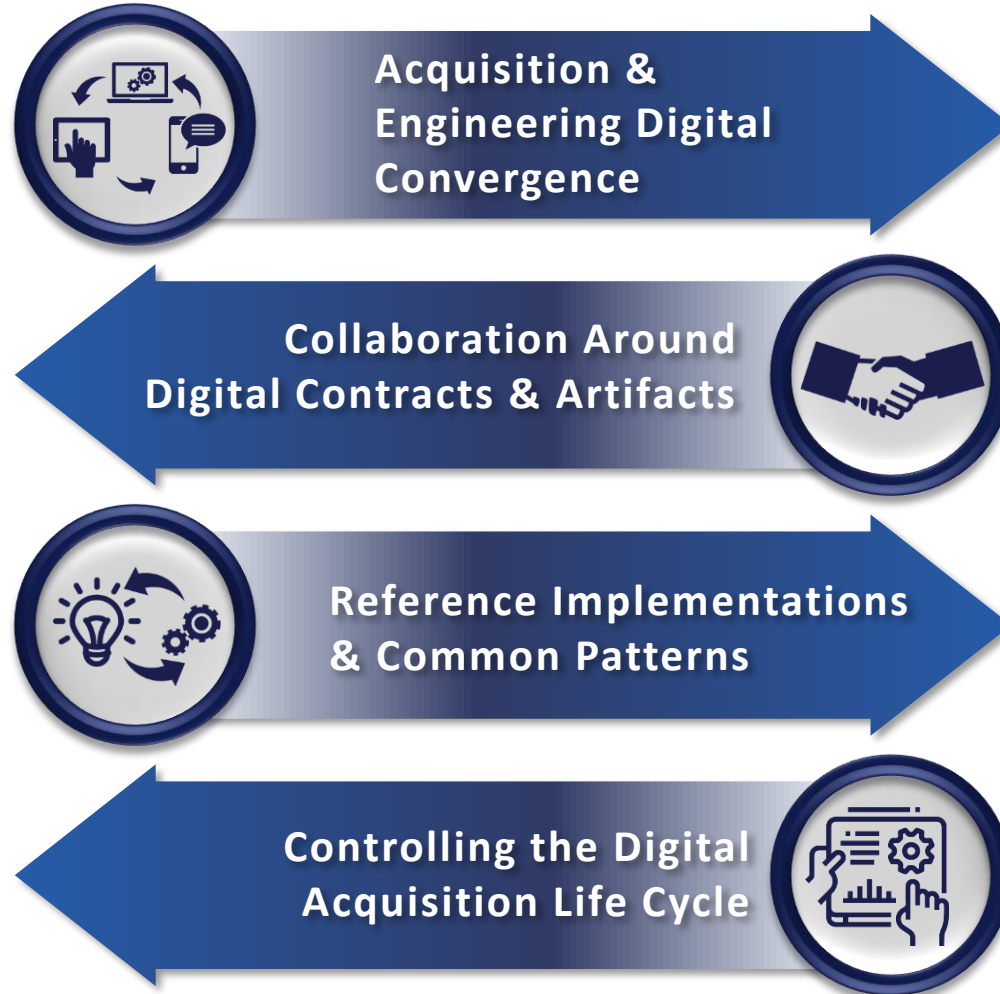Seamless & Efficient Data Flows & Improved Acquisition Decisions

SE Modernization Roadmap Overview (SERC WRT 1058)

Roadmap Overview

Seamless & Efficient Acquisition & Engineering Process Integration

Acquisition & Engineering Digital Convergence

Collaboration Around Digital Contracts & Artifacts

Reference Implementations & Common Patterns

Controlling the Digital Acquisition Life Cycle

Workforce Development

SE Modernization Ongoing Activities

Oct 2022
SE MOD Agile Practices (SERC WRT 1051)

March 2023
SE MOD Roadmap (SERC WRT 1058)

SE Guidance Updates

Update Community of Practice
Hosted by DAU

Lessons Learned Database
Hosted by SERC & DEBoK

SETR Modernization
Use of agile and continuous data & models throughout the life cycle

Knowledge Management/Outreach
Ongoing Collaboration with Government, Industry & Academia

Ontologies
Explore next steps for development & usage

Distribution Statement A. Approved for public release. Distribution is unlimited. DOPSR Case # 23-S- 3183

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Office of Systems Engineering and Architecture

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https://www.cto.mil/sea/

Distribution Statement A. Approved for public release. Distribution is unlimited. DOPSR Case # 23-S- 3183

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Backup

SE MOD Abstract

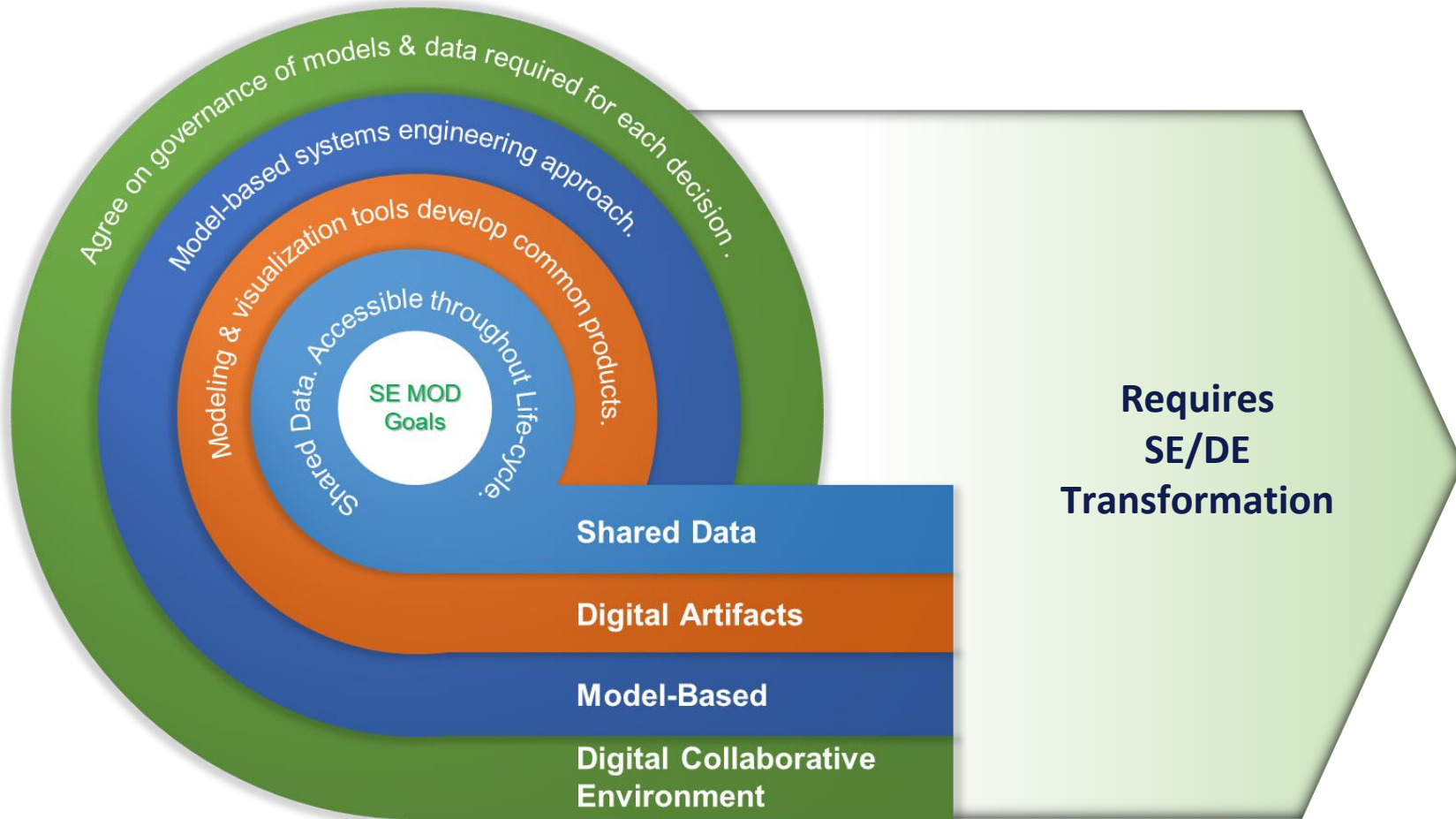- The SE&A Director, Systems Engineering (SE) and the System Engineering Research Center (SERC) completed the initial phase of the SE Modernization program study. They initiated the SE Modernization effort to understand delays in the implementation of the digital transformation into the SE process, artifacts, and guidance. While the current SE technical processes and technical management processes remain relevant at the macro level, there is a lack of guidance regarding governance of shared data and models. The study is intended to promote an understanding of agile and continuous data and model development approaches and their impact on the Systems Engineering Technical Review (SETR) process. The SE Director will present the outcome of the initial phase of the SE Modernization effort to include the following:

- (1) - A revised mental model for SE execution that is iterative and data centric.

- (2) - A set of recommendations to address current pain points.

- (3) - A roadmap that outlines recommended research efforts.

  - In addition, the presenters will discuss upcoming efforts to develop guidance for:

- (1) SE Modernization implementation into DoD acquisition programs and

- (2) Model-based SETR processes that enable agile continuous data and model development along with recommended digital artifacts usage and management.

SE Modernization Goals & Lines of Effort (LOEs)

Agree on governance of models & data required for each decision.

Model-based systems engineering approach.

Modeling & visualization tools develop common products.

Shared Data. Accessible throughout Life-cycle.

SE MOD Goals

- **Shared Data**
- **Digital Artifacts**
- **Model-Based**
- **Digital Collaborative Environment**

Requires SE/DE Transformation

LOE 1 - SE MOD BoK & Community of Practice

LOE 2 - Policy & Guidance Review & Update

LOE 3 - Model Based Artifacts, Data Workflow

LOE 4 - Roadmaps & Framework (Iterative Mental Model)

LOE 5 - Digital Acquisition Thread Exemplar – DAU led

LOE 6 - Workforce: DE/SE Topic Workshops & Webinars , Lessons Learned Database