Systems Engineering Technical Review (SETR) Modernization

27th Annual National Defense Industrial Association Systems and Mission Engineering Conference

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Norfolk, Virginia
October 2024

Systems Engineering (SE) – Digital Engineering (DE) Relationships

…digital engineering represents a transformation in how programs conduct systems engineering (INCOSE SEBOK)

Digital Engineering Strategy (2018)

- Formalize use of models at enterprise & program to support decisions
- Authoritative Sources of Truth
- Incorporate Tech Innovation
- Establish Infrastructure for collaboration
- Transform Culture & Workforce

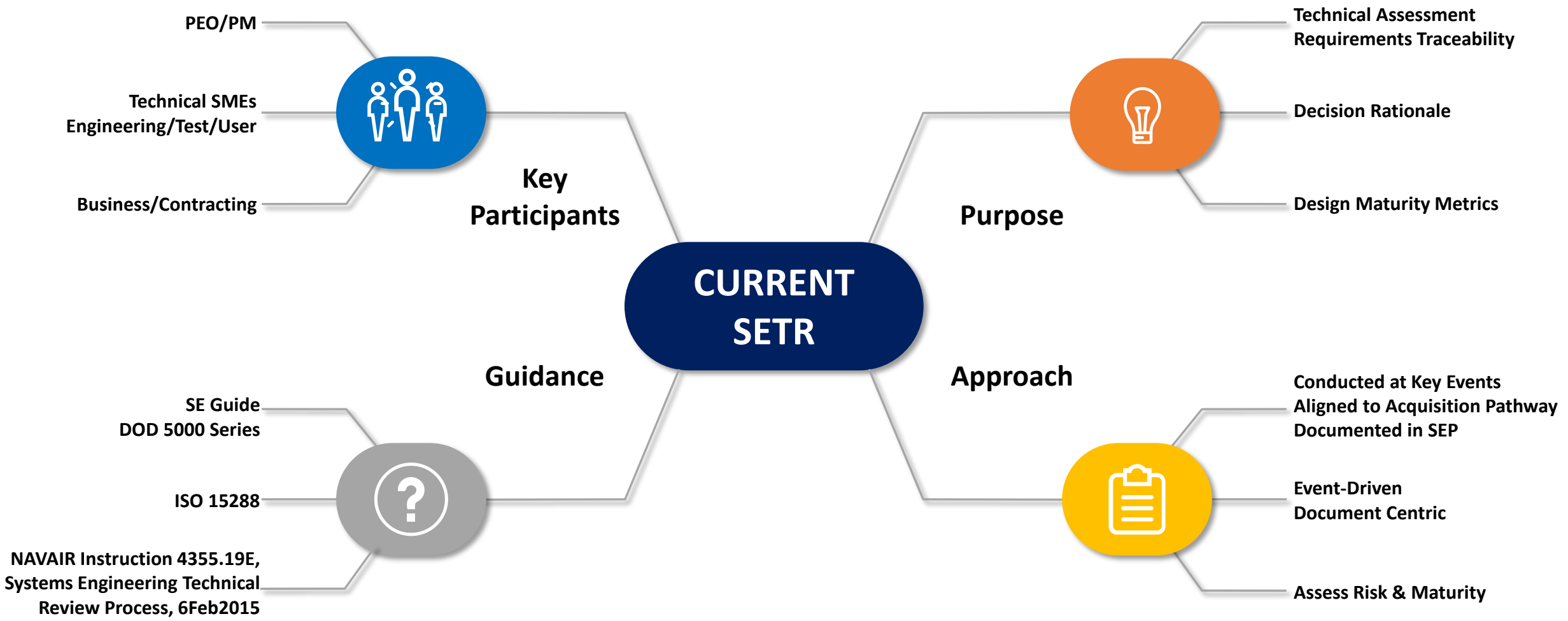
SE Modernization

SETR Modernization

- Test Continuum
- R&M MBSE Initiatives
- Digital Contracting – MBAcq
- SWE Modernization
- Mission Engineering
- Sustainment
- …lots of others

Model-based systems engineering (MBSE) is a subset of digital engineering. MBSE supports the systems engineering activities of requirements, architecture, design, verification, and validation. (INCOSE SEBOK)

Traditional SETR



SETR Transformation Aligned to Digital Transformation

Document Centered

- Conducted at key knowledge points aligned to AAF pathway
- Relies on subject matter expertise
- Redundant
- Difficult to keep all documents up to date

Digital Transformation

- INCOSE /NDIA– DE WORK, FUSE, DEMM,
- SERC studies (SUPRA Cycle)
- SE MOD LOEs/MBSE/Ref Arch/SEP
- DE: DEM&S COP, DEBOK, MBSE
- OMG- MBAcq

- Test Continuum – MB TEMP
- Digital SEP
- R&M COP
- SW Modernization
- Data Strategy (CIO)
- Ontology WG
- MOSA

Knowledge Centered (Data & Models)

- MBSE
- DE Infrastructure
- Collaboration around Data & Models
- Data & Model Governance

SETR Modernization Approach

BOTTOM LINE: ***Systems engineering processes remain valid,*** *but practices and methodology need to change to take advantage of the digital transformation that supports Agile system development. (SERC 2023)*

NEED STATEMENT

- **Provide exemplars and implementation strategies regarding shared data and models** used to enable agile and continuous data & model development approaches (**SE Digital Threads**) that support the **systems engineering workflow** WRT technical and technical management decisions and reviews.

WHY THIS MATTERS

- Continuation of **document centric methods does not support the full integration of ongoing important initiatives related to the digital transformation** to include: MOSA, SW Modernization and Agile program development methods.
- **Lacks Agility** in iterative development cycles
- **Lacks transformation to digital/data centric process** and methods that cannot maintain up to date, knowledge-based decision support

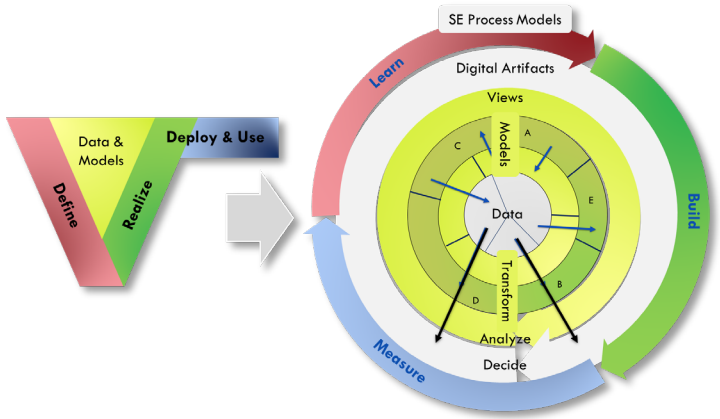
INTENDED OUTCOMES

- Guidance for implementing model based SETR processes
- **Model based SEP/SETR processes** that enable agile continuous data and model development
- Recommended **digital artifacts usage and management**
- Exemplars for **governance/oversight/sharing of model-based artifacts (SE Digital Threads)**
- Recommended approach to SETR use of Agile principles for continuous data/models
  - Standard Approach/**Best Practices**
  - **Workforce Training**

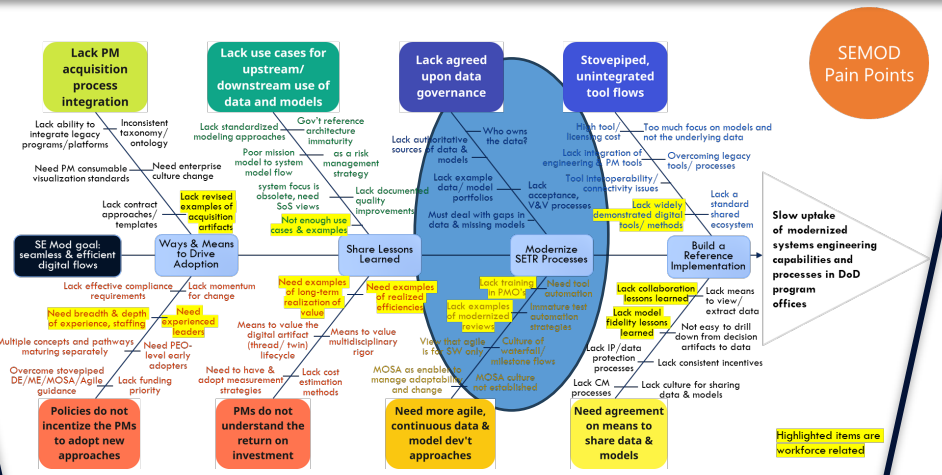
Modernize Systems Engineering (SERC STUDY 2021-2022)

What?

We envisioned new **mental models** for modernized systems engineering in a fully digital, iterative world



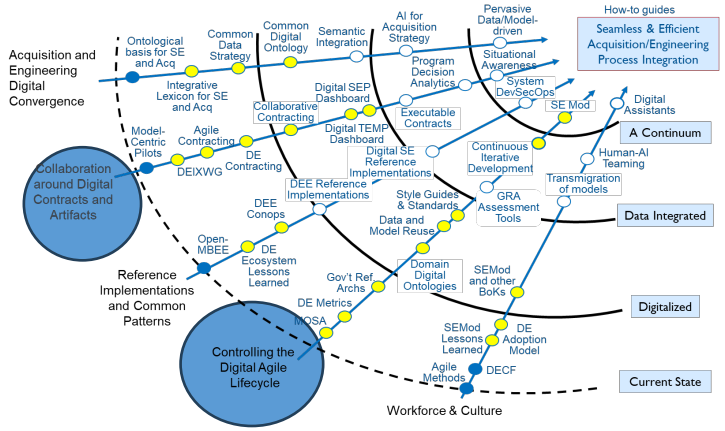
Why?



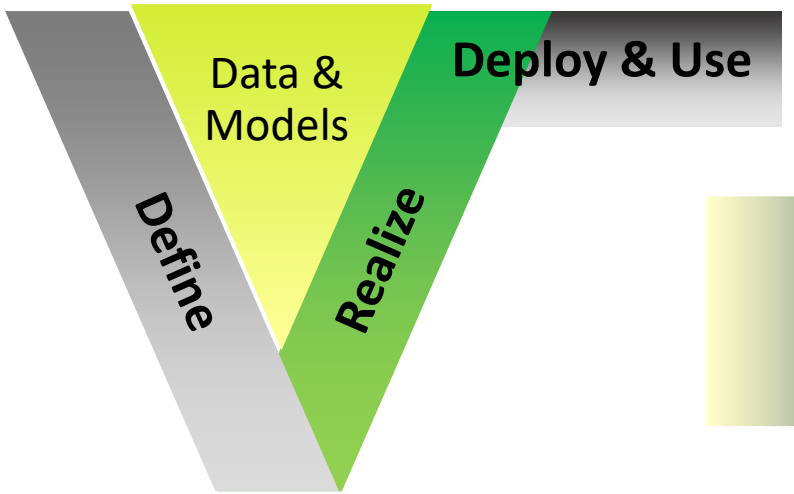
We captured a set of interrelated issues/ **pain points** and stakeholder needs to implementation of this mental model

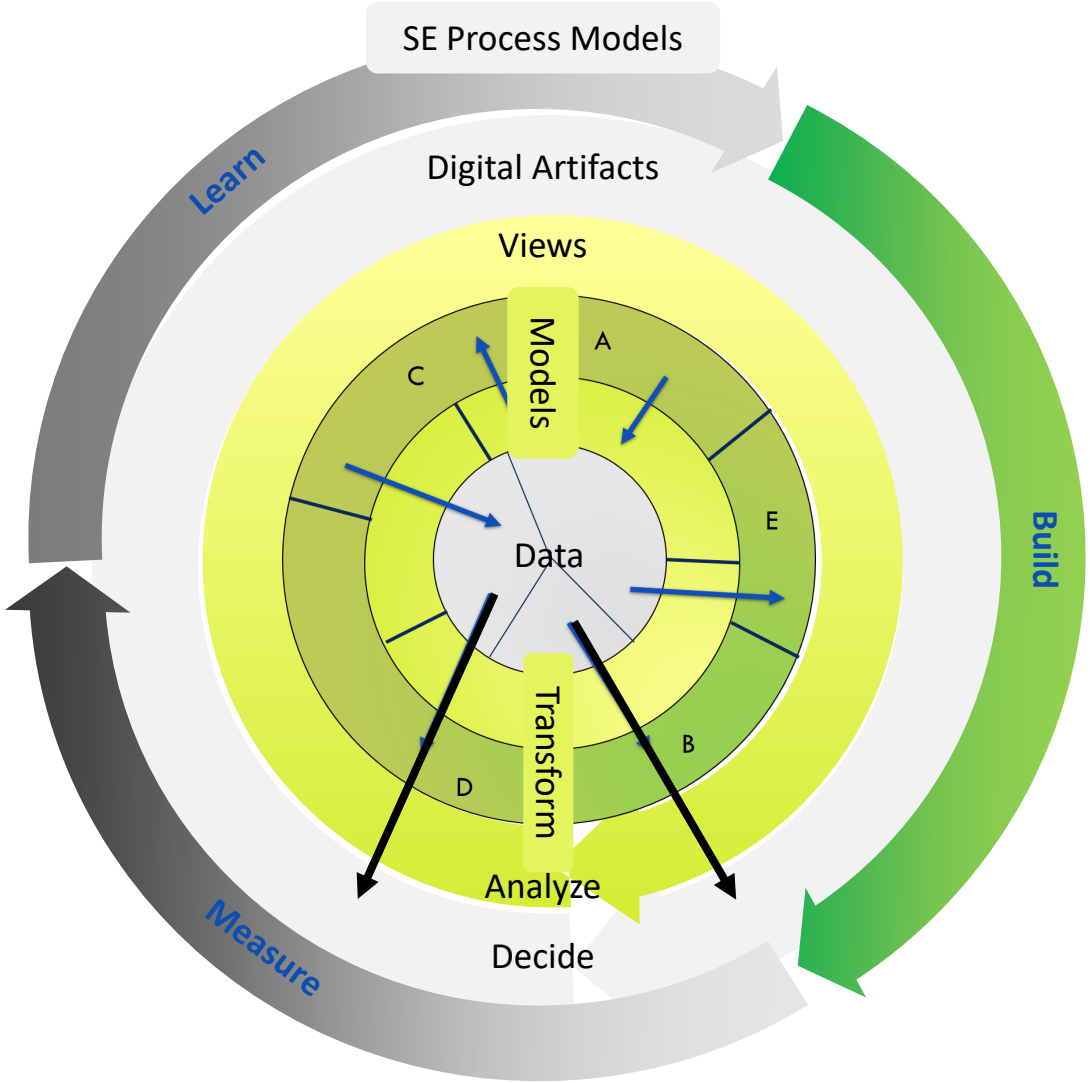
How?

We drafted a **roadmap** of developmental needs and recommendations to improve the uptake of modernized systems engineering



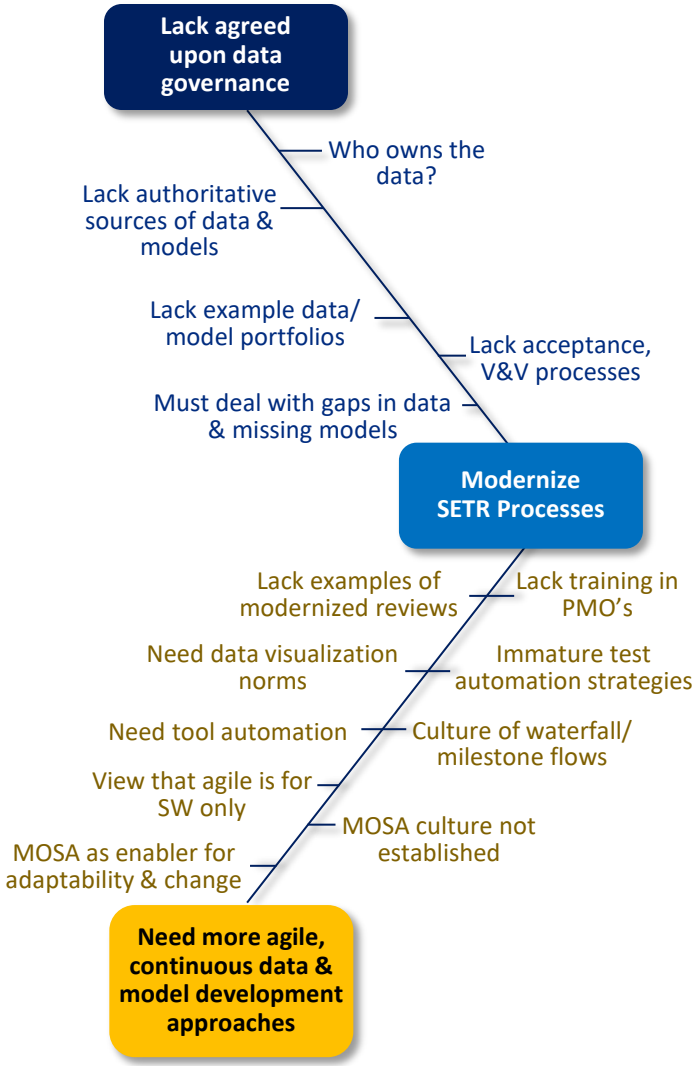
Revised Mental Model





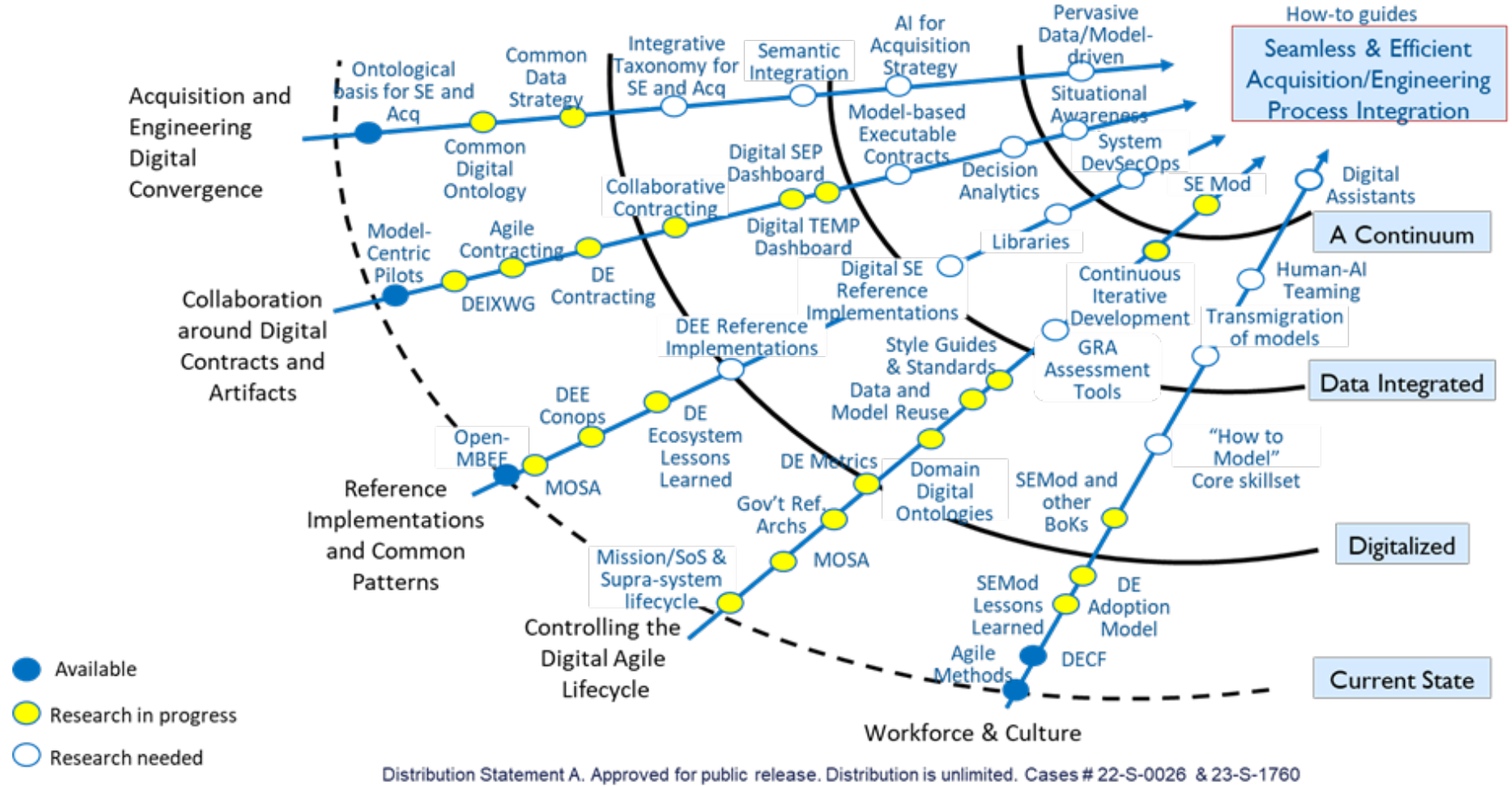
- In this mental model we redraw the Define->Realize->Deploy & Use stages of the SE Lifecycle in a circular Learn->Build->Measure process to represent it as:
  (1) Data transformations at the core
  (2) Layered across disciplines & tasks
  (3) Continuous processes that could be entered from any point

Modernize Program Review Processes



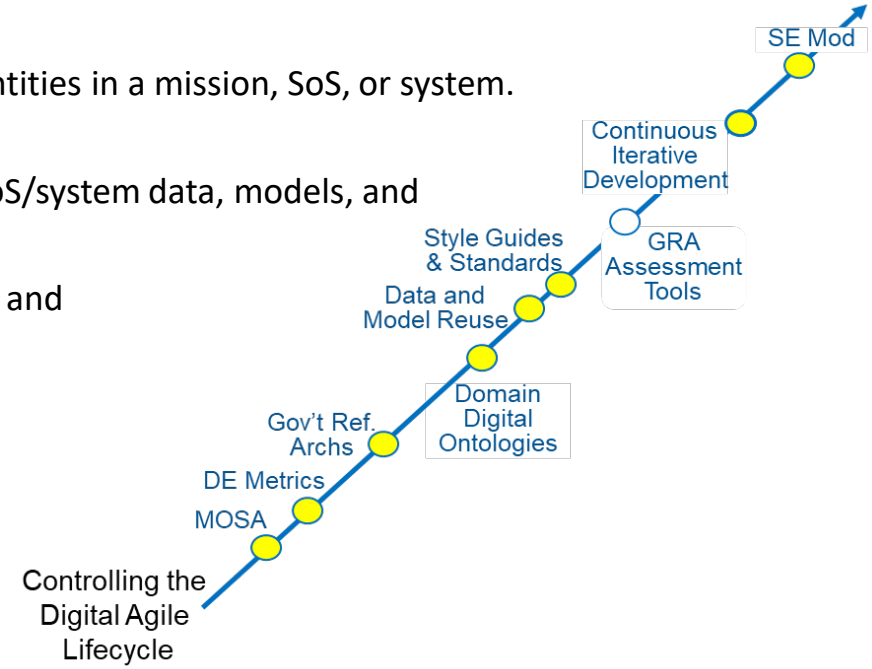
- **Pain Points:**
  - Lack of review and collaboration processes that focus on use of data and models instead of static presentation artifacts.
  - Lack authoritative sources of data/models to build from
  - Reviews should support more agile and continuous data & model development processes.
- **Stakeholder Needs:**
  - Structural and process approaches for government data/model ownership
  - Mature libraries of data and models and data/model portfolios
  - Processes for establishment and acceptance/validation of authoritative data and models
  - Change the prevailing view of development as a set of waterfall milestones, adopt agile principles
  - MOSA approaches for data/model and tool infrastructures
  - Digital information exchange standards
  - Training for everyone
  - More automation from the tools

SE Modernization – Research Roadmap (SERC)

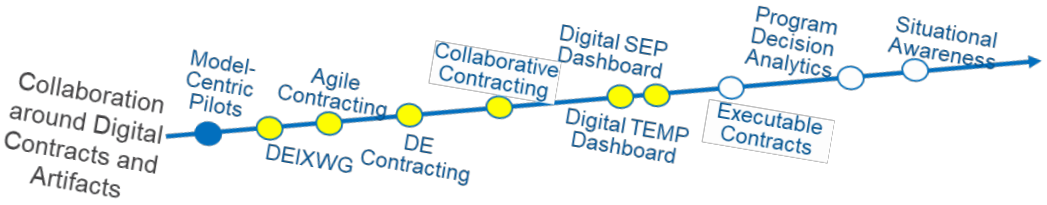


Controlling the Digital Agile Life Cycle (SERC Study)

- **MOSA:** A complete government business and technical approach to manage adaptability and affordability of defense systems over time, managed at the portfolio level. Title 10 U.S.C. 2446a.(b) and 2320(e) provide a basis for better government definition and control of the systems they acquire.
- **Digital Engineering Metrics:** Measuring and improving efficiency and quality of defense systems development to improve deployment, cost, and schedule outcomes.
- **Government Reference Architectures (GRAs):** Government developed, owned, and maintained authoritative sources of data and models that guide system design, development, production, and sustainment in an acquisition program.
- **Domain Digital Ontologies:** The digital graph of domain-specific models and relationships between entities in a mission, SoS, or system. Necessary for constructing data models underlying authoritative sources.
- **Data and Model Reuse:** Development of government maintained and provided libraries of mission/SoS/system data, models, and reference architecture templates to reduce ambiguity and increase speed of acquisition.
- **Style Guides and Standards for Systems Models:** Guides for consistency in system modeling methods and design as well as tools to improve interoperability and reuse across programs, portfolios and services.
- **GRA Assessment Tool:** What data are needed to say a GRA is acceptable, what criteria do data and models need to meet?
- **Continuous Iterative Development:** Both an architecting and development process approach to manage risk by separately architecting platforms and capabilities and more frequently deploying and validating capabilities.
- **Systems Engineering Modernization (SEMod):** Evolution of SE life-cycle processes and digital tools to improve the efficiency and quality of defense systems development.



Collaboration around Digital Contracts (SERC Study)



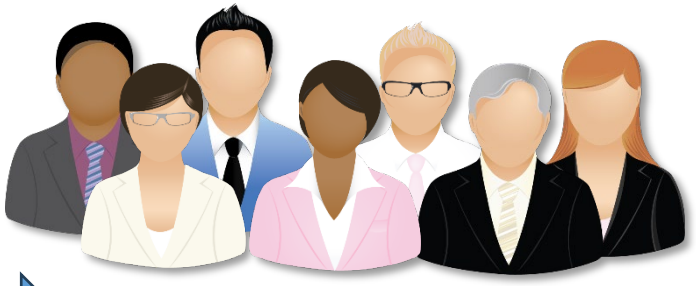
- **Model-Centric Engineering:** Demonstration pilot programs exploring the art of the possible to achieve a full set of SE and Acquisition activities 100% "in the model"
- **Digital Engineering Information Exchange Working Group (DEIXWG):** A community activity to develop a set of "common views" for executing digital, model-based engineering & technical reviews
- **Collaborative Contracting:** Flexible contracting approaches for collaboration around data and models
- **SEP Dashboard:** A digital version of the Systems Engineering Plan (SEP) that provides an interactive dashboard for a program office to plan, monitor, and control the SE development process
- **TEMP Dashboard:** A digital version of the Test & Evaluation Master Plan (TEMP) that provides an interactive dashboard for a program office to plan, monitor, and control the systems integration, developmental test, and operational evaluation processes
- **Executable Contracts:** Bridging the gap between current legal language and digital data exchange using declarative (outcome-based) transaction models, and software orchestration (dynamic workflows for multiple task automation)
- **Program Decision Analytic Tools:** Common digital ontologies and data strategies enable development of new digital decision analysis tools using emerging artificial intelligence and visualization technologies to improve acquisition decision making
- **Program Situational Awareness:** Digitally connected visualization dashboards that achieve full near real-time situational awareness and measures of performance across all engineering, technical, and management activities

SETR Modernization – Intended Outcomes

INTENDED OUTCOME	ONGOING ACTIVITIES
Guidance & workforce training for implementing model-based SETR processes workflow	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	SERC Roadmap Research Activities SE Emerging Content
Recommended digital artifacts usage and management during the SETR	SERC Roadmap Research Activities, Service Use Cases, Industry Collaboration

Workforce Progress

- **Digital competencies to work digitally enabled agile workflows and tools.**
- Training in all the software components of DE (data, models, software products), agile methods and tools.
- Systems thinking and foundational modeling skills to enable problem solving and effective decision making.



Almost 1000 Digital Engineering Credentials earned so far across DOD through DAU courses

How Should Organizations Get Started?

SE/DE Focused Forums & Knowledge Management Forums

- DEM&S Community of Practice
- TE/MBSE Modeling Collaboration
- DAU hosted COPs/Webinars
- SE/DE Industry Forums
- SEBOK; DEBOK

Digital Maturity Assessment Tools

- Model-Based Capability Matrix (INCOSE)
- Digital Engineering Competency Matrix (SERC)
- *Digital Engineering Tool Evaluation Criteria Template (DETECT)*

Sample of resources that support model-based, data centric workflows, infrastructure, and methodology

Systems/Digital Engineering/Test – policies & guidance (subset)

- **DoD Digital Engineering Strategy** 2019
- **DoD Digital Modernization Strategy** 2021
- **DoD Digital Engineering Instruction 5000.97** 2023
- **M&S Strategy** In Update
- **SE Guidebook** 2022
- **Engineering of Defense Systems 5000.88** 2021
- **Major Capability Acquisition DoDI 5000.85** In Update
- **T&E Enterprise Guidebook** 2022

Emerging Role for AI

SERC AI4SE Roadmap
Summary report from October 2023
AI4SE & SE4AI Workshop 2023 (sercuarc.org)

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