33rd Annual INCOSE international symposium

hybrid event

Honolulu, HI, USA
July 15 - 20, 2023

INCOSE 2023 International Symposium
Daniel Hettema
Director, Digital Engineering, Modeling and Simulation
Office of the Under Secretary of Defense (Research & Engineering)

Digital Engineering, The Next Chapter

How does the systems engineering discipline need to change to be more digital?

“To make the systems engineering discipline more digital, several changes and adaptations are required. Here are some key areas that would benefit from transformation:

1. Data-driven approach
2. Model-based systems engineering
3. Virtual prototyping and simulation
4. Internet of Things (IoT) integration
5. Collaborative platforms and tools
6. Agile and iterative methodologies
7. Cybersecurity and resilience
8. Continual learning and skill development

By embracing these changes, systems engineering can leverage digital technologies to enhance efficiency, improve system performance, and accelerate innovation.” ChatGPT 7/10/2023

Executive Branch of the United State of America

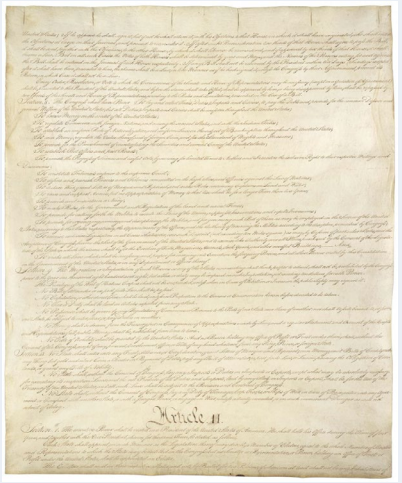
Leaders

Joe Biden
President

Kamala Harris
Vice President

Authority From

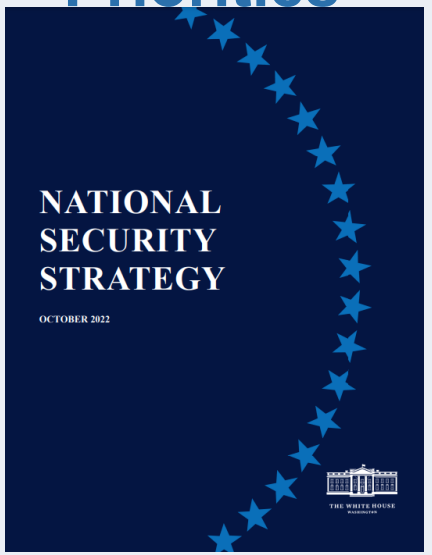
The Constitution



https://www.archives.gov/founding-docs/constitution-transcript

"The President shall be **Commander in Chief** of the Army and Navy of the United States, and of the Militia of the several States, when called into the actual Service of the United States"

Priorities



The war in Ukraine highlights the criticality of a vibrant Defense Industrial Base for the United States and its allies and partners. It must not only be capable of rapidly manufacturing proven capabilities needed to defend against adversary aggression, but also **empowered to innovate and creatively design solutions** as battlefield conditions evolve.

Department of Defense

SE&A
Systems Engineering & Architectures

DEM&S
DIGITAL ENGINEERING
MODELING AND SIMULATION

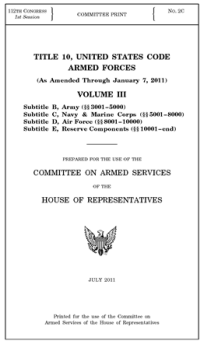
Leaders

Lloyd J. Austin III
Secretary of Defense

Dr. Kathleen H. Hicks
Deputy Secretary of Defense

Authority From

Title 10: U.S. Code


TITLE 10, UNITED STATES CODE
ARMED FORCES
(As Amended Through January 7, 2011)
VOLUME III
COMMITTEE ON ARMED SERVICES
HOUSE OF REPRESENTATIVES
JULY 2011

https://uscode.house.gov/browse/prelim@title10&edition=prelim

"(a)(1) There is a Secretary of Defense, who is the **head of the Department of Defense**, appointed from civilian life by the President, by and with the advice and consent of the Senate."

Priorities

2022 National Defense Strategy
Section VI. ANCHORING OUR STRATEGY IN ALLIES AND PARTNERS AND ADVANCING REGIONAL GOALS- PG 14

To succeed….the Department will **reduce institutional barriers**,….that inhibit….**interoperability,** intelligence and **information sharing**,…We will work across the U.S. government to **upgrade technology**….facilitate **information exchange for mutual benefit**.

Office of the Under Secretary Of Defense for Research and Engineering

SE&A
Systems Engineering & Architectures

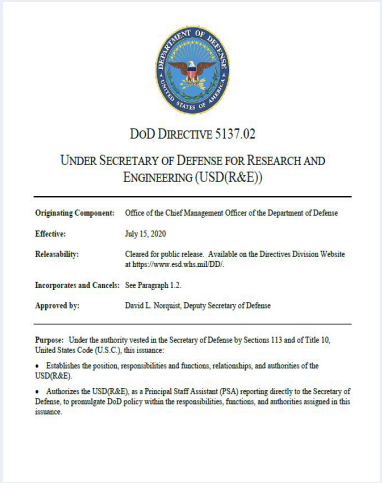
DEM&S
DIGITAL ENGINEERING MODELING AND SIMULATION

Leaders

Heidi Shyu
Under Secretary of Defense for Research and Engineering

Dr. David A. Honey
Deputy Under Secretary of Defense for Research and Engineering

Authority From
DODD 5137.02



DoD DIRECTIVE 5137.02

UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING (USD(R&E))

Originating Component:	Office of the Chief Management Officer of the Department of Defense
Effective:	July 15, 2020
Releasability:	Cleared for public release. Available on the Directives Division Website at https://www.esd.whs.mil/DD/.
Incorporates and Cancels:	See Paragraph 1.2.
Approved by:	David L. Norquist, Deputy Secretary of Defense

Purpose: Under the authority vested in the Secretary of Defense by Sections 113 and 10, United States Code (U.S.C.), this issuance:

- Establishes the position, responsibilities and functions, relationships, and authorities of the USD(R&E).
- Authorizes the USD(R&E), as a Principal Staff Assistant (PSA) reporting directly to the Secretary of Defense, to promulgate DoD policy within the responsibilities, functions, and authorities assigned in this issuance.

https://www.esd.whs.mil/DD/

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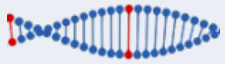
- **Authorizes** the USD(R&E),….reporting directly to….promulgate **DoD policy** within the responsibilities, functions, and **authorities assigned**…..

Priorities

OUSD(R&E) - Critical Technologies

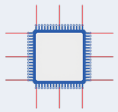
SE&A
Systems Engineering & Architectures

DEM&S
DIGITAL ENGINEERING
MODELING AND SIMULATION

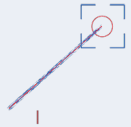


Biotechnology

Trusted AI and Autonomy

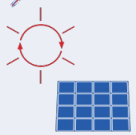


Microelectronics



Directed Energy

Integrated Network SOS

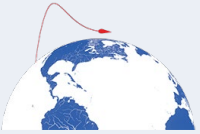


Renewable Energy

Integrated Sensing and Cyber

Advanced Computing and Software

Advanced Materials



Hypersonics

Future Generation Wireless

Space Technology

Human Machine Interface

Quantum Science

OUSD(R&E) - Engineering Activities

SE&A
Systems Engineering & Architectures

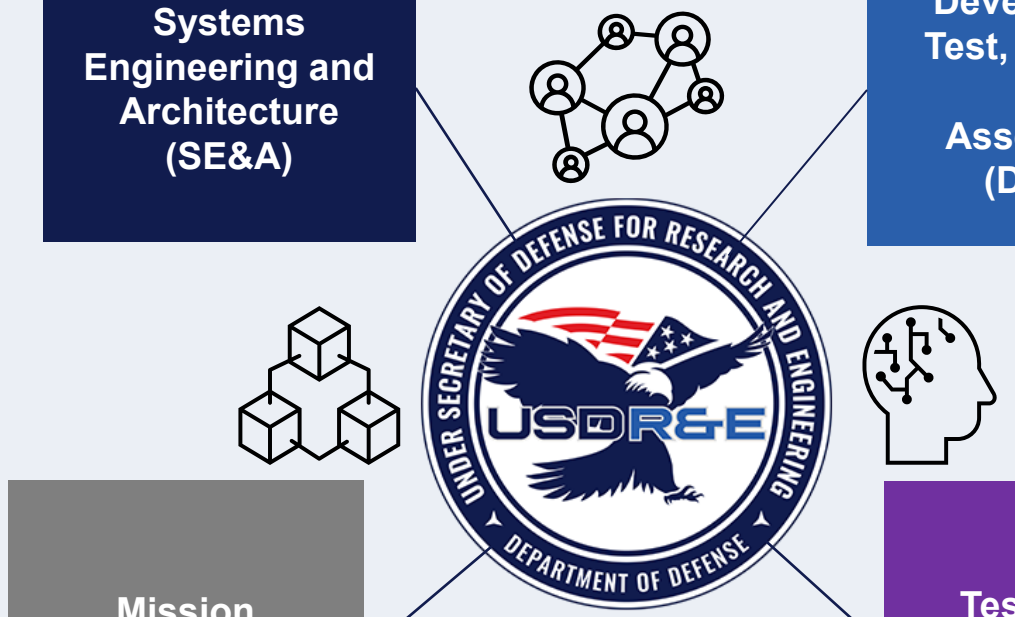
DEM&S
DIGITAL ENGINEERING
MODELING AND SIMULATION

- Engineering Applications
- Engineering Foundations

Systems Engineering and Architecture (SE&A)

Developmental Test, Evaluation & Assessments (DTE&A)

- Inform Critical Acquisition and Warfighting Capability Decision
- Champion Adaptive DT&E and SE Approaches



- Analyze Mission Engineering Threads
- Data Curation and Modeling & Simulation Tools

Mission Engineering (ME)

Test Resource Management Center (TRMC)

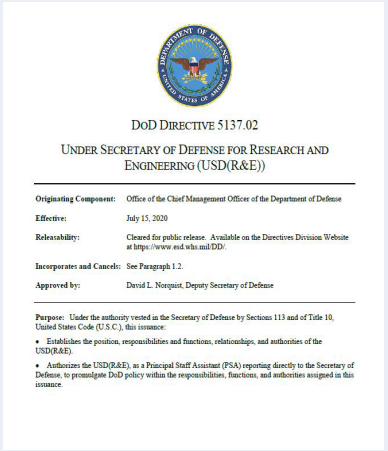
- Central T&E Investment Program
- T&E Range Oversight Division

Executive Directorate for Systems Engineering & Architecture

Leader

Thomas W. Simms
Executive Director, SE&A

Authority From
DODD 5137.02



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https://www.esd.whs.mil/DD/

Section 2, Paragraph q:
" q. ….with key stakeholders, **develops** governing **policy** and **advances practices** and **workforce competency** for…., **modeling and simulation, and digital engineering."**

Priorities

Mission Statement

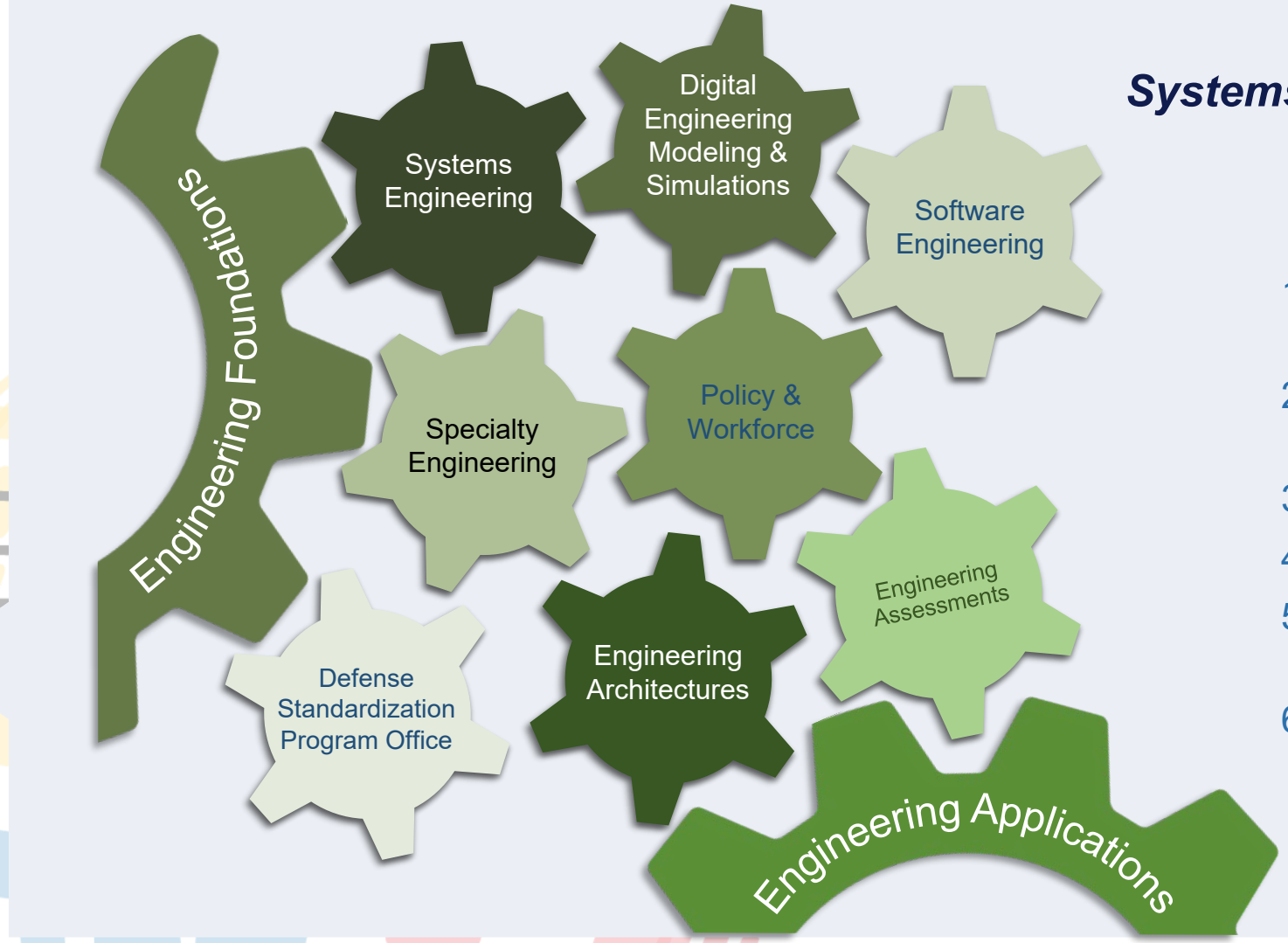
Engineering Foundations' mission ….**develop and drive** the use of **innovative** and modern **engineering principles and techniques**….within the DoD….This team **provides policy, guidance, standards, and best practice** resources facilitates **communities of practice**; and **develops the workforce**….

Engineering Applications' mission is….to **inform risk-based decisions** and develop….architectures to **reduce integration risks** for mission-enabling systems. This team provides **engineering assessments and architectures**.

SE&A
Systems Engineering & Architectures

DEM&S
DIGITAL ENGINEERING MODELING AND SIMULATION

Executive Directorate for Systems Engineering & Architecture



Systems Engineering & Architecture

Lines of Effort

1. Advance the Engineering Practice
2. Connect & Strengthen the Technical Community
3. Develop the Workforce
4. Advance and Manage Standards
5. Provide Independent Engineering Assessments
6. Provide Systems of Systems (SoS) Architectures Guidance

SE&A Systems Engineering & Architectures

DEM&S DIGITAL ENGINEERING MODELING AND SIMULATION

Directorate for Digital Engineering, Modeling & Simulation

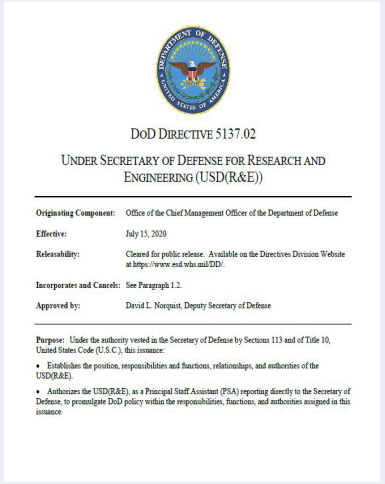
SE&A
Systems Engineering & Architectures

DEM&S
DIGITAL ENGINEERING
MODELING AND SIMULATION

Leaders

Daniel Hettema
Director

Authority From
DODD 5137.02



DoD Directive 5137.02

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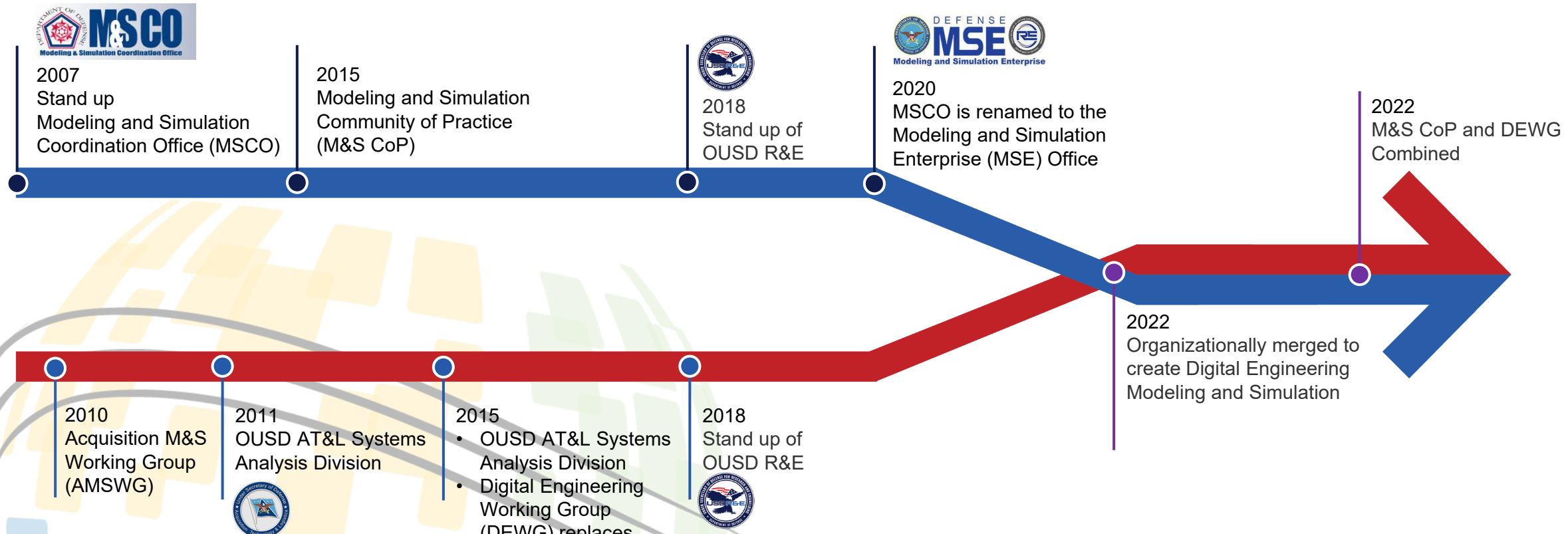
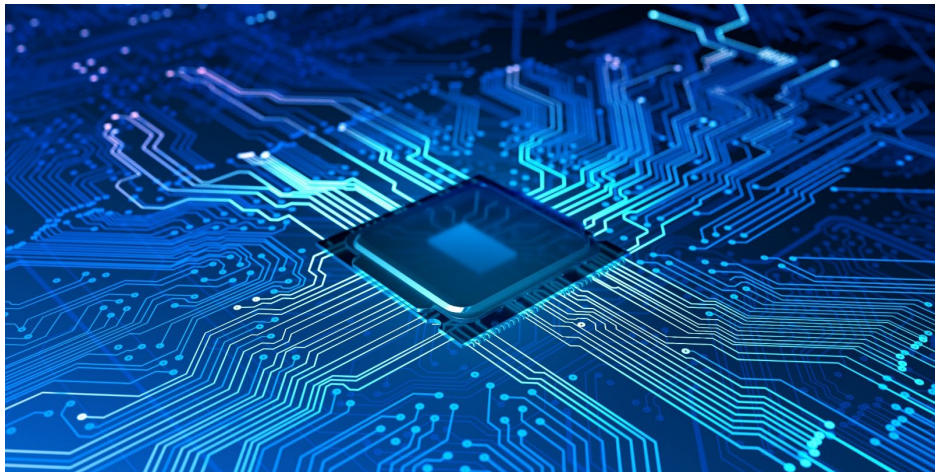
" q. ….with key stakeholders, **develops** governing **policy** and **advances practices** and **workforce competency** for…., **modeling and simulation, and digital engineering."**

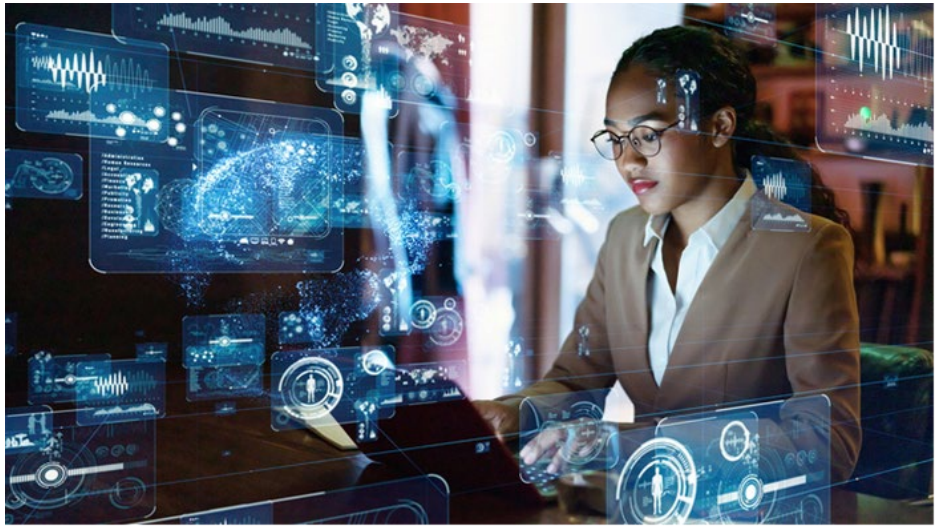
DEM&S Organizational Journey



The Vision for Digital Engineering, Modeling & Simulation

1. Digital becomes **the normal**
2. Data & Information **flow across disciplines** and ecosystems throughout the lifecycle
3. Powerful modeling, simulation, **and visualization** tools are used
4. AI is used to **elevate experts** and gain insights
5. **Decisions are data driven** and made with confidence earlier
6. **Innovative culture** is adaptive and continuously improves practices across the Defense Acquisition Lifecycle





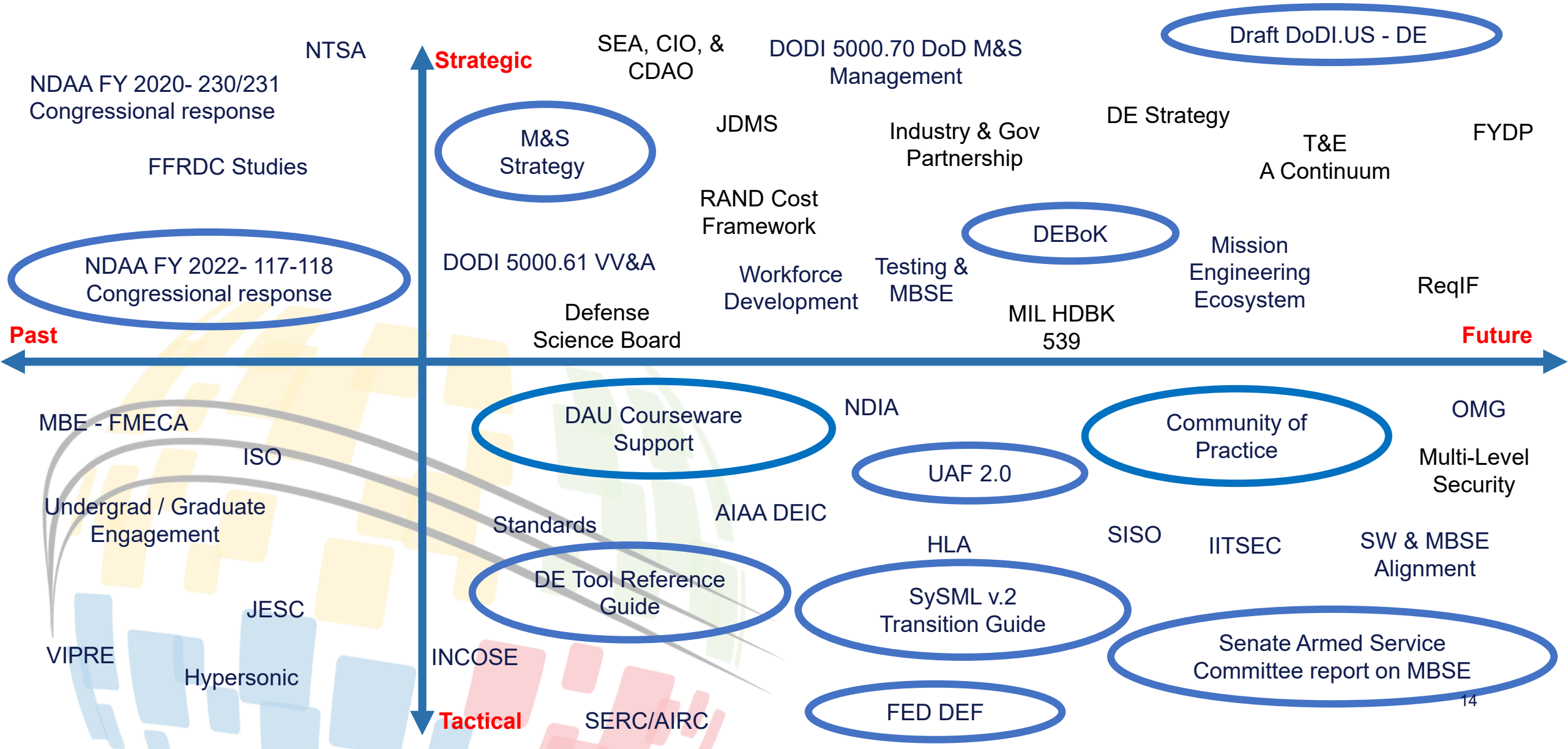
Outcomes

- Outpace rapidly changing threats and technological advancements
- Deliver advanced capabilities more quickly and affordably with improved sustainability to the warfighter

5 Foundational Principles for the Next Chapter

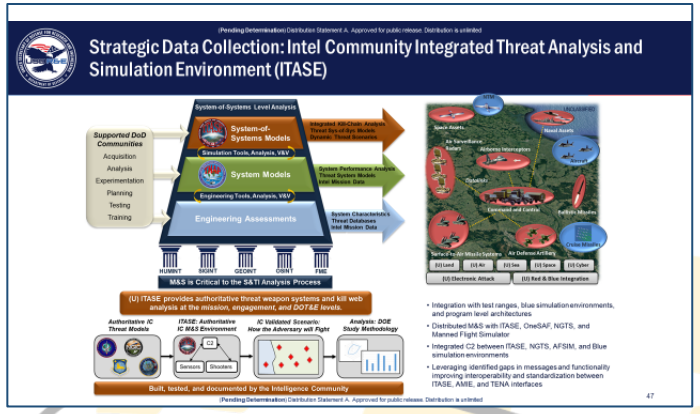
1. Doing Over Planning
2. Leveraging Data over Existing Process
3. Upskilling Over Future Hires
4. Interoperability Over Tool Verticals
5. Information Sharing Over Organizational Silos

DEM&S Portfolio to Achieve the Vision



NDAA FY 2022-117/118 Congressional Responses

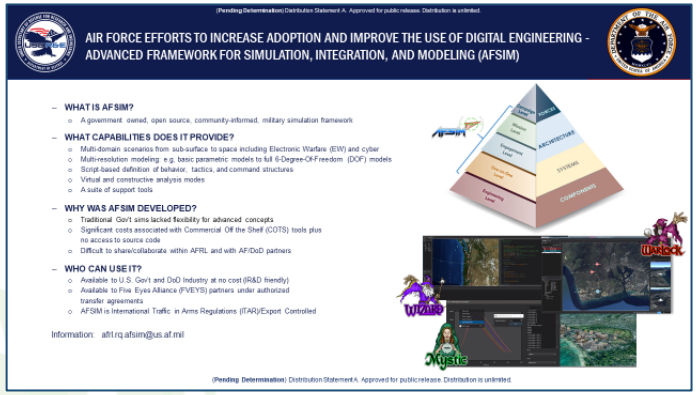
ADVANCING GAMING, EXERCISING, MODELING AND SIMULATION (GEMS) CAPABILITIES



Brief Outline:

- Enterprise-Level GEMS Strategy
- Training and Experimentation
- Strategic Data Collection and Modeling & Simulation
- Technology-based enablers
- Promoting GEMS Governance

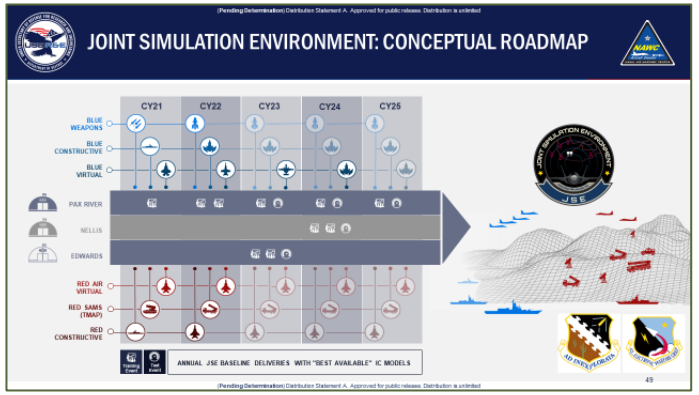
STATUS OF ADOPTION & IMPLEMENTATION OF DIGITAL ENGINEERING INFRASTRUCTURE & WORKFORCE DEVELOPMENT WITHIN THE DEPARTMENT OF DEFENSE



Brief Outline:

- Workforce Development Required
- Implementation of Best Practices
- Efforts to Increase Adoption of Digital Engineering
- The Amount of Funding Provided

USING MODELING AND SIMULATION TO INCREASE SPEED TO MARKET, REDUCE RISK, AND FOSTER INTEROPERABILITY IN THE INDUSTRIAL BASE



Brief Outline:

- Modeling &Simulation Strategy
- Department of Defense Policy
- Organizational Support & Knowledge
- Implementation & Execution
- Artificial Intelligence & Digital Twin
- Outcomes

Senate Armed Service Committee report on MBSE

SASC requested DoD report on Model-Based Systems Engineering (MBSE):

- Investments in MBSE efforts across the DOD
- Provide a plan for establishing a coordinating mechanism to guide future investments and support adoption into programs for MBSE.

MBSE: A formalized application of modeling to support system requirements, design, analysis, verification and validation activities beginning in the concept design phase and continuing throughout development and later lifecycle phases.

JUL 2022
Senate Request

FEB 2023
Lead: OUSD(R&E)

MAR 2023
Report Initiated

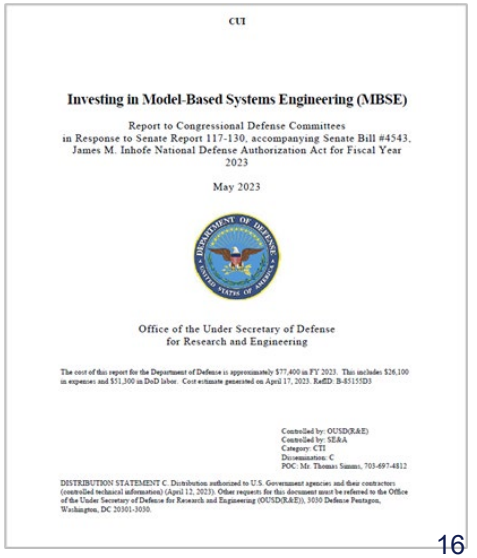
MAR 2023
Inputs Received

APR 2023
Draft Report/Informal Coord

APR 2023
Final Report

APR 2023
Formal Coord

JUNE 2023
Deliver to SASC



CUI

Investing in Model-Based Systems Engineering (MBSE)

Report to Congressional Defense Committees
in Response to Senate Report 117-130, accompanying Senate Bill #4543,
James M. Inhofe National Defense Authorization Act for Fiscal Year 2023

May 2023

Office of the Under Secretary of Defense
for Research and Engineering

Development of Modeling & Simulation Strategy

Primary Goals:

I. Develop a joint, enterprise-level common technical framework and infrastructure, supporting modeling and simulation
II. Promote interoperability and trust within the M&S community through common and accessible authoritative sources of data
III. Leverage existing DoD Institutions, processes and capabilities to establish a professional development system supporting modeling & simulation
IV. Cultivate integration of enterprise-level M&S Services within the DoD and the larger M&S community.
V. Adapt policies, processes, and infrastructure enabling rapid (agile) assessment and procurement of emerging technologies and tools.

SEP 2022
Initial Draft

DEC 2022
Informal Reviews

APR 2023
1st Govt Review

MAY 2023
Final Draft

JUN 2023
2nd Govt Review

INCOSE IS 2023

JUL 2023
Pre-Publish Reviews

AUG 2023
USD Signature

SEP 2023
Published

OCT 2023
Road Show

DRAFT DoDI 5000.US: Digital Engineering

INCOSE IS 2023

"3.4 IMPLEMENTATION OF DIGITAL ENGINEERING

a. The PM is responsible for implementing digital engineering procedures as early in program planning as possible and across the system lifecycle.
   1) Major Capability Acquisition…
   2) Middle Tier of Acquisition …
   3) Software Acquisition…
   4) Defense Business System Acquisition…
   5) Urgent Capability Acquisition…
   6) Acquisition of Services…

b. The PM will identify digital models and artifacts as deliverables in the contract…

c. The PM will consider implementing the following key elements…

d. … PMs should consider using existing DoD digital engineering resource before investing in new digital engineering capabilities."

JAN 2022
First Draft

JUN 2022
Second Draft

SEP 2022
Third draft to WHS

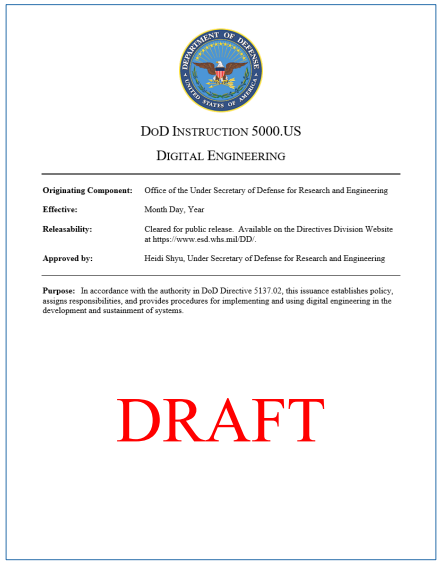
NOV 2022
Fifth Draft Formal Coord

OCT 2022
Fourth Draft to OGC

FEB 2023
Comments WHS Coord

JAN 2023
Initiated WHS Coord

APR 2023
- Pre-Signature Coord
- Expected Publication



DoD INSTRUCTION 5000.US

DIGITAL ENGINEERING

Originating Component: Office of the Under Secretary of Defense for Research and Engineering

Effective: Month Day, Year

Releasability: Cleared for public release. Available on the Directives Division Website at https://www.esd.whs.mil/DD/.

Approved by: Heidi Shyu, Under Secretary of Defense for Research and Engineering

Purpose: In accordance with the authority in DoD Directive 5137.02, this issuance establishes policy, assigns responsibilities, and provides procedures for implementing and using digital engineering in the development and sustainment of systems.

DRAFT

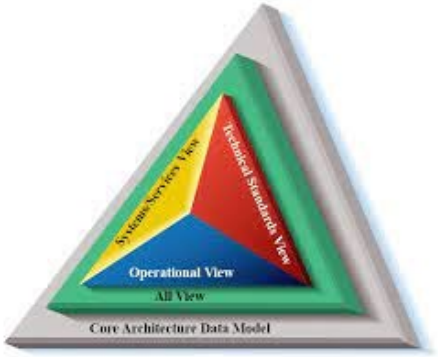
Unified Architecture Framework (UAF) in Policy

- The DoD has decided to transition away from DoD Architecture Framework (DoDAF) to the Object Management Group (OMG) UAF standard
  - DoDAF is no longer supported
  - OMG UAF v2 standard continues to mature and is due to be released in ~ 2025
  - The DoD CIO is a voting member in the OMG Architecture Board
- Importance of UAF to OUSD (R&E)
  - UAF is a key enabler to building architectures and accessing architecture data and supporting more effective Mission analysis and Joint architecture
- Initial steps to migrate from DoDAF to UAF
  - Assessment of Policies / Guidance that mandate DoDAF views
  - Insert initial language in JCIDS manual as a first step:

"When permissible, the Unified Architecture Framework (UAF) profile may be used to generate DoDAF views per the mapping within the UAF specification."

  - Develop / coordinate training
  - Update contractual language
- Establishing a consortium of stakeholders from across the DoD Community
  - monthly meetings to collaborate and act

DoDAF



UAF®
OMG UNIFIED ARCHITECTURE FRAMEWORK®

Systems Modeling Language (SysML) v2 Transition Guide

- SysML V2 is a significant change from SysML V1
- Getting in front of this change presents an opportunity to do better
- Using the Skyzer Model to test implementation
- Accelerate adoption and improve practice consistency when v2 releases

DEC 2022
Project Kickoff

JAN 2023
Workshop 1 INCOSE IW

FEB 2023
Workshop 2 DoD Services

MAR 2023
OMG TIM

MAY 2023
FAQ Draft

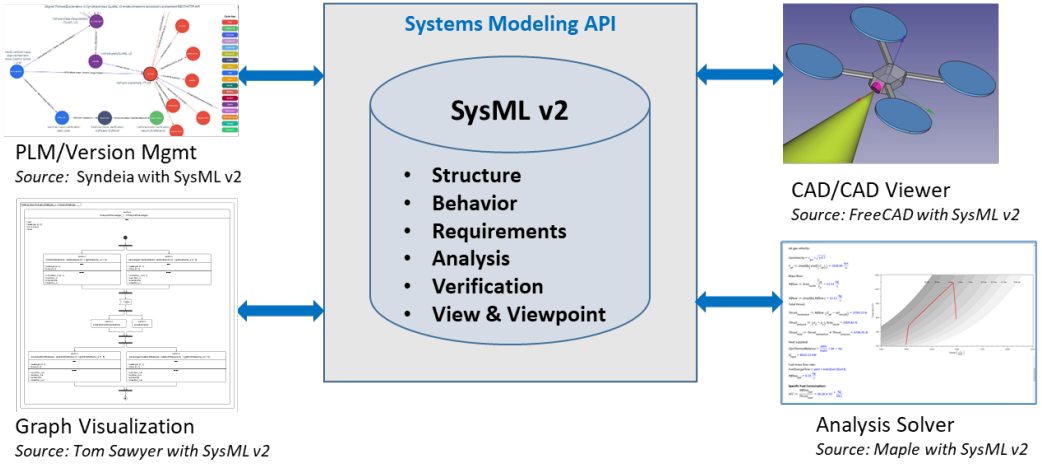
AUG 2023
Publish FAQ

JUN 2023
SysML V2 Transition Guide Outline

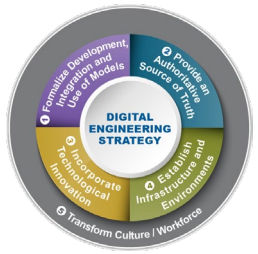
OCT 2023
Initial Draft SysML V2 Transition Guide

DEC 2023
Final Draft SysML V2 Transition Guide

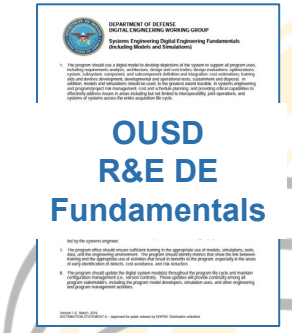
MAR 2024
Published SysML V2 Transition Guide



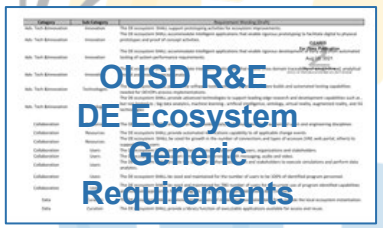
Digital Engineering Tool Selection (DETS) Reference Guide



SETDB
SYSTEMS ENGINEERING TOOLS DATABASE



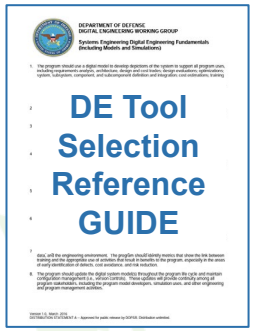
OUSD R&E DE Fundamentals



OUSD R&E DE Ecosystem Generic Requirements

Ecosystem Tool Categories

DE Tools Selection Criteria



DE Tool Selection Reference GUIDE

Purpose

Provide guidance to DE architects, planners and implementers focused around making **tool decisions** to align engineering with enterprise goals for digital transformation

FY24
DETS REF GUIDE

Aug 2023
NEW COA

- Refine Criteria applicability
- Ecosystem Tool Categories
- Collaborate other DE Tools efforts (DoD, Industry)
- Focus on enterprise Ecosystem influence

May 2023
Directed to Rescope to a DE Tool Selection Ref Guide

Jan 2023
Draft Criteria @ IW

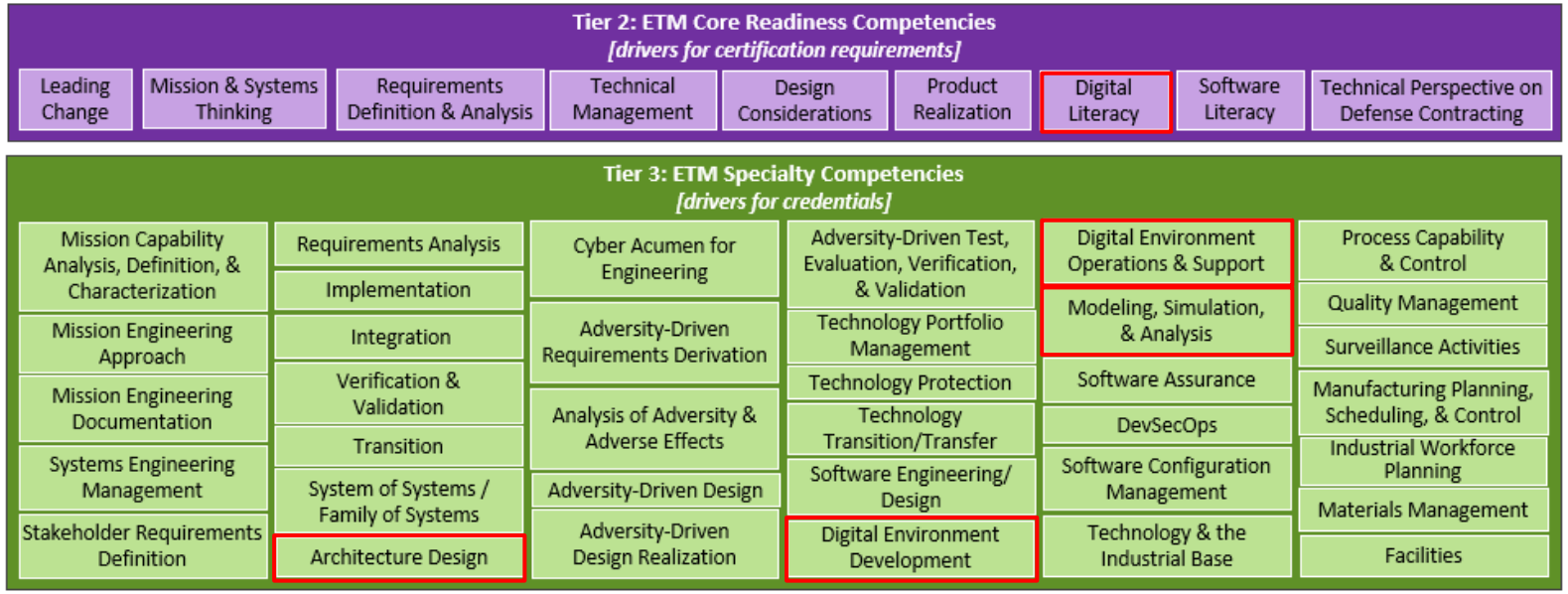
Nov 2022
Draft Criteria @ NDIA

FY2022
Kickoff

Goal

Create a more shared, collaborative environment with **increase in automation,** improved vendor tool **interoperability,** and expanded commonality across **enterprise solutions**.

DEM&S Workforce Development Activities



New Tier 2 & 3 for Engineering and Technical Management at DAU

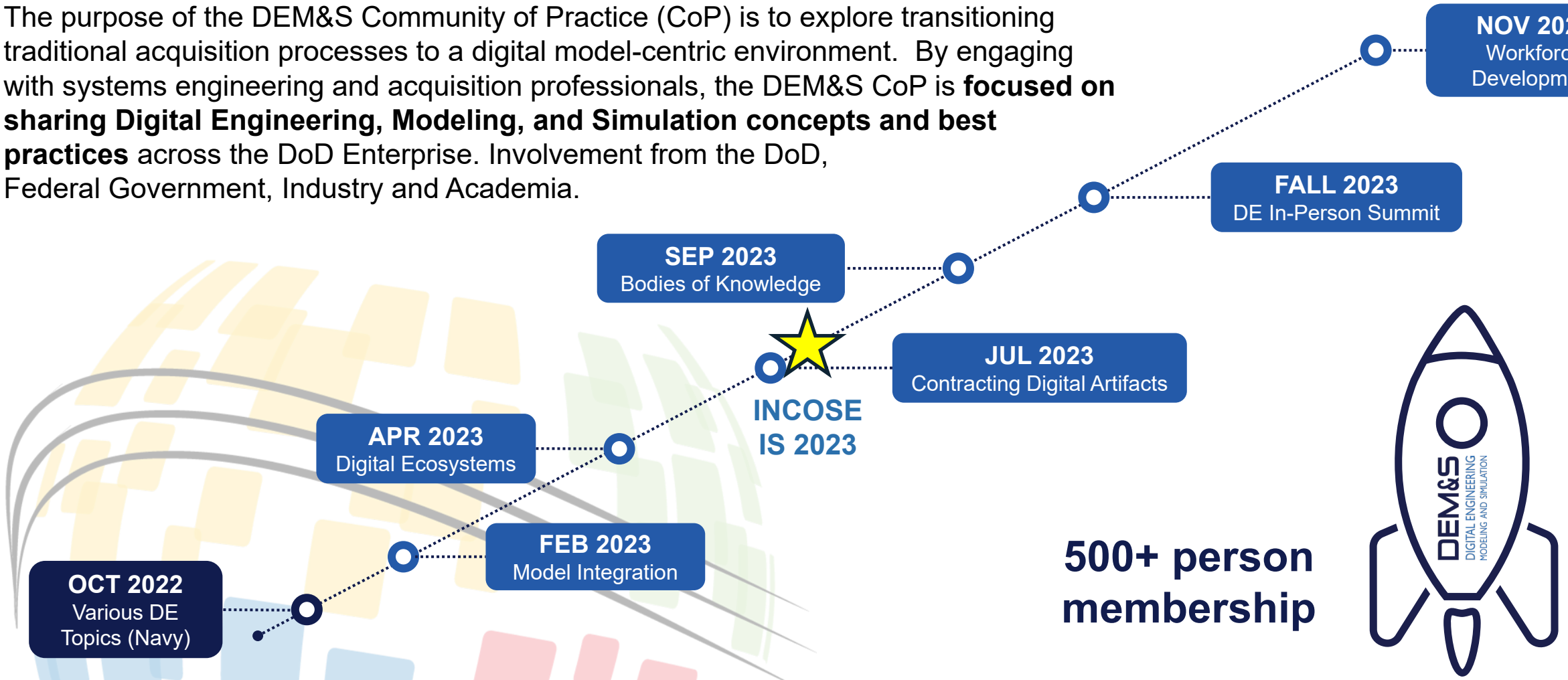
Competency	Definition
Digital Literacy	Considering digital behaviors and practices to support implementations of digital concepts (e.g., IT, cybersecurity, and digital engineering).
Digital Environment Development	Develop a digital enterprise environment that is an integrated digital development framework in which digital models and representations are interconnected such that the content and activities within it are managed to accomplish the organizational objectives of the enterprise.
Digital Environment Operations and Support	Operate within and supporting a digital enterprise environment.
Modeling, Simulation, and Analysis	Create and analyzing a digital prototype of a physical system to predict its performance in the real world. Models and simulations are used to help system designers and engineers understand whether, under what conditions, and in which ways a system component could fail and what loads it can withstand through analysis.
Architecture Design	Create a system or mission architecture design using digital models that satisfies the documented requirements for hardware, software, and human elements; their enabling processes; and related internal and external interfaces.

Current DAU Offerings

CLE 084 – Models, Simulation, and Digital Engineering
CENG 001 – MBSE: Model-Based Systems Engineering
CLE 023 – Modeling and Simulation in T&E
ETM 1070 – Digital Literacy Fundamentals
ETM 2070V – Digital Literacy for Practitioners

DEM&S Community of Practice

The purpose of the DEM&S Community of Practice (CoP) is to explore transitioning traditional acquisition processes to a digital model-centric environment. By engaging with systems engineering and acquisition professionals, the DEM&S CoP is **focused on sharing Digital Engineering, Modeling, and Simulation concepts and best practices** across the DoD Enterprise. Involvement from the DoD, Federal Government, Industry and Academia.



Digital Engineering Body of Knowledge

DEBoK
Digital Engineering Body of Knowledge

- Creates a community of collaboration to **accelerate capability** development
- Provides **access to resources**, best practices and lessons learned

The DEBoK provides a knowledgebase of **authoritative** artifacts to enable the effective and efficient development of Digital Engineering practices using Modeling and Simulation

DEC 2022
Full Operating Capability

MAR 2023
- Complete DTIC Content Migration
- Conduct Governance Board

FEB 2023
Conduct DEM&S CoP

APR 2023
Continue business practice development

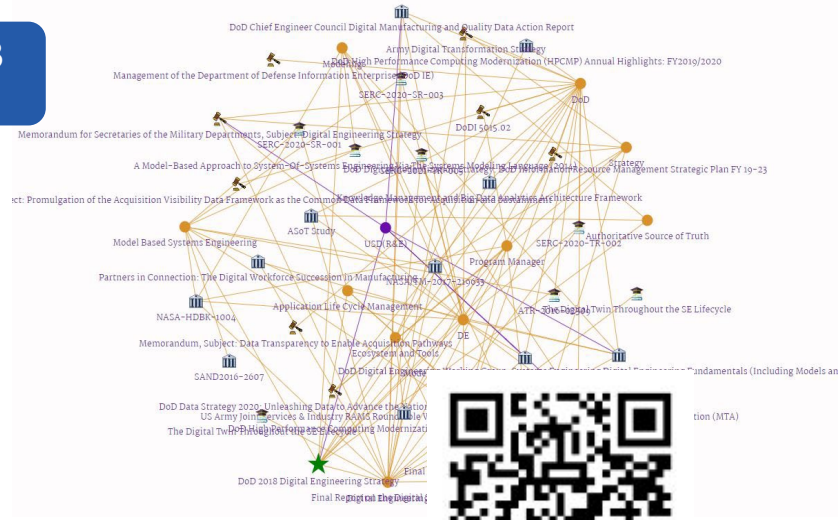
INCOSE IS 2023

NOV 2023
IITSEC

JUN 2024
SIPR Baseline

MAR 2024
CUI Baseline

SEP 2024
Classified capability



https://de-bok.org/

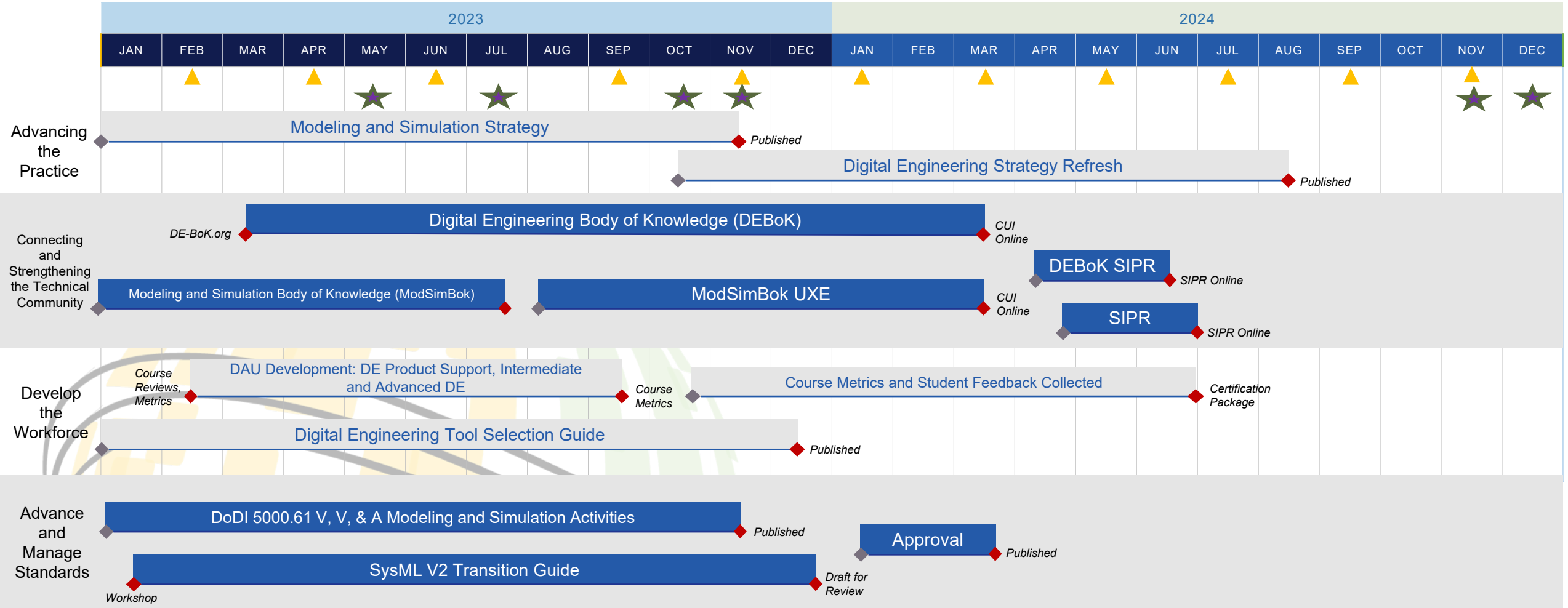
Continuous Capability Maturity | Continuous Content Curation | Continuous Outreach Activities

1st Annual Federal Digital Engineering Forum

- Advance digital engineering practices; Emphasis on culture and workforce
- Exchange information and network in a welcoming environment
- Share knowledge and experience in digital engineering methods, processes, and tools
- Promote sharing of models and data across the government
- Share best practices, success stories, and failures
- Encourage model reuse and cost reduction opportunities
- Develop and prioritize list of common challenges and recommended courses of action

https://fed-def.org/

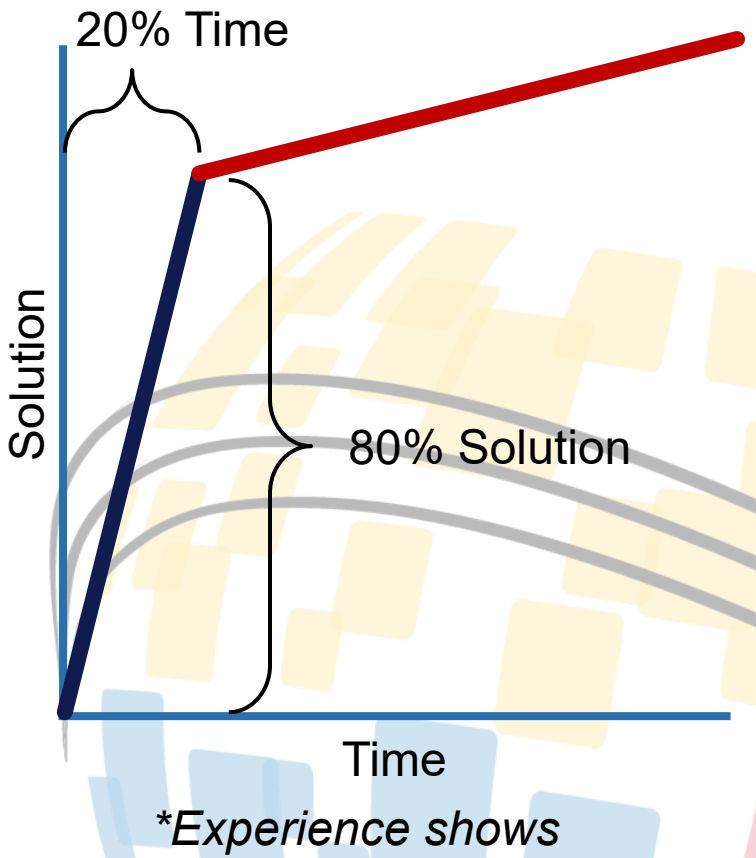
Delivering Value to the Department



How Do We Write the Next Chapter?

3 Actions for Practitioners

1. Answer the 80% first



*Experience shows

2. Actually, Learn the Lessons Learned

"But have we tried a square wheel?"

3. Address Technical Management Early

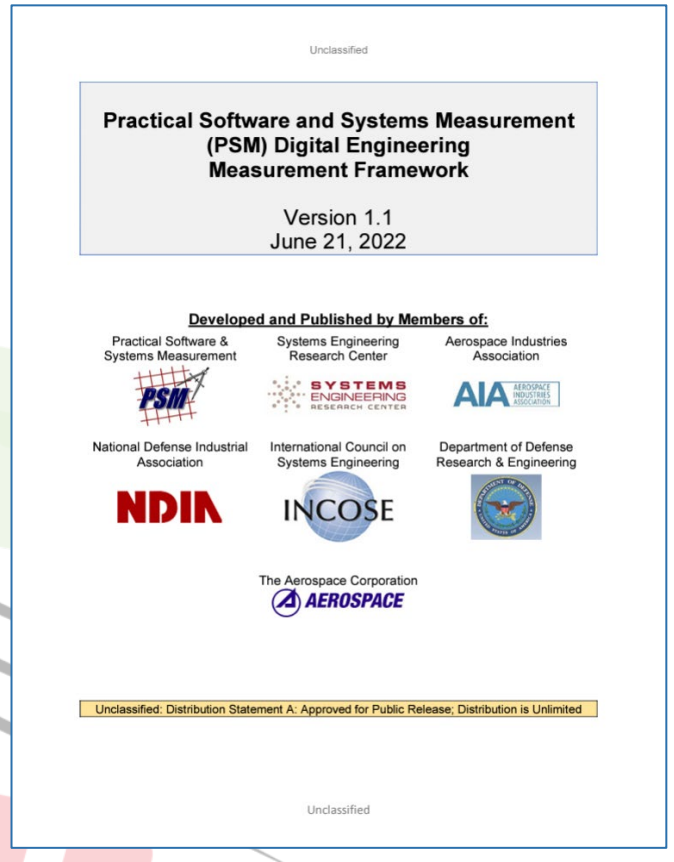
Project Planning Process	Project Assessment and Control Process
Decision Management Process	Risk Management Process
Configuration Management Process	Information Management Process
Measurement Process	Quality Assurance Process

ISO 15288 Technical Management

3 Actions for Leaders

1. Ask New Questions

2. Measure What You Want to Improve


Unclassified

Practical Software and Systems Measurement (PSM) Digital Engineering Measurement Framework

Version 1.1
June 21, 2022

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International Council on Systems Engineering — INCOSE
Department of Defense Research & Engineering
The Aerospace Corporation — AEROSPACE

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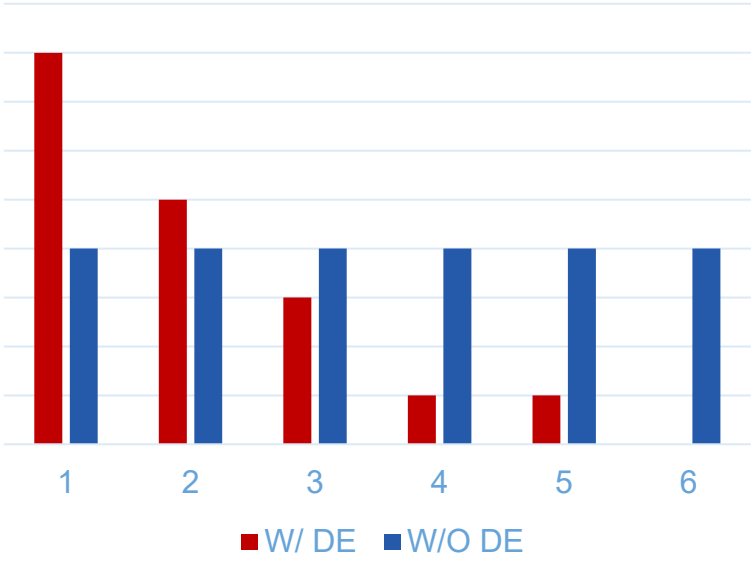
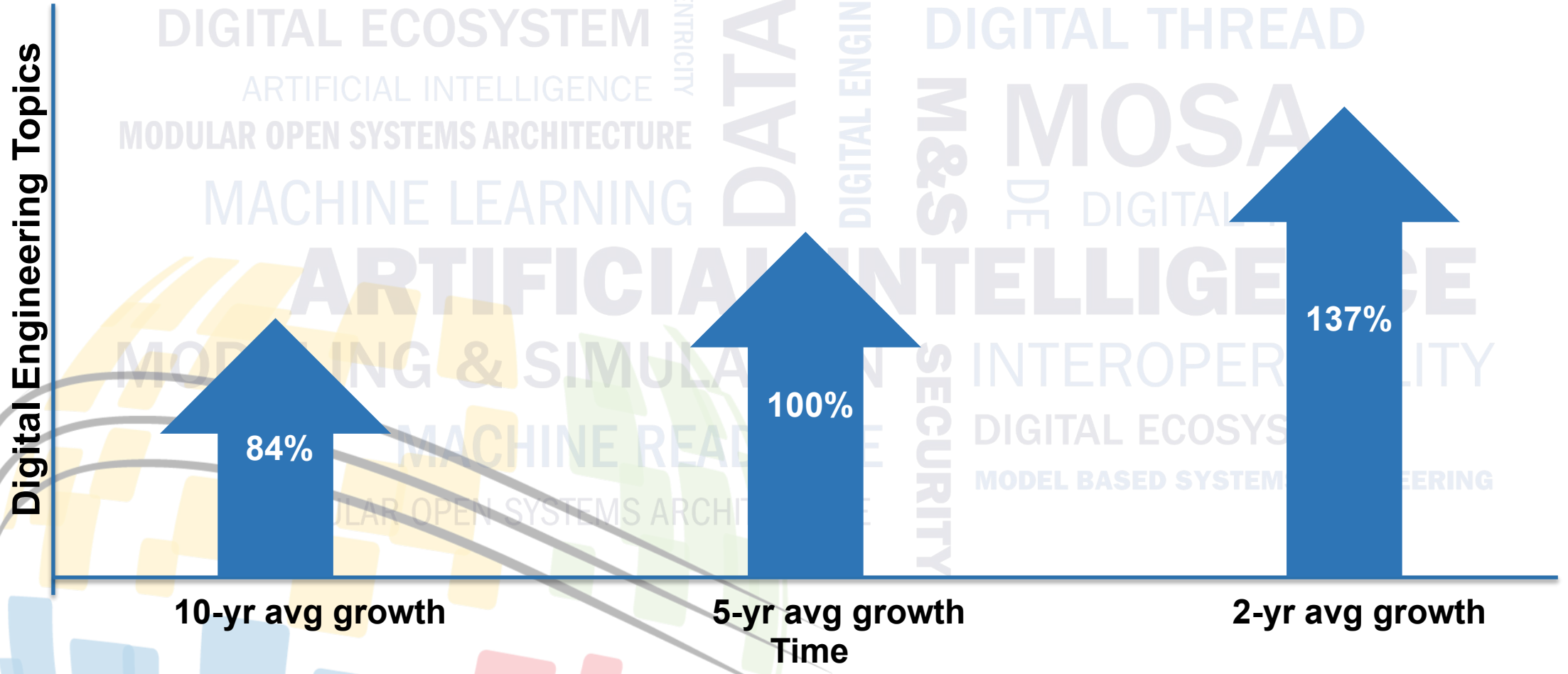
3. Think Lifecycle Costs



**Notional total costs*

Measuring Congressional Interest in Digital Engineering



*Source included all Congressional records represented for a 10-year period through the 117th Congress

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