

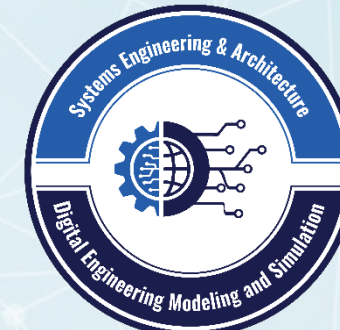
A Celebration of Digital Engineering Sweet Success

Daniel Hetteema
Director, Digital Engineering,
Modeling & Simulation (DEM&S) OUSD (R&E)
Daniel.I.hetteema.civ@mail.mil





Digital Engineering, Modeling & Simulation's Place in the Federal Government



Joe Biden
President
whitehouse.gov



Lloyd J. Austin III
Secretary of Defense
defense.gov



Heidi Shyu
Under Secretary of Defense
(OUSD) for Research and
Engineering (R&E)
cto.mil



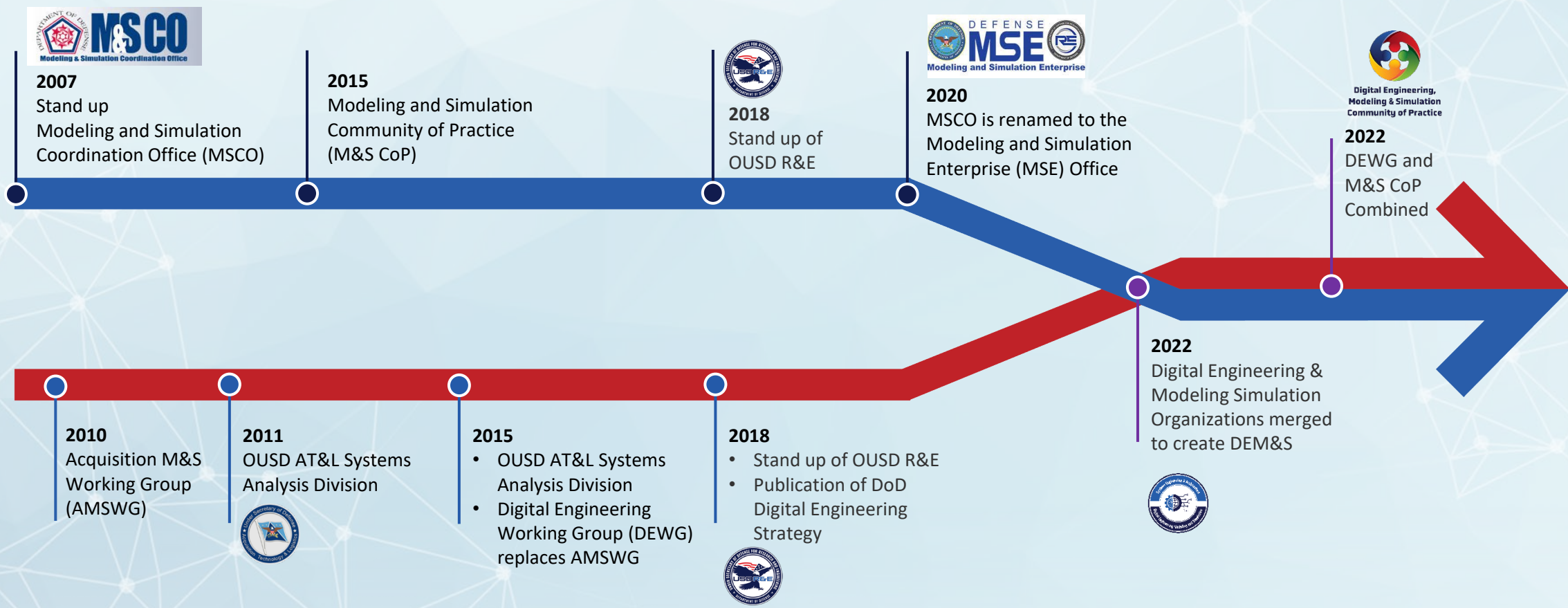
Tom Simms
Executive Director, SE&A
cto.mil/sea



Daniel Hetteema
Director
cto.mil/sea/dems



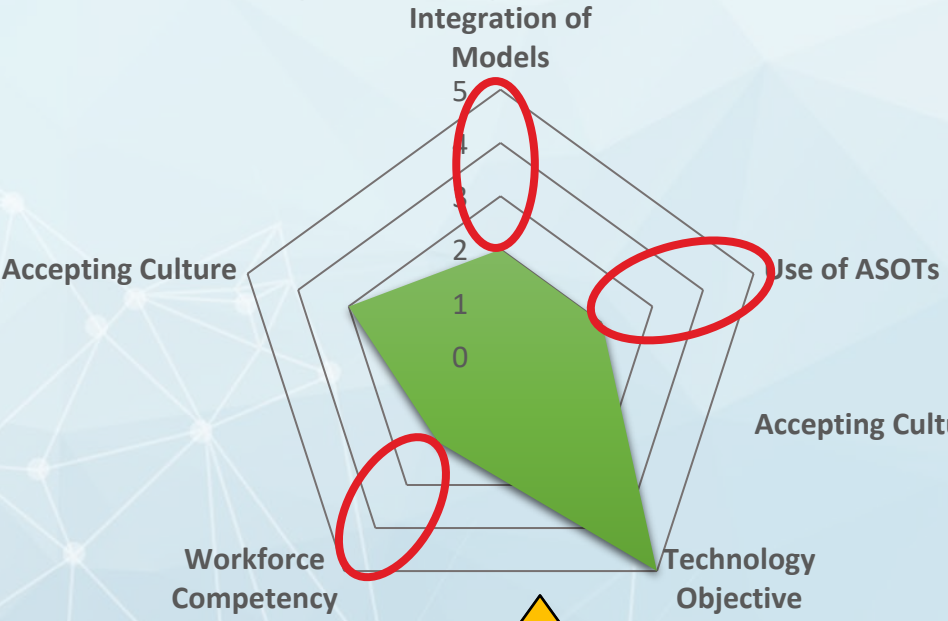
DEM&S Organizational Journey



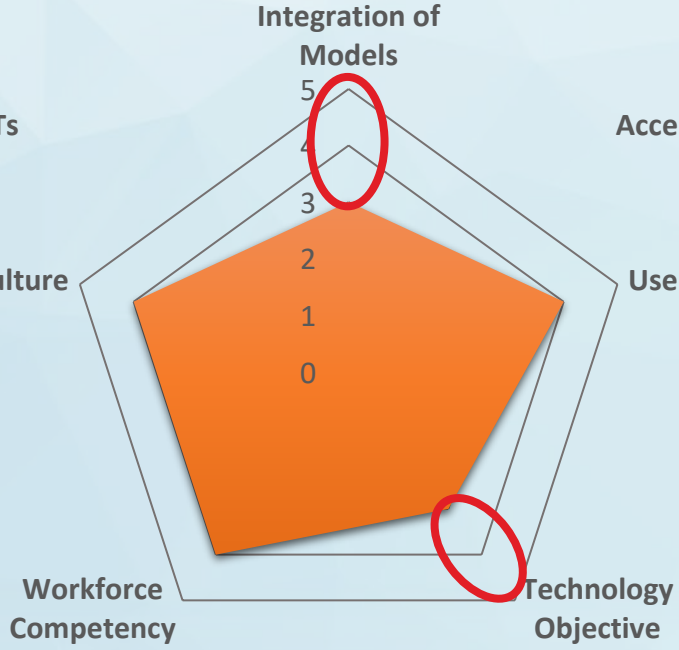


Analysis of Maturity of Modeling & Simulation Communities

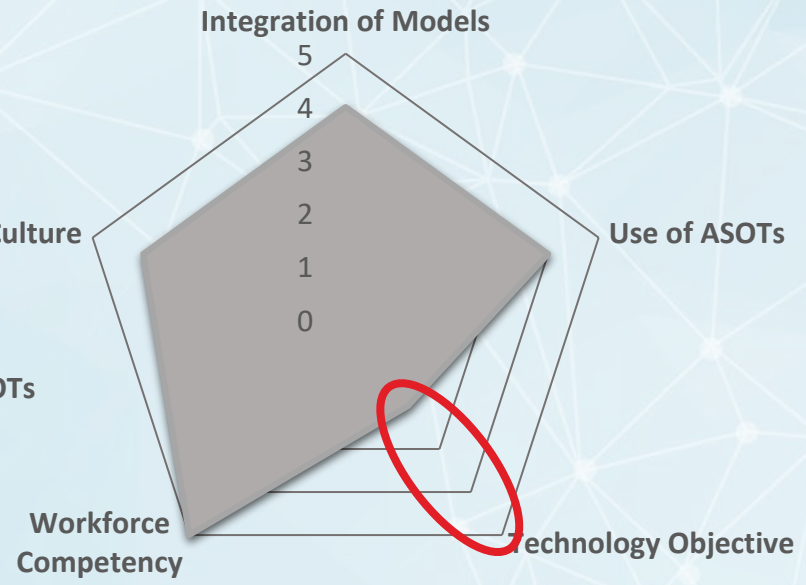
Engineering Community



Analysis Community



Training Community



**Primary Focus
for DEM&S**

Based on Analysis of Pain Points & Stakeholder Feedback

What Number Are You?



MENTIMETER
QR CODE

LearningLegendario.com



DEM&S Efforts to Drive Change

STANDARDS

- ISO
- JESC
- ReqIF
- HLA
- **FMECA**
- SISO
- OMG
- Digital Twin
- IEEE
- ASME

POLICIES

- **M&S Strategy**
- **DoDI 5000.61**
- DoDI 5000.70
- **DoDI 5000.97**
- JCIDS Manual
- Congress Tasks

TECHNICAL GUIDANCE

- **SysML v2**
- 5000.61 RPG
- VIPRE
- **UAF 2.0**
- **MIL HDBK 539**
- API Guidance

ECOSYSTEMS

- Tool Catalog
- Mission Eng. Ecosystem
- **DETECT**
- JESC

MEASURES OF SUCCESS

- DSB & DBB Reports
- **RAND**
- DE Measurement Framework

WORKFORCE & CULTURE

- **INCOSE**
- **AIAA**
- **SERC/AIRC**
- National Academies
- **DEM&S CoP**
- **FED DEF**
- **DEBoK**
- NDIA
- **ETM & DAU**

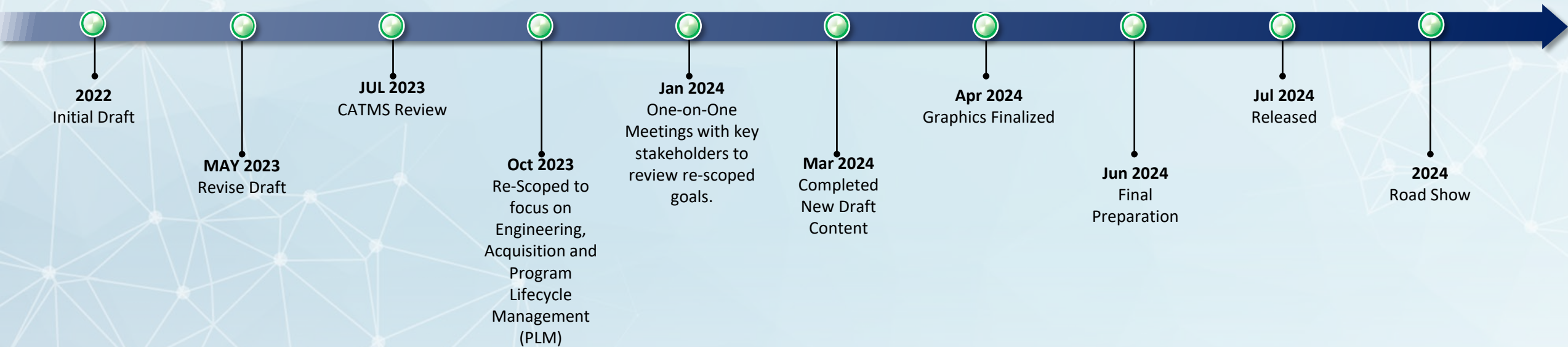


Development of Modeling & Simulation for Engineering Strategy



Primary Goals:

- Goal 1 Develop a joint, enterprise-level common technical framework and infrastructure, supporting modeling and simulation.
- Goal 2 Promote trust within the M&S community through authoritative sources of data.
- Goal 3 Leverage the professional development system supporting modeling and simulation.
- Goal 4 Cultivate integration of enterprise-level management within the DoD and the larger M&S community.
- Goal 5 Adapt policies, processes, and infrastructure enabling rapid (agile) assessment and procurement of emerging technologies and tools.





DODI 5000.97 Digital Engineering

Purpose: The Department of Defense is transforming its engineering practices to incorporate digital technology and innovations into an integrated, digital, model-based approach. This instruction establishes policy, assigns responsibilities, and provides procedures for implementing and using digital engineering in the development and sustainment of systems.

This policy directs:

- Programs started after the date of the policy will incorporate digital engineering during development unless the program's decision authority provides an exception.
- Programs started before the date of the policy should incorporate digital engineering, to the maximum extent possible, when it is practical, beneficial, and affordable.
- Digital engineering should be addressed in the Acquisition Strategy and in the Systems Engineering Plan.
- Digital engineering methodologies, technologies, and practices support a comprehensive engineering program for defense systems.



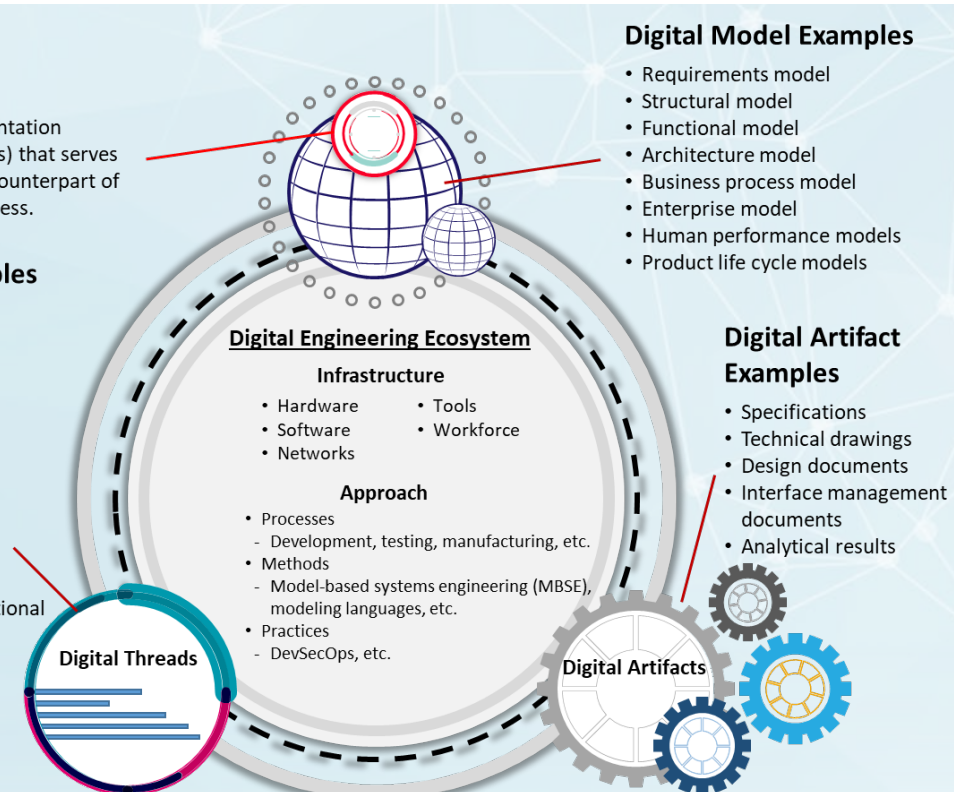
Digital Twin

A computerized representation (integrated set of models) that serves as the real-time digital counterpart of a physical object or process.

Digital Thread Examples

- Requirements analysis
- Architecture development
- Design and cost trades
- Design evaluations and optimizations
- System, subsystem, and component definition and integration
- Cost estimations
- Training aids and devices Development
- Developmental and operational tests
- Product support

--- Data ---



Digital engineering transforms DoD systems engineering practice.

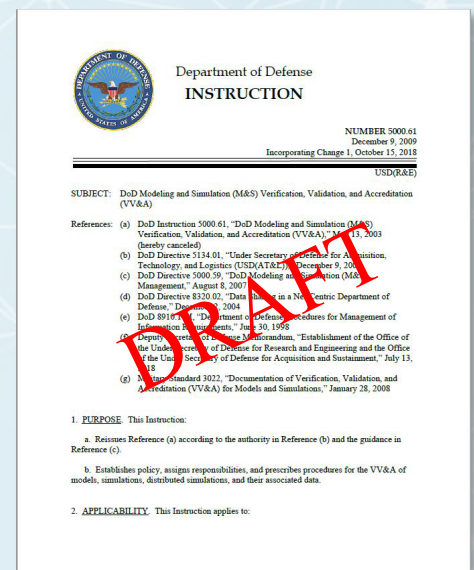
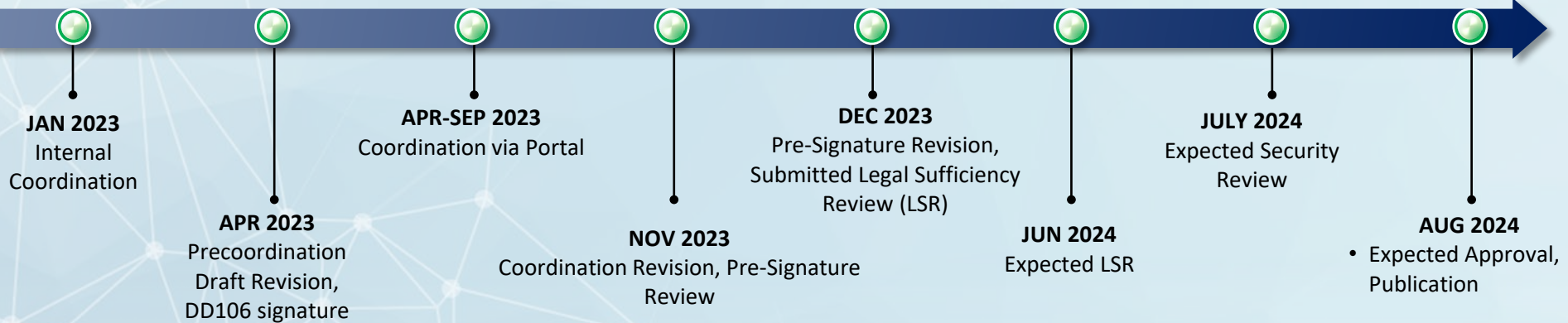


DODI 5000.61 DoD Modeling and Simulation (M&S) Verification, Validation & Accreditation (VV&A)

Establishes DoD policy for VV&A of M&S

- Requires VV&A of models, simulations and data used to support DoD processes, products and decisions
- Directs VV&A results be documented and made accessible
- Assigns Components and PAS* Officials as final validation authority for representations in their areas of responsibility

Establishes standards for documentation and accessibility of VV&A results

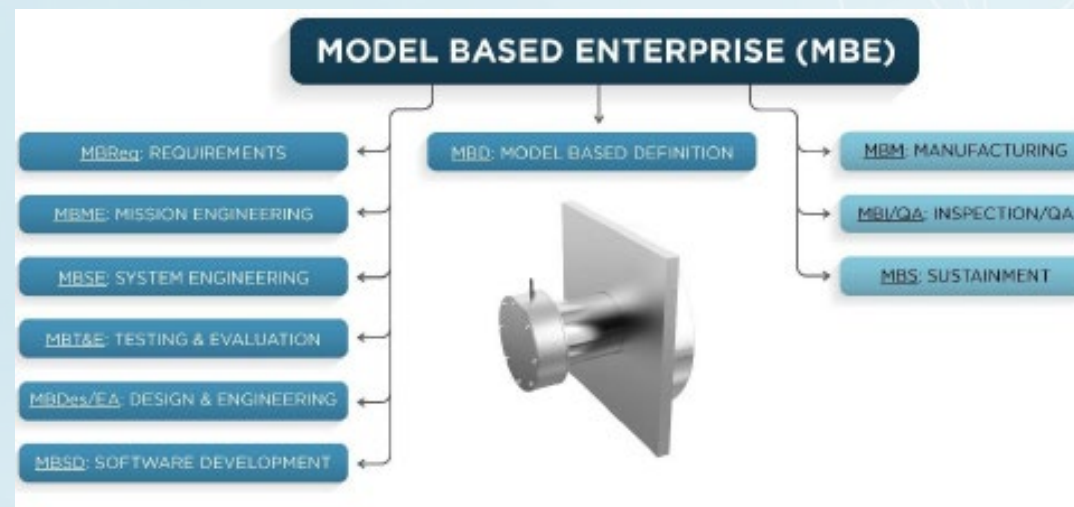
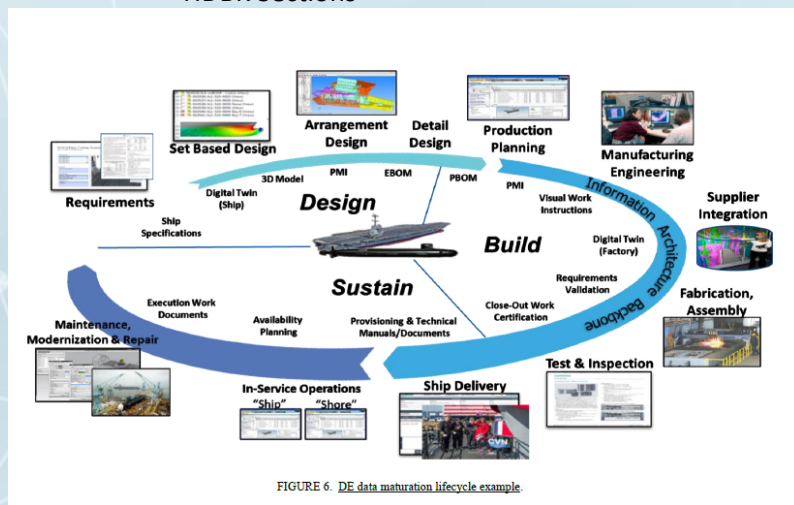
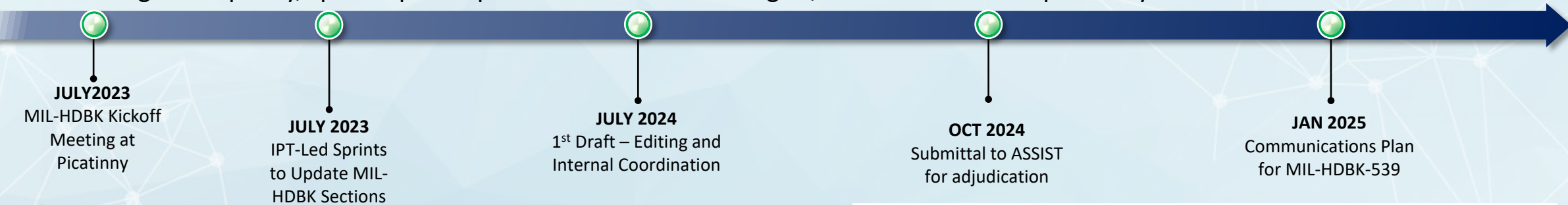




DoD Military Handbook 539

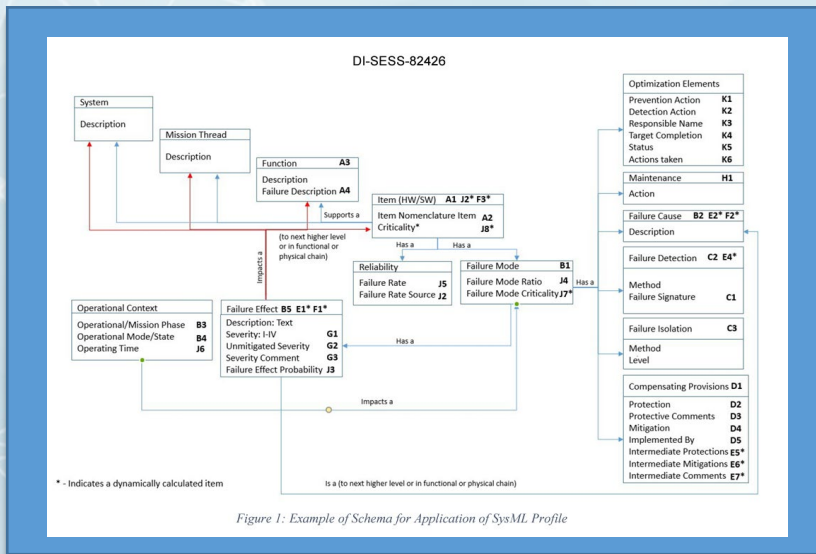
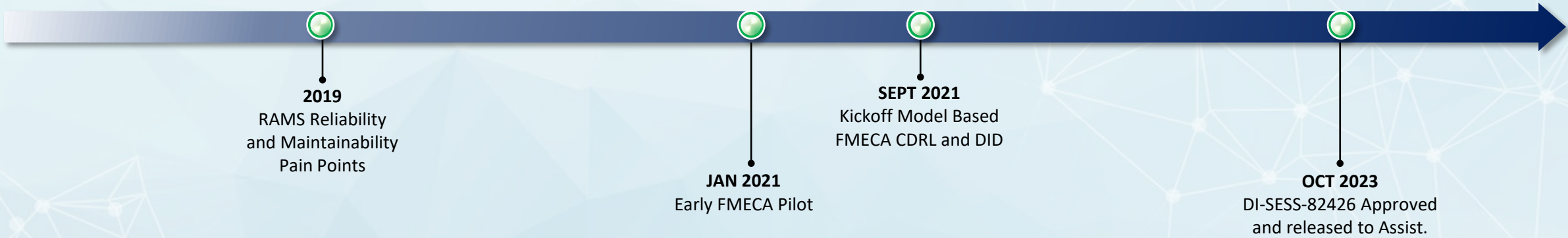
Developing the second edition of the Digital Engineering Military Handbook (MIL-HDBK-539)

- MIL-HDBK-539 is meant to serve as a “middle tier” of DE and Modeling (DEM) information below policy and above specific detail for DEM implementation
- Provides information for DoD activities and foreign partners on selecting standardized DEM approaches to improve data exchange and quality, speed up incorporation of new technologies, and increase interoperability





Failure Mode, Effects, and Criticality Analysis (FMECA)

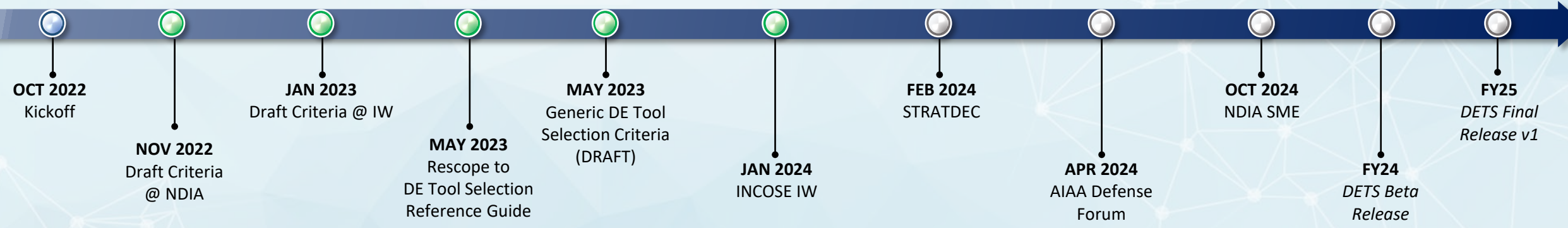


DATA ITEM DESCRIPTION TITLE: MODEL-BASED ENGINEERING FAILURE MODES, EFFECTS, AND CRITICALITY ANALYSIS PROFILE (SYSML VERSION)

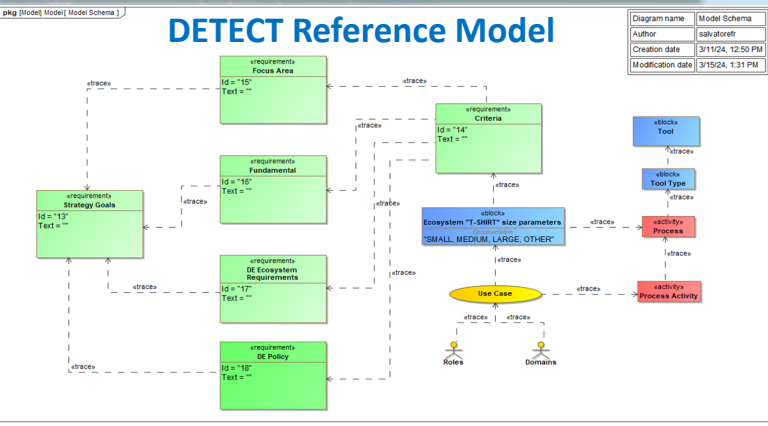




Digital Engineering Tool Evaluation Criteria Template (DETECT) Reference Guide Milestones



- Deliverables:**
- Generic DE Tools Selection Criteria
 - DE Ecosystem Scoping Guidance
 - Architecture Reference Model(s)



DETECT Sizing Parameters S,M,L

Users = >1000
 Platforms = Multiple Applications, Multiple Data
 Engineering Domains = >3
 Geographic Locations = >5
 Collaboration Partners = >5
 Cycle Phases = All
 Information = Advanced, Enterprise-level, F...
 Storage = Petabytes
 Investment = >\$1M
 Product Deliverables = 1000's

DETECT Tool Criteria, Per Size

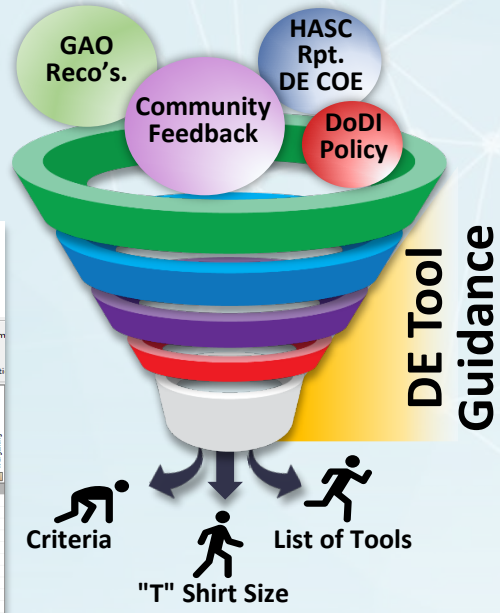
Criteria

Row Element Type: Requirement
 Row Scope: Criteria
 Dependency Criteria: Trace

DETECT Tool Types, Per Size

Criteria

Row Element Type: Block
 Row Scope: Tools
 Dependency Criteria: Trace

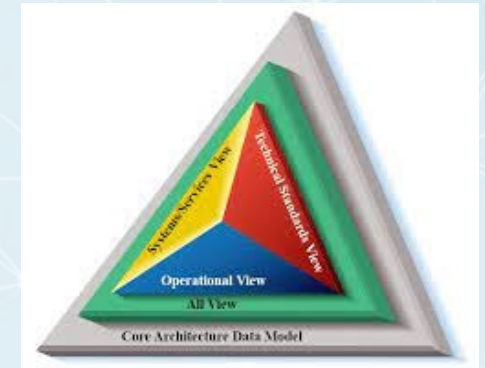




Unified Architecture Framework (UAF) in Policy

- 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 take action

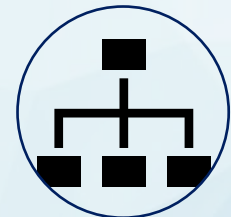
DoDAF





Systems Modeling Language (SysML) v2 Transition Guide

OMG Wiki



15,000 +

Models in DoD,
Based on sampling counts of government owned ecosystems

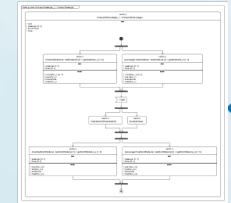


25%

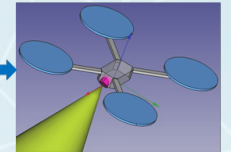
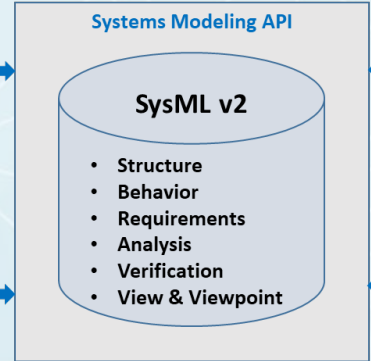
DoD Engineers use models,
Based on reported data and user assumptions of those ecosystems



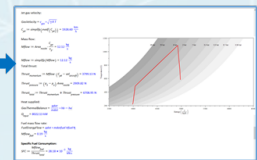
PLM/Version Mgmt
Source: Syndeia with SysML v2



Graph Visualization
Source: Tom Sawyer with SysML v2



CAD/CAD Viewer
Source: FreeCAD with SysML v2



Analysis Solver
Source: Maple with SysML v2



DEC 2022
Project Kickoff

JAN 2023
Workshop 1
INCOSE IW

FEB 2023
Workshop 2 DoD
Services

MAR 2023
OMG TIM

MAY 2023
FAQ Draft

JUN 2023
SysML V2 Transition
Guide Outline

AUG 2023
Publish FAQ

OCT 2023
Initial Draft SysML
V2 Transition Guide

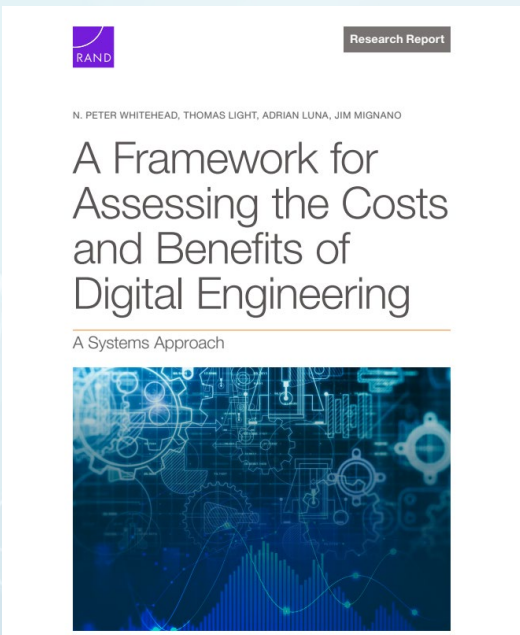
DEC 2023
Final Draft SysML V2
Transition Guide

MAR 2024
Published SysML
V2 Transition
Guide

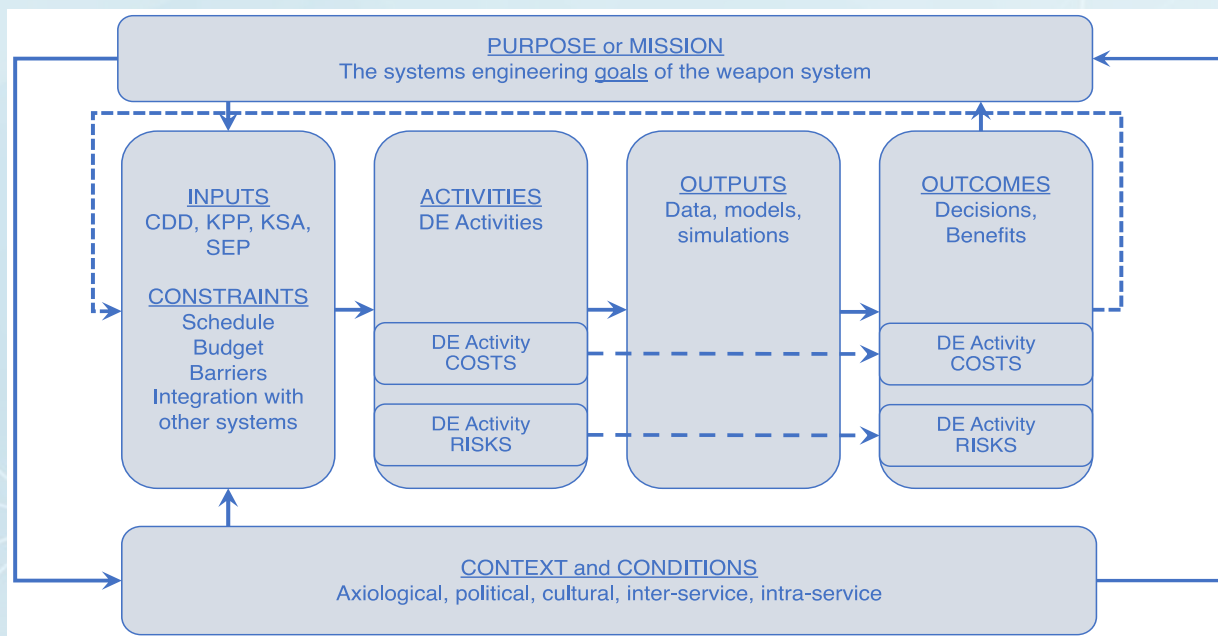


Framework for Assessing the Costs and Benefits of Digital Engineering

- PMs and lead systems engineers make **decisions** on DE based-on SE IoPs including **costs** and **benefits** – a compliment to classic CBA
- Aligns all DE **benefits** with program **goals** – not requirements – designed to be deign and goal iteration friendly
- Encourages an iterative requirements development/refinement flow such as MVP
- DE maturity model as a path to improving outcomes without any cost data, causality map, or risk analysis to support that conclusion.



Systems Engineering Evaluation Framework

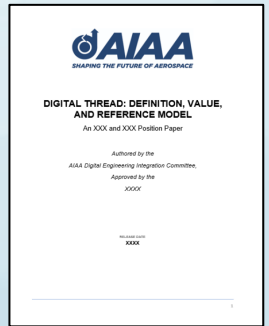




Professional Engagements

AIAA DEIC

American Institute of Aeronautics and Astronautics (AIAA)
Digital Engineering Integration Committee (DEIC)



Key Initiatives:

- Digital Twin Position Paper
- Digital Thread Position Paper
- Digital Ecosystem Position Paper
- Digital System Model Position and Implementation Paper
- Workforce Development

SERC/AIRC

Systems Engineering Research Center (SERC)
Acquisition Innovation Research Center (AIRC)



Key Initiatives:

- Digital Engineering Transformation
 - Digital Engineering Measures
 - Enablers to Systems Engineering Modernization
 - Foundations for Model Based Portfolio Analysis

INCOSE



Key Initiatives:

- DE Primer
- DE Guide for IEEE
- DE Taxonomy for IEEE
- Digital Engineering View Model (DVM)
- Decision Analysis Data Model



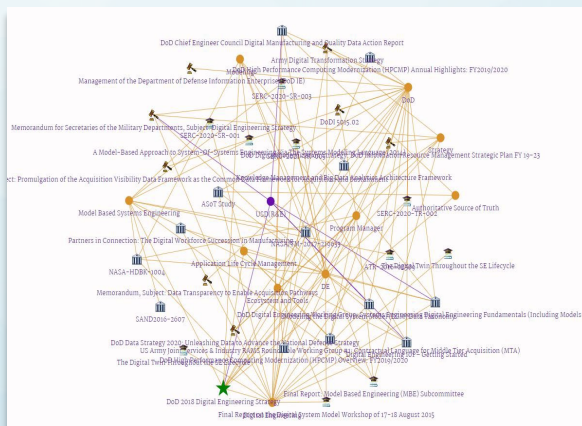
Digital Engineering Body of Knowledge

Continuous Capability Maturity Continuous Content Curation Continuous Outreach Activities



DEBoK

Digital Engineering Body of Knowledge



Community Calendar

Filter By
Title Search

Today Back Next May 2024 Month Week Day Agenda

Sun	Mon	Tue	Wed	Thu	Fri	Sat
28	29	30	01	02	03	04
	DICE Digital Engineering Conference 2024					
05	06	07	08	09	10	11
	2024 Department of the Air Force Model...		CIMdata PLM Road Map &...			
12	13	14	15	16	17	18



DEC 2022
Full Operating Capability

FEB 2023
Conduct DEM&S CoP

MAR 2023
• Complete DTIC Content Migration
• Conduct Governance Board

APR 2023
Continue business practice development

MAY 2023
DEBoK Jam

JUN 2023
Initiate RMF process

NOV 2023
IITSEC

MAR 2024
CUI Baseline

DEC 2024
SIPR Baseline

JUN 2025
Classified Capability

- DEM&S Knowledgebase
- Hosts authoritative resources
- Geared toward accelerating capability development
- Collaborative community

<https://de-bok.org/>





Upcoming DEM&S Community of Practice in 2024

Sharing Digital Engineering, Modeling & Simulation Concepts and Best Practices

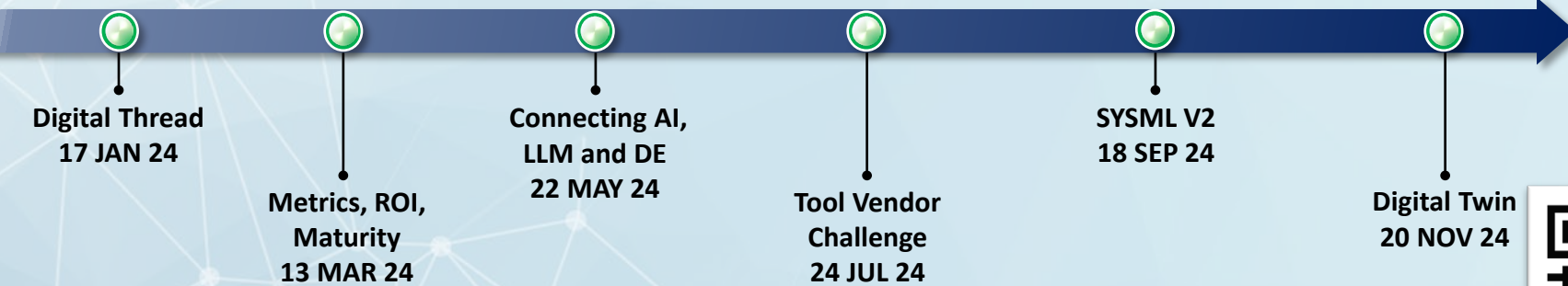
- Involvement from the DoD, Federal Government, Industry and Academia.

Advantages of Participating

- Networking Opportunities
- Knowledge Exchange
- Exclusive Events
- Collaborative Projects
- Resources and Learning Materials

2023 Topics

- Model Interoperability
- Digital Ecosystems
- Contracting/Digital Artifacts
- Bodies of Knowledge
- Workforce Development



**Digital Engineering,
Modeling & Simulation
Community of Practice**

**500+ person
membership**

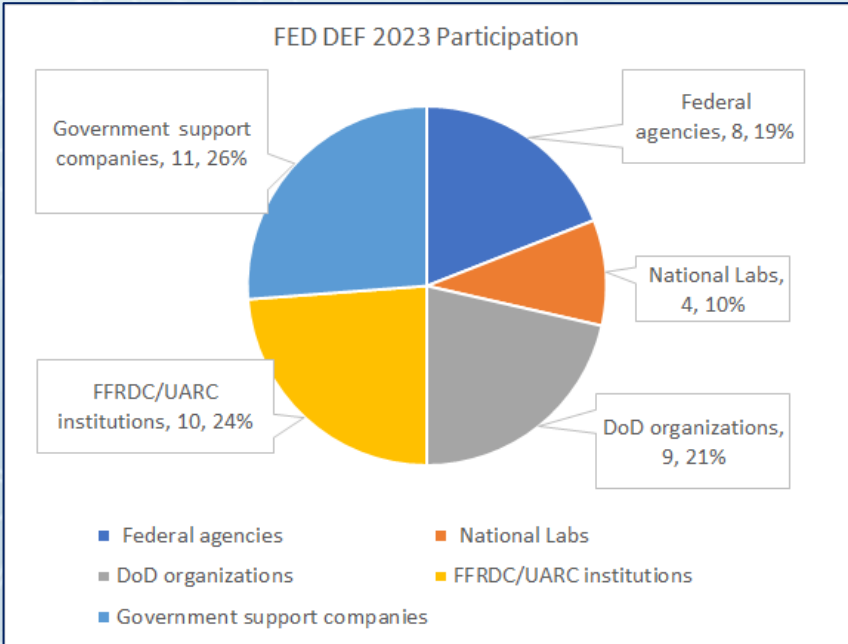


Federal Digital Engineering Forum (FED DEF)



HIGHLIGHTS FROM 2023 FED DEF

- 200 Attendees
- 26 Overviews
- 10 Working Groups



- ### MAIN GOALS OF FED DEF
- Advance DE practices
 - Share best practices, success stories, and failures
 - Promote sharing of models and data
 - Encourage model reuse
 - List and prioritize common challenges

SAVE THE DATE
FED DEF
March 11-13, 2025



Visit us at fed-def.org



DEM&S Efforts to Drive Change

STANDARDS

- ISO
- JESC
- ReqIF
- HLA
- **FMECA**
- SISO
- OMG
- Digital Twin
- IEEE
- ASME

POLICIES

- **M&S Strategy**
- **DoDI 5000.61**
- DoDI 5000.70
- **DoDI 5000.97**
- JCIDS Manual
- Congress Tasks

TECHNICAL GUIDANCE

- **SysML v2**
- 5000.61 RPG
- VIPRE
- UAF 2.0
- **MIL HDBK 539**
- API Guidance

ECOSYSTEMS

- Tool Catalog
- Mission Eng. Ecosystem
- **DETECT**
- JESC

WORKFORCE & CULTURE

- **INCOSE**
- **AIAA**
- **SERC/AIRC**
- National Academies
- **DEM&S CoP**
- **FED DEF**
- **DEBoK**
- NDIA
- ETM & DAU

MEASURES OF SUCCESS

- DSB & DBB Reports
- **RAND**
- DE Measurement Framework



The DoD Doesn't Make Big Moves

WHERE WE ARE

EXPLORING

Leverage traditional technologies to automate existing capabilities & dabbling with digital. No real change to the organization.

DOING

Leverage digital technologies to extend capabilities, but still largely the same business, operating, & customer models.

BECOMING

Leverage digital technologies & becoming more synchronized & less siloed with advanced changes to current business, operating, & customer models.

REALIZING

A need has been realized. Concept ideation & research stage.

BEING

Business, operating, & customer models are optimized for digital & profoundly different from previous models.





We can't adopt digital engineering until...

"...the current method stops working."

"...WE ADDRESS HOW WE MODEL ALL OF OUR LEGACY SYSTEMS."

"..we demonstrate the ROI."

"...we know the tool will work."

"...we navigate the approval challenges."

"...the DoD selects a tool for us."

"...we have a directive on it."

"...we get more direction through policy."

"...we figure out data aggregation concerns."

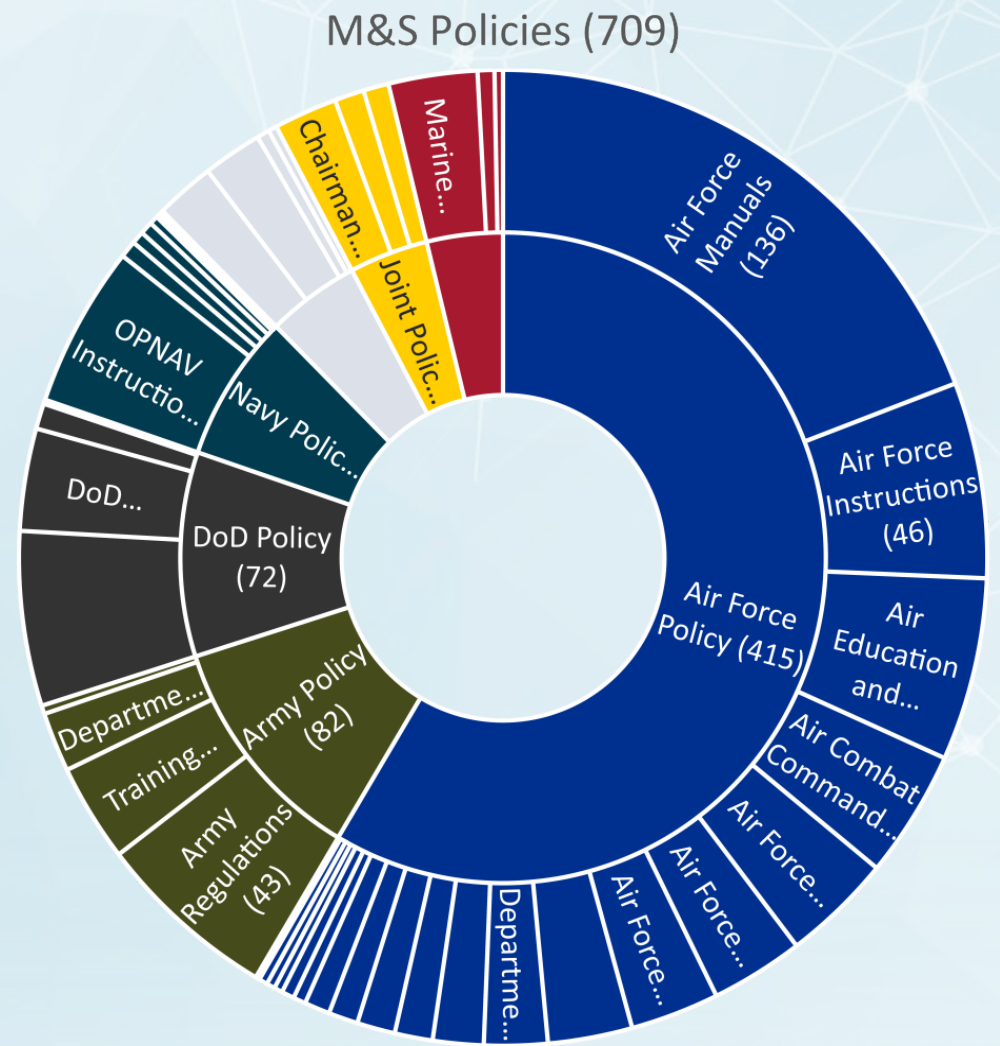
"...we figure out how to do V&V of models?"

"..we have to agree on a definition / ontology."



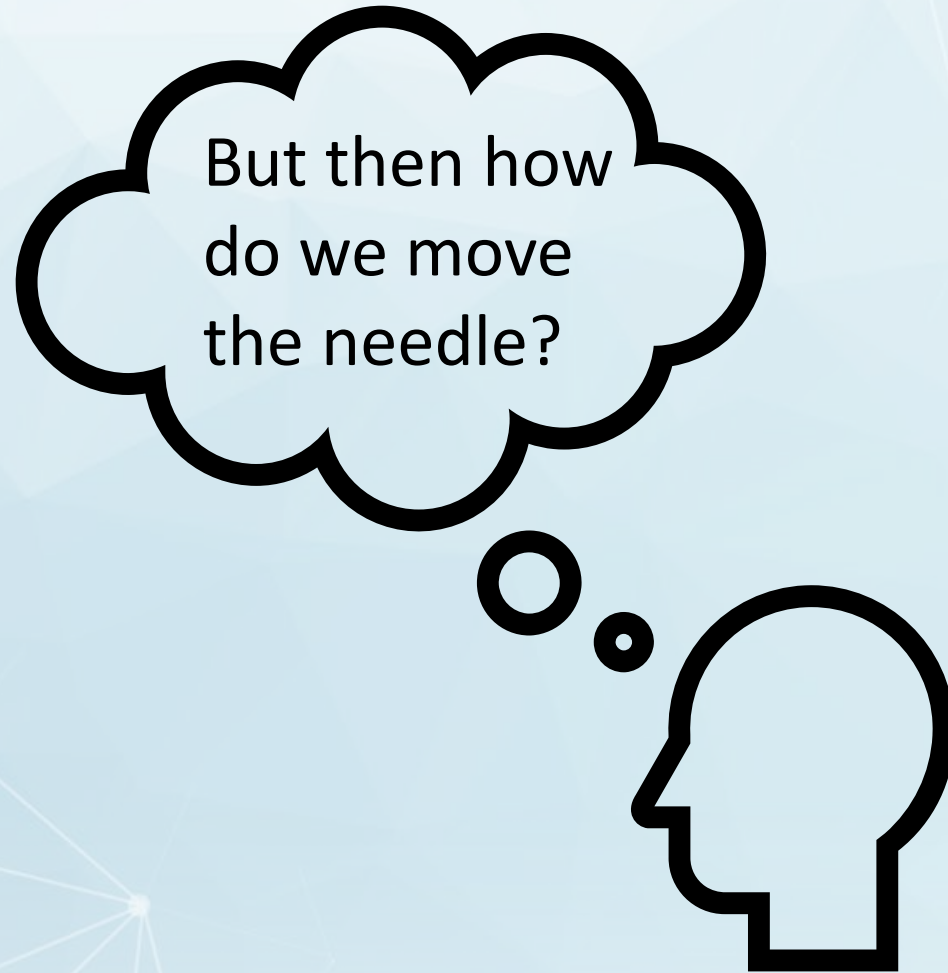
Modeling & Simulation Policy Challenges

- Policies are broad and do not solve every issue.
- Policy development is a slow process.
 - Empower the practitioner
 - Focus on interfaces / boundaries
 - Update / Improve Standards
 - Educate on right sizing
- There is no policy that stops digital engineering.
- Policy isn't a life vest.
- Connect policy to guidance.





What You (in the audience) are thinking...





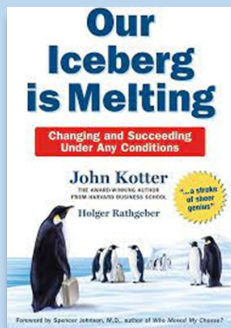
Guiding Literature

OUR ICEBERG IS MELTING

John Kotter

"Our SysML v2 Transition Guidance initiative mirrors the insightful narrative of 'Our Iceberg is Melting,' offering time-tested strategies for the Department's shift from v1 to v2."

-DEM&S Task Order Lead
Mimi Davidson



SWITCH

Chip & Dan Heath



"'Switch' is a great read for anyone doing DE Transition across an organization. It helps provide a template on how to change the culture and push towards the objective."

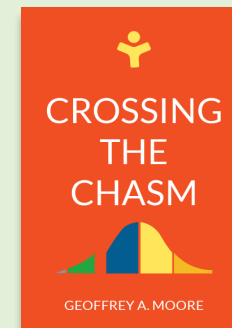
-SAIC Sr. Systems Engineer Frank Salvatore

CROSSING THE CHASM

Geoffrey Moore

"'Crossing the Chasm' helps the DE community by framing the adoption as a planned transition. It provides tips on how to convey your message in a way the audience can understand."

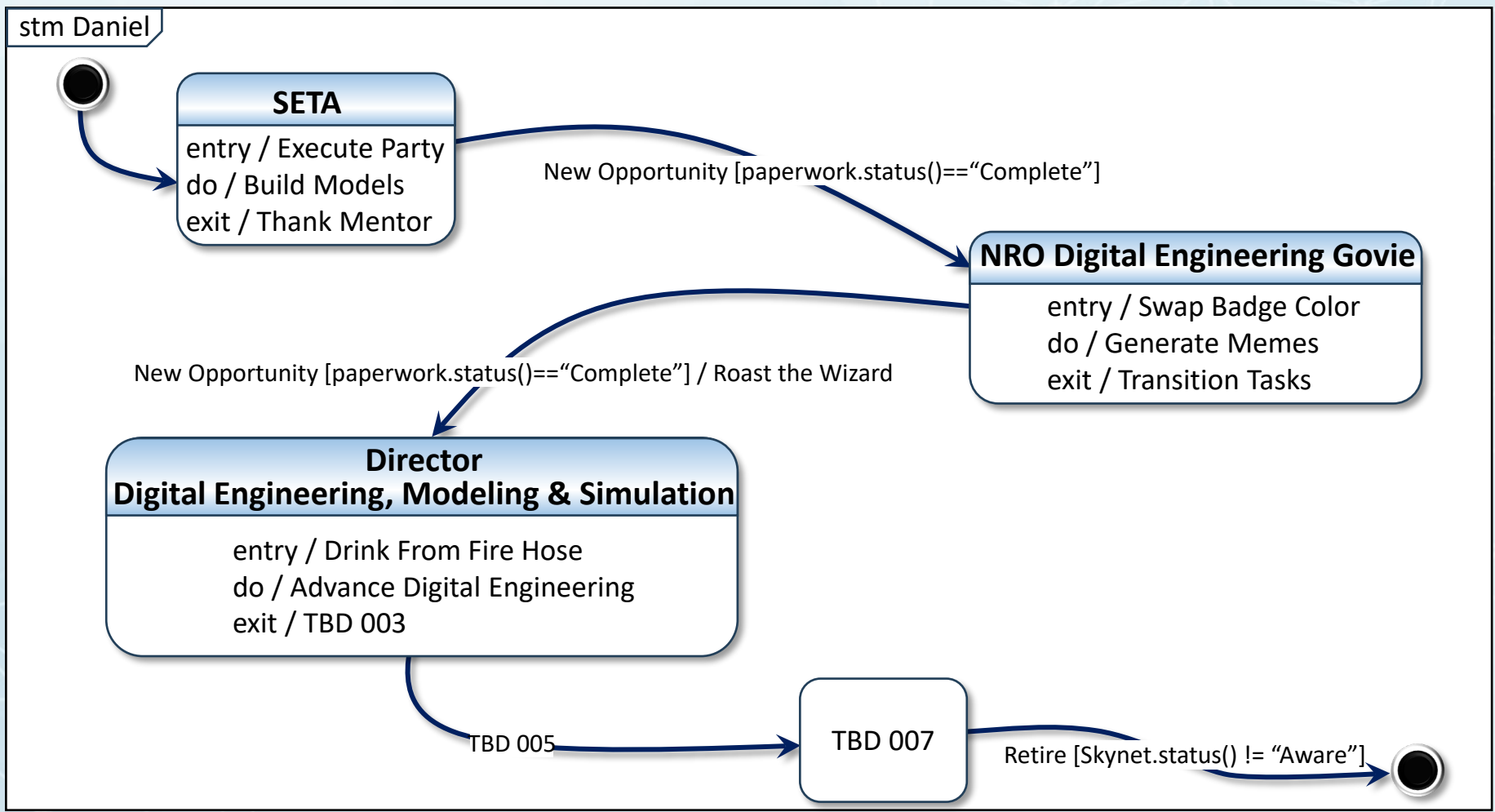
-SERC Research Scientist
Philomena Zimmerman





Change Yourself

- DIB
- DoD
- OUSD(R&E)
- SE&A
- DEM&S
- PERSONAL





Change Your Team

- DIB
- DoD
- OUSD(R&E)
- SE&A
- DEM&S**
- PERSONAL





SE&A Adopts Culture

- DIB
- DoD
- OUSD(R&E)
- SE&A
- DEM&S
- PERSONAL





Change Your Organization

DIB

DoD

OUSD(R&E)

SE&A

DEM&S

PERSONAL

DEVELOPMENTAL TEST, EVALUATION & ASSESSMENT

T&E Continuum and the Model-Based Systems Engineering "V"

- The SE community has historically used a serial interpretation of the SE "V".
- Executing the T&E as a Continuum will integrate ME, SE, and T&E into parallel, collaborative, and combined efforts through a dynamic, connected new model-based SE "V" Environment.
- Using this model-based environment, DoD can transition to a "model-test-validate-design-test" process providing early and continual information on expected mission capability.
- "Collapsing" of the SE "V" does not negate good SE practices. The model-based continuum will allow the SE community to manage the many complex activities being conducted simultaneously within this continuum across the "V".

DTEEA Test as a continuum April 13, 2023 UNCLASSIFIED MISE: Model-based Systems Engineering TEaEC: T&E as a Continuum 3

TEST RESOURCE MANAGEMENT CENTER

C4T T&E S&T Technologies to Expand CHEETAS Capabilities

CHEETAS
Cloud Hybrid Edge to Edge-to-Edge Evaluation & Test Analysis System

USMTRA Audio Sensors
Ready Link to T&E Dataset Tactical Data Links via Video CH 10

Analytics Across Full Multi-Variant Dataset

Advanced Visualization Techniques to Find the Anomalies in the Dataset

JOINT FEDERATION ASSURANCE CENTER

Our Mission

JFAC provides a federation of software and hardware assurance capabilities across the Department of Defense (DoD).

Our Values

- Build Relational Bridges
- Pursue Enterprise Hard Problems
- Explore the Solution Space
- Move Forward in Steadfast Resilience
- Empower the Community

Our Vision

Building Trust through Holistic Assurance

Strategic Goals

- Stay ahead of the threat landscape
- Migrate towards holistic assurance across the lifecycle
- Maximize discovery and utilization of federated assurance resources
- Mature assurance technologies and deliver capabilities at the speed of mission
- Provide affordable and scalable assurance solutions

MISSION ENGINEERING GUIDEBOOK

Mission Engineering Guide

November 2020

Office of the Deputy Director for Engineering
Office of the Under Secretary of Defense
for Research and Engineering

Washington, D.C.

DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited.

Mission Threat

Mission Engineering Threat

Mission Analysis



Change the Department

DIB

DoD

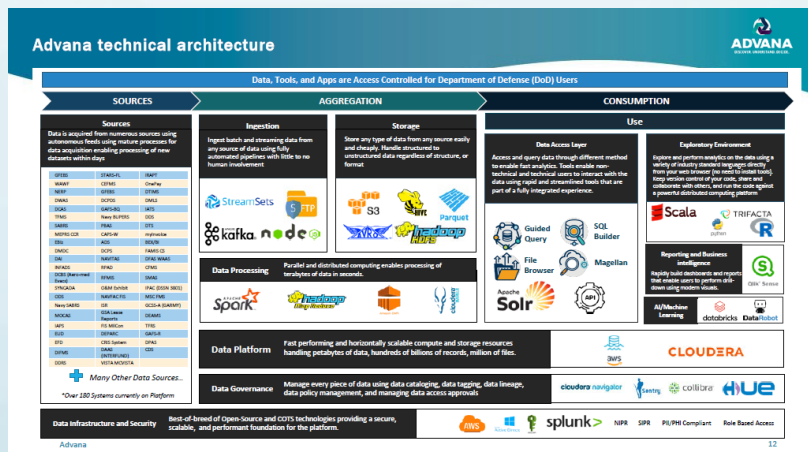
OUSD(R&E)

SE&A

DEM&S

PERSONAL

CDAO



AIR FORCE



Strategic Priorities Digital Transformation

AQ Digital Acquisition Priorities

AFMCM Digital Materiel Management (DMM) Priority

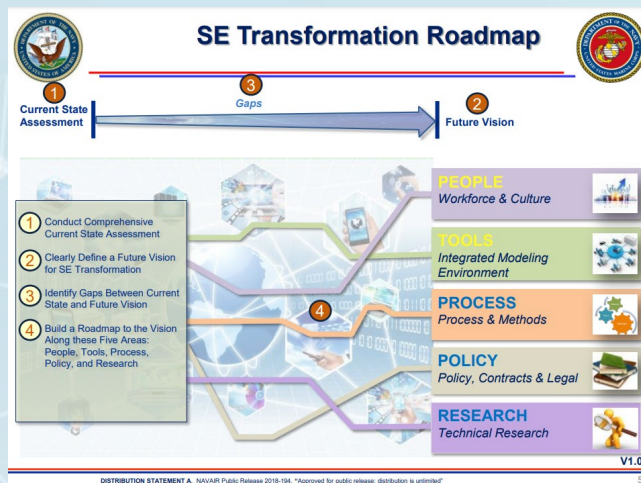
1. Implement Open Systems Standards and Reference Architectures
2. Ensure Programs Are "Born Digital" or Digitally Adapt over the Lifecycle
3. Expand Enterprise Solutions and Embrace Cloud-based Collaborative Environments
4. Institutionalize Processes for Agile Software Development and Software-Intensive Systems

1. Structure and Secure our Data
2. Train our Digital Workforce
3. Provide Access to DMM Tools
4. Develop Digital strategies
5. Instill a digital-first culture
6. Modernize IT infrastructure

Aligned for Enterprise Digital Dominance

Integrity - Service - Excellence

NAVY



ARMY

DE ROADMAP: OUR OBJECTIVE CAPABILITY



- Objective Capability**
- Ontology based, open architecture
 - Maximum scalability / growth potential
 - Not Prescriptive for A&A industry
 - Enables AI/ML enhancements

- Enables concurrent engineering with reduced risk**
- Data captured in Authoritative Sources of Truth - accessible to all stakeholders / users
- Enables AI/ML enhancement**
- Database is accessible for statistical analysis, reinforcement learning, and making predictions from the available data
 - AI / ML enhancements grow exponentially as more data is populated

- Key Activities:**
- Evaluating available and emerging options
 - Industry (SBIR)
 - Academia (UARC)
 - Developing OWL-based Ontology
 - Development of workforce KSA's

- Risks**
- IA compliance
 - User Interface / experience

Makes Armaments System data searchable, accessible, and actionable by applying Armament-specific domain ontologies allowing for more comprehensive analysis and informed decision making



Change the Community

DIB

DoD

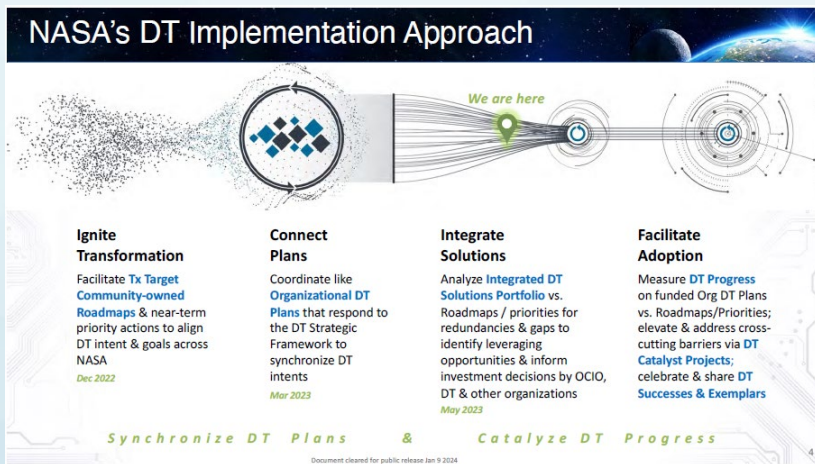
OUSD(R&E)

SE&A

DEM&S

PERSONAL

NASA

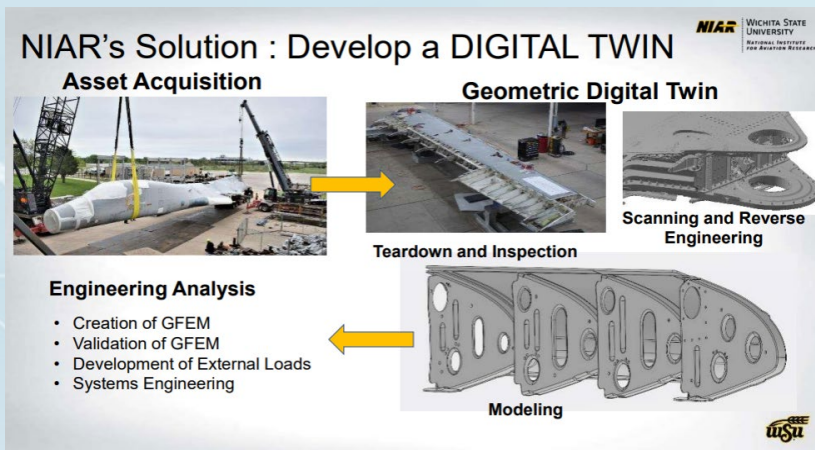


IDAHO NATIONAL LAB

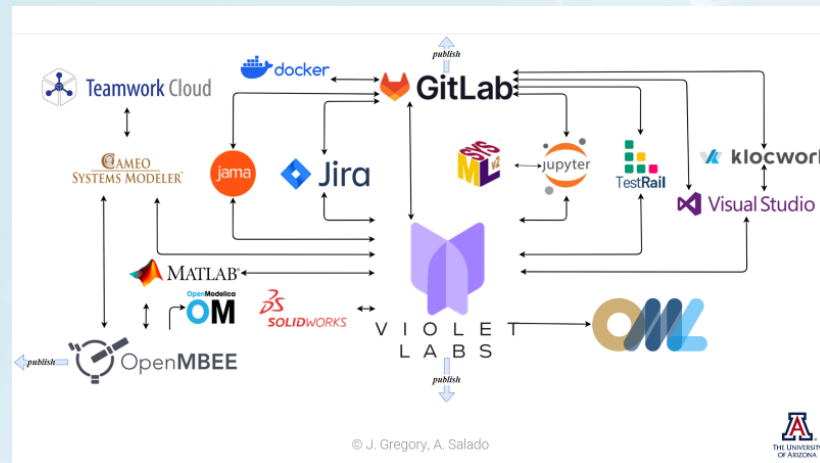


Open-source data warehouse focused on enabling complex projects to embrace digital engineering. It accomplishes bringing digital thread and digital twins to these projects with integrations to a large collection of software systems across a project's lifecycle.

WICHITA STATE

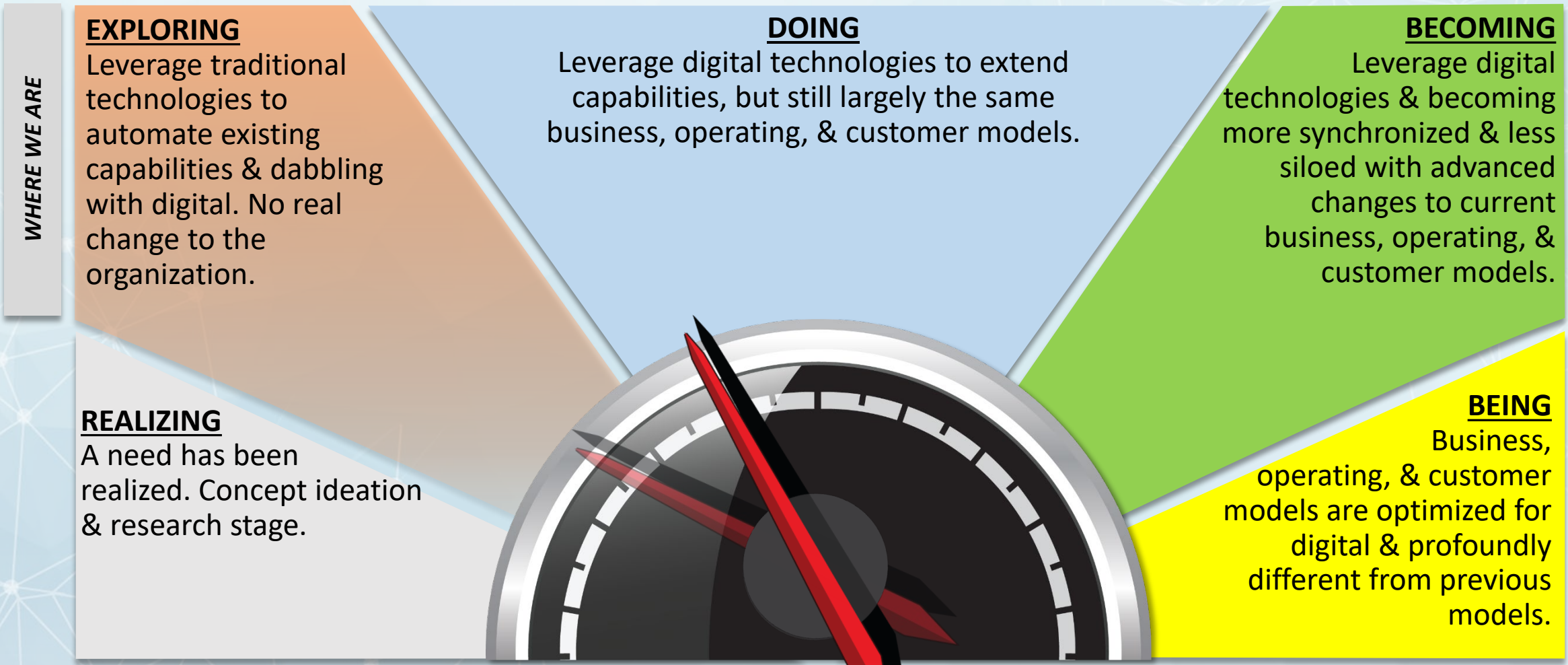


UNIVERSITY OF ARIZONA





The DoD Doesn't Make Big Moves But... We Can Move the Needle with Small Wins

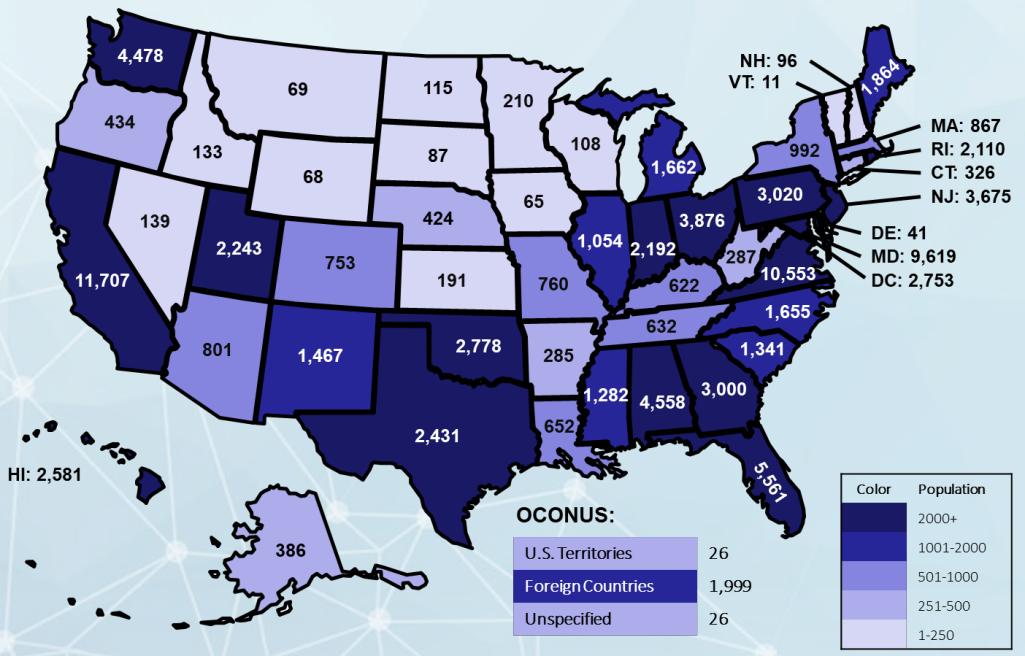




Don't Loose Sight of the Real Audience

We need communication to be successful. How do we reach the community outside of this room and who do we need to reach?

DoD Engineers work and live across the country



- 1.4+ Million Contractors
- 700,000 federal DoD civilian employees
- 2.1 Million Armed Services
- 50% of the audience is in 11 states

Geographic Area	DoD Total	DoD Eng
Washington, DC (MD-VA-WV, CBSA)	61,000	9,000
California	58,000	8,600
Texas	45,000	6,600
Virginia Counties and Independent Cities	35,000	5,200
Georgia	31,000	4,600
Florida	30,000	4,400
Washington	28,000	4,100
Ohio	24,000	3,600
Oklahoma	23,000	3,400
Pennsylvania	23,000	3,400
Alabama	22,000	3,300
North Carolina	19,000	2,900

References: [Office of Personnel Management - Policy Data Oversight](#)



Case Study: The Office of Strategic Services

The screenshot shows the CIA website's 'Exhibits' section. The main exhibit title is 'The Office of Strategic Services: America's First Intelligence Agency'. Below the title is a section titled 'About the OSS' with a paragraph of text: 'Before World War II, the US Government left the business of collecting and disseminating intelligence to American foreign-policy experts and elements of the armed services. America's entry into the war following the intelligence failure of Pearl Harbor led to the establishment of the Office of Strategic Services (OSS) on 13 June 1942.' To the right of the text is a blue document cover titled 'SIMPLE SABOTAGE FIELD MANUAL' by 'Strategic Services (Provisional)'. The cover also includes the text 'Prepared under direction of The Director of Strategic Services' and a red 'DECLASSIFIED' stamp over a 'SECRET' stamp.



“(11) General Interference with Organizations and Production

(a) Organizations and Conferences

(1) Insist on doing everything through "channels." Never permit short-cuts to expedite decisions.

...

(3) When possible, refer all matters to committees, for "further study and consideration." Attempt to make the committees as large as possible - never less than five.

...

(8) Be worried about the propriety of any decision - raise the question of whether such action as is contemplated lies within the jurisdiction of the group or whether it might conflict with the policy of some higher echelon.”

*Don't accept organizational sabotage in the use of models in a digital ecosystem.
Focus on driving value, moving forward, and celebrate the wins.*



My Challenge to You



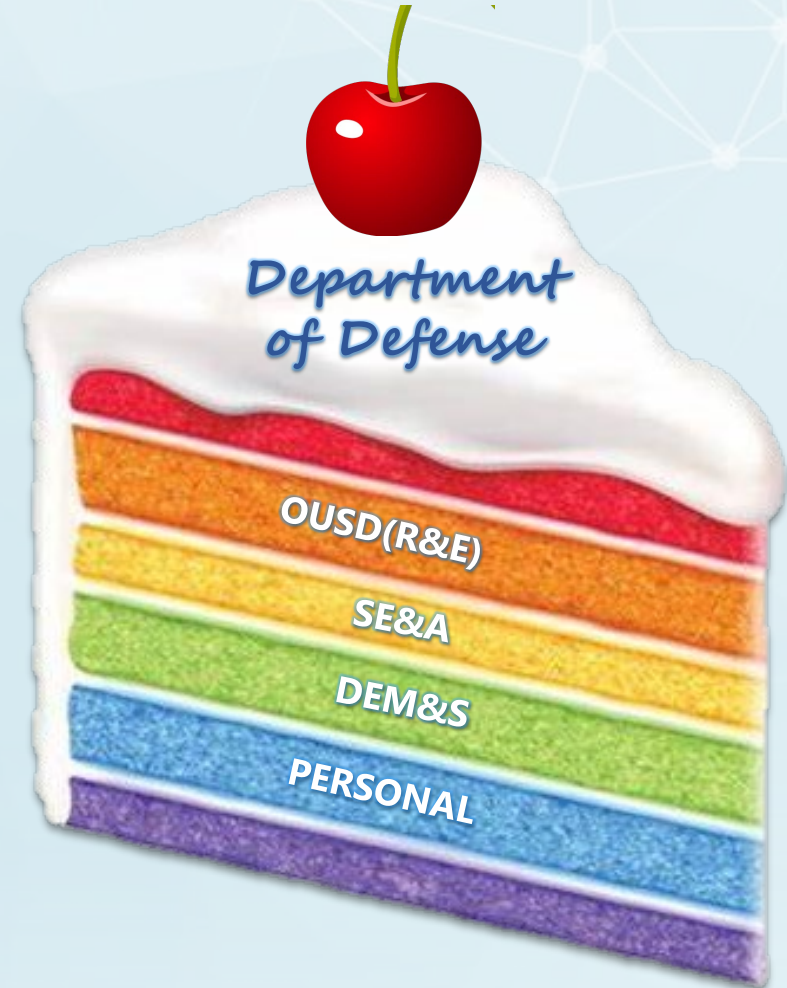
Change your team in one way



Celebrate the small wins



Help someone else change

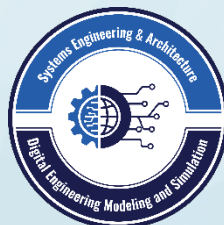




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