Engineering at the Speed of Mission: The Next Era of Defense Systems

PLM Road Map

Mr. Daniel Hettema
Director, Digital Engineering, Modeling & Simulation
Director, Joint Architecture for Capabilities & Systems
Sponsor & Program Manager,
Systems Engineering Research Center (SERC)
Acquisition Innovation Research Center (AIRC)

May 06, 2026

PLM Road Map™ & PDT North America 2026
AI in PLM: A Disruptive Opportunity and Challenge
Turning AI disruption into enterprise value:
Strategic insights for the PLM professional
6-7 May 2026

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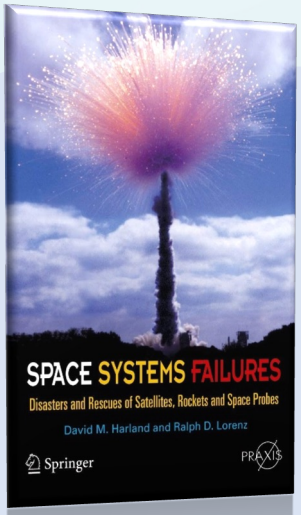
www.CIMdata.com

Lesson Learned about the Importance of Digital Engineering



Titan 4 & Milstar-3, April 1999

"The investigation found a software error in the guidance system. The 'constant' for the roll rate had been **entered with the decimal point one place to the left, making it one-tenth of the value**. … the Centaur had consumed 85 per cent of its hydrazine attitude control propellant, …, with the result that it released its payload in an orbit with an apogee that fell far short of geosynchronous altitude. … **At $1.23 billion ($880 million for the satellite and $433 million for the lunch vehicle) this was the most costly satellite loss** to date for the Department of Defense."


Titan 4B


Milstar-3

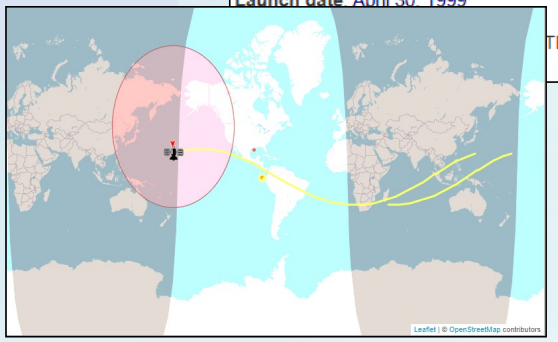
USA 143

Track USA 143 now!
10-day predictions
USA 143 is classified as:

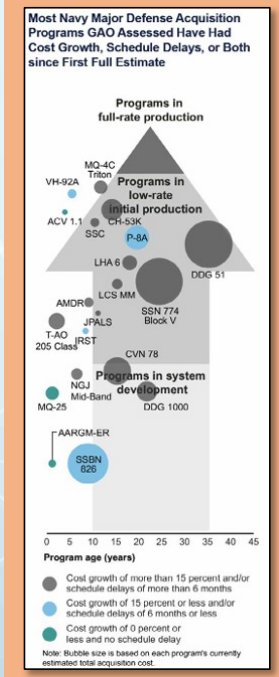
- Geostationary
- Military

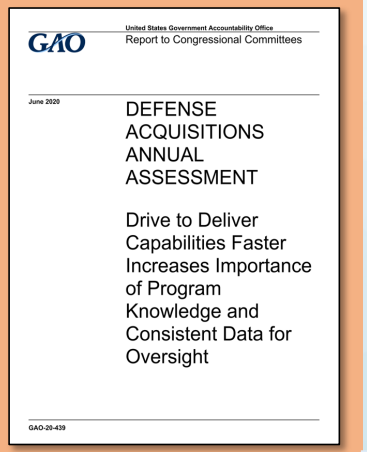
NORAD ID: 25724
Int'l Code: 1999-023A
Perigee: 1,105.5 km
Apogee: 5,153.9 km
Inclination: 28.2 °
Period: 153.6 minutes
Semi major axis: 9500 km
RCS: Unknown
Launch date: April 30, 1999

TEST RANGE



Slow Delivery of Capability & Strategic Competition





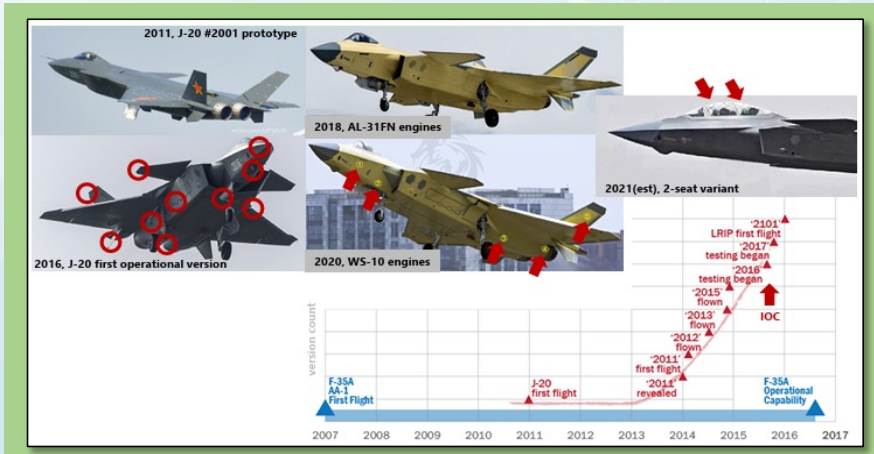
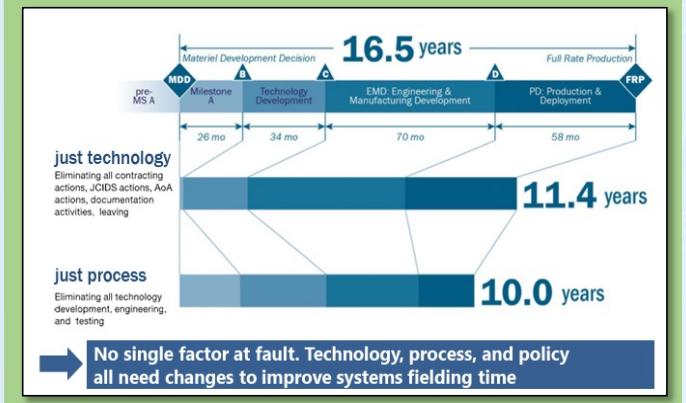


Table 17: Statistically Significant Knowledge-Based Acquisition Practices and Their Corresponding Performance Outcomes among 21 Selected Major Defense Acquisition Programs

Knowledge practice	Programs that implemented the practice	Programs that did not implement the practice	Net performance difference
Complete a system-level preliminary design review prior to starting system development	• -13.1% unit cost growth • 11.6% schedule growth	• 33.6% unit cost growth • 46.3% schedule growth	• 46.7% less unit cost growth • 34.7% less schedule growth
Release at least 90 percent of design drawings by critical design review	• -5.5% unit cost growth • 10.3% schedule growth	• 45.1% unit cost growth • 50.3% schedule growth	• 50.6% less unit cost growth • 40.0% less schedule growth
Test a system-level integrated prototype by critical design review [a]	• 13.3% schedule growth	• 43.2% schedule growth	• 29.9% less schedule growth

Source: GAO analysis of Department of Defense data. | GAO-20-439.



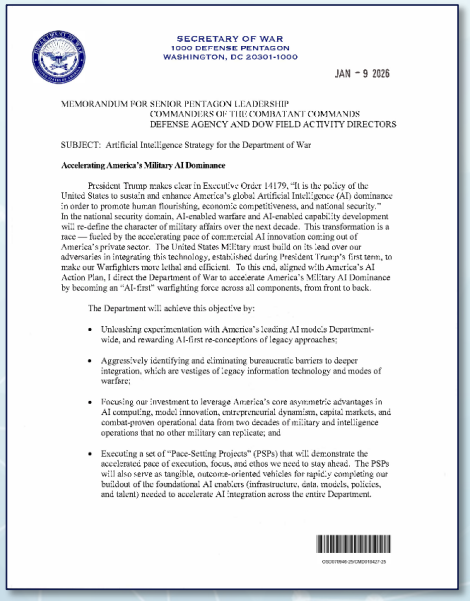
Clear Mission: Transform Acquisition

On November 7, in response to EO 14265, "Modernizing Defense Acquisitions and Spurring Innovation in the Defense Industrial Base," Secretary Hegseth announced the transformation of the Defense Acquisition System – emphasizing the need to accelerate the delivery of new technology and advanced capabilities to the warfighter and maintain military superiority.

"The [Warfighting Acquisition System] is dependent on many parts to deliver the world's most sophisticated and capable weapon systems; ***systems engineering is one of the most critical disciplines****."*
– Acquisition Transformation Strategy, November 2025

"I'd rather have an 85% solution in the hands of the warfighter, than a 100% solution stuck in test."
– Secretary Hegseth, November 2025

Unlocking our Data



SECRETARY OF WAR
1000 DEFENSE PENTAGON
WASHINGTON, DC 20301-1000

JAN – 9 2026

MEMORANDUM FOR SENIOR PENTAGON LEADERSHIP
COMMANDERS OF THE COMBATANT COMMANDS
DEFENSE AGENCY AND DOW FIELD ACTIVITY DIRECTORS

SUBJECT: Artificial Intelligence Strategy for the Department of War

Accelerating America's Military AI Dominance

President Trump makes clear in Executive Order 14179, "It is the policy of the United States to sustain and enhance America's global Artificial Intelligence (AI) dominance in order to promote human flourishing, economic competitiveness, and national security." In the national security domain, AI-enabled warfare and AI-enabled capability development will re-define the character of military affairs over the next decade. This transformation is a race — fueled by the accelerating pace of commercial AI innovation coming out of America's private sector. The United States Military must build on its lead over our adversaries in integrating this technology, established during President Trump's first term, to make our Warfighters more lethal and efficient. To this end, aligned with America's AI Action Plan, I direct the Department of War to accelerate America's Military AI Dominance by becoming an "AI-first" warfighting force across all components, from front to back.

The Department will achieve this objective by:

- Unleashing experimentation with America's leading AI models Department-wide, and rewarding AI-first re-conceptions of legacy approaches;
- Aggressively identifying and eliminating bureaucratic barriers to deeper integration, which are vestiges of legacy information technology and modes of warfare;
- Focusing our investment to leverage America's core asymmetric advantages in AI computing, model innovation, entrepreneurial dynamism, capital markets, and combat-proven operational data from two decades of military and intelligence operations that no other military can replicate; and
- Executing a set of "Pace-Setting Projects" (PSPs) that will demonstrate the accelerated pace of execution, focus, and ethos we need to stay ahead. The PSPs will also serve as tangible, outcome-oriented vehicles for rapidly completing our buildout of the foundational AI enablers (infrastructure, data, models, policies, and talent) needed to accelerate AI integration across the entire Department.

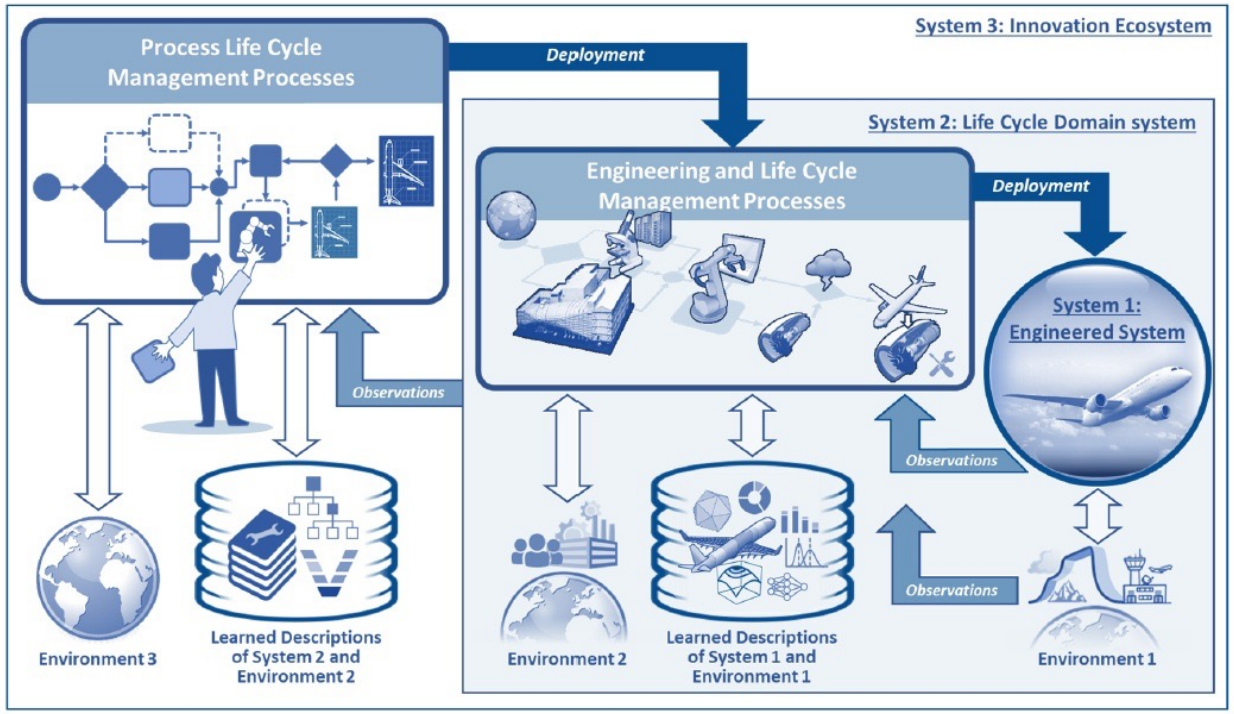
Memo: Artificial Intelligence Strategy for the Department of War

Data Access. I direct the CDAO to enforce, and all Do W Components to comply with, the 'DoD Data Decrees' to further unlock our data for AI exploitation and mission advantage. Military Departments and Components will establish, maintain, and update federated data catalogs exposing their system interfaces, data assets, and access mechanisms across all classification levels.

Modular Open Architectures. In the AI arms race, system architectures must enable component replacement at commercial velocity to maintain overmatch. I direct Military Department and Component Program Managers acquiring AI capabilities to enforce Modular Open System Architectures (MOSA) along with the "DoD Data Decrees," exposing modular interfaces and associated documentation sufficient for third-party integration without prime contractor support.

Data and Digital Models will gain
mission advantage & build MOSA first systems.

“System 3” Mission Space



System 3 Focus Area

INCOSE Patterns Working Group
Agile Systems Engineering Life Cycle Model (ASELCM)

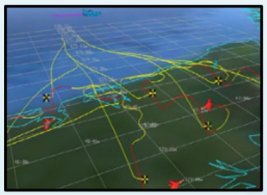
Practitioners want:

1. Data
2. Tools
3. Time

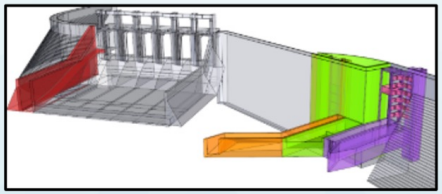
Practitioners want less:

1. Meetings
2. Emails
3. Bosses

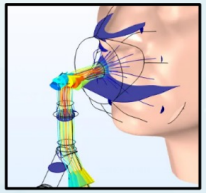
Engineering across the DoW



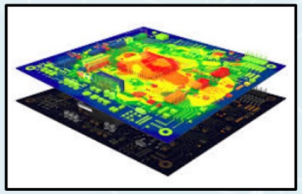
Mission



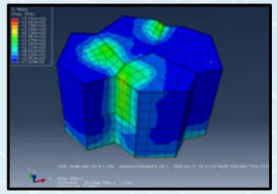
Civil



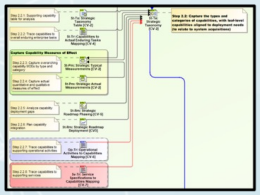
Biomedical



Computer

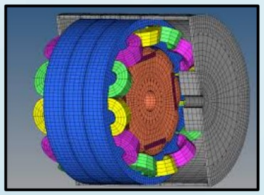


Materials

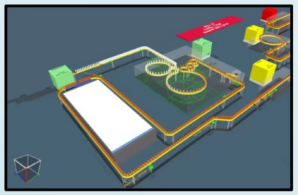


Enterprise

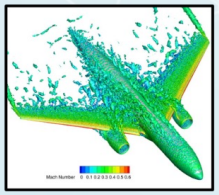
Systems



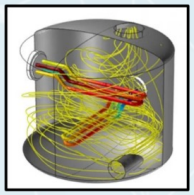
Electrical



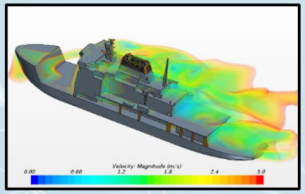
Industrial



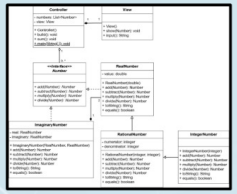
Aerospace



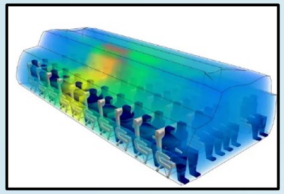
Chemical



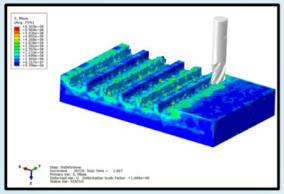
Naval



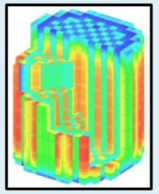
Software



Environmental

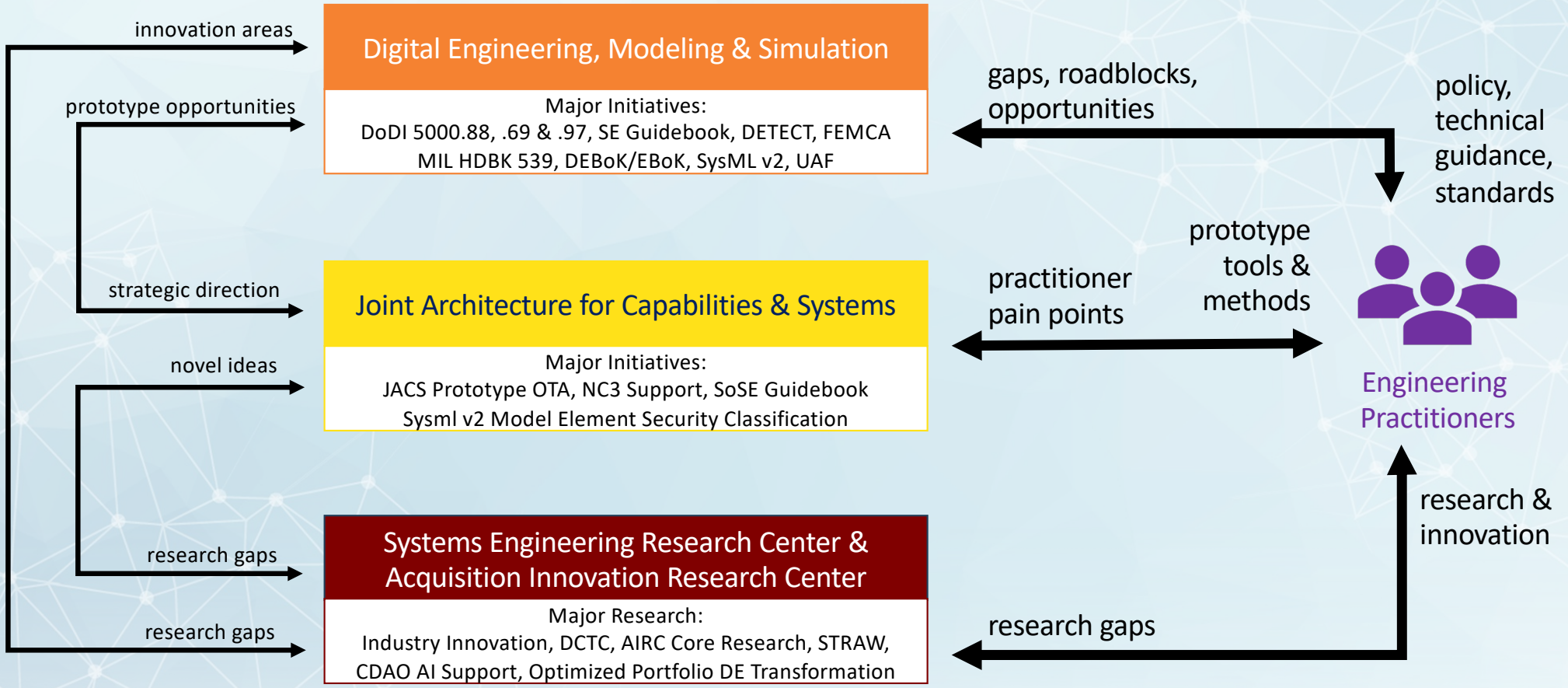


Mechanical



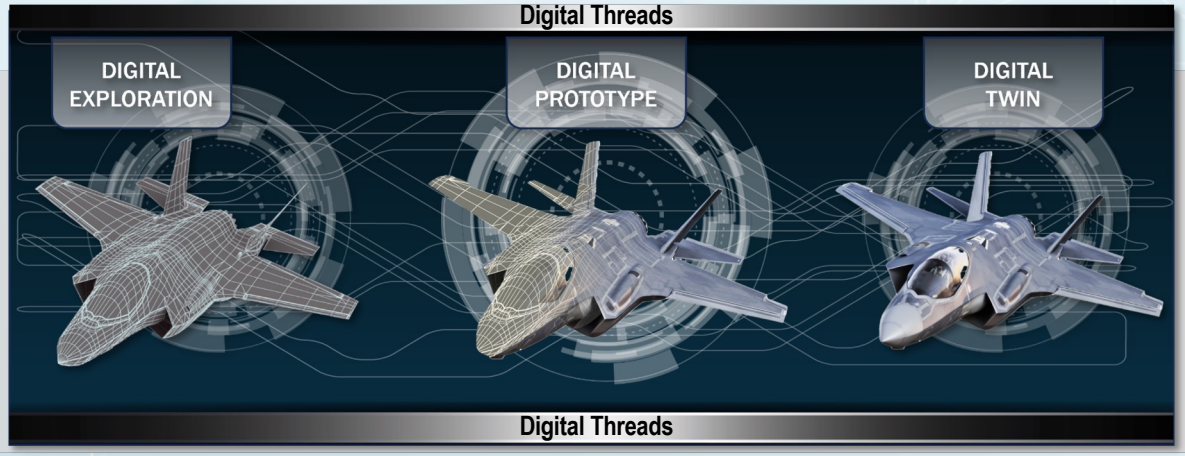
Nuclear

Portfolio Interactions



Digital Engineering Simplified

Engineering on

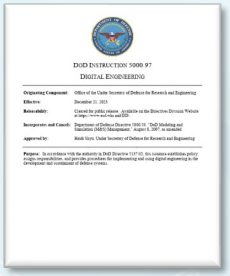


Critical Technologies

Continuous Integration Continuous Delivery (CI/CD) Pipeline

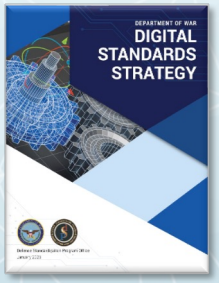
Superior Operational Warfighting Capability

Guiding Policies & Strategies


DOD INSTRUCTION 5000.97
DIGITAL ENGINEERING

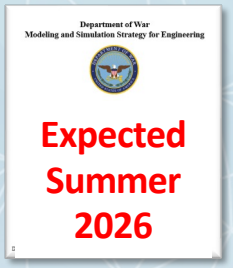
DoDI 5000.97 DIGITAL ENGINEERING

- “The DoD will use digital engineering methodologies, technologies, and practices”
- “PM will implement digital engineering procedures to the maximum extent possible.”
- “PMs should use existing DoD or Military Service-level digital engineering resources to the maximum extent possible before investing in new digital engineering capabilities.”



DIGITAL STANDARDS STRATEGY

- Unified strategy to accelerate innovation and the adoption of new technologies.
- Standards must be published in common digital format to shift from paper -> machine readable content & machine interpretable content
- Defense Standards Program Office (DSPO) will deploy a digital standards ecosystem within ASSIST to realize MILDEP digital standards initiatives.



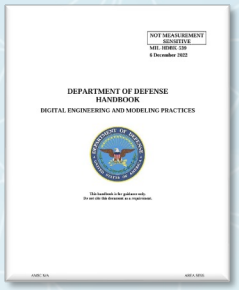
M&S STRATEGY FOR ENGINEERING

- Establishes Modeling and Simulation (M&S) as a central enabler of the Department of War's Acquisition Transformation Strategy, mandating a shift from paperwork-driven cycles to model-governed, evidence-based pathways to accelerate capability delivery.

Digital Engineering Related Guides

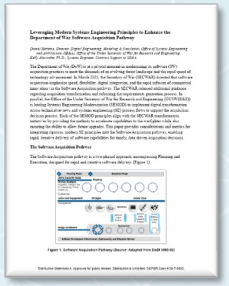
DOD MIL HANDBOOK 539

- Provides guidance to the DoW community for applying DE and modeling practices across all areas of the acquisition lifecycle.
- Promotes a shift from document-centric to data-centric activities to enable data-driven decisions and improve agility, interoperability, and reusability.
- Version 2 is published in ASSIST for download



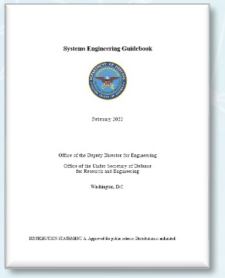
SE CONSIDERATIONS FOR SOFTWARE

- Enhanced SW pathway considerations (Prepare & develop the workforce, Modernize the workflow, Implement MOSA principles, Implement modern design practices)
- Require programs to conduct self-assessments and determine how to balance cost, schedule, and performance in alignment with their operational priorities and risk posture.



SYSTEMS ENGINEERING GUIDEBOOK

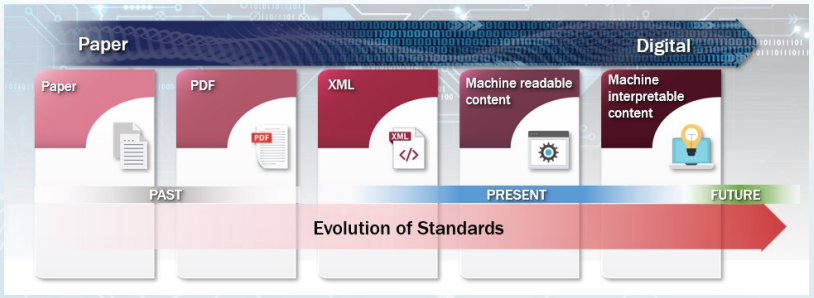
- Provides interim guidance and best practices for Program Managers and Systems Engineers to plan and execute SE activities in defense acquisition programs.
- Details the DoW's Digital Engineering strategy, guiding the shift to a data-centric, model-based approach to accelerate the delivery of capabilities.

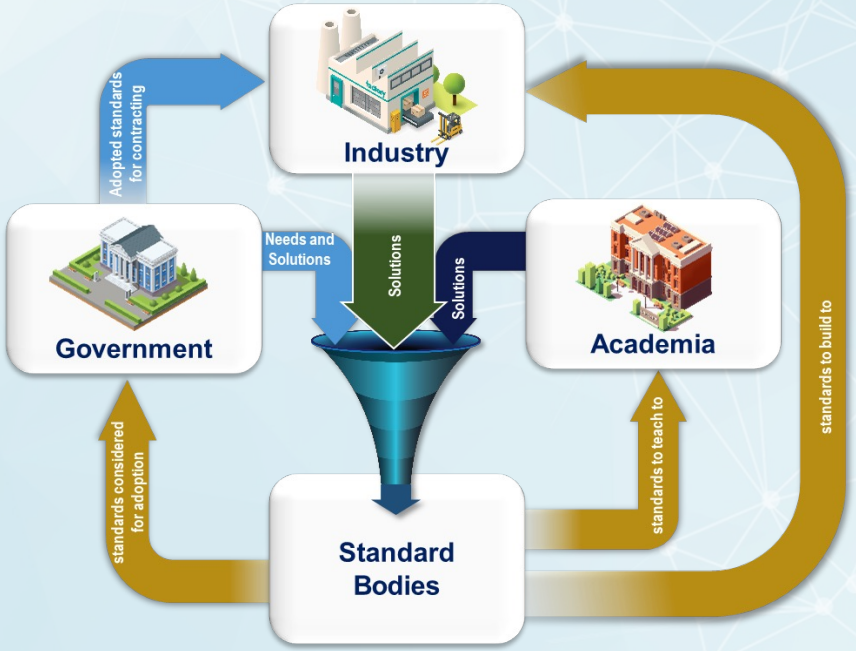


Standards Are Critical to U.S. National Security

- **Consensus-based Standards:**
  - National Technology Transfer and Advancement Act of 1995, Public Law 104-113
  - OMB Circular A-119, Federal Participation in the Development and Use of Voluntary Consensus Standards
- **Drivers to adopt new standards:**
  - New DoW needs:
    - Emerging technologies, interoperability, replace outdated standards
  - Congressional Direction:
    - Example: Conduct a review of ANSI/HFES Standard 400- 2021 (Sec 241, PLAW 118-159, FY2025 NDAA)

The Vision: Moving Towards Digital Standardization Products





DoW involvement with standards bodies is critical to U.S. National Security

DEM&S Venues for Collaboration

Digital Engineering Modeling & Simulation Community of Practice

750+ membership

The DEM&S CoP serves as a Department-wide force multiplier, championing digital engineering across the services and agencies and pushing rapid advancement of modern engineering practices.

2026 Meeting Themes

- Integration of Physical Data into Digital Models
- Mission Engineering in the Digital Era: From Models to Warfighting Outcomes
- Digital Engineering at Speed: Agile Acquisition and Rapid Fielding through DE
- Trustworthy Digital Ecosystems: Data, Cyber, and AI for Assured Engineering

Past Meeting Themes

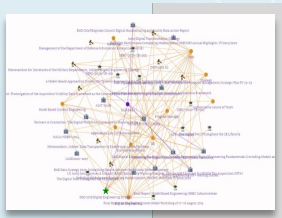
- Model Trust
- Application Updates: DE Successes Following 5000.97
- Tool Vendor Showcase
- Generative AI and DE M&S Collaboration
  - Digital Thread & Digital Twins
  - Metrics, ROI Maturity
  - Connecting AI,LLM & DE
  - Tool Vendor Challenge
  - SysML V2

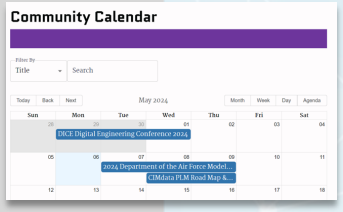
DEM&S CoP Website
https://www.cto.mil/sea/dems_cop/

DEBoK

Digital Engineering Body of Knowledge

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





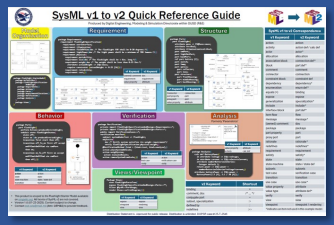
Vision: Provide the Engineering (Non-Construction) civilian, military, and contractor practitioners across the defense industrial base the information needed in a community driven Body of Knowledge on the IT networks where they work.

E-BoK
Engineering Body of Knowledge

DEBoK.org

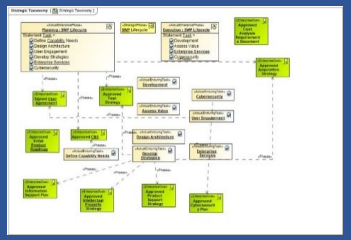
Systems Modeling Language (SysML) v2

We've Been Developing SysMLv2 Products Since 2023



Our SysML v2 products (including our SysML v1 to v2 Quick Reference Guide) can be downloaded from the DEBoK.

Connecting SysMLv2 to UAF and AI



Exploring with Industry and Academic partners the application of Unified Architecture Framework (UAF) and AI to SysML v2 model translations.

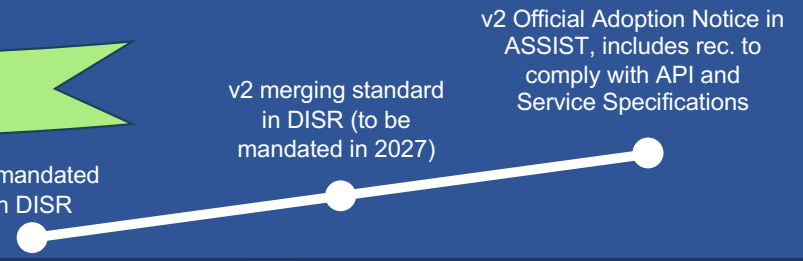
Diamond Sponsor

Developing a SysMLv2 Web App for DEE Guidance

Translating DEM&S DEE Guidance (DETECT) from SysMLv1 to SysMLv2 using Github & SysIDE to:

- **expand accessibility and flexibility** by transitioning to a open-source enabled web platform.
- **demonstrate practical SysML v2 implementation** that supports reuse

SysMLv2 is Headed for ASSIST



Unified Architecture Framework (UAF)

Policy Demand Signal from 2024 NDAA Section 811

UAF is the only framework that meets the interoperability objectives stated in the FY2024 NDAA directive to retire and replace DoDAF.

DoW UAF Tiger Team is Kicked-Off and Underway

FY2024 NDAA Reform Element Focus: Enabling Interoperability through…	UAF 1.x	* UAF 2.0	** NAF	Zachman	FEAF	TOGAF
Application Program Interfaces (API)	1	3	1	1	1	1
Enterprise Architectures and Platforms	3	3	2	2	1	1
Government and Commercial Standards	3	3	1	1	1	2

OUSD R&E Whitepaper survey of the DIB resulted in ~70% currently already adopting/implementing UAF. In general, all are waiting/expecting on formal policy/guidance/directive to transition.

CUI White Paper Available

- Addressed the handling of classification markings for models within the Unified Architecture Framework (UAF).
- Strategized the Department of War's transition to UAF v2.0, covering risks, timeline, costs, and required guidance.

Engaging Industry Leaders in DoW Adoption Strategy

Key Data Item Descriptions (DID)

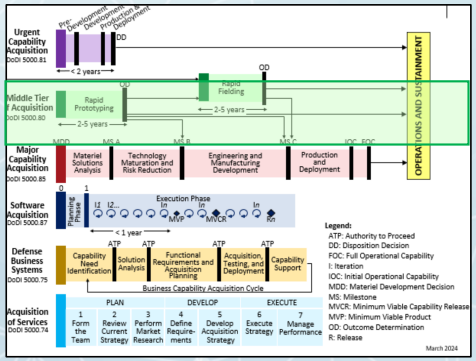
ASSIST comprehensive web site used by standardization management activities in accordance with the policies and procedures of the Defense Standardization Program (DSP).

Number	Name	Status
DI-SESS-80776B	Technical Data Package	Active
DI-SESS-82380	Model Development Plan	Active
DI-SESS-82364	Digital System Model	Being Updated
DI-SESS-82483	Digital Twin (DT) Description	New
DI-SESS-#####	Digital Engineering Plan (DEP)	Coordination
DI-SESS-#####	Model Federation Plan	Coordination
DI-SESS-82400	System Architecture Model	Active
DI-IPSC-81432	System or Subsystem Design Description	Active
DI-IPSC-81435	Software Design Description	Active

RAND Study: Framework for Assessing Digital Engineering ROI

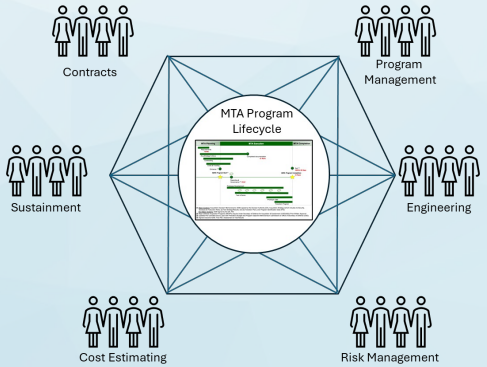
Develop Tabletop Exercise (TTX)

- Develop fictional acquisition program for use in TTX
- Create key programmatic documentation required for each acquisition phase
- Focus on Middle Tier of Acquisition Pathway (MTA) to appeal to a wide range of defense programs



Execute TTX

- Participants will represent program office functional areas through the program's lifecycle

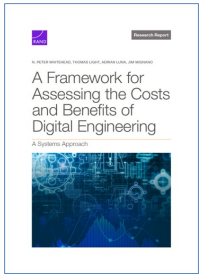


- Explore avenues for digital engineering implementation
- Focus on touchpoints between functional areas and lifecycle phases
- Highlight applicable costs and benefits
- Seeking participants for the non-attribution TTX

Document TTX

- Summarize results to inform acquisition programs of potential inclusion of digital engineering
- Identify actionable insights into how digital engineering can be effectively implemented
- Highlight the timing, roles, and artifacts required to support digital engineering adoption
- Provide validated, actionable decision support for program offices

Initial RAND Research



Scan to access report

To participate in the TTX, please contact Brittany Clayton (bclayton@rand.org) or John Yurchak (jyurchak@rand.org)

Joint Architectures for Capabilities & Systems (JACS)

MISSION

Promote, guide, and establish an enterprise-wide and cultural approach to system-of-systems engineering and architecture

Vision

Support the Department in sustaining warfighting dominance through system-of systems engineering and architectures

JACS Community of Practice

Goal: Codify and disseminate best practices, architecture governance, and digital thread implementation

JACS Approach

- Conduct research on system of systems
- Provide value-add SMEs
- Fund novel industry idea
- Develop key standardization approaches

Aim: lots of small changes to "move the needle" on the culture challenge.

Objective: Provide tools to practitioners in support of their efforts to architect missions.

JACS 3-yr Plan

FY 26
Theme: Seed

- Fund industry proposed solutions to address challenges experienced by engineering practitioners
- Each prototype should “move the needle” for engineers building architecture and systems models in support of acquisition efforts.

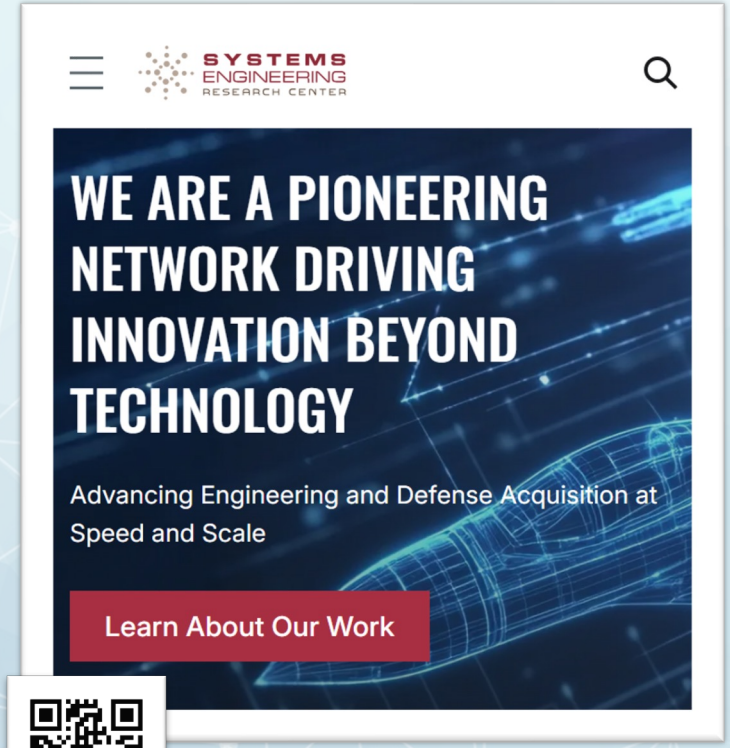
FY 27
Theme: Grow

- Grow prototypes with DoW components for scaling.
- Identify pathfinding programs to pilot.
- Expand JACS CoP to further identify and nominate potential gaps & pain points.

FY 28
Theme: Cultivate

- Pain points are incorporated for future prototype funding.
- COP hosts an in-person event to highlight success stories across the DoW.
- COP builds a “budget story” for budget activities showing the impact of successful architectures.

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



https://sercuarc.org/

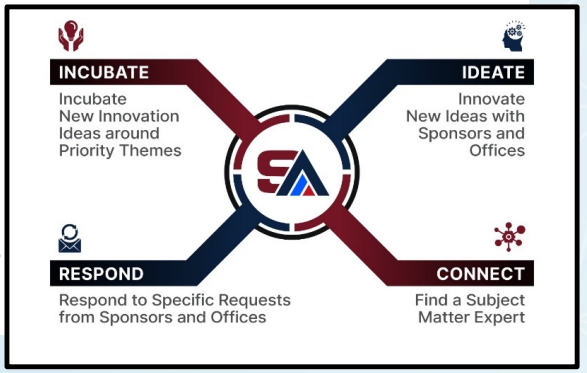
Connecting the DoW with University Talent

- Network of ~25 universities
- Experts on the front lines of innovative research & technologies
- Granting capabilities to enable new engineering and acquisition methods and tools faster and at scale

Researching and Applying Innovative Technologies

Research includes:

- Artificial Intelligence Resilience
- Acquisition Innovations
- Program Development & Workforce Training
- System and Architecture Improvements
- Secure Cyber Resilient Engineering



Innovating research today to empower the warfighters of tomorrow

Systems Engineering Research Center (SERC)
Subject Matter Experts & Researchers

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The George Washington University
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Stevens Institute of Technology
Concept of Operations Analysis, Data Analytics, Digital Engineering, System of Systems

Dr. Mark Blackburn
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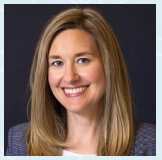

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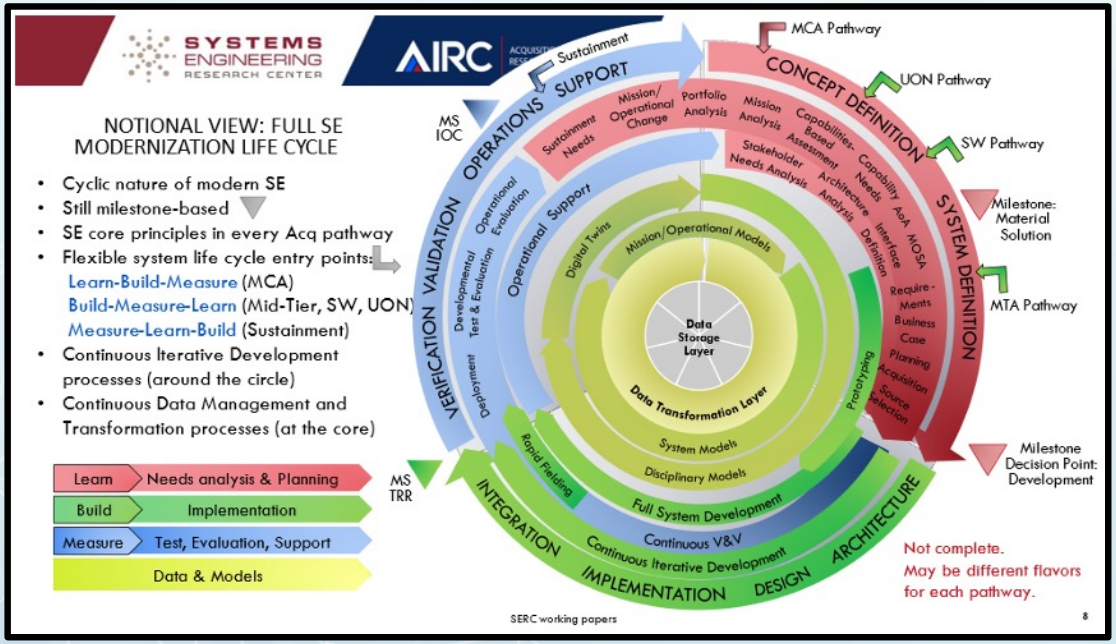
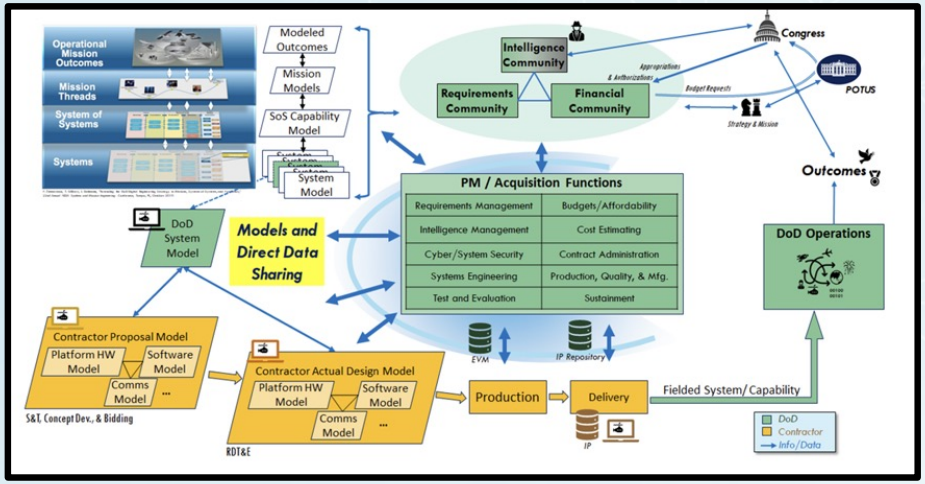
The University of Arizona
Systems Engineering, Electronics Engineering, Space Systems Engineering

Impactful SERC & AIRC Research

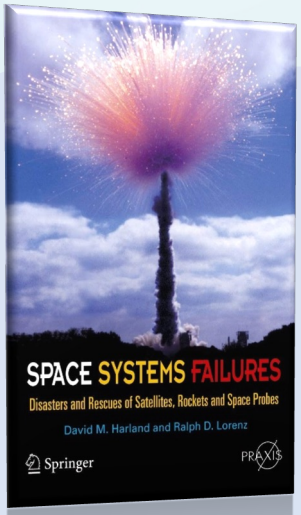


Systems Engineering Modernization Policy, Practice, And Workforce Roadmaps

Innovative, Data-Enabled Acquisition Strategy (IDEAS)
Concepts for Driving the Digital Transformation of Defense Acquisition



Lesson Learned about the Importance of Digital Engineering



Titan 4 & Milstar-3, April 1999

"The investigation found a software error in the guidance system. The 'constant' for the roll rate had been **entered with the decimal point one place to the left, making it one-tenth of the value**. … the Centaur had consumed 85 per cent of its hydrazine attitude control propellant, …, with the result that it released its payload in an orbit with an apogee that fell far short of geosynchronous altitude. … **At $1.23 billion ($880 million for the satellite and $433 million for the lunch vehicle) this was the most costly satellite loss** to date for the Department of Defense."


Titan 4B


Milstar-3

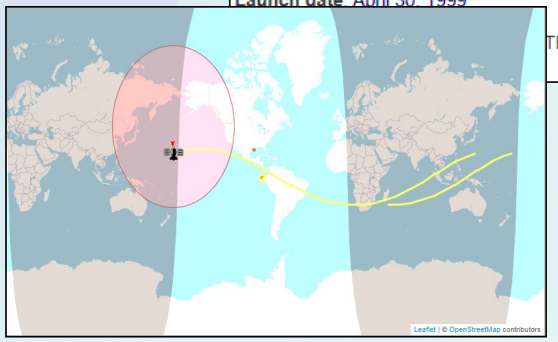
USA 143

Track USA 143 now!
10-day predictions
USA 143 is classified as:

- Geostationary
- Military

NORAD ID: 25724
Int'l Code: 1999-023A
Perigee: 1,105.5 km
Apogee: 5,153.9 km
Inclination: 28.2 °
Period: 153.6 minutes
Semi major axis: 9500 km
RCS: Unknown
Launch date: April 30, 1999

TEST RANGE



Small Interventions = Big Changes

“For anything to change, someone has to start acting differently”

– Chip & Dan Heath, SWITCH

Leaders

Ask new questions

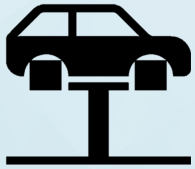
Are you changing your behavior? Are you communicating how much rigor you need? Are you asking the hard question that you haven’t asked before?

Require data-driven insights

Are you asking for a digital-twin, but then require briefs in PowerPoint? Are you enabling your team to create dashboards for real-time visibility? Are you waiting months to make a decision that could be measured in minutes?

Practitioners

Actually Learn the Lessons Learned

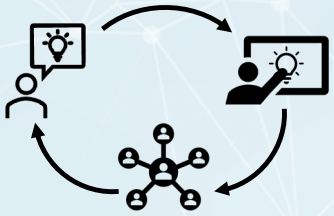


“But have we tried a square wheel?”

Are you spending time researching if others have solved similar problems? Are you documenting where you tried a good practice and where it needed to be tailored? Are you sharing with the boarder community your lessons learned?

Everyone

Identify 1 Idea To Try



1. Talk to the person
2. Explain your problem space
3. **Try the idea!**
4. Report back within 30 days
5. Document your lessons learned
6. Tell others

Contact Information

Office of the Under Secretary of War for Research and Engineering OUSW(R&E)

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https://www.cto.mil/sea

DEBoK
Digital Engineering Body of Knowledge