21st Annual National Defense Industrial Association Systems and Mission Engineering Conference

Digital Engineering and Environment, Safety, and Occupational Health (ESOH)

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October 25, 2018
Abstract

Advancements in computing, modeling, data management, and analytical capabilities offer great opportunities to the engineering practice. Applying these tools and methods, the DoD is shifting toward a dynamic digital ecosystem. Digital Engineering is an integrated digital approach that uses authoritative sources of systems’ data and models as a continuum across disciplines to support lifecycle activities from concept through disposal. This presentation will provide an overview of the DoD digital engineering strategy that sets the vision for encouraging innovation in the way we conceive, build, test, field, and sustain our national defense systems.
The World Today
Technology Is Transforming the Battlespace

- Easy proliferation of knowledge and technology has eroded U.S. historic advantages
  - Increasing systems capabilities
  - Advanced production capabilities
    • Driving lower costs
    • Decreasing “time to market”

- Increased rate of investment in military research and development (R&D) from near-peers

- Increasingly competitive national security technical environment

- Speed and cycle time become the discriminator

- NSF 2015 data predicted R&D investment parity with China in 2020
  - Feb 2018 National Science Board (NSB) estimates China R&D investment parity with U.S. by end of 2018

- 2017 GLOBAL R&D FUNDING FORECAST WINTER 2017  Industrial Research Institute, R&D Magazine
“We will modernize key capabilities, recognizing we cannot expect success fighting tomorrow's conflicts with yesterday's weapons or equipment. Investments in space and cyberspace, nuclear deterrent forces, missile defense, advanced autonomous systems, and resilient and agile logistics will provide our high-quality troops what they need to win.”

“To keep pace with our times, the department will transition to a culture of performance and affordability that operates at the speed of relevance. Success does not go to the country that develops a new technology first, but rather, to the one that better integrates it and more swiftly adapts its way of fighting. Our current bureaucratic processes are insufficiently responsive to the department's needs for new equipment. We will prioritize speed of delivery, continuous adaptation and frequent modular upgrades.”
Digital Engineering Overview

- **What is Digital Engineering?**
  - Combines model-based techniques, digital practices, and computing infrastructure
  - Enables delivery of high payoff solutions to the warfighter at the speed of relevance

- **Reforms Business Practices**
  - Digital enterprise connects people, processes, data, and capabilities
  - Improves technical, contract, and business practices through an authoritative source of truth and digital artifacts

*Modernizes how we design, operate, and sustain capabilities to outpace our adversaries*
Leveraging Multiple Activities

Infusion in Policy & Guidance

http://www.acq.osd.mil/se/pg/guidance.html

ODASD(SE) Initiatives

Defense Acquisition Guidebook Chapter 3

DoD 5000.02, Enclosure 3, Section 9: Modeling and Simulation

DoD Digital Engineering Working Group (DEWG)

Digital Engineering Strategy

System Engineering Research Center (SERC): Model Centric Research

Digital System Model (DSM) Taxonomy: Defining categories of data across acquisition

Engineered Resilient Systems: Adapting to changing requirements

High Performance Computing Modernization Program (HPCMP) Computational Research and Engineering Acquisition Tools and Environments (CREATE): Physics Based Modeling

Partnerships

Armed Services

DoD Components

Interagency

Industry/OEMs/Industrial Orgs

Academic

Advancing the state of practice for Digital Engineering

NASA – National Aeronautics and Space Administration
NNSA – National Nuclear Security Administration
NDIA – National Defense Industrial Association
INCOSE – International Council on Systems Engineering
AIA – Aerospace Industries Association
AIAA – American Institute of Aeronautics and Astronautics
OEMs – Original Equipment Manufacturers

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Digital Engineering Relationships

Digital Engineering Ecosystem

Digital Engineering Strategy

User selected and integrated based on desired outcome

Traditional Mod/Sim Solutions

Physics-based & Engineering Design Tools

Supporting tools: (Large Tradespace Analytics datasets, Analysis of Alternatives, Virtual Prototyping Evaluation, etc.)

World-class Computational Resources (High Performance Computing, Software, Networking)

Other Artifacts and Initiatives (e.g. Infrastructure that scales to realistic conditions as required)

Computational Research and Engineering Acquisition Tools and Environments (CREATE)

(DoD) Modeling and Simulation Coordination Office (DMSCO)
Model: A Day in the Life

Customer Requirements
• Draft CDD

System Requirements

System Architectures
• Operating Scenarios
• System Behaviors
• Physical Arch
• Dynamic Simulations

Allocated Requirements

Alt Prelim Design Concepts
• CAD/PLM
• Software

Trade-off Studies

1 2 3 . . N

Design Analyses
Stress, Thermal, Vibration, Perf, Reliability, Etc.

Selected Designs
• CAD/PLM
• Specs
• Drawings
• Software

Prototype Fabrication
• Mfg Instructions

Prototype Fabrication

Mfg Info
• Process Plans
• Work Instr
• N/C Instr

Testing
• Test Plans
• Test Results

Final Designs
• CAD/PLM
• Specs
• Drawings
• Software

Baseline
(System Spec)

Baseline
(Allocated Specs)

Baseline
(Preliminary Product Baseline)

Baseline
(Product Baseline - TDP)

Technology Development

Engineering and Manufacturing Development

Production/Deployment

This is valuable Intellectual Property that must be captured and made available for reuse

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Model: A Day in the Life

Customer Requirements
• Draft CDD

System Requirements
Allocated Requirements

System Architectures
• Operating Scenarios
• System Behaviors
• Physical Architecture
• Dynamic Simulation

Alt Prelim Design Concepts
• CAD/PLM
• Software

Tradeoffs
• CAD/PLM
• Software

Selected Designs
• CAD/PLM
• Specs
• Drawings
• Software

Prototype Fabrication
• Manufacturing Instructions

Testing
• Test Plans
• Test Results

Final Designs
• CAD/PLM
• Specs
• Drawings
• Software

Mfg Info
• Process Plans
• Work Instructions
• N/C Instructions

Logistics Mgmt Info
• Tech Manuals
• Provisioning Data
• Training Materials

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Digitally executed processes & workflow

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Digital Engineering Strategy

- Digital Engineering Strategy (Video link)
  - Basic capabilities needed by Services and Agencies to begin use of Digital Engineering practices

- Objective
  - Guide the planning, development, and implementation of digital engineering across the services and agencies

- Expected Impact
  - Increase technical cohesion and awareness of system in lifecycle activities
  - Reform the Department’s business practices for greater performance and agility

- Coordination
  - Approved by USD(R&E), DASD(SE), and each Service

Formalize the development, integration, and use of models to inform enterprise and program decision making

1. Formalize the planning for models to support engineering activities and decision making across the lifecycle

2. Formally develop, integrate, and curate models

3. Use models to support engineering activities and decision making across the lifecycle
Digital Engineering Strategy
Goal 2

Provide an enduring, authoritative source of truth

1. Plan and develop the authoritative source of truth

2. Govern the authoritative source of truth

3. Use the authoritative source of truth across the lifecycle
Digital Engineering Strategy

Goal 3

Incorporate technological innovation to improve the engineering practice

1. Establish an end-to-end digital engineering enterprise

2. Use technological innovations to improve the engineering practice
Digital Engineering Strategy

Goal 4

Establish a supporting infrastructure and environments to perform activities, collaborate, and communicate across stakeholders

1. Develop, mature, and use digital IT infrastructures

2. Develop, mature and use digital engineering methodologies

3. Secure IT infrastructure and protect intellectual property
Digital Engineering Strategy

Goal 5

Transform the culture and workforce to adopt and support digital engineering across the lifecycle

1. Improve the digital engineering knowledge base

2. Lead and support digital engineering transformation efforts

3. Build and prepare the workforce
“The strategy sets a new vision for the way we conceive, build, test, field and sustain our national defense systems. It also transforms how we must train and shape the workforce to use digital engineering practices....”

“We will convene a Digital Engineering Summit.....We invite the Services and agencies to share their Digital Engineering Implementation initiatives....”

Separate memo to DEPSECDEF:
“I expect the first implementation plans from each Service by end of December 2018”

- US Army Lead: Dr. Nancy Bucher
nancy.m.bucher.civ@mail.mil
Digital Engineering Way Ahead

Collaborators/Partnerships

- Armed Services
- DoD Components
- Interagency
- Industry/OEMs/ Industrial Orgs
- Academic

Strategy & Service Plans

Outlines DoD’s five strategic goals for Digital Engineering initiatives

Service Implementation Plans

Next Steps

- Service Delivery and Execution of Implementation Plans
- Foundational & Cross-Cutting Challenges
  - Data Patterns/Digital Artifacts
  - Data Rights / Access and Intellectual Property
  - Model Trust / Curation
  - Model Improvement (e.g., from test data)
  - Securing the Digital Artifacts
  - Determine Additional Efficiencies / Measurement
  - Tool Characterization
  - Workforce Development

Implementing Digital Engineering Across the Services
DoD Research and Engineering Enterprise
Solving Problems Today – Designing Solutions for Tomorrow

DoD Research and Engineering Enterprise
https://www.acq.osd.mil/chieftecnologist/

Defense Innovation Marketplace
https://defenseinnovationmarketplace.dtic.mil

Twitter
@DoDInnovation
For Additional Information

Digital Engineering website:
https://www.acq.osd.mil/se/initiatives/init_de.html

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