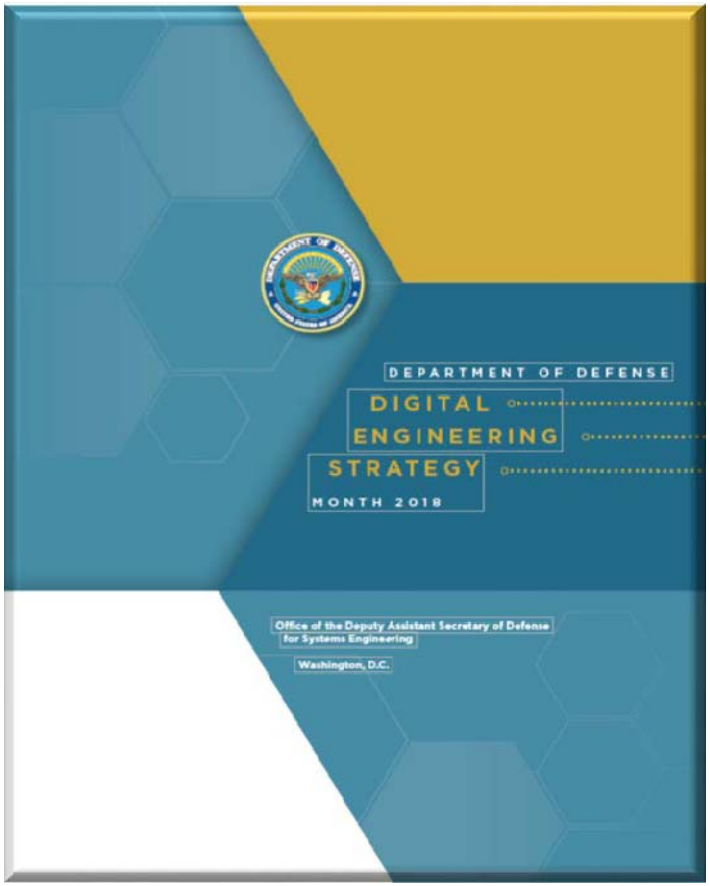
Digital Engineering

Ms. Philomena Zimmerman
Deputy Director, Engineering Tools and Environments
OUSD(R&E)/Systems Engineering

Practical Systems Measurement,
Impact of Digital Engineering on Measurement
September 13, 2018

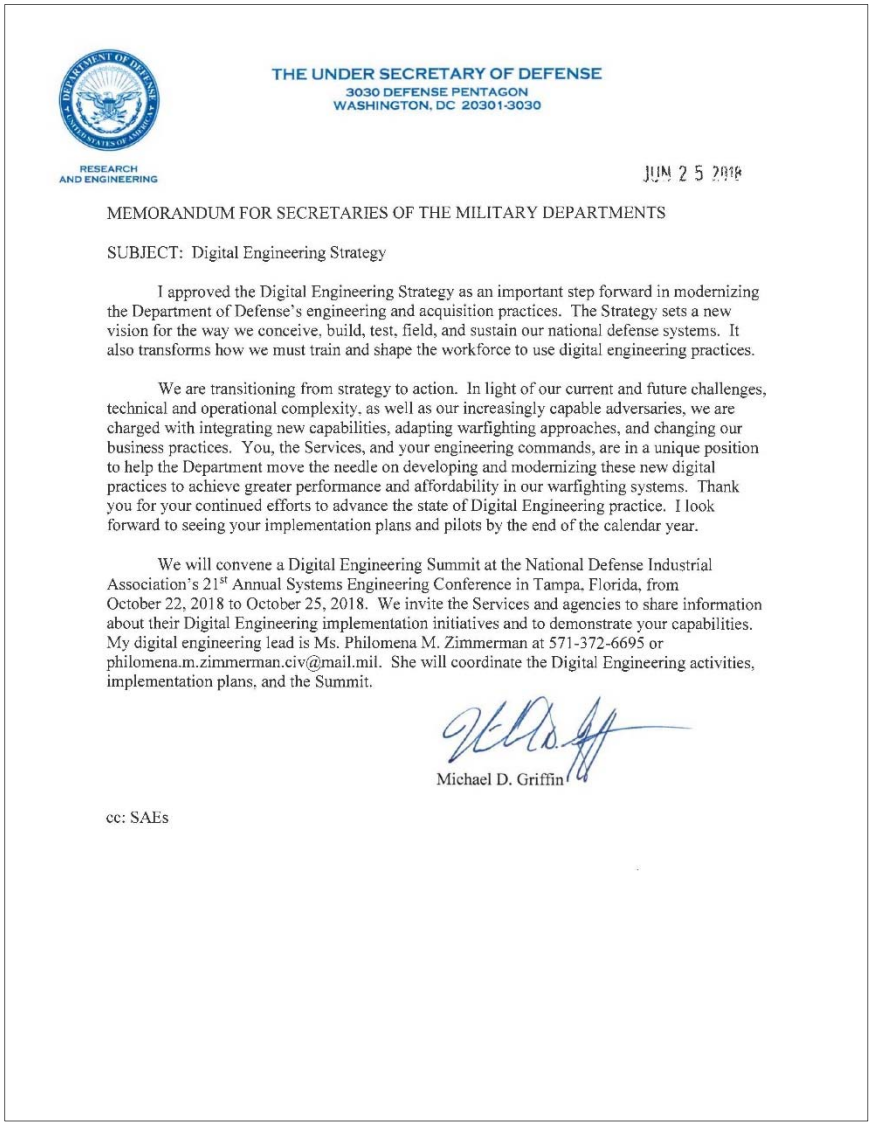
Digital Engineering Strategy



- **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

https://www.acq.osd.mil/se/docs/2018-DES.pdf

Digital Engineering to Service Secretaries and DEPSECDEF



THE UNDER SECRETARY OF DEFENSE
3030 DEFENSE PENTAGON
WASHINGTON, DC 20301-3030

RESEARCH AND ENGINEERING

JUN 25 2018

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS

SUBJECT: Digital Engineering Strategy

I approved the Digital Engineering Strategy as an important step forward in modernizing the Department of Defense's engineering and acquisition practices. 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 are transitioning from strategy to action. In light of our current and future challenges, technical and operational complexity, as well as our increasingly capable adversaries, we are charged with integrating new capabilities, adapting warfighting approaches, and changing our business practices. You, the Services, and your engineering commands, are in a unique position to help the Department move the needle on developing and modernizing these new digital practices to achieve greater performance and affordability in our warfighting systems. Thank you for your continued efforts to advance the state of Digital Engineering practice. I look forward to seeing your implementation plans and pilots by the end of the calendar year.

We will convene a Digital Engineering Summit at the National Defense Industrial Association's 21st Annual Systems Engineering Conference in Tampa, Florida, from October 22, 2018 to October 25, 2018. We invite the Services and agencies to share information about their Digital Engineering implementation initiatives and to demonstrate your capabilities. My digital engineering lead is Ms. Philomena M. Zimmerman at 571-372-6695 or philomena.m.zimmerman.civ@mail.mil. She will coordinate the Digital Engineering activities, implementation plans, and the Summit.

Michael D. Griffin

cc: SAEs

"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"

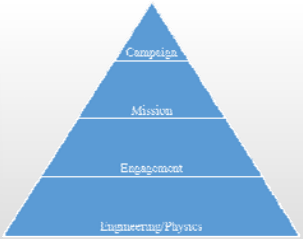
- **US Army Lead: Dr. Nancy Bucher**
  nancy.m.bucher.civ@mail.mil

Digital Engineering Relationships

Digital Engineering Strategy

User selected and integrated based on desired outcome

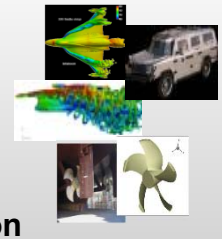
Traditional Mod/Sim Solutions



(DoD) Modeling and Simulation Coordination Office (DMSCO)

Physics-based & Engineering Design Tools

CREATE



Computational Research and Engineering Acquisition Tools and Environments (CREATE)

Large Tradespace Analytics & Virtual

ERS
ENGINEERED RESILIENT SYSTEMS
DEPARTMENT OF DEFENSE

World-class High Performance Computing (HPC)

DOD HPC
MODERNIZATION PROGRAM

Infrastructure that scales to complex conditions

Computational Environment for Digital Engineering Activities

Other Initiatives

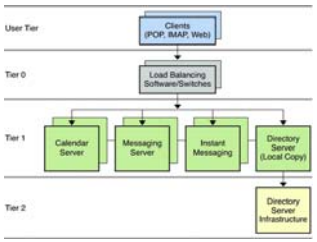
Model: A Day in the Life

Customer Requirements
- Draft CDD

System Requirements

Allocated Requirements

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



Alt Prelim Design Concepts
- CAD/PLM
- Software

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Trade–off Studies

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

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

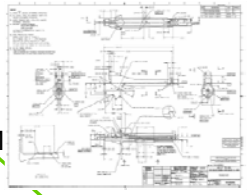
This is valuable Intellectual Property that must be captured and made available for reuse

Prototype Fabrication
- Mfg Instructions

Testing
- Test Plans
- Test Results

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

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



Logistics Mgmt Info
- Tech Manuals
- Provisioning Data
- Trng Matrls

Baseline (System Spec)

Baseline (Allocated Specs)

Baseline (Preliminary Product Baseline)

Baseline (Product Baseline - TDP)

Technology Development | **Engineering and Manufacturing Development** | **Production/ Deployment**

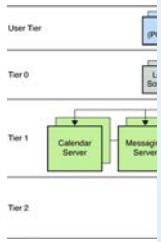
Model: A Day in the Life

Customer Requirements
• Draft CDD

System Requirements

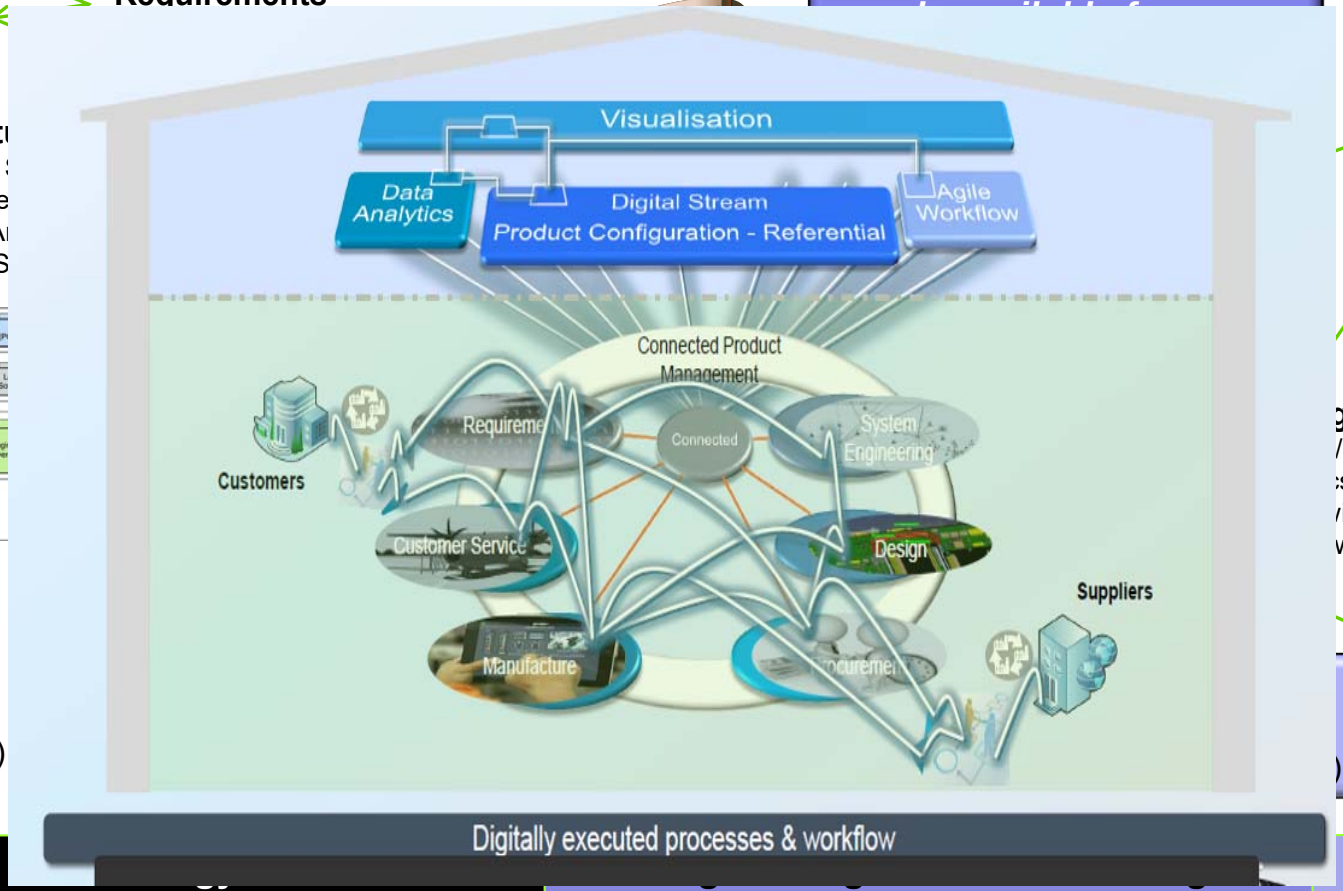
Allocated Requirements

System Architectu
• Operating
• System Be
• Physical A
• Dynamic S



Baseline
(System Spec)

This is valuable Intellectual Property that must be captured and



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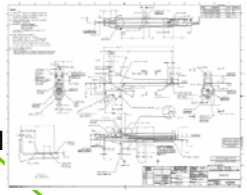

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Logistics Mgmt Info
• Tech Manuals
• Provisioning Data
• Trng Matrls

Development | **Development** | **Production/ Deployment**

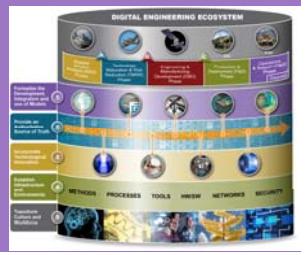
Digital Engineering Strategy
Goal 1

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**

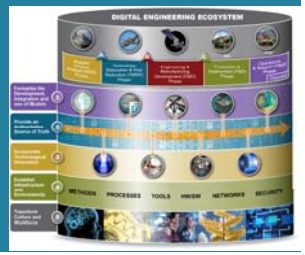
3. **Use models to support engineering activities and decision making across the lifecycle**



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**

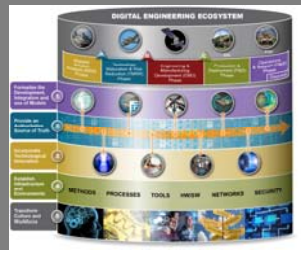
2. **Develop, mature and use digital engineering methodologies**

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



Digital Engineering: Thoughts on What is Necessary to Measure?

Workforce Adoption

- Appropriate level of skill required to function at different levels, in different roles, within a Digital Engineering Ecosystem
- Applicability of 'domain' measures to Digital Engineering adoption measurement
- Use of value of Digital Engineering effectiveness to combat resource cost argument
- Tool and environment availability and impact to digital engineering adoption
- Non-engineering skills impact to digital engineering adoption
- Usability of Digital Engineering tools, per skill level
- Assessment of new skills; vs adaptation of current skills

Digital Engineering Effectiveness

- The expected result was achieved; and the achievement was due to the use of Digital Engineering Practices
- Usability and reusability of digital artifacts
- Accountability of impact of digital artifact development, and reuse on overall program schedule
- Impact of lack of computing resources on digital engineering effectiveness
- Accounting for changes to digital artifacts as a part of ROI calculation
- Impact to Product quality (Risk and Opportunity understanding)
- Digital Engineering tools effectiveness to product quality
- Appropriateness of authoritative source of truth

Measurement Unknowns….

- What do we measure?
- How will the measurement be used?
- What functional alignments make sense for measurement?
- What is baseline to compare to if Acquisition / Engineering processes are changing?
- How is Return-on-Investment captured and described so that any ROI comparison is relevant?
- What does Digital Artifact completeness look like?
- How much ‘modeling’ is enough?
- How is cyber-resilience of Authoritative Source of Truth assessed?
- How to assess workforce skill changes to remove impedance to Digital Engineering adoption?

DE Measurement Workshop

- **PSM has developed an Information Category-Measurable Concept Measurement (ICM) table which reflects measurement best practices**
- **Objectives of the workshop**
  - Assess the impact digital engineering may have on measurement
  - In particular, review the ICM table to assess how does measurement change as projects implement digital engineering approaches

What impact does the move towards Digital Engineering have on measurement?

Systems Engineering: Critical to Defense Acquisition










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

DASD, Systems Engineering
https://www.acq.osd.mil/se

For Additional Information

Digital Engineering website:

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

Philomena Zimmerman

ODASD, Systems Engineering

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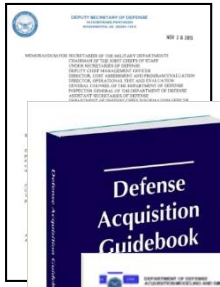
Leveraging Multiple Activities

Infusion in Policy & Guidance

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



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

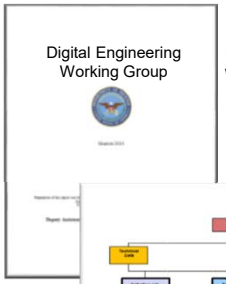
Defense Acquisition Guidebook Chapter 3

DoD Digital Engineering Fundamentals

Defense Acquisition University

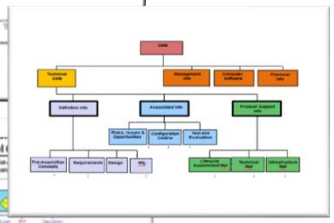
NASA – National Aeronautics and Space Administration
NNSA – National Nuclear Security Administration
NDIA – National Defense Industrial Association
INCOSE – International Council on Systems Engineering
AIA – Aerospace Industries Association
AIAA – American Institute of Aeronautics and Astronautics
OEMs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

ODASD(SE) Initiatives

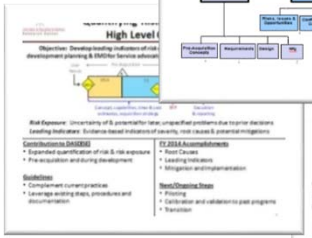


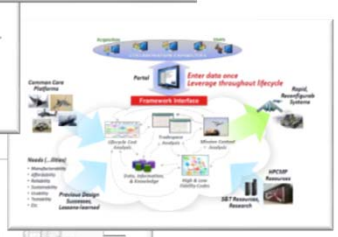
DoD Digital Engineering Working Group (DEWG)

Digital Engineering Strategy



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





System Engineering Research Center (SERC): Model Centric Research

NASA: Sounding Rocket Program

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

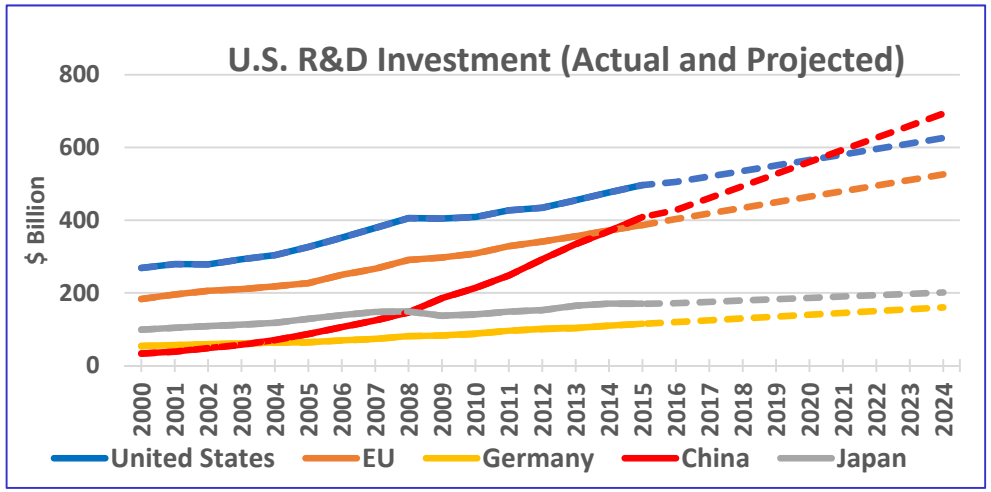
- **Armed Services**
  - U.S. ARMY
  - U.S. AIR FORCE
  - U.S. NAVY
- **DoD Components**
  - Department of Defense
  - Defense Logistics Agency
  - National Geospatial-Intelligence Agency
  - National Reconnaissance Office
- **Interagency**
  - NASA
  - Federal Aviation Administration
  - Department of Veterans Affairs
  - Department of Homeland Security
  - NNSA
  - National Nuclear Security Administration
- **Industry/OEMs/ Industrial Orgs**
  - NDIA
  - INCOSE
  - AIA
  - AIAA
- **Academic**
  - DAU Defense Acquisition University
  - SYSTEMS ENGINEERING RESEARCH CENTER

Advancing the state of practice for Digital Engineering

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 the "time to market"
- **Increased rate of investment in military Research & Development (R&D) from near-peers**
- **Increasingly Competitive National Security Technical Environment**
- **Speed and cycle time become the discriminator**

- 2017 GLOBAL R&D FUNDING FORECAST WINTER 2017
Industrial Research Institute, R&D Magazine



- 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

Digital Engineering and the National Defense Strategy

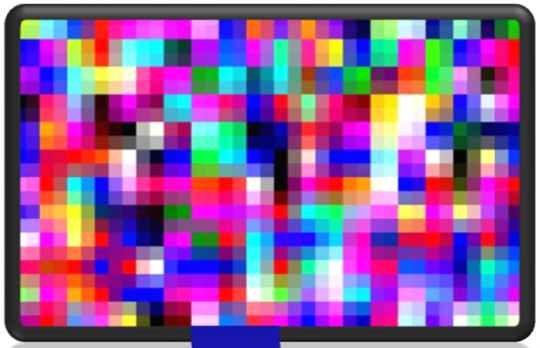
Remarks by Secretary Mattis
on the National Defense Strategy
January 19, 2018

"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."

Let Us Begin a Dialogue on Digital Artifacts

We start with a lot of complex technical stuff

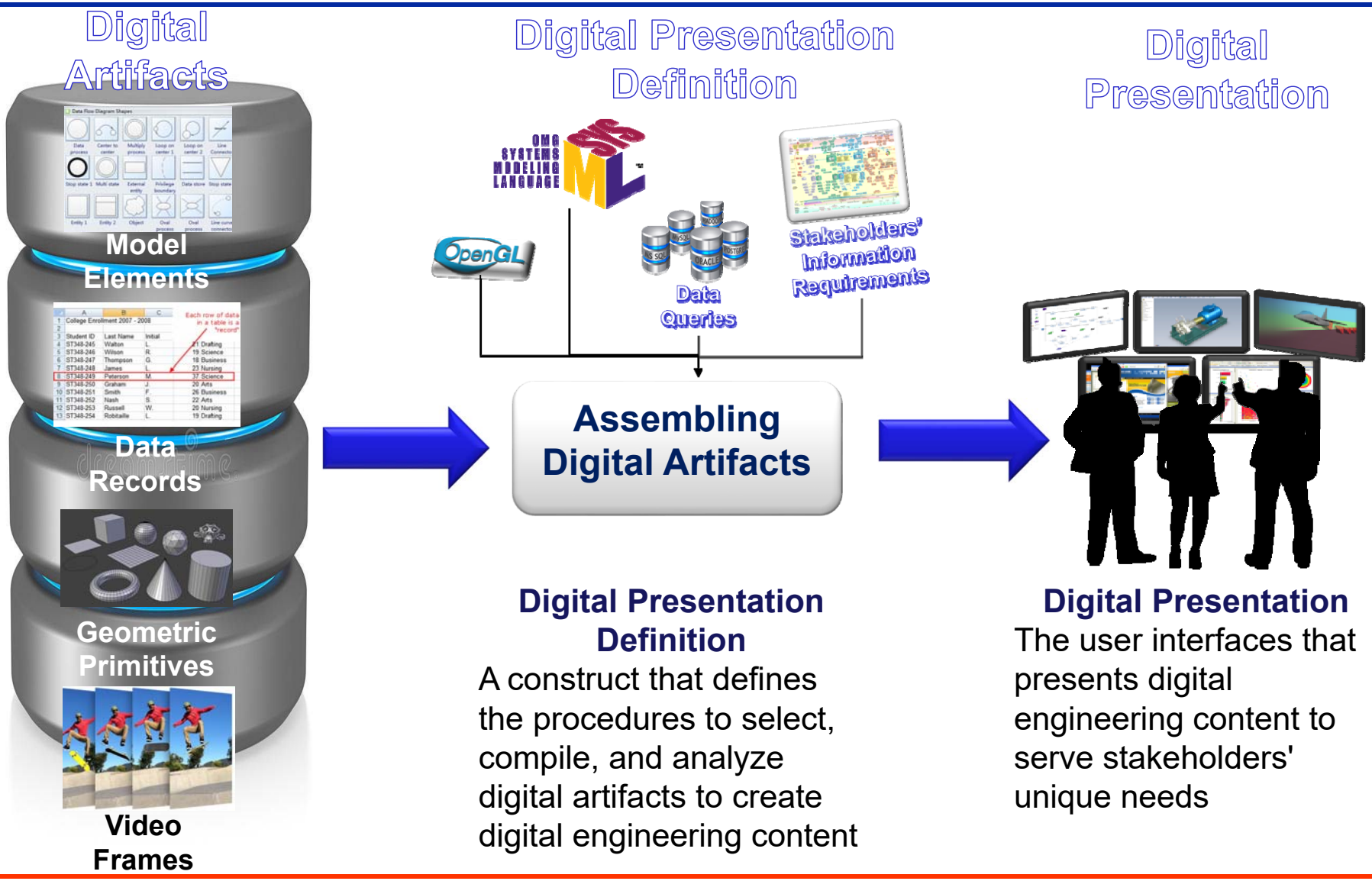


We finish with stuff stakeholders understand

We organize and evolve it in ways that make sense

How do we make this happen?

Transforming Digital Artifacts to Stakeholder Wisdom



Digital Presentation Definition

A construct that defines the procedures to select, compile, and analyze digital artifacts to create digital engineering content

Digital Presentation

The user interfaces that presents digital engineering content to serve stakeholders' unique needs

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

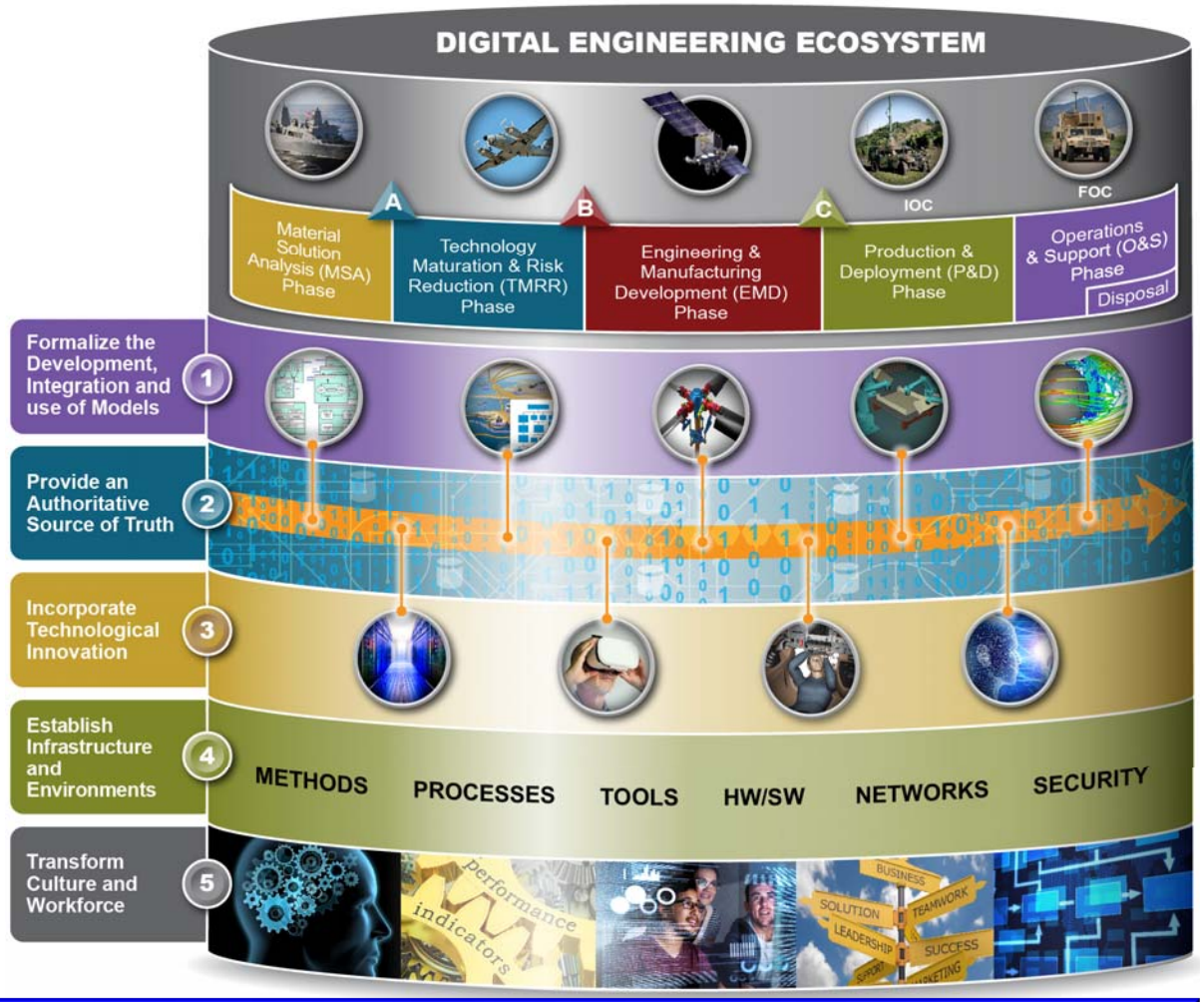
- ❑ **Service Delivery and Execution of Implementation Plans**
- ❑ **Foundational & Cross-Cutting Challenges**
  - o **Data Patterns/Digital Artifacts**
  - o **Data Rights/Access and Intellectual Property**
  - o **Model Trust / Curation**
  - o **Model Improvement (e.g., from test data)**
  - o **Securing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

Implementing Digital Engineering Across the Services

Digital Engineering Overview

- **What is Digital Engineering?**
  - Combines model-based techniques, digital practices, and computing infrastructure
  - Enables Delivery of high pay off 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