

# **Digital Engineering**

### Phoenix Integration Conference Ms. Philomena Zimmerman Deputy Director, Engineering Tools and Environments

#### **April 2018**



### Systems Engineering Purpose



Systems Engineering focuses on engineering excellence – the creative application of scientific principles:

- To design, develop, construct and operate complex systems
- To forecast their behavior under specific operating conditions
- To deliver their intended function while addressing economic efficiency, environmental stewardship and safety of life and property

DASD(SE) Mission: Develop and grow the Systems Engineering capability of the Department of Defense – through engineering policy, continuous engagement with component Systems Engineering organizations, and through substantive technical engagement throughout the acquisition life cycle with major and selected acquisition programs. U.S. Department of Defense is the World's Largest Engineering Organization

Over 108,000 Uniformed and Civilian Engineers

Over 39,000 in the Engineering (ENG) Acquisition Workforce

A Robust Systems Engineering Capability Across the Department Requires Attention to Policy, People, and Practice



## **National Defense Strategy Anchor**



**"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."

- Gen Mattis, SECDEF







### Continuation...

- We will expand the competitive space while pursuing three distinct lines of effort:
- First, rebuilding military readiness as we build a more lethal Joint Force;
- Second, strengthening alliances as we attract new partners; and
- <u>Third, reforming the Department's business practices for</u> <u>greater performance and affordability</u>.

- Gen Mattis, SECDEF





- Background
  - Dynamic operational and threat environments
  - Growth in system complexity and risks
  - Linear acquisition process that lacks agility and resiliency

Digital Engineering: 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.

- Cost overruns and delayed delivery of capabilities to the warfighter
- Current practices can't keep pace with innovation and technology advancements
- Need
  - Outpace rapidly changing threats and technological advancements
  - Deliver advanced capabilities more quickly and affordably with improved sustainability to the warfighter
  - Foster a culture of innovation

#### Digital Engineering transforms the way the DoD innovates and operates





- A model is a representation of reality.
- If you constrain the model building blocks to Data, Algorithms, and/or Processes; AND
- If you accept that Digital Engineering uses computers to perform as much of the lifecycle activities as practical <u>THEN</u>:
- Digital Engineering uses computers to develop, warehouse, evolve, curate, and execute our models (SEE ABOVE) in support of system lifecycle activities, to include activities supporting ESOH concerns and decisions

Provides for cohesion, concordance, and continuum of information usable by all stakeholders in the system, regardless of the system form

### Minimizing the risk caused by unnecessary human intervention



## **Digital Engineering Relationships**





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## Model: A Day in the Life







## Digital Engineering Strategy: Five Goals





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



Provide an enduring **authoritative source** of truth



Incorporate **technological innovation** to improve the engineering practice



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



Transform a **culture and workforce** that adopts and supports Digital Engineering across the lifecycle



Drives the engineering practice towards improved agility, quality, and efficiency, resulting in improvements in acquisition

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#### Stakeholders

- Auditing
- Business Cost Estimating
- Business Financial Management
- Contracting
- Engineering
- Facilities Engineering
- Industrial Contract
  Property Management
- Information Technology
- Life Cycle Logistics
- Production, Quality, & Manufacturing
- Program Management
- Purchasing
- Science & Technology Management
- Test and Evaluation





### Provide an Enduring, Authoritative Source of Truth





### Incorporate Technological Innovation









# **Establish Supporting Infrastructure**







## **Transform Culture and Workforce**







## **Strategy-in-Action Example**



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Warfighting Benefits	How	Examples
More Effective & Lethal Weapon Systems	Ability to manufacture complex shapes and otherwise impossible designs/components	Consolidated assemblies Lattice structures Multi-functional materials Embedded sensors
Tailored Solutions for the Mission and Warfighter	Ability for mission tailorability and mass customization at almost no additional cost	ArmorWeaponsMunitionsUnmanned systemsNutritionally Tailored FoodsInvariant
Agility of Production Line - New era of supply chain independence	Ability to produce only what is needed, where it is needed, when it is needed	Improved field fabrication "Good enough" & "Conditionally Approved" parts Environment-independent printers
Reduced Sustainment Costs and Increased Responsiveness	Ability to make obsolescence obsolete	Rapid reverse-engineering Anti-corrosive Anti-degradation materials
Accelerated Capability Development	Ability for INNOVATION; novel designs, rapidevelopment, faster transitions	d Urgent needs Rapid response

AM is any process by which digital 3D design data is used to build up a component in layers by depositing material.



## **Expectations & Big Rocks**



#### Digital Engineering Expectations

Informed decision making/greater insight through increased transparency

Enhanced communication

Increased understanding for greater flexibility/adaptability in design

Increased confidence that the capability will perform as expected

Increased efficiency in engineering and acquisition practices

from Inter-Agency Working Group: Model-Based System Engineering (MBSE) Infusion Task Team, "Digital Model-based Engineering: Expectations, Prerequisites, and Challenges of Infusion," 2017

#### **Digital Engineering Big Rocks**

Investment

Culture and workforce

Policy, guidance, contracting

Governance

Security

Intellectual property protection

Tool/model portability

Infrastructure and environments

Model quality and assurance

synthesized from Digital Engineering Working Group; National Defense Industrial Association Model-Based Engineering Report, Aerospace Industries Association Model-based Engineering reports

# Coordinating with the Services/Agencies to implement Digital Engineering strategy elements and develop mitigation for remaining challenges





- Business processes and behaviors (culture) need to be changed to realize the benefits of Digital Engineering implementation
- Multiple activities in government, industry, academia, and professional organizations are being leveraged to advance digital engineering concepts within DoD enterprise
- Expected benefits of implementing digital engineering practice outweigh the monetary, time, and training needed up front
- Basic elements of Digital Engineering are in place; we need to weave them together and instantiate with policy, guidance, and training



### Systems Engineering: Critical to Defense Acquisition





Defense Innovation Marketplace http://www.defenseinnovationmarketplace.mil

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