Digital Engineering (DE) and Computational Research and Engineering Acquisition Tools and Environments (CREATE)

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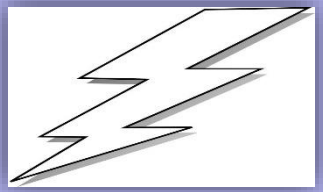
History

1st Industrial Revolution

MECHANICAL

Use of mechanical production powered by water and steam

2nd Industrial Revolution



ELECTRICAL

Use of mass production powered by electrical energy

3rd Industrial Revolution

INFORMATION TECHNOLOGY

Use of electronics and IT to further automation

4th Industrial Revolution

DIGITAL

Use of a digitally connected end-to-end enterprise

1800

1900

2000

TODAY

Traditional Models and Simulations (M&S)

Simulation Based Acquisition (SBA)

Model-Based Systems Engineering (MBSE)

DIGITAL ENGINEERING (DE)

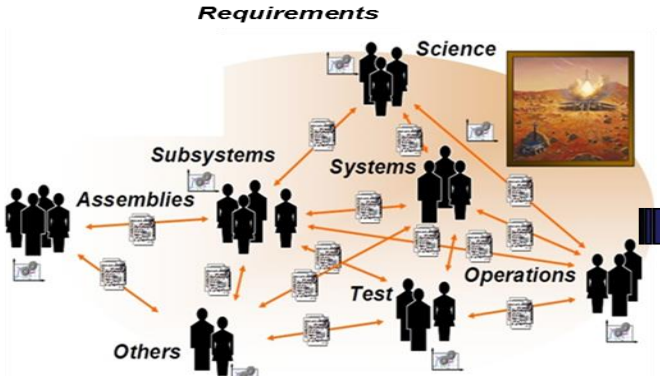
Digital Engineering: MBSE approach for DoD

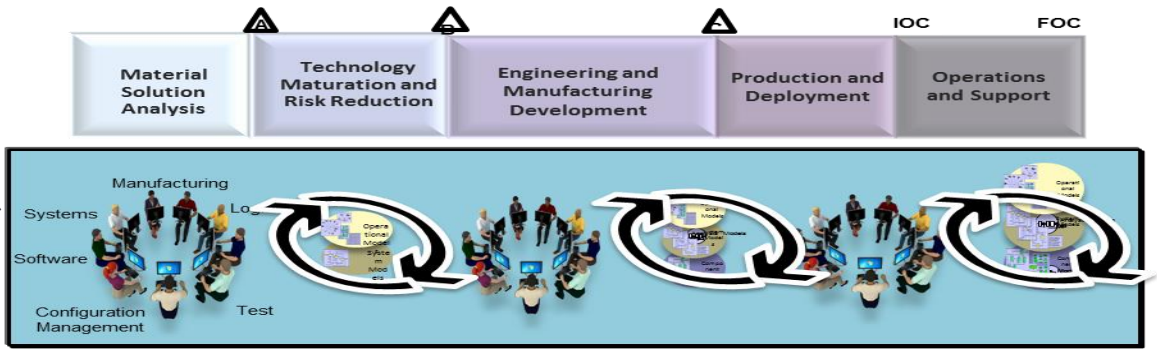
Current State

- Our workforce uses stove-piped data sources and models in isolation to support various activities throughout the life-cycle
- Current practice relies on standalone (discipline-specific) models
- Communication is through static disconnected documents and subject to interpretation

Future State

- Digital Engineering moves the engineering discipline towards an integrated model-based approach
  - Through the use of digital environments, processes, methods, tools, and digital artifacts
  - To support planning, requirements, design, analysis, verification, validation, operation, **and/or** sustainment of a system
- Digital Engineering ecosystem links our data sources and models across the lifecycle
  - Provides the authoritative source of truth





Current: Stove-piped models and data sources

Future: Digital Engineering Ecosystem

CREATE Products in Digital Engineering Context

Digital Engineering

- **Digital Engineering vision moves the engineering discipline towards an integrated model-based approach through the use of digital environments, processes, methods, tools, and digital artifacts**
- **Model is a representation of reality**
  - Model is ‘composed of’ data, algorithms and/or processes
  - Computable or used in a computation

CREATE

- **CREATE program develops and deploys validated physics-based High Performance Computing (HPC) applications to enable DoD engineers to implement and execute the digital engineering paradigm for major DoD platforms (naval, air, & ground vehicles and RF antennas)**
- **Includes ability to construct and improve digital product models for weapon platforms**
  - Tools address all stages of the acquisition process

Digital Engineering Relationships

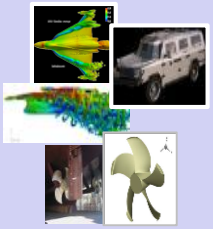
Digital Engineering Ecosystem

Digital Engineering Strategy

User selected and integrated based on outcome needed

Physics-based / Engineering Design Tools

CREATE



Computational Research and Engineering Acquisition Tools and Environments (CREATE)

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

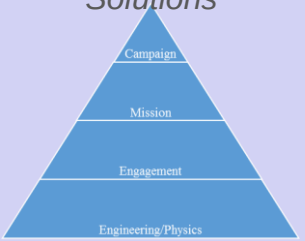
DOD HPC MODERNIZATION PROGRAM

Other Initiatives

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

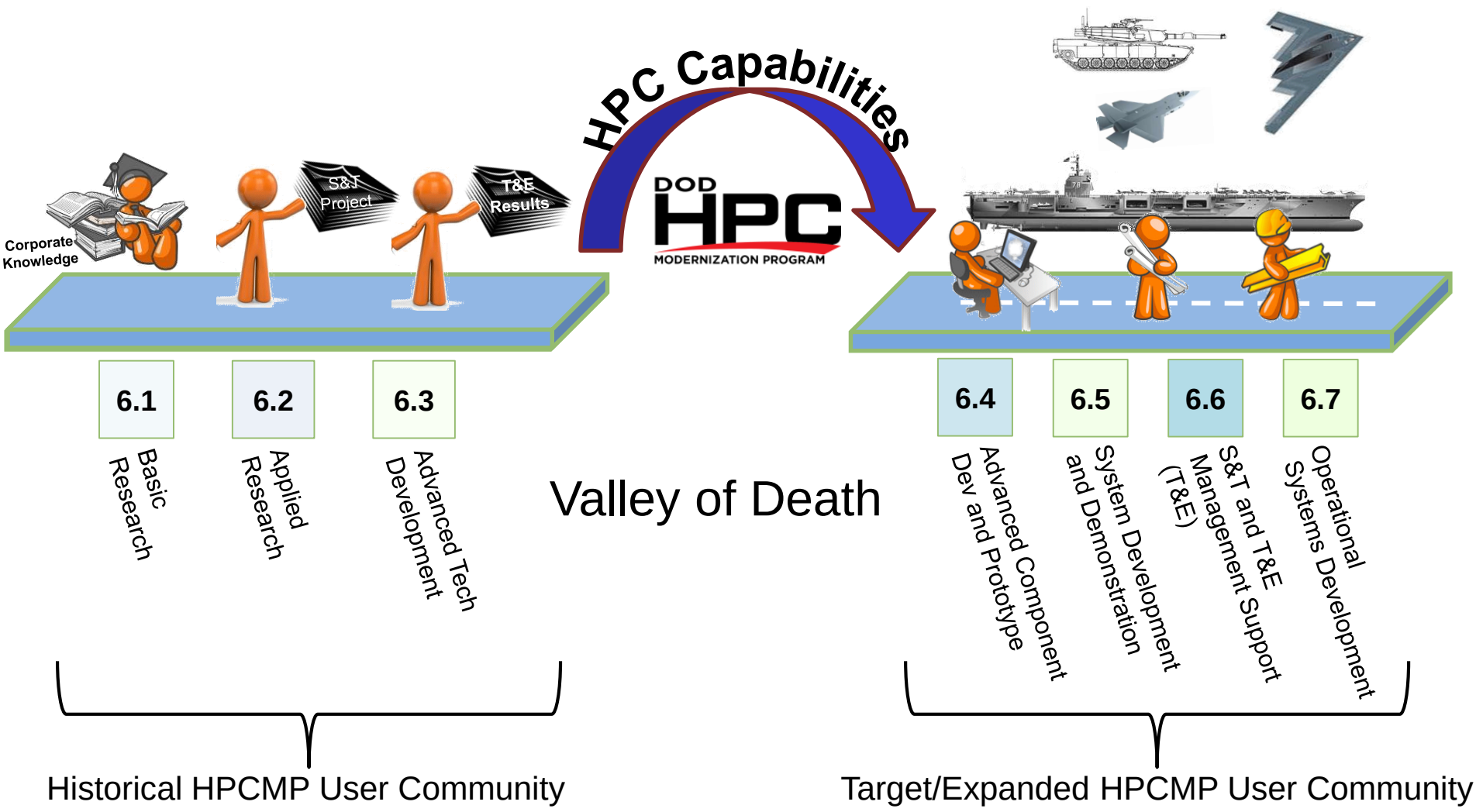
ERS ENGINEERED RESILIENT SYSTEMS

Traditional Mod/Sim Solutions



(DoD) Modeling and Simulation Coordination Office (DMSCO)

Transitioning S&T, T&E and Corporate Knowledge to Engineering & Acquisition



DRAFT Vision for ERS, CREATE, et al (crossing the Valley of Death)

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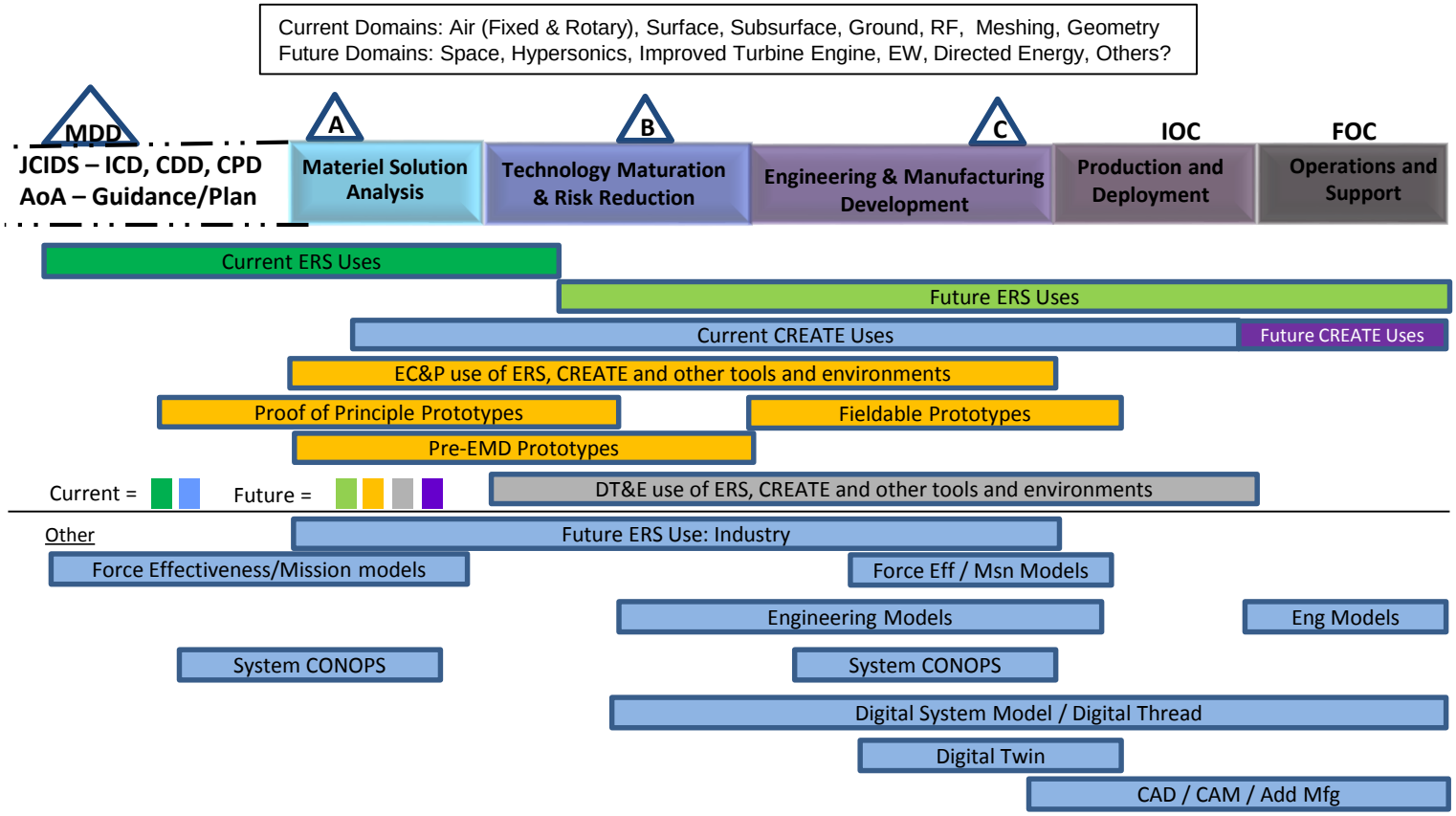
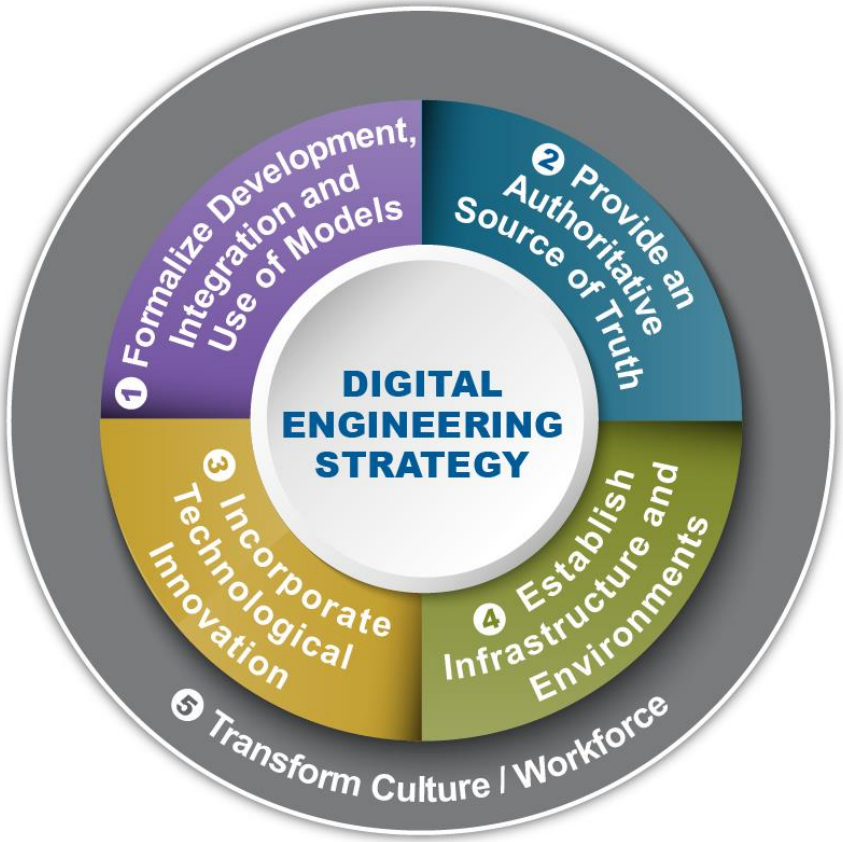


Digital Engineering Strategy: Five Goals

1. Formalize the **development, integration and use of models** to inform enterprise and program decision making
2. Provide an enduring **authoritative source of truth**
3. Incorporate **technological innovation** to improve the engineering practice
4. Establish supporting **infrastructure and environments** to perform activities, collaborate, and communicate across stakeholders
5. 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

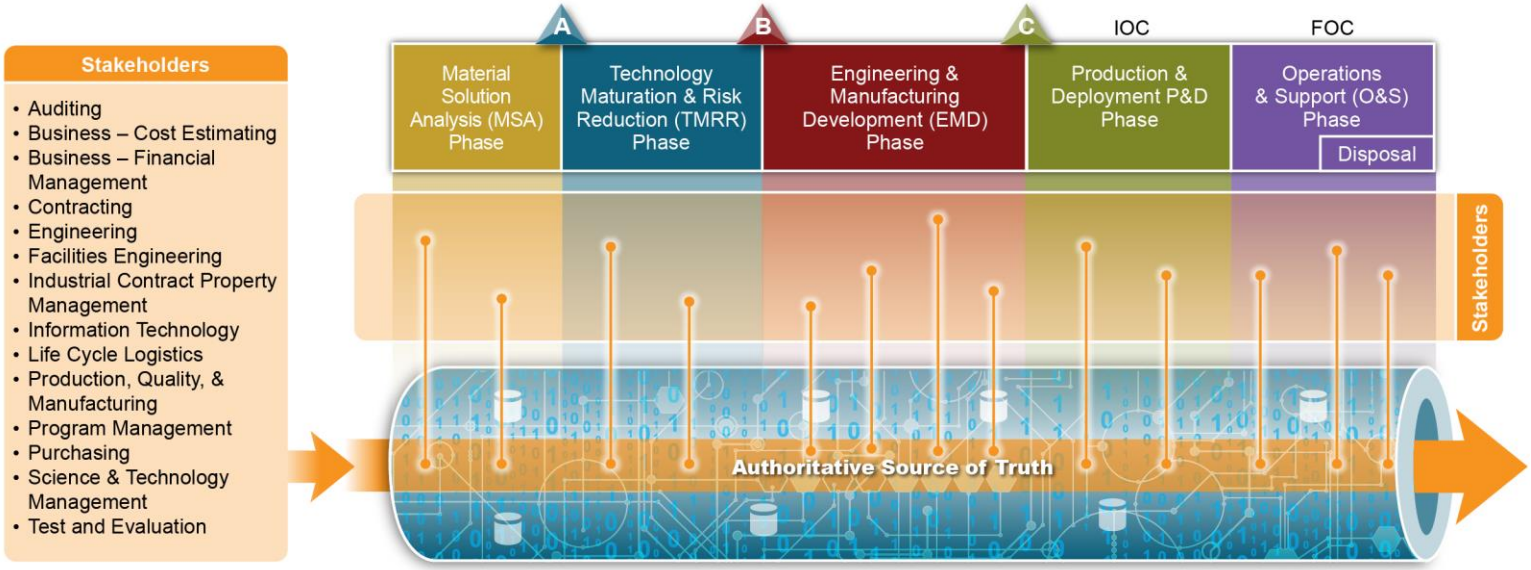
Goal #1: Formalize Development, Integration & Use of Models

CREATE in DE Goal 1:

- Develop, deploy and support physics-based software applications that enable DoD engineers to rapidly:
  - Develop digital product models (virtual prototypes) for weapon systems which can be used to populate design spaces
  - Analyze the performance of the of the systems, using medium- and high-fidelity physics-based HPC tools, identifying and fixing system design defects and performance shortfalls thus reducing rework, and costs, risks, and schedule, and improving performance for all stages of the acquisition process

Models as the cohesive element across a system's lifecycle

Goal #2: Provide an Authoritative Source of Truth



CREATE in DE Goal 2:

- Develop and deploy verified and validated physics-based HPC tools that include: all important effects, accurate solution algorithms, and model the complete system i.e. everything needed to accurately predict the performance in short enough compute times for parameter studies

Right information, right people, right uses, right time

Goal #3: Incorporate Technological Innovation

- **Big Data and Analytics**
- **Cognitive Technologies**
- **Computing Technologies**
- **Digital-to-Physical Fusion Technologies**

CREATE in DE Goal 3:

- HPCMP eco-system employs innovative technologies (High Performance Computers, high speed networks and advanced software).
- DoD engineers develop innovative systems by rapidly and efficiently generating many design options; identifying the failures and successes; and improvements
- Use of small teams to take risks, fail early and quickly in order to identify successful product designs

Harness technology, new approaches, and human-machine collaboration to enable an end-to-end digital enterprise

Goal #4: Establish Infrastructure & Environments

CREATE in DE Goal 4:

- High Performance Computing Ecosystem:
  - Subject matter experts from relevant stakeholders
  - Validated and verified data for use in engineering and acquisition activities
  - HPC Distributed Resource Centers
  - High-bandwidth network (DREN)
  - Software applications (CREATE codes now and in the future)

Foundational support for Digital Engineering environments

Goals #5: Transform Culture and Workforce

CREATE in DE Goal 5:

- HPCMP Partnerships with Service Engineering Organizations
- Development and use of CREATE builds computationally skilled DoD workforce
- Training and support is provided for those accessing CREATE – over 180 DoD organizations with ~1400 users.
- CREATE software is being incorporated into Service Academy and other university curricula
- Regular release of upgraded software capability

Institutionalize Digital Engineering across the acquisition enterprise

There Is Much More to Do…

- **Publish the Digital Engineering Strategy**
  - Support development of implementation guidance/direction in Services/Agencies
  - Follow with policy?
- **Finish the Digital Engineering Starter Kit**
  - Continue development; share/obtain feedback on digital artifact use
- **Engage with Acquisition Programs**
  - Establish criteria for use of Digital Engineering artifacts for decision points
- **Update Competencies across Acquisition Curricula**
  - Identify Digital Engineering education and training outside of acquisition curricula
- **Update Policy and Guidance (Engineering, et al)**
  - Develop/update governance processes, policy, guidance and contracting language
- **Transform Acquisition Practice**
  - Engage acquisition users
  - Incorporate rigor from Digital Engineering practices and artifacts into system lifecycle activities

Instantiation of Digital Engineering practice is necessary to meet new threats, maintain overmatch, and leverage technology advancements

Systems Engineering: Critical to Defense Acquisition










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

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

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