Office of the Under Secretary of Defense
Research and Engineering
Advanced Capabilities—Engineering

Systems Engineering Research Council
Sponsor Research Review

Keynote Address

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Deputy Director, Engineering

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OUSD(R&E) Mission

- **Ensure Technological Superiority for the U.S. Military**
  - Set the technical direction for the Department of Defense (DoD)
  - Champion and pursue new capabilities, concepts, and prototyping activities throughout the DoD research and development enterprise

- **Bolster Modernization**
  - Pilot new acquisition pathways and concepts of operation
  - Accelerate capabilities to the Warfighter

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**Advanced Capabilities—Engineering**
- Propagate Engineering Best Practices
- Solve Engineering Problems
- Connect the Engineering Community

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“Our mission is to ensure that we, if necessary, reestablish and then maintain our technical advantage.”

— Under Secretary Griffin, April 2018
USD(R&E) Operational Vision

“We will accelerate delivery of capabilities to the warfighter by first doing the up-front engineering work, then fielding prototypes, conducting demonstrations, and gaining important user feedback.”

- Jim Faist, Director of Defense Research and Engineering for Advanced Capabilities
Advanced Capabilities Overview

Role: Accelerate Modernization & Mature Technology to Capability, from Prototyping to Acquisition

Goals:
- Establish mission integration analytics
- Support Assistant Director (AD) technology roadmap development and execution
- Drive NDS responsive projects that close gaps in joint service capabilities
- Define technical risk and opportunities in major programs
- Enhance policy to accelerate modernization (remove barriers)

Prototyping & Software
- Deliver leap-ahead and disruptive technologies
- Execute allied prototyping initiative projects

Engineering
- Propagate engineering best practices
- Solve engineering problems
- Connect the engineering community

Test Resource Management Center
- Provide robust and flexible testing & evaluation capabilities
- Align test & evaluation efforts with DoD modernization goals
- Ensure ranges are ready to test new capabilities as they emerge
Advanced Capabilities/Engineering Org Chart

Advanced Capabilities

- Prototyping & Software
  - Developmental Test, Evaluation & Assessments
  - Mission Integration

- Engineering
  - Engineering Policy & Systems
  - Strategic Intelligence Analysis Cell

- Test Resource Management Center
  - Joint Hypersonics Transition Office
Advanced Capabilities Engineering Cycle

**Concept Formulation**
- Developmental Test, Evaluation & Assessments
  - Programs of Record

**Concept Implementation**
- Strategic Intelligence Analysis Cell (SIAC)
  - War-gaming / Strategic analysis

**Concept Refinement**
- Joint Staff / COCOMS
  - Industry
  - DDRE (Modernization)

**Mission Engineering**
- Mission Integration

**Legend:**
- Internal to DoD
- External to DoD

- Chief Engineers Council
- M&S Group
- T&E Group

Legend: DD, ENG DD, P&S
The Mission Engineering process analyzes multiple, intersecting levels of timeframe, complexity, and analytical rigor to:

- Integrate mission-based architectures as frameworks for analysis
- Model end-to-end mission threads to quantify efficacy of modernizations concepts
Mission Engineering - Roles, Policy, Guidance

**POLICY AND GUIDANCE**

- DoDI 5000.02 (Revision)
- DoDI 5000.ENG (New)
- Mission Engineering Guide (New)

**KEY TENETS**

- Applies to all Defense Acquisition System Pathways
- Continually assess/reassess Mission Risk, Issue, Opportunity (RIO) at decision points
- Programs must come with mission analyses
- Shared data
- Shared responsibility
- Use higher-level models when applicable
- Engineer lower-levels models to support higher level models
- TRANSPARENCY
## Mission Engineering Approach and Methodology

- **Steps 1-4:** Conduct Mission Engineering Analysis Planning (sharpen the blade)
- **Step 5:** Run the models/perform the analysis (cut the tree)
- **Step 6:** Document the study conclusions to inform trades, investment decisions (wood products from the tree)

### Mission Engineering Approach

<table>
<thead>
<tr>
<th>ME Analysis Planning</th>
<th>ME Analysis Execution</th>
<th>Reporting and GRA Documentation</th>
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<tbody>
<tr>
<td><strong>Problem Statement</strong></td>
<td><strong>Design of Analysis</strong></td>
<td><strong>Document Study Conclusions</strong></td>
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<tr>
<td>• Questions</td>
<td>• Define Trial</td>
<td>• Selected Architecture</td>
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<tr>
<td>• Suspected Gap(s)</td>
<td>approaches to evaluated</td>
<td>• ME Analysis Report</td>
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<tr>
<td>• Technologies</td>
<td>• Define per trial:</td>
<td>• Curated Data/Models for reuse</td>
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<tr>
<td>• Concepts</td>
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<td>• Decisional Briefings</td>
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<td></td>
<td>o Data</td>
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<tr>
<td><strong>Mission Characterization</strong></td>
<td>• Design of Analysis – Define MTs / METs for each trial</td>
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<tr>
<td>• Scenarios</td>
<td>• Define Architectures</td>
<td>• Telos “Mission” for a single Vignette</td>
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<tr>
<td>• Vignettes</td>
<td>o ‘As-Is’ baseline (reference case blue forces)</td>
<td>• “Capability” when analyzed for commonality across Vignettes &amp; MTs/METs</td>
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<tr>
<td>• ROE/CONOPS</td>
<td>o ‘To-Be’ alternative (alt. blue force &amp; performance)</td>
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<tr>
<td>• Assumptions</td>
<td>o Gather Data/Models</td>
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<td>• Threat Laydown and capability</td>
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### Mission Metrics

- **MOS & MOEs – Success and Effectiveness**
- **Quantifiable and Relevant**
- **Link MOEs:**
  - Top-down & bottom-up
  - Iterative decomposition

### ROE = Rules of Engagement

### MOS = Measures of Success

### MOE = Measures of Effectiveness

### MET = Mission Engineering Thread

### MT = Mission Thread

**Timeframe of interest**

Repeat until desired confidence is achieved
Why Capability Portfolio Management?

[Image with flowchart showing concepts like Capabilities, Threats, Mission Threads, Roadmaps, Systems and Technologies, Resources, Mission Threads, etc.]

Strategic Synchronization Across The Department
Digital Engineering Update

• Driving Digital Engineering transformation through a focus on implementation.

• Cultivating Digital Engineering Community of Practice and Practitioners
  - Instantiating the tenets of the strategy, driving implementation
  - Building and enabling collaboration
  - Establishing a body of knowledge to guide implementation
  - Developing a digital ecosystem
  - Tracking progress using measures of merit
Air Force Digital Engineering Update

- **2019**: The Air Force established the Digital Engineering Enterprise Office (DEEO) to Institutionalize Digital Engineering across the Air Force
  - DEEO Mission: To facilitate and accelerate the digital engineering transformation through the identification of common problems, gaps, and opportunities; the alignment of innovative initiatives; the deployment of solutions; and the sharing of knowledge

**Department of the Air Force Digital Trinity**

**Principles of Digital Acquisition**

- Agile Development
- Digital Engineering Management
- Open Architectures

- Collaborative Environments
- Assured Clouds
- Authoritative Lifecycle Models

**Speed and Agility**

- Own, Share, and Promote the Tech Stack
- Web from Stack to the Edge
- Evolve before you Assert

**Digital Enabler – Government Reference Architectures**

- Government Reference Architectures guide and constrain solutions.
  - Developing GRAs, Models, Analytic tools, and infrastructure that can be immediately leveraged by emerging and legacy programs to enable rapid development, testing, and integration.

**Integrated, Gov’t Owned Tech Stack**

Distribution Statement A: Approved for public release. Distribution is unlimited.
Army Digital Engineering Update

- Army Digital Engineering Vision signed by HON Bruce Jette, Army SAE, in 2020
- The Army’s Office of the Chief Systems Engineer drafting digital engineering policy and implementation guidance
- Transforming existing document centric, stove-piped processes to digital engineering processes using an integrated modelling environment
Navy Digital Engineering Update

- Navy Digital Engineering Strategy aligned with the DoD Strategy - Objectives:
  - Formalize the Development, Integration, and Use of Models
  - Establish Enduring Authorized Knowledge Source
  - Incorporate Technologies
  - Develop a Digital Engineering Infrastructure / Environment Across Lifecycle
  - Transform Culture of Workforce
Updating DoD Systems Engineering to the 21st Century

- Changing DoD Systems Engineering Practices
  - Working to adapt to newer technology (Digital Engineering, Modular Open Systems Approach, M&S, Machine Learning, Agile/DevSecOps, and Adaptive Acquisition Pathways)
  - Shift practices from risk-averse to risk-managed
  - Appropriate documentation and Best Practices tailoring to different sized programs
  - Better support agile development

- Need to update and transform Systems Engineering to address state-of-the-art Engineering practices
  - “As we continue to strengthen the United States military readiness for the future, our imperative is to build upon the gains we have made in recent years, while adapting to stay ahead of emerging challenges.” – Secretary Esper, Oct. 2020.
Office of Under Secretary of Defense (OUSD) Research and Engineering (R&E) initiating a project that will update processes, methodologies, and documentation to transform Systems Engineering.

We will be putting together a diverse team of experts from the Services, DoD Agencies, Other Gov’t Organizations, and Industry.

Over the next few months, we will be formulating the work plan.
Questions

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A Mission Engineering Approach...

... Linking evolving warfighter concepts to solutions...

**Mission Engineering Objectives**

- Mission-focused threat-informed analyses to evaluate capability solutions, advise on development of requirements and inform technology investment decisions.
- Identify enhanced capabilities, technologies, system inter-dependencies, and architectures to close mission gaps.
- Provide mission concepts/ops into sets of Mission Blueprints to guide other activities.
- Synchronize prototypes and systems in development to meet evolving mission needs.

**Method to Synergize Missions**

- Concepts
- Systems
- Technologies
- Budgets
- Requirements
ME Guide Purpose

- Speaks to a novice that is required to conduct mission engineering
- Invokes critical thinking throughout the mission engineering process
- Provides overarching guidance and information on ME by:
  - Explaining what is and what is not ME
  - Describing the best practices, principles, and attributes for ME
  - Elaborating on the benefits of using ME
  - Establishing a set of common terms and definitions
- Enables practitioners to formulate problems and build a firm understanding of the main principles involved in performing analysis in a mission context
- Provides users with insight as to how to document and portray results or conclusions via a set of products that help inform key decisions (e.g., Government [Mission or Capability] Reference Architectures)
- OUSD(R&E) will promulgate ME guidance
  - ME Guide will replace the draft version of the OUSD A&S Mission Engineering & Integration (ME&I) Guidebook
  - Additional efforts include development of ME training material
Assembled working group consisting of representatives from Army, Navy, Air Force, Joint Staff, OUSD(A&S), MDA, CAPE, and CIO/CDO to collaborate on guide development

- Providing review and feedback on guide and lexicon
- Providing ME process and content examples from their respective organizations to help ensure alignment with the guide

• Leveraging complimentary ME activities, where appropriate, to ensure community agreement of concepts, lexicon, and processes
Mission Engineering links concepts to relevant and timely delivery of capability

Inform Concept Maturation

Inform Technology Efficacy and Investment Decisions

Inform Materiel Requirements

Inform Prototyping

Inform Acquisition Decisions (Enable Capability Portfolio Management)
Mission Engineering Informs “Big A” Acquisition

Adaptive Acquisition Framework

JCIDS

PPBE

Modernization

"We cannot expect success fighting tomorrow’s conflicts with yesterday’s weapons or equipment.”
– National Defense Strategy

- 5G
- Autonomy
- Biotechnology
- Cyber
- Directed Energy
- Fully Networked Command, Control, and Communications
- Hypersonics
- Machine Learning / Artificial Intelligence
- Microelectronics
- Quantum Science
- Space

For each modernization priority, a Portfolio Manager (Assistant Director) is responsible for establishing the DoD-wide, mission-focused strategy and execution plan.