Defense Engineering Excellence

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Engineering Within DoD

Systems Engineers creatively apply scientific principles across a broad portfolio of weapons, sensors, command and control, logistics, and business systems:

- 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

- *US 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*





Unprecedented Focus on Technical Excellence

"We at the Pentagon must… be open to new ideas and new ways of doing business that can help us operate more efficiently and perform more effectively in an increasingly dynamic and competitive environment.

As DoD counters the very real dangers we face in the world, we will also grab hold of the bright opportunities before us – opportunities to …re-forge our nation's military and defense establishment into a future force that harnesses and develops the latest, cutting-edge technology, and that remains superior to any potential adversary…"

Secretary of Defense Ash Carter
Submitted Statement, Senate Appropriations Committee-Defense (Budget Request)
May 06, 2015

"…our technological superiority is slipping…we want to achieve an overmatch over any adversary from the operational theater level all the way down to the fighter plane, Navy ship or infantry squad…Battlefield advantages in the future are going to be very short-lived because the amount of technology that is out there right now is unbelievable."

Honorable Robert Work
Deputy Secretary of Defense
US Army War College, April 2015

"Simply delivering what was initially required on cost and schedule can lead to failure in achieving our evolving national security mission — the reason defense acquisition exists in the first place."

Honorable Frank Kendall
Under Secretary of Defense (AT&L)
2015 Performance of the Defense Acquisition System

Better Buying Power 3.0

Achieving Dominant Capabilities Through Technical Excellence and Innovation

http://bbp.dau.mil

Achieve Affordable Programs

- Continue to set and enforce affordability caps

Achieve Dominant Capabilities While Controlling Lifecycle Costs

- Strengthen and expand "should cost" based cost management
- Anticipate and plan for responsive and emerging threats by building stronger partnerships of acquisition, requirements and intelligence communities
- Institutionalize stronger DoD level Long Range R&D Program Plans
- Strengthen cybersecurity throughout the product lifecycle

Incentivize Productivity in Industry and Government

- Align profitability more tightly with Department goals
- Employ appropriate contract types, but increase the use of incentive type contracts
- Expand the superior supplier incentive program
- Increase effective use of Performance-Based Logistics
- Remove barriers to commercial technology utilization
- Improve the return on investment in DoD laboratories
- Increase the productivity of corporate IRAD

Incentivize Innovation in Industry and Government

- Increase the use of prototyping and experimentation
- Emphasize technology insertion and refresh in program planning
- Use Modular Open Systems Architecture to stimulate innovation
- Increase the return on and access to small business research and development
- Provide draft technical requirements to industry early and engage industry in funded concept definition
- Provide clear and objective "best value" definitions to industry

Eliminate Unproductive Processes and Bureaucracy

- Emphasize acquisition chain of command responsibility, authority and accountability
- Reduce cycle times while ensuring sound investments
- Streamline documentation requirements and staff reviews
- Remove unproductive requirements imposed on industry

Promote Effective Competition

- Create and maintain competitive environments
- Improve DoD outreach for technology and products from global markets
- Increase small business participation, including more effective use of market research

Improve Tradecraft in Acquisition of Services

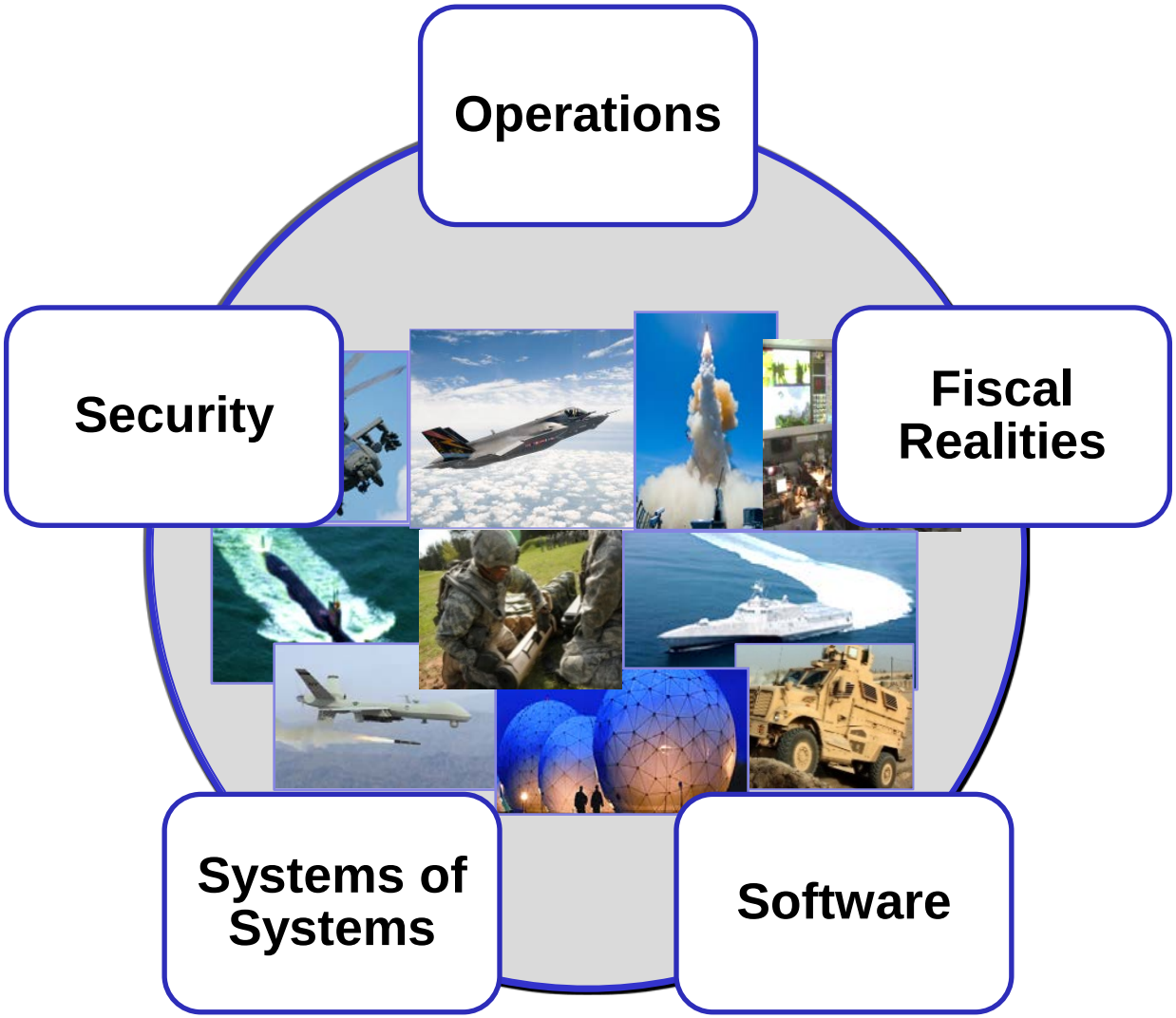
- Strengthen contract management outside the normal acquisition chain — installations, etc.
- Improve requirements definition for services
- Improve the effectiveness and productivity of contracted engineering and technical services

Improve the Professionalism of the Total Acquisition Workforce

- Establish higher standards for key leadership positions
- Establish stronger professional qualification requirements for all acquisition specialties
- Strengthen organic engineering capabilities
- Ensure development program leadership is technically qualified to manage R&D activities
- Improve our leaders' ability to understand and mitigate technical risk
- Increase DoD support for STEM education

Continue Strengthening Our Culture of Cost Consciousness, Professionalism, and Technical Excellence

What Drives Our Ability to Achieve Technical Excellence



Complexity of our Defense Systems

Contributors	Complicated By
Operations	Assuring current mission performance while maintaining ability to support predicted and unknown future operational needs
Fiscal Realities	Reduced forces, reduced budgets; ensuring affordability as part of the systems trade space
Software	Critical dependence on software; sheer amount of code; can we develop, integrate, maintain and assure our software?
Systems of Systems	Integration of multiple systems to achieve mission effects which may or may not be their primary design requirement
Security	The threat has unprecedented access to our technical data—and can capitalize on this

How Does Complexity Drive Systems Engineering?

Critical attributes of DoD Systems Engineering

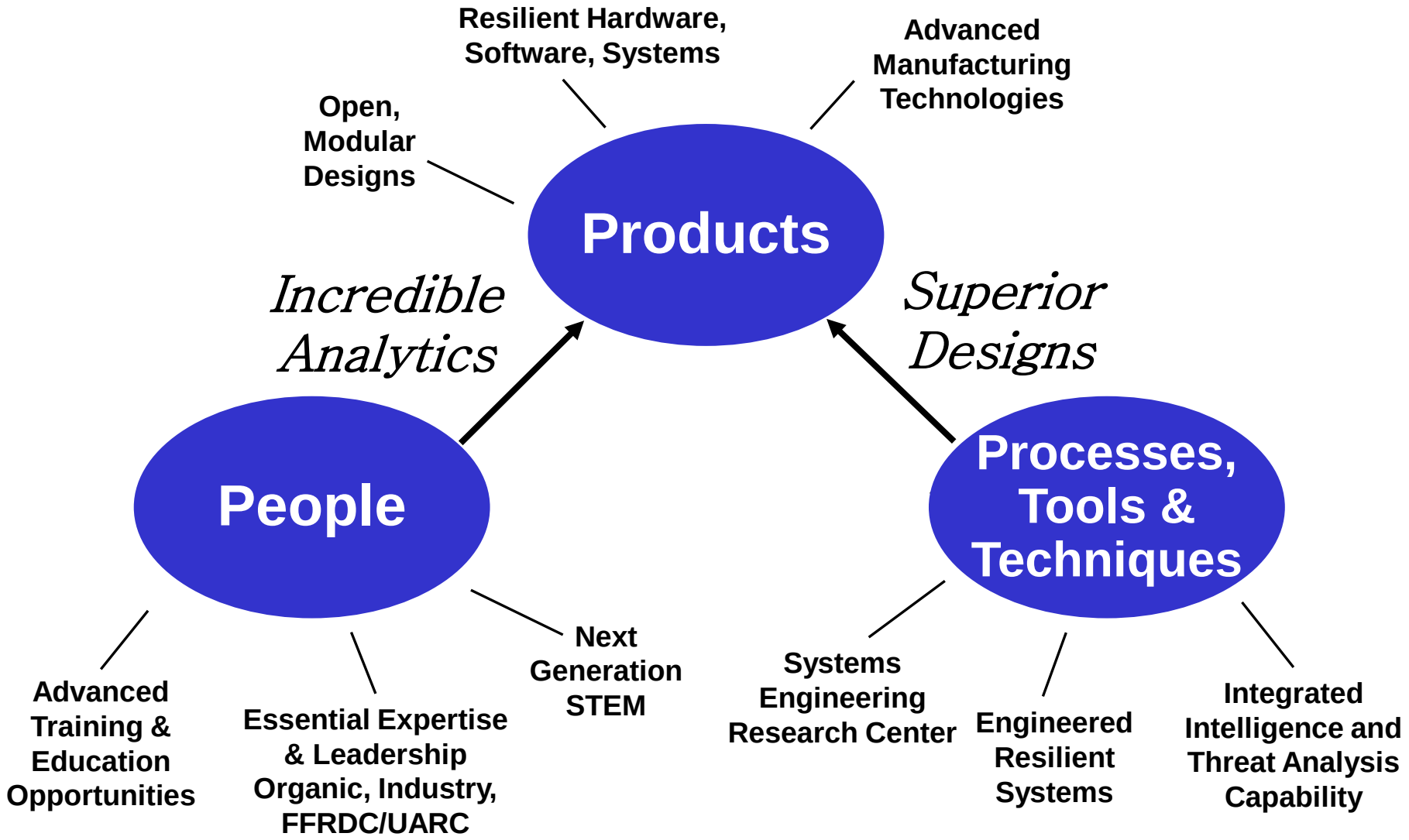
- **Flexible designs that adapt and are resilient to unknown missions and threats**
- **Ability to quantify cost and affordability attributes of the design trade space**
- **Systems of Systems, and Enterprise contexts driving requirements from multiple stakeholders**
- **Responsive, and able to balance agility with rigorous analysis and data**
- **Safeguarding critical information while designing for interoperability and global markets**
- **Applied across significantly diverse domains**

Balancing these attributes is challenging to SE, drives the state of the practice, and stresses critical workforce capacity

Vision for Defense Engineering

Persistent learning…talented engineering leadership…advanced tools and methods that enable deep analysis for informed decisions…solutions that are well designed, can adapt, and are secure, sustainable, and affordable

Transforming Core Elements of Defense Engineering



People

Initiatives and Outcomes

STEM Engineering	• Expand SE Capstone Program to be a broad DoD, Industry, University Initiative • Promote the “E” in DoD STEM programs
Organic Engineering	• Identify critical technical capabilities for the organic workforce • Establish JIT delivery of technical training and education to complement existing acquisition training • Baseline and track advanced engineering degree programs for uniformed and civilian engineers

Processes, Tools & Techniques

Initiatives and Outcomes

Digital Engineering Design (DED)	• Pilot digital artifacts in program acquisition • Finalize the digital engineering data taxonomy
Engineering Enterprise	• Measure and recognize performance of Component Engineering Centers • Provide DoD-wide access to commonly-used engineering standards

Products

Initiatives and Outcomes

Modular, Open Systems	• Construct MOSA guidance to achieve tailored product goals • Mature and disseminate MOSA standards, support program implementation
Resilient Systems	• Establish Joint Federated Assurance Center as primary HW/SW assurance resource for programs • Integrate intelligence and acquisition sources for proactive protection of technical information • Establish cyber resilient engineering policy, guidance and design standards

Interagency Working Group for Engineering of Complex Systems

Interagency Cooperation

- Develop common understanding of problems
- Collaborate, share expertise and resources

Position Paper at:
http://www.acq.osd.mil/se/outreach/pubs.html

Current Participants:

- National Science Foundation
- National Aeronautics and Space Administration
- National Oceanic and Atmospheric Administration
- Department of Defense
- National Institute of Standards and Technology
- Department of Energy
- Department of Transportation
- Department of Homeland Security
- Federal Aviation Administration
- Veterans Administration

"We need to investigate the core principles of engineering & science that lay the foundation for significant, next generation advances in cross-discipline engineering practice and education in multi-scale environments."
IAWG Joint Statement

Systems Engineering Research Center

1. Stevens Institute of Technology
2. University of Southern California
3. Air Force Institute of Technology
4. Auburn University
5. Carnegie Mellon University
6. Georgetown University
7. Georgia Institute of Technology
8. Massachusetts Institute of Technology
9. Missouri University of Science and Technology
10. Naval Postgraduate School
11. North Carolina Agricultural & Technical State University
12. Pennsylvania State University
13. Purdue University
14. Southern Methodist University
15. Texas A&M University
16. Texas Tech University
17. University of Alabama in Huntsville
18. University of California - San Diego
19. University of Maryland
20. University of Massachusetts Amherst
21. University of Virginia
22. Wayne State University

Research Focus Areas:

- Enterprise Systems and Systems of Systems
- Trusted Systems
- Systems Engineering and Systems Management Transformation
- Human Capital Development

140 journal and conference papers
88 technical reports

NOTABLE PROJECTS

- **Trade Space and Affordability Methods, Tools, and Processes**
- **System Security Engineering**
- **Quantitative Risk**

SERC leverages expertise of over 400 researchers across the Nation

Opportunities for DoD and Industry Collaboration

- Contribute to development of engineering standards for cyber resilient systems
- Transition microelectronics design and evaluation tools
- Share intelligence, counterintelligence, and law enforcement analysis for more proactive protection of critical information
- Identify and address gaps in modular, open standards
- Pilot and transition ERS technologies
- Monitor advanced manufacturing institutes for opportunities to advance SE processes, tools, and techniques
- Partner to establish a broad Capstone Program to improve systems education in engineering degrees

Technical Excellence End State

- **Improved organic engineering workforce capability and environment**
- **Efficient processes; maturing data and growing knowledge over time**
- **Enhanced communication with industry throughout requirements, design, manufacturing, and sustainment**
- **Affordable systems achieving near- and far-term dominance**

Systems Engineering: Critical to Defense Acquisition










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

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