DoD Systems Engineering Update

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Office of the Under Secretary of Defense (AT&L)

NDIA Systems Engineering Division Meeting

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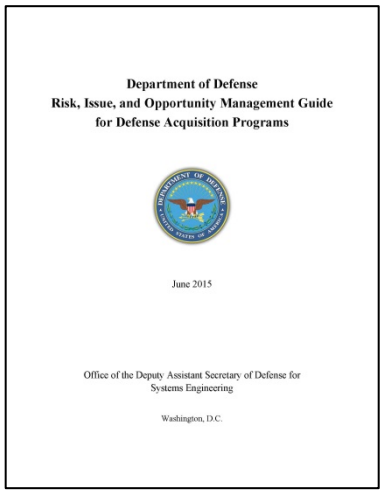
Systems Engineering Policy and Guidance

- **Guidance**
  - Department of Defense Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs (DoD RIO Guide) published June 2015 http://www.acq.osd.mil/se/docs/RIO-Guide-Jun2015.pdf
    - Supports the Better Buying Power 3.0 initiative: Improve our leaders' ability to understand and mitigate technical risk
    - Ensures understanding, implementation, and reporting of risk identification, management, and mitigation across the Department


Department of Defense
Risk, Issue, and Opportunity Management Guide
for Defense Acquisition Programs

June 2015

Office of the Deputy Assistant Secretary of Defense for Systems Engineering

Washington, D.C.

- **Standards Development**
  - IEEE 15288.1-2014, "IEEE Standard for Application of Systems Engineering on Defense Programs" – published May 2015
  - IEEE 15288.2-2014, "IEEE Standard for Technical Reviews and Audits on Defense Programs" – published May 2015
  - SAE AS6500, "Manufacturing Management Program" – published November 2014
  - EIA 649_1, "Configuration Management Requirements for Defense Contracts" – published November 2014
  - Working with SAE and IEEE/NDIA to develop implementation guidance for above standards

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DoD Systems Engineering Research Center (SERC)

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

- Tradespace and Affordability Methods, Tools, and Processes
- System Security Engineering
- Quantitative Risk

SERC leverages expertise of over 400 researchers across the Nation

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Recent SERC Final Technical Reports

- RT-107: Quantitative Risk
- RT-108: Assessing the Impact of Development Disruptions and Dependencies in Analysis of Alterative System of Systems
- RT-109: Computational Intelligence Approach to System of Systems (SoS) Architecting and Analysis
- RT-110: Enterprise Systems Analysis
- RT-112: Development and Application of FACT Portfolio Management Capability
- RT 113: Tradespace and Affordability
- RT-115: Security Engineering
- RT-118: Transforming Systems Engineering through Model-Based Systems Engineering (MBSE)
- RT-122: Interactive Model-Centric Systems Engineering (IMCSE)
- RT 123: Design and Development Tools for the Systems Engineering Experience Accelerator
- RT-129: Advanced Technical Leadership

http://www.sercuarc.org/technical-reports/

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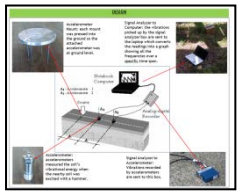
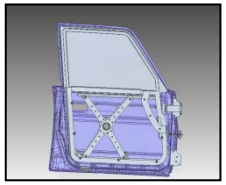
Dealing With Complexity Starts With Education

- **Most engineers graduate with depth in one discipline, but limited breadth and leadership**
  - Shortfalls in fundamentals of multi-disciplinary activities, such as System Engineering, Design and Addressing Complexity
- **DoD sponsoring SERC research to establish a Capstone Marketplace; seeing significant value at low cost**
  - Multi-disciplinary teams of engineering students use systems engineering methods on senior design projects
  - Example: Six universities proposed solutions to projects sponsored by U.S. Special Operations Command in 2014-15; topics included Vessel Disablement, Armored Windows, Information Overload, Austere Landing Zones, Enhanced Human Performance, Water-activated Life Vests
- **Next-generation engineers provide sponsors with fresh insights, novel approaches, innovative solutions to complex problems**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UT Austin Example – Complex Capstone Projects

- **Fundamental SE principles can be integrated into hands-on capstone design without displacing other course content**
- **Design applications enable real-world SE learning**

- **Concept tested and validated at Texas A&M**

Chaput, Mark, "Teaching Aircraft Systems Engineering as a Fundamental Principle of Design ", AIAA-2014-0062, 2014, ASM 2014, Washington, DC

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Engineering Education Challenges and Opportunities

- **Understanding the complexity of real-world systems is essential for today's engineering students**
- **Research and pilots have demonstrated a transition opportunity**
- **Government, Industry, and Professional Organizations can benefit from engaging with Academia to:**
  - Provide the hard problems the require technical leadership and multi-disciplinary solutions
  - Serve as the customer and mentor, convey realistic requirements
- **Leadership and commitment are needed to realize the benefits of this research on a broader scale**

Develop the Next Generation of Engineering Talent

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Better Buying Power 3.0

Achieving Dominant Capabilities through Technical Excellence and Innovation

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

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Strengthening Cybersecurity throughout the Product Lifecycle

- A vital aspect of maintaining U.S. technological superiority is ensuring cybersecurity of our networks and systems. Systems today, as well as all of their external interfaces, must be resilient from cyber adversaries.
- In FY 2014, the Department amended the Defense Federal Acquisition Regulation Supplement (DFARS) to safeguard unclassified Controlled Technical Information (CTI); we must now ensure this provision is effectively applied to all new DoD contracts.
- We will also identify the acquisition and technology programs most critical to enabling U.S. technological superiority in order to focus our cybersecurity and protection resources.
- We will integrate efforts from acquisition, law enforcement, counterintelligence, and intelligence communities toward a common goal of protecting our programs.
- We will develop a new Enclosure for DoDI 5000.02 addressing all aspects of the program manager's and others' responsibilities for cybersecurity throughout the product lifecycle.

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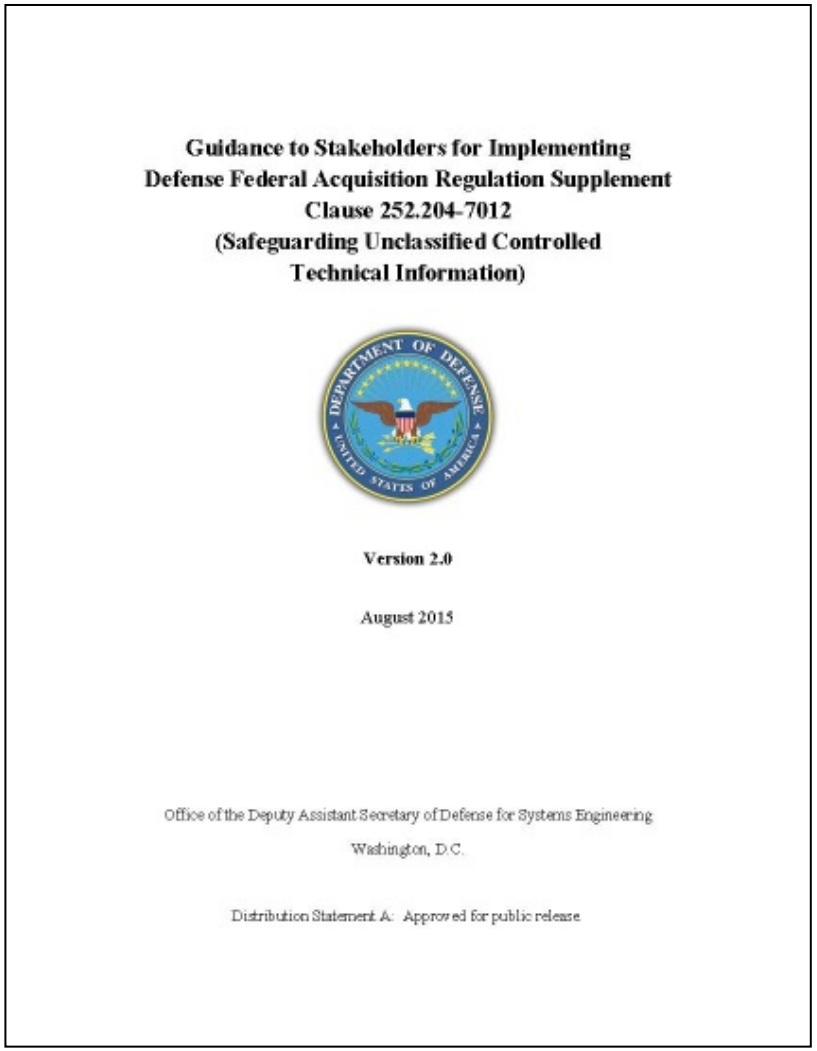
Updated Cyber Guidance

Released updated "Guidance to Stakeholders for Implementing Defense Federal Acquisition Regulation Supplement Clause 252.204-7012 (Safeguarding Unclassified Controlled Technical Information)," Version 2.0 August 2015.

http://www.acq.osd.mil/se/docs/DFARS-guide.pdf



Guidance to Stakeholders for Implementing
Defense Federal Acquisition Regulation Supplement
Clause 252.204-7012
(Safeguarding Unclassified Controlled
Technical Information)

Version 2.0

August 2015

Office of the Deputy Assistant Secretary of Defense for Systems Engineering

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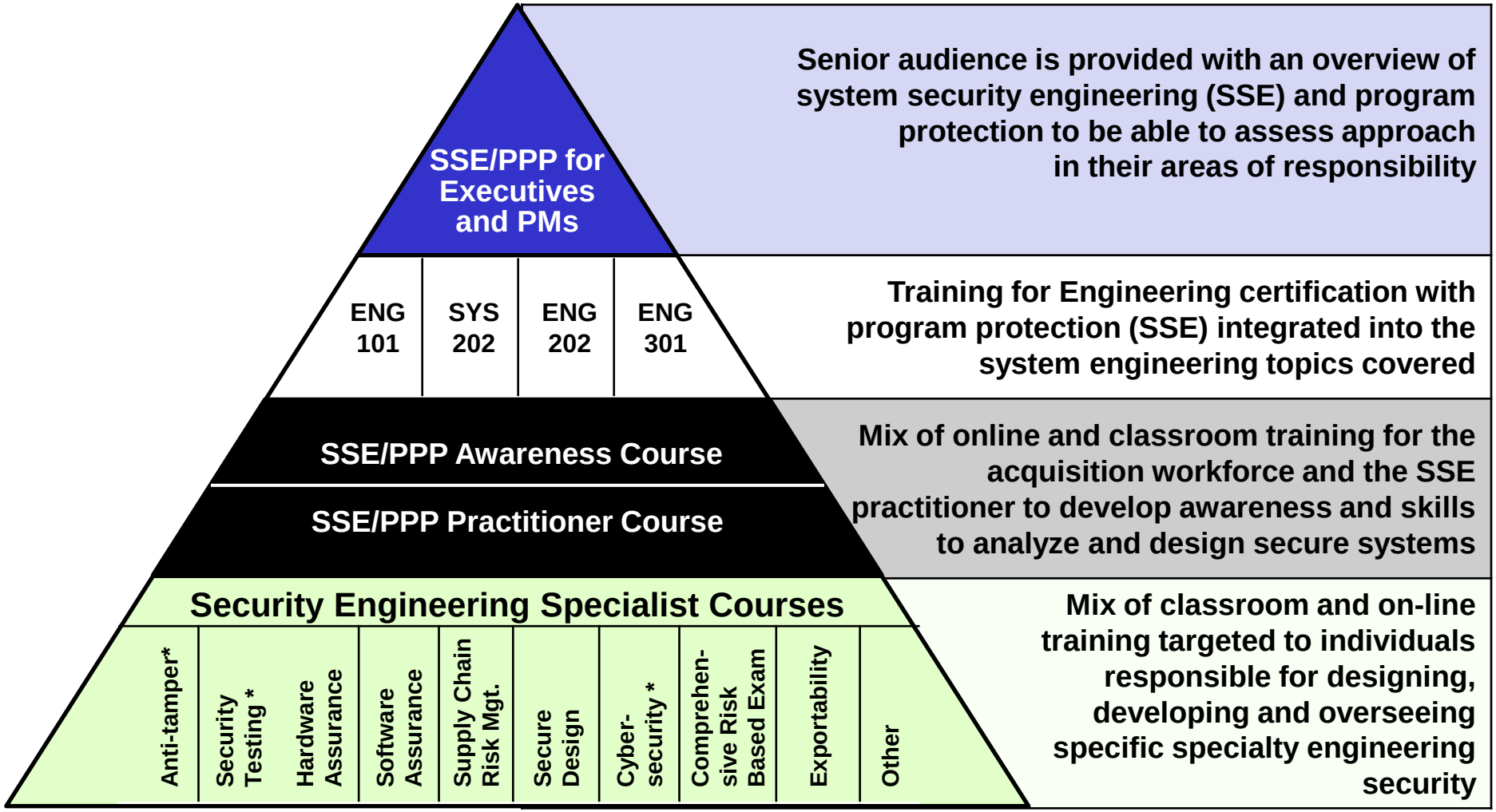
System Security Engineering Learning Architecture



Learning Architecture Is Organized To Provide Role-appropriate Knowledge.

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System Security Engineering

- **Government, Industry, Academia play an important role:**
  - **Integrating SSE into SE methods, processes and tools**
  - **Investing in research, tools, and processes to protect systems and supply chains**
  - **Developing flexible security architectures for designed-in protections**
  - **Developing SSE metrics**

Question: How do you measure the effectiveness of system security engineering; are our systems more secure?

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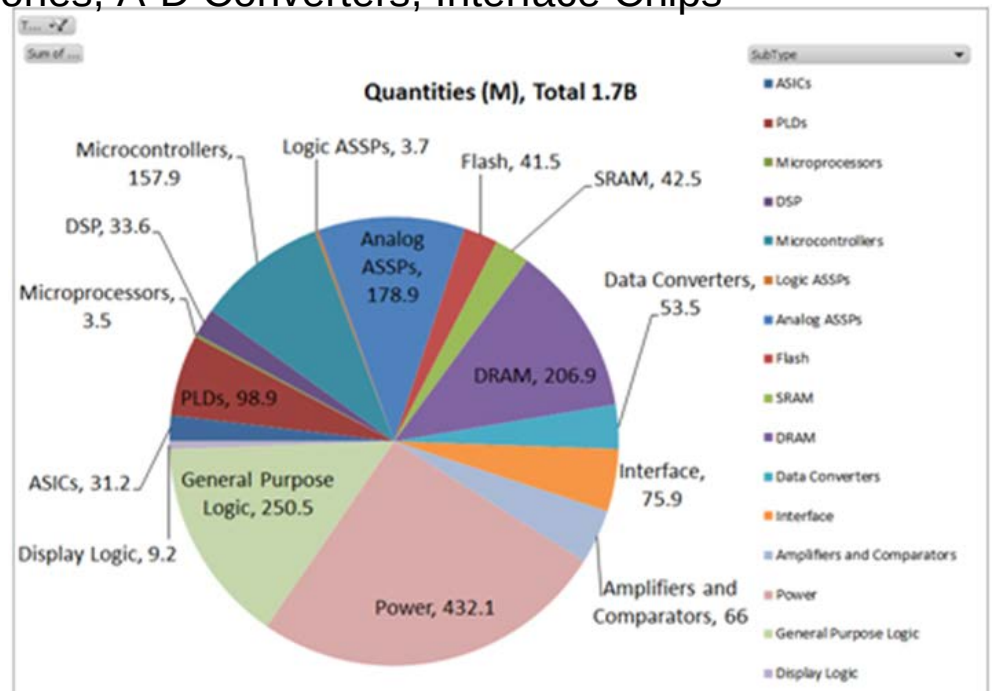
Trusted Microelectronics

- **Application Specific Integrated Circuit (ASIC) policy: DoD end-use ASICs can only be procured from a DMEA-accredited Trusted supplier**
  - Accounts for <2% of the 1.9B ICs DoD acquires per year
  - No trusted supply chain for other than custom ASICs exists
  - In general order of interest for trust: ASICs, FPGAs, Microprocessors, Logic Application Specific Standard Products, Memories, A-D Converters, Interface Chips

- **What is needed:**
  - A risk-based process for identification and prioritization of all critical ICs to address risk mitigation across life-cycle
  - More effective and affordable risk mitigation countermeasures for ICs
  - Continued collaboration between Government, Industry, and academia



Source: Institute for Defense Analysis

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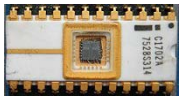
Joint Federated Assurance Center (JFAC)

Field Programmable Gate Array

Binary Computer Software Code

```
static void goodG2B() { char * data;
char data_buf[100] = ""; data =
data_buf; /* FIX: Specify the full
pathname for the library */
strcpy(data,
"C:\\Windows\\System32\\winsrv.dl
l"); { HMODULE hModule; /*
POTENTIAL FLAW: If the path to
the library is not specified, an
attacker may be able to * replace
his own file with the intended
library */ hModule =
LoadLibrary(data); if (hModule !=
NULL) { FreeLibrary(hModule);
printLine("Library loaded and freed
successfully"); } else { /* */
printLine("Unable to load library");
} } }
```

Computer Source Software Code



Erasable Programmable Read-Only Memory (EPROM)

Assure Mission SW and HW Security

Intent:

- Congress directed DoD to "…provide for the establishment of a joint federation of capabilities to support the trusted defense system needs…to ensure security in the software and hardware developed, acquired, maintained, and used by the Department." (FY14 NDAA, Sect. 937)

Expected Outcomes/Deliverables:

- Federated cross-DoD awareness and coordination of software and hardware assurance (SwA/HwA) capabilities and expertise
- Development and sharing of SwA/HwA vulnerability assessment best practices, tested tools, and proven processes
- Identification of R&D needs to advance SwA/HwA capabilities for programs in acquisition, operational systems, and legacy systems and infrastructure

Key Participants:

- Sponsor(s): ASD(R&E)/DASD(SE)
- Contributors: CIO, AF, Army, Navy, USMC, NSA, NRO, MDA, DISA, Defense Microelectronics Activity (DMEA)

Approach:

- Establish Federation of HwA and SwA capabilities to support programs in program protection planning and execution
- Support program offices across life cycle by identifying and facilitating access to Department SwA and HwA expertise and capabilities, policies, guidance, requirements, best practices, contracting language, training, and testing support
- Coordinate with DoD R&D for HwA and SwA
- Procure, manage, and distribute enterprise licenses for HW and SW assurance tools

Milestones:

Formed Steering Committee and Working Groups	07-2014
Initiated First Series of Technical Tasks	09-2014
Charter signed by Deputy Secretary of Defense	02-2015
Congressional Report on funding, organization, management, and operations of JFAC signed & submitted	03-3115
CONOPS signed by stakeholders of Federation	08-2015
Capability Assessment, Gap Analysis, Strategic Plan	10-2015
Joint Federated Assurance Center (JFAC) IOC	12-2015

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Modular / Open Systems

- **3 distinct directed activities – but with overlap**
  - **MOSA Technical Standards Working Group**: "…exploratory group to determine what role the Defense standardization Council (DSC) and standards generated or adopted under the Defense Standardization Program (DSP) should play in supporting the use of MOSA"
  - **Better Buying Power 3.0**: Use Modular Open Systems Architecture to stimulation innovation – "…to ensure that our designs are modular and that the government is in a position to control all the relevant interfaces so that competitors with superior technology have the opportunity to win their way onto our programs." Includes standards and gaps identification, as well as Service specific implementation guidance development.
  - **NDAA 2015, Title VIII, Section 801**: Modular open systems approaches in acquisition programs - "…detailing a plan to develop standards and define architectures necessary to enable open systems approaches in the key mission areas of the (DoD) with respect to which (USD) determines that such standards and architectures would be feasible and cost effective…", as well as policy and guidance review

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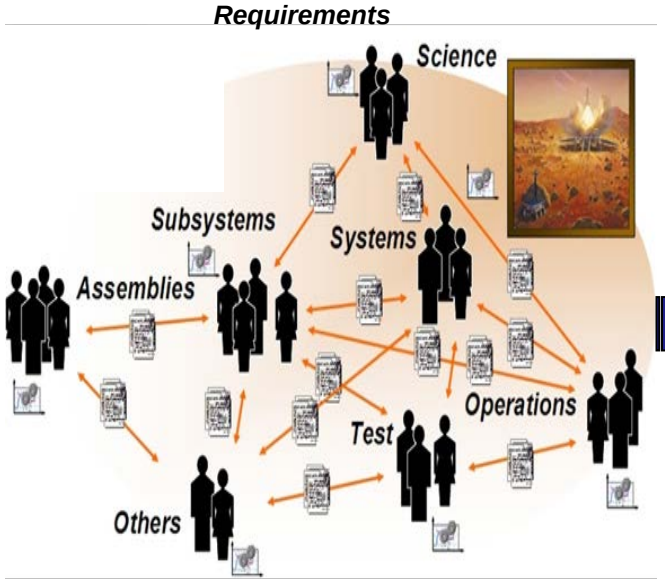
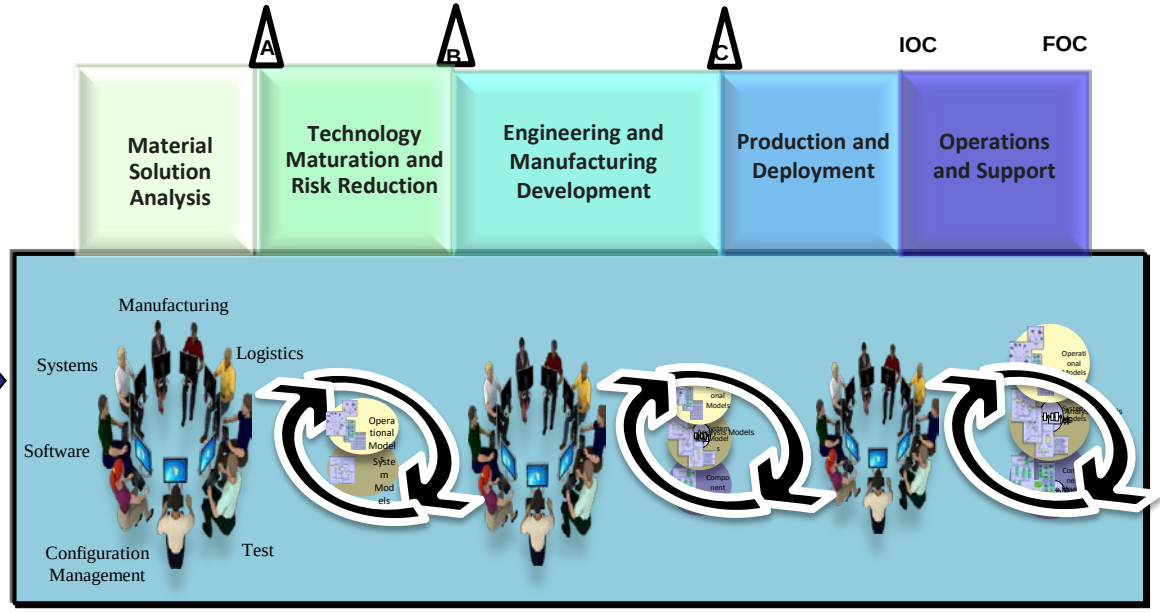
Transforming SE Through a Digital Model-Centric Environment

Shifting away from a linear, document-centric acquisition process towards a dynamic digital model-centric ecosystem

- Low fidelity, implicit representations shift to high fidelity, explicit models serving as the “single source of truth”
- Documents shift from the primary role of specification to the secondary role of communication



Today: **Stove-piped data sources**



Future: **Dynamic lifecycle intelligence**

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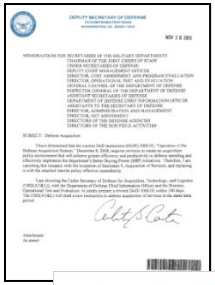
Foundation for Advancing Digital Model-Centric Engineering within DoD

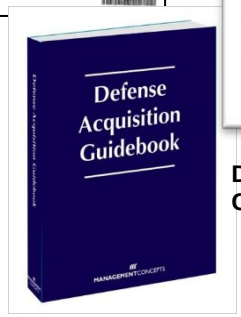
Language in Policy and Guidance

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



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

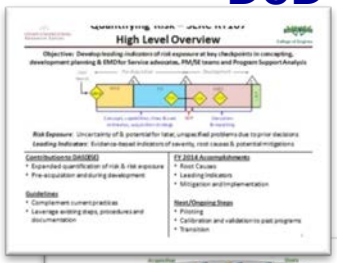
DoD Digital Engineering Fundamental



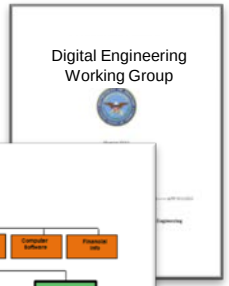
Defense Acquisition Guidebook Chapter 4

DoD Initiatives

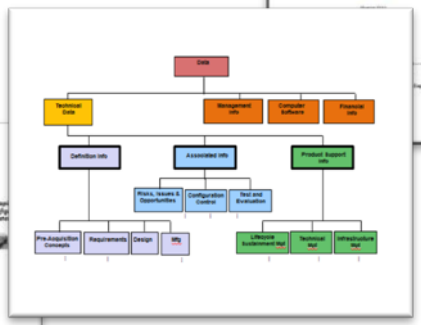
SERC: Model Centric Collaborative Environment



DoD Digital Engineering Working Group



ERS: Adapting to changing requirements

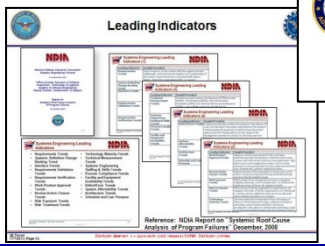


DSM Taxonomy: Foundation for defining categories of data across acquisition

HPCMP CREATE: Physics Based Modeling

Other Partnerships

IAWG



NDIA: Essential Elements of the System Model

NASA: Sounding Rocket Program

Additive Manufacturing

USAF Own the Technical Baseline

Advancing the future state of Digital Engineering within DoD

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Improve Tradecraft in the Acquisition of Services

Improve the effectiveness and productivity of contracted engineering and technical services

- **DoD relies extensively on contracted services for technical management, systems engineering, and engineering services, including program-associated Systems Engineering and Technical Assistance contracts.**

- **Enterprise approaches for acquiring these engineering and technical (ETS) services should be used to increase effectiveness of engineering-related outcomes, improve technical information management, identify cost efficiencies for engineering-related studies, and promote innovation and maintaining technical superiority**

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Acquisition of Engineering Technical Services

- **New, stand-alone DoDI 5000.ac "Defense Acquisition of Services" complements the newly-issued DoDI 5000.02 "Operation of the Defense Acquisition System"**
- **DoDI 5000.ac provides key areas for management and oversight of contracted services:**
  - Establishes Service Categories (S-CATs), thresholds, and decision authorities
  - Strengthens the Services Requirements Review Board (SRRB) structure on review and approval
  - Provides flexibility to Military Departments and Defense Agencies to develop specific procedures based on organizational resources and structure
  - Includes tripwires
  - Focuses on DAU 7-Step Acquisition of Services process for standardization

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Functional Domain Expert (FDE) Roles & Responsibilities

Provide strategic leadership to improve planning and collaboration to achieve greater efficiency and reduce costs

- **Plan**
  - Reduce redundancy in business arrangements
  - Identify opportunities for strategic sourcing
  - Leverage small business capabilities
  - Inform acquisition planning and execution
- **Collaborate**
  - Share best practices, lessons learned, useful metrics and data
  - Leverage Requirement Review Board process to improve requirements definition and validation process
  - Report portfolio accomplishments

Seeking input from Government/Industry on Best Practices for acquisition of Engineering and Technical Services

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Better Buying Power 3.0 Resources (http://bbp.dau.mil)

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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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