Implementing a Modular Open Systems Approach in DOD Acquisitions

Lynn M. Williams
Director, Acquisition Policy
Federal Legislative Affairs
September 15, 2021

Implementing the MOSA Mandate

- Congress began citing the benefits of "modular, open architectures" as early as 2009, and by 2016 mandated that all major defense acquisition programs be designed and developed with a modular open system approach (10 USC 2446a-2446c).
  - MOSA required in requirements and acquisition documents (e.g., AoA, acquisition strategy, and requests for proposal)
  - Requires coordination with external stakeholders regarding major system interface standards
  - Directs implementation by the Service Secretaries (e.g., planning, programming, budgeting, workforce) to fulfill requirements
- Congress expanded the law to cover other defense acquisition programs in 2019.
- DOD established a Modular Open Systems Working Group to address “pain points” affecting DoD’s ability implement MOSA. Several Tiger Teams were formed and are focal points for government/industry collaboration through organizations like NDIA.

- Accessing and Discovering Standards Tiger Team
- Strategic Outreach Tiger Team
- Defining MOSA Tiger Team
- Evaluating MOSA Tiger Team

- Implementing MOSA Tiger Team
- Contracting for MOSA Tiger Team
- Enabling MOSA Tiger Team

Systems Engineering Division
CTO Forum

Ms. Holly Dunlap, Raytheon Technologies
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NDIA Systems Engineering Division

Mission

The Systems Engineering Division advocates for the widespread use of systems engineering in the Defense Department acquisition process to achieve affordable, supportable, and interoperable weapon systems that meet the needs of warfighters and provide the United States a technological advantage. In addition to supporting the open exchange of ideas and concepts between government and industry, the Division works for a new understanding of a streamlined systems engineering process and aims to provide state-of-the-art national defense systems early in the formation of policies, guidance, initiatives, and investments.

Objective

- Advance SE technical & business practices
- Promote excellence in the SE program lifecycle & across all disciplines
- Transform & modernize SE practices while maintaining SE principles
- Improve SE processes & practices to deliver system performance
- Push SE boundaries for system development & ensure efficient lifecycle management
- Provide industry perspective to government partners and advocate for SE policy & guidance improvements

SYSTEMS ENGINEERING DIVISION

Division Executive Board

Steering Committee
- Pete Larkin – GD, Electric Boat
- vacant – Raytheon
- Esma Elmazaj – L3Harris
- vacant – Lockheed Martin
- Mark Schaeffer – ManTech Int'l
- Brian Maciel – Northrop Grumman
- Christi Gau Pagnanelli – Boeing
- William Luk – BAE Systems
- David Schulte – SAIC
- Angela Wallace – Booz Allen Hamilton
- Everett Lewis – Rolls Royce

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Holly Dunlap, Raytheon

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VICE-CHAIR:
Chris Schreiber, Lockheed Martin

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- Nadine Geier – USD(R&E)/SE
- vacant – USD(A&S)/SASA
- J. Evans-Morgis – US Army
- Marty Irvine – US Navy
- Kristen Baldwin – USAF
- vacant – ODASD C3/Cyber

NDIA Division Executive
Dave Chesebrough

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Affiliate Groups
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- Garry Roedler – INCOSE
- Dr. Ken Nidiffer – IEEE Computer Soc.
- Bob Rassa – IEEE AESS
- Les Orlidge – IEEE SCC20
- George Rebovich – MITRE
- Dr. Jeff Boleng – SEI
- Marilee Wheaton – Aerospace Corp

ADAPT Committee
- Scott Sinclair, Spectrum
- Suzette Johnson, Northrop Grumman
- Robin Yeman, Catalyst Campus

Architecture Committee
- Robert Scheurer, Boeing
- Ed Moshinsky, OUSD (R&E) SE

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Enterprise Health Mg't Cmte
Chris Reisig, Boeing (St Louis)

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- Tim Sheehan, Raytheon
- Sherman Forbes, USAF

Human Systems Integration Cmte
- Dr. Matthew Risser, Pacific S&E
- Randi Rohrer, Boeing

Modeling & Simulation Committee
- David Allsop, Boeing
- Jon Backhaus, Lockheed Martin

Software Committee
Dr. Ken Nidiffer, GMU

Systems Engineering Effectiveness Committee
- Paul Hershey, Raytheon
- Joe Elm, ESS

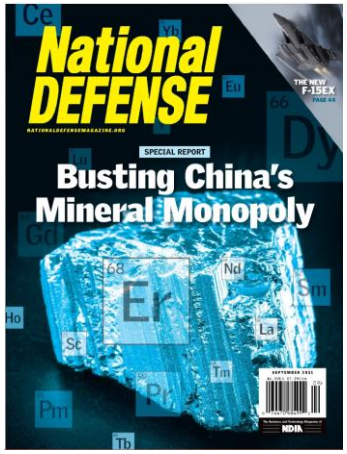
System-of-Systems Committee (w/ Interoperability & ME)
- Rick Poel, Boeing
- Dr. Judith Dahmann, MITRE
- Jennie Horne, Raytheon
- John Daly, Booz Allen Hamilton

Systems Security Engineering Committee
- Holly Dunlap, Raytheon
- Cory Ocker, Raytheon
- Melinda Reed, USD(R&E)/STP&E

NDIA Systems Engineering Division

CTO Request

- Please review the NDIA SED org chart for respective company representation.
- ***Steering Committee*** provides valuable industry leadership perspective to our members and our Government leadership partners.
- Encourage active and regular participation in committees, special projects, divisional meetings, and annual conference.



https://digital.nationaldefensemagazine.org/?m=46185&i=718483&p=24&ver=html5


Viewpoint BY HOLLY DUNLAP AND DAVE CHESEBROUGH

Transforming Our Systems Engineering Approach Using Digital Technology

Digital transformation is pervasive in our daily lives. Seemingly limitless and lightning quick access to people, information and services has the world thinking differently, getting more done and moving faster than ever before.

But how are we using the power of digital technology in our work to advance our national defense posture and accelerate the development and delivery of superior capabilities to the U.S. military and its allies?

For decades, the U.S. military has enjoyed technological superiority over potential adversaries. Now, the global dynamics of modern technology and their applications in military systems development are working to diminish this advantage. Maintaining this technological superiority while continuing to provide capabilities to our forces that are more advanced than those of our adversaries — who are unencumbered by the rules of our acquisition system — requires us to accelerate acquisition processes all together.

One of those key tenets is systems engineering, an inter-disciplinary process which, at its end, delivers a fully functioning system that meets customers' requirements. In addition, the emphasis now is on increasing flexibility, innovation and rapid capability development as well. The challenge is doing them all while remaining true to the fundamental acquisition principles of quality, timeliness and accountability.

One very concrete and clear response is the revised 5000 series Adaptive Acquisition Pathways policies which provide a new set of key tenets for the defense acquisition system that

the answer and is partially driving the change as modern engineering practices have outpaced current policy and process.

Industry is rising to the challenge.

"In our industry, success isn't just about speed on the battlefield, but speed to the battlefield. Working with data from all different formats and linking high-fidelity models together allows us to be faster and more predictive in our execution," said Wes Kremer, president of Raytheon Missiles & Defense. "Our investments in digital design allow us to connect a mechanical model and a thermal model to a performance model and a cost model. We're creating a digital thread throughout the product lifecycle, and we're already seeing the benefits of this approach. It's exciting because we're only scratching the surface of what this technology can do."

For years, engineers have relied on digital technology for important analyses (finite element analysis, for example). These tools provide an understanding of a specific aspect of a design (i.e., stress and strain under various load conditions). But these are static analyses. Modern practices simulate the attributes of a full system in dynamic conditions, a much more daunting challenge that integrates various areas into a whole.

Modern engineering practices evolving within the defense community include, among other things, mission engineering, modeling and simulation, digital engineering, modular open systems approach, system security engineering, and agile software development. Indeed, there are initiatives within the Defense Department addressing each of these. The real challenge is integrating them into a systems engineering model, one that overcomes the built-in resistance of the Federal Acquisition Regulation-based acquisition process and that spans the entire system lifecycle with a "digital thread."

NDIA is deeply engaged in the modernization of systems

https://www.ndia.org/events/2021/12/6/24th-sme-conference-virtual

Prime opportunity to collaborate & directly influence
PLEASE TAKE THE OPPORTUNITY!

NDIA SE Architecture Committee
Implementing a Modular Open Systems Approach (MOSA) in Defense Acquisitions

September 15, 2021

Steve Thelin

stephen_thelin@raytheon.com

SE Architecture Committee

Mission / Purpose

- **Mission:** Grow Relevance, Usefulness, and Awareness of System Architecting and Architectures in National Defense Systems and Applications
- **Purpose:** To Facilitate Acumen and Successful Outcomes from System Architecting and Architectures
- **Leadership:**
  - **Bob Scheurer, Boeing;**
  - **Ed Moshinsky, OUSD(R&E)**

Stakeholders / Sponsors / Collaborators

- Stakeholders: Defense Industrial Base Members, DoD, & Services
- **Sponsor: Nadine Geier, OSD R&E**
- **Collaborators: INCOSE, AIA, DoD MOSWG;**
  - **Paul Jonas, MOSA Metrics, US Army Research**
- **Membership: 95+ members from government, industry, and academia.**

Recent Accomplishments

- On-Going Bi-Weekly Full Committee Meetings
- On-Going Bi-Weekly Sub-Committee Meetings (e.g., MOSA Metrics) and Special Meetings, as Needed
- Participating with NDIA Manufacturing Division / Supply Chain Network Committee: Ethan Plotkin, Chair, "Helping OSD Do Sustainment Better"
- Participating in DoD's MOSA (MOSWG) and Tiger Team(s)
- Participating in PSM's Digital Engineering (DEWG) Working Group: Functional Completeness and Volatility Metric
- Participating in Paul Jonas Army MOSA Metrics Working Group Activities/Surveys (They are now also participating in our NDIA SE Architecture Committee metrics work) – Current Jonas status unclear
- MOSA White Paper and Supporting Briefings

2021 Plans / Events / Milestones

- **Focus on MOSA Metrics / Metrics Sub-Committee**
  - **MOSA Terms/Definitions (Initiating Reviews)**
  - **Metrics (On-Going)**
  - **Contracting Language (Q4/2021 Initiation)**
- **2021 S&ME Conf. Track on System Architecture (Tentative)**
- **MOSWG & Tiger Teams Support: MOSA Outreach, et**
- **Digital Engineering Working Group Support**
- Joint Effort w/NDIA Mfg Division/Ethan Plotkin: Better OSD Sustainment - SD-22 Guidebook Update: Data gathering phase underway
- Mission Engineering Working Group activity
- Other Relevant Plans/Support Areas
  - SE Modernization w/Nadine Geier, OUSD(R&E) SE Director
  - Reference Architectures (Q4/2021 initiation)
  - Modularity & Openness Partitioning and Representations in Architecture Models

DoD Initiatives Support by NDIA Architecture Committee

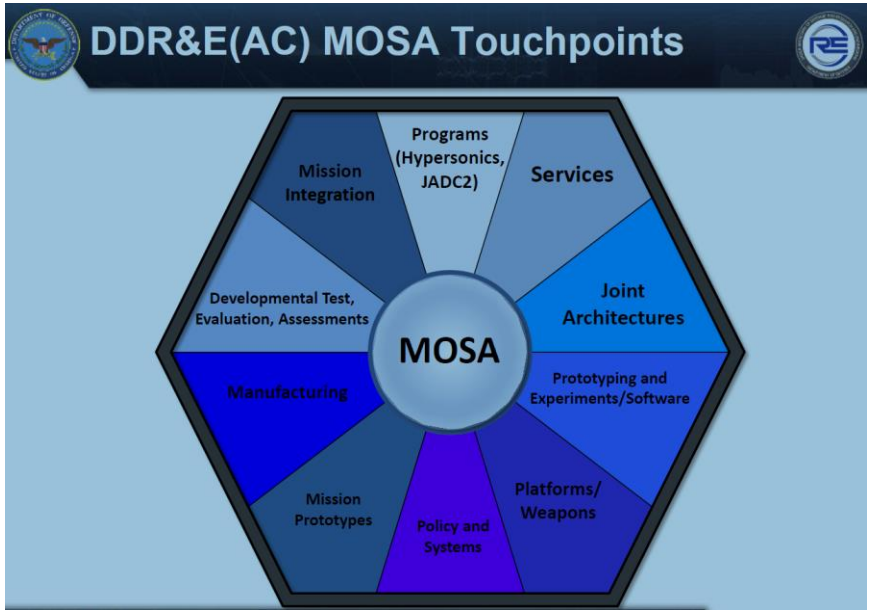
DoD Initiative	Prime DoD Objectives	NDIA Architecture Committee
Modular Open Systems Approach (MOSA)	• Enduring Platform Relevance • Improved Capabilities	• MOSA White Paper: Acquirer and Supplier Recommendations • MOSA Metrics / Application Guidance • Joint Approach Definition w/DoD
Digital Engineering (DE)	• Accelerate Developments • Generate Cost/Schedule Efficiencies	• DE Metrics Initiative
Mission Engineering (ME)	• Optimize Mission Outcomes of SoS • Identify Capability Gaps	• Contributor to ME Phase II Study (2019) • Monitoring • Aligning Focus: SoS Architectures
Systems Engineering (SE) Modernization	• TBD	• Monitoring • Collaborating

MOSA Overview

DoD Implementation of MOSA

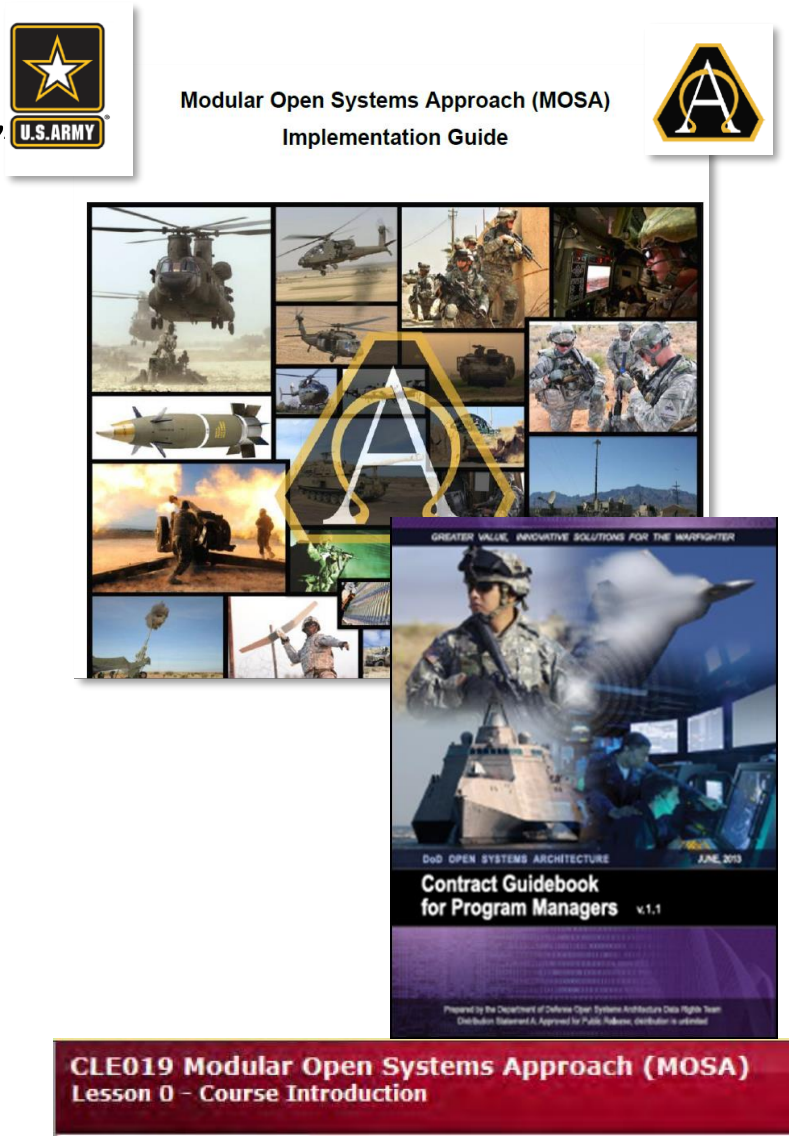
- DoD is aggressively pursuing MOSA capabilities
- Congress is looking for DOD to develop methods to measure programs conformance to MOSA
- Focus on open interfaces and standards development
- MOSA part of AF digital Trinity
  - MOSA/OSA
  - Digital Engineering
  - Agile software
- Additional MOSA requirements and processes under development by the services

▪ *The DoD must prioritize speed of delivery, continuous adaptation, and frequent modular upgrades*



DoD MOSA Procurement

- No proprietary interfaces, “put IP in the box”
- Future USAF contracts will tie award/incentive fees to compliance and verification of MOSA implementation
- Contracts will ensure delivery of TDP with sufficient data rights and modularity to compete future system upgrades
- Use of Government Reference Architectures (GRA) to define acquisition frameworks and systems/systems of systems architecture, constraints and requirements
- Development of meaningful MOSA architectures to facilitate rapid mission engineering capability



MOSA Implementation on Programs

- **Determine customer MOSA requirements and objectives**
- **Define Program MOSA strategy**
  - MOSA objectives
  - IP protection
- **Develop MOSA architecture**
  - Develop program modularity concept
    - Reflect customer MOSA objectives
    - Implement objectives for commonality and composability
  - Define key interfaces that need to be open and how they will be managed
    - Ensure IP is not in key interfaces
    - Select open standards to be used
    - Define openness and how to manage for interfaces not covered by an open standard
  - Demonstrate that MOSA objectives map to requirements and verification
  - Establish MOSA metrics/TPMs to demonstrate progress to customer

DoD MOSA Primary Objectives
Increased Interoperability
Enhanced Competition
Technology Refresh
Increased Innovation
Cost Savings

Defense Acquisition Guidebook H 3-2.4.1

Additional MOSA Objectives
Faster Deployment time
Better Maintainability and Supportability
Increased Upgradeability Capability
Reduced Training Costs
Incremental Approach to New Capabilities

MOSA White Paper

MOSA White Paper Intended Audience

Government – Those who determine guidance for executing Contracts and producing System Architectures realized by those contracts and defense industrial base members.

Prime Contractors – Those who execute the contracts

- Investment Strategy Considerations
- Subcontractor Impacts
- Intellectual Property Ramifications

Systems Engineers in Govt. who write the RFP's for acquisitions

- MOSA requirements
- RFP Guidance
- Evaluation criteria

NDIA Architecture Team, et. al.

- Guidance to help with developing the recommendations and changes needed in current policies and guidance
- Policy recommendations and standards development


NDIA

Meetings & Events Policy Membership Divisions

2020 Reports

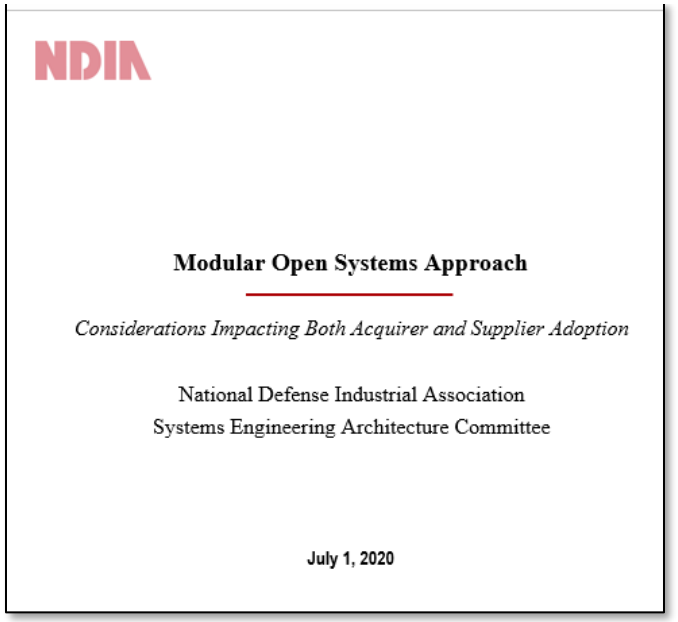
Modular Open Systems Approach – Considerations Impacting Both Acquirer and Supplier Adoption

Systems Engineering Architecture Committee

July 1, 2020

The Systems Architecture Committee provided this white paper containing recommendations to government and industry program managers and acquisition professionals regarding the implementation of the Modular Open Systems Approach (MOSA). The Architecture Committee consisting of a broad representation of industry, government, and the Services, studied the various facets of MOSA (past and present) in the context of their professional experience in order to provide practical guidance regarding the approach.

NDIA MOSA White Paper Final Release NDIA Architecture Committee 2020


NDIA

Modular Open Systems Approach

Considerations Impacting Both Acquirer and Supplier Adoption

National Defense Industrial Association
Systems Engineering Architecture Committee

July 1, 2020

https://www.ndia.org/divisions/systems-engineering/studies-and-publications

Overview: Premises for MOSA Success

A. **Government and industry need to work together** to define a MOSA implementation for mutual benefits
B. **A structured approach is needed** in responding to congressional language mandating the use of MOSA
C. **Properly implemented MOSA can provide numerous benefits**: increased competition, reduced costs and new synergistic capabilities and missions
D. **MOSA is an enabler** on which Mission Engineering, Digital Engineering and System Security Engineering can build
E. **Understanding how to apply open interfaces is critical** in fostering innovation, competition, and protection of Intellectual Property.
F. **MOSA is not a result, it is a process**

MOSA Implementation Recommendations*

(Items Underlined and Marked in Green Represent Current Follow-On Focus Efforts)

1. **Develop MOSA strategy and objectives early in the acquisition process**
2. **Define MOSA implementation approach (acquirer and supplier roles)**
3. **Define interfaces within the System of Systems in terms of MIL-STD-881D Taxonomy Levels of Detail and leverage existing Open System Architectures for lower levels of detail**
4. **Apply MOSA in software architectures at appropriate levels of abstraction and complexity**
5. **Implement MOSA as part of a larger and more robust Digital Engineering strategy**
6. **Incorporate cybersecurity strategy in a MOSA application at the time of initial design, not as a later addition**
7. **DOD and industry work together to define how to evaluate MOSA**
8. **Develop and implement enablers with appropriate investment to affect culture change required for successful widespread adoption of MOSA**
9. **Create Library of MOSA Systems and Interfaces**
10. **Define a means for comparing and specifying standards and interfaces for a MOSA-enabled environment.**

MOSA Recommendations & White Paper Folder on Committee's Collaboration Site hosted by Mitre

- From NDIA Systems Engineering Division Architecture Committee White Paper Dated July 1, 2020
  Available along with other AIA Studies and Publications
  at https://www.ndia.org/divisions/systems-engineering/studies-and-publications

MOSA Metrics Development

Key Concepts for Metric Development

- **Need exists to be able to compare architectures and assess MOSA implementation**
  - More modularity may not always create the attributes needed
  - Important to measure the MOSA attributes that drive the architecture
  - Most attributes already have defined metrics which can be used to define the value of that attribute to the system
  - To increase MOSA attributes in DOD systems
    - Analyzing system architectures, especially above the procurement level being considered
    - Identification of key interfaces to drive correct modularity and openness
  - Assessing MOSA architectures and measuring MOSA implementation are two different applications of metrics

MOSA Knowledge and Decision Points

10 USC 2446b. Requirement to address modular open system approach in program capabilities development and acquisition weapon system design - Key Knowledge Points and Decision Points

(a) Program Capability Document.—A program capability document for a major defense acquisition program shall identify and characterize— **Metric Potential** 7

Analysis of Alternatives.—The Director of Cost Assessment and Performance Evaluation, in formulating study guidance for analyses of alternatives for major defense acquisition programs and performing such analyses under SECTION 139A(D)(4) OF THIS TITLE, **shall ensure that any such analysis for a major defense acquisition program includes consideration of evolutionary acquisition, prototyping, and a modular open system approach.**

(c) Acquisition Strategy.—In the case of a major defense acquisition program that uses a modular open system approach, the acquisition strategy required under SECTION 2431A OF THIS TITLE shall 8

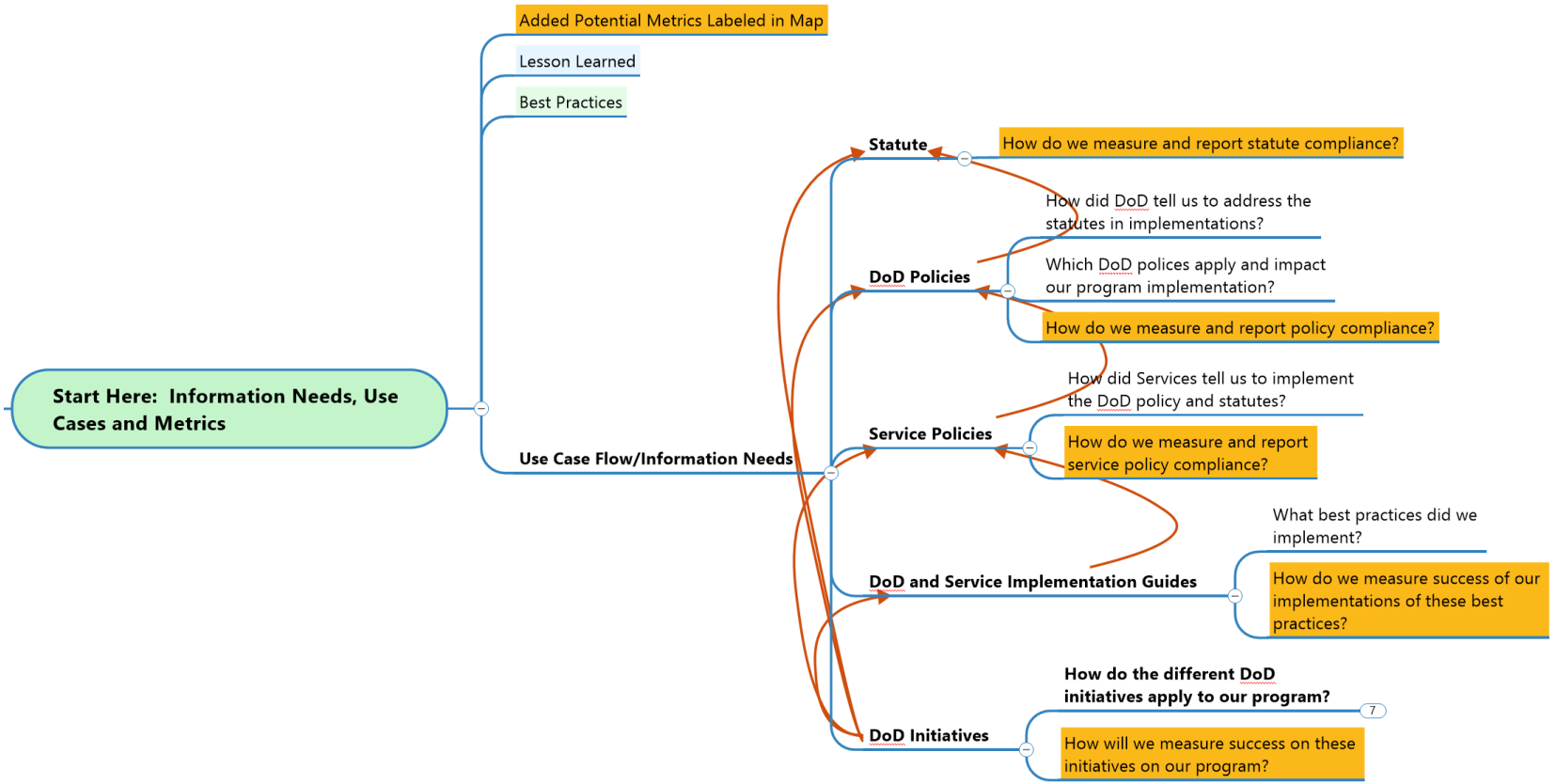
(d)**Request for Proposals.—The milestone decision authority for a major defense acquisition program that uses a modular open system approach shall ensure that a request for proposals for the development or production phases of the program shall describe the modular open system approach and the minimum set of major system components that must be included in the design of the major defense acquisition program**

(e)Milestone B.—A major defense acquisition program may not receive Milestone B approval under SECTION 2366B OF THIS TITLE until the milestone decision authority determines in writing— 5

(f) Implementation Guidance.—The Secretaries of the military departments shall issue guidance to implement the requirements of this section 9

What information do we need to comply with this statute?

Key Metrics Questions



Information Needs Drive Metric and Measurement Selection

Summary

DoD is serious about MOSA implementation and the prospective benefits of MOSA architectures

- It is now the Law of the Land
- Policy, processes and training are in development

NDIA SE Architecture Committee: Govt./Services and Industry Working Together

- Helping define and influence MOSA development, implementation, and measurement *by acquirers and suppliers alike*
  - MOSA White paper
  - Measuring MOSA and Outreach Tiger Teams
  - MOSA definitions and Key Terms
  - Mission Engineering with MOSA
  - MOSA Strategy development / Systems Engineering Modernization
  - Updates to DAU CLE - 019 (Modular Open Systems Approach)
  - Reference Architecture Development

Potential Future Topics

1. Data Models, Ontologies, taxonomies, and other data related topics and their importance to architecture and MBE, MBSE, ME and DE.
2. Initiate an effort to address “Data and Information in architecture and MDE, ME and DE”
3. Address problems with Interoperability (now Information) Support Plans (ISPs) especially with respect to Data/Information and consistent Function/activity usage and naming.
4. MOSA in Portable Models: Representative models of system elements containing MOSA features
5. MOSA-Based RFP Template: Contains MOSA-compliant basis for solicitation language found in Section L and MOSA-related evaluation criteria found in Section M
6. Metadata model and tool set implementations examples for data standardizations and taxonomies: catalog of various MOSA data representations
6. Guidelines for applying MOSA principles to Mission Engineering (e.g., SoS considerations) and Digital Engineering (e.g., data flows and relationships).
7. MOSA standards in Meta Models: Considerations and categories for “Pick-Lists”
8. Raising awareness and acumen of MOSA user stakeholders: guidance and training approach (Important topic).
9. Taxonomies in the various frameworks involved with MOSA models: grouping MOSA implementation patterns as relevant to various product domains; specific emphasis for domain-specific applications of MOSA.
10. Potential conflicts between MOSA-constrained environments and the IP/Data Rights issues; Issue of IP rights in a MOSA world
11. Architectural Tools evolution to support Architectures: Tool interoperability; SE tool integration with Engineering design tools

Backup

Holly Dunlap Bio

- BS Electrical Engineering, University of Kansas
- Masters Business Administration, Webster University
- 10 yrs Nuclear Weapons, National Nuclear Security Administration (NNSA) Kansas City Plant, M&O Honeywell
  - 3 Year Rotational Leadership Development Program (10 years experience in 3 years)
    - Program Manager of B83 Nuclear Weapons Program
    - Supply Chain 18 months (Rotated every 3 months)
  - Intelligence Community Special Projects (Reverse Engineering, Rapid Fielding, Analysis)
  - Certified 6 Sigma Black Belt – Microelectronics
- +3 yrs OSD DDR&E Technical Intelligence, Pentagon
  - Emerging & Disruptive Technology. Investment strategy to ensure US technical capability advantage. Work intimately with Anti-tamper Executive Agent, National & Defense Intelligence Community, and Defense System Developers. Strategic 15 – 20 Year Planning.
- Ktech Later Acquired by Raytheon Missile Systems
  - USD(I) Contract Supply Chain, Transportation & Logistics Layered Analysis; Data & Information Exploitation. 18 month effort.
- +15 years Raytheon Technologies
  - NDIA System Engineering Division Elected Chair (+13 Committees, +500 members; government, industry, academia, FFRDC)
  - NDIA System Security Engineering Committee Chair, +9 years
  - Systems Engineering Council – Cyber Resiliency & System Security Project Lead
  - Raytheon Cyber Enterprise Campaign
  - Cyber Operations Development & Evaluation Center, Cyber Supply Chain Risk Management Lead
  - PI Security & Trustworthy Foundations for Electronics Resurgence (STryFER) IDIQ CRAD Proposal

Steve Thelin Bio

- BS Mathematics Brigham Young University
- BS Electrical Engineering, Utah State University
- Defense Acquisition School
- 10 Years USAF
  - Flight Line Technician (F-4 Weapons Control and radar)
  - Officer Commission, Titan 34 D SPO (launching classified payloads), Titan and Shuttle failure review boards/recovery
- 18 Years Boeing
  - Architect of the Sea Launch Operations (Russian, Ukrainian, Norwegian US launch team)
  - Developed Sea Launch Commercial Range
  - Sea Launch Mission Director and Operations Program Manager
  - Site manager on Meck Island/Kwajalein for all GBI launch/operations
  - Maui Optical tracking site, as manager for upgrades and operations supporting MDA test launches
- 15+ Years Raytheon Technologies
  - Raytheon Engineering Fellow
  - Certified Architect, Corporate Architecture Board, Architecture Review Board
  - Raytheon Excellence in Engineering and Technology award
  - Developed KV configurations for MKV/MOKV including MDA common DACS development
  - RKV lead architect
  - Small Sat development and marketing
  - RMD/MOSA lead for Composability Initiative
  - MOSWG Member (including participation in several Tiger Teams)
  - NDIA Architecture Working Group
- Launch Systems Engineering
  - Personal business consulting with launch industry (Vector Launch, Phantom Space, Black Arrow)
- Summary
  - Extensive experience in mission systems engineering, systems architecture, large scale mission system integration, and test and operations. Have experience with; missile defense systems, kill vehicle design, missile design and operations, COCOM operations modeling, satellite systems, launch vehicles, manned space, Range development and operations, and aircraft systems development and operations.