MOSA - Key Points for Implementation from the NDIA Architecture Committee

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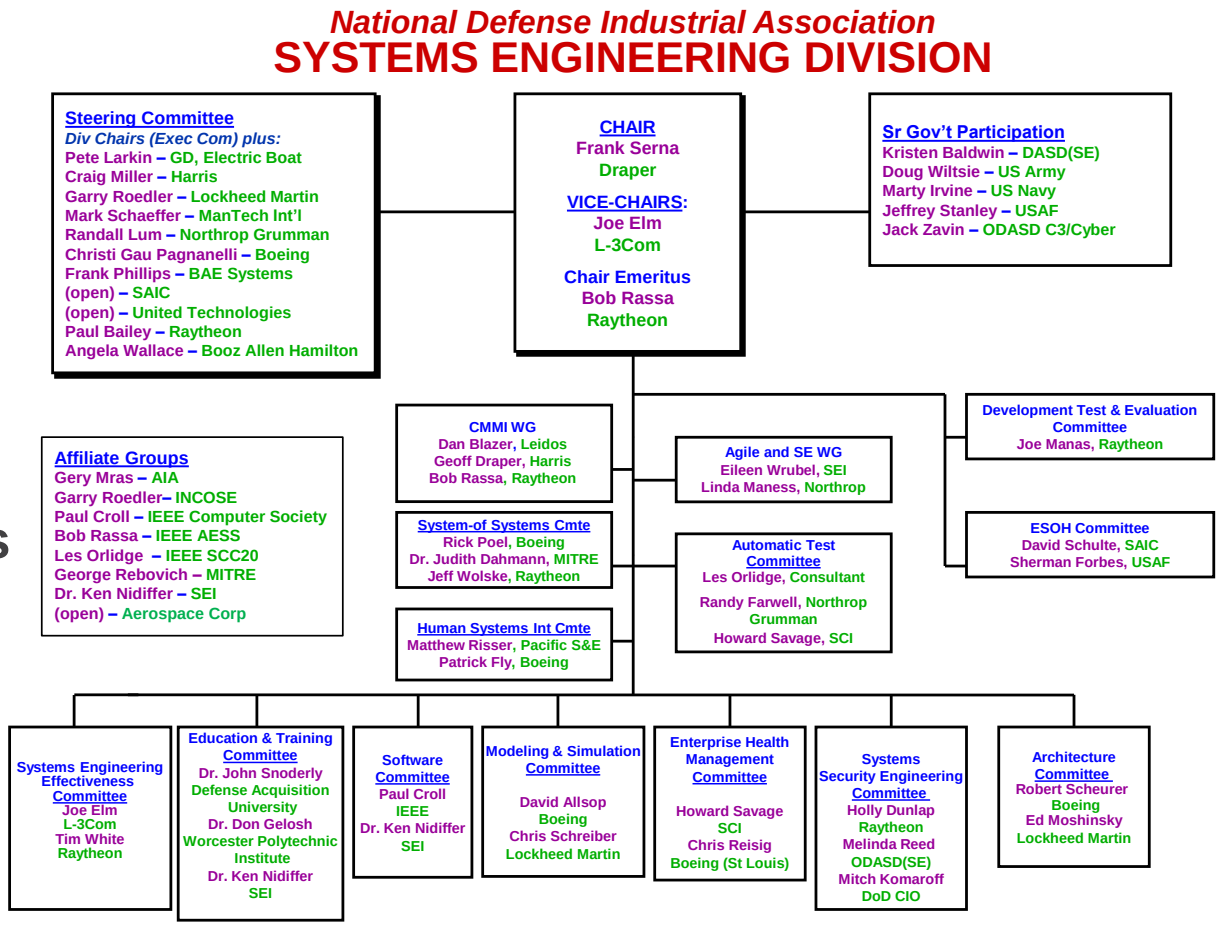
Topics

- **NDIA Architecture Committee Overview**
- **Modular Open Systems Approach (MOSA)**
  - Overview and Drivers
- **Key MOSA Concepts and Challenges**
  - Methodology Concept
  - Openness of Interfaces
  - Architecting for Modularity
  - System Group/ Taxonomies Considerations
- **MOSA White Paper Organization**
- **Top 10 Committee Recommendations**

NDIA Architecture Committee Overview

- **National Defense Industrial Association (NDIA)**
  - *"Promotes the best policies, practices, products and technology to build a more responsive and collaborative community in support of defense and national security"*
- **NDIA SE Division (org chart)**
- **Architecture Committee - key focus on MOSA**
  - MOSA white paper to be published in coming months; co-authors are welcome to join
  - This presentation captures key points from the Committee's work



Modular Open Systems Approach (MOSA)

Objective: To design systems with highly cohesive, loosely coupled, and severable modules that can be competed separately and acquired from independent vendors

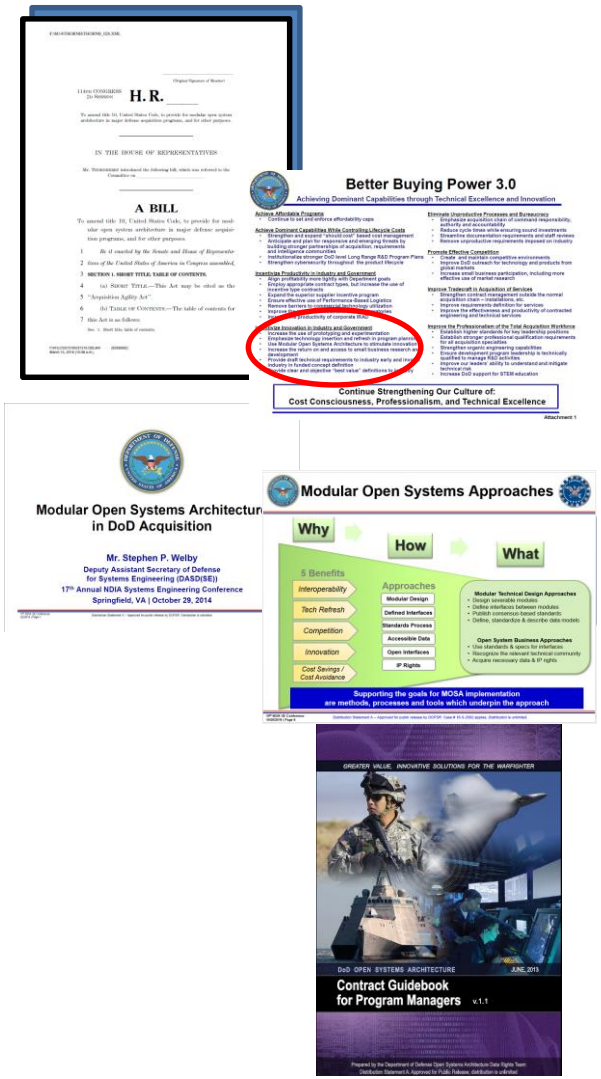
- **Allows DoD to acquire warfighting capabilities, including systems, subsystems, software components, and services, with more flexibility and competition.**
- **MOSA implies the use of modular Open Systems Architecture, a structure in which system interfaces share common, widely accepted standards, with which conformance can be verified.**

An integrated business and technical strategy to achieve competitive and affordable acquisition and sustainment over the system life cycle

Source: *ODASD Systems Engineering website:* https://www.acq.osd.mil/se/initiatives/init_mosa.html

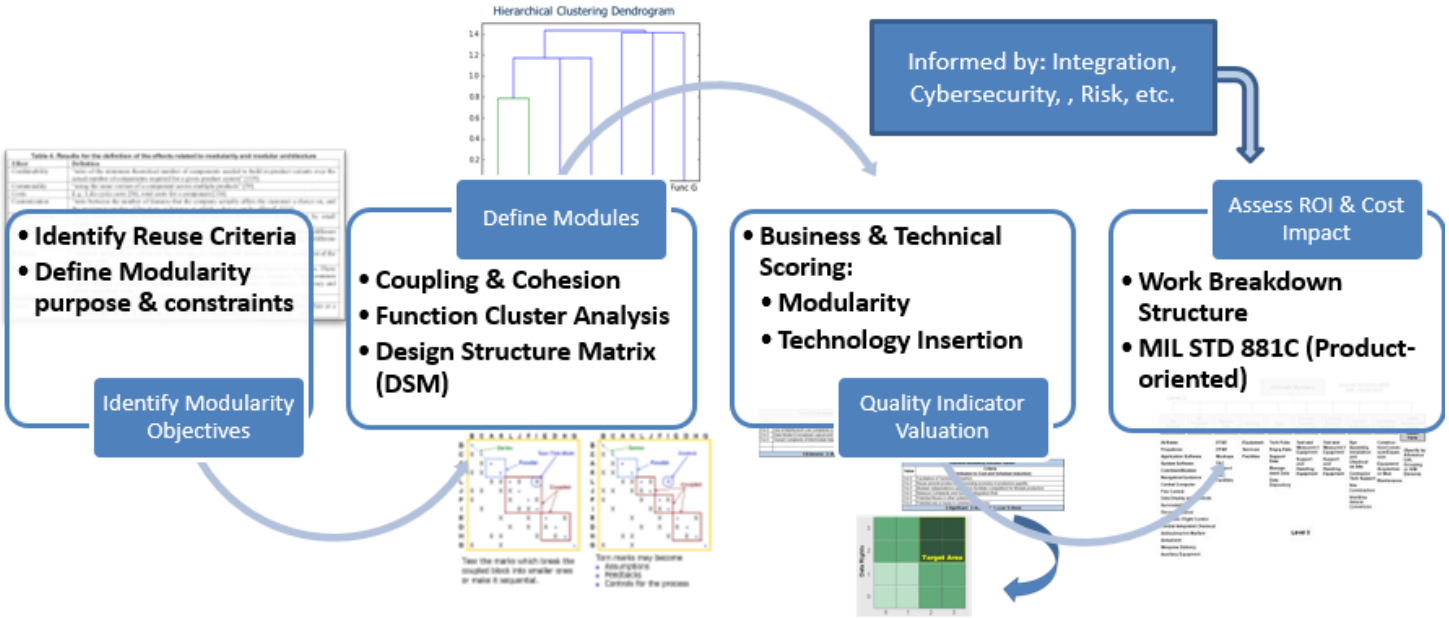
Drivers for MOSA Implementation

- Acquisition Reform driving Openness into DoD acquired systems
  - National Defense Authorization Act for 2017 requires implementation of MOSA for major DoD acquisitions by 2019
- DoD is implementing on Major Defense Acquisition Programs (MDAP)
  - Driven by rapid evolution in technology and threats that require much faster cycle time for fielding and modifying warfighting capabilities
  - MOSA can accelerate and simplify incremental deliveries of new capabilities into systems.
- DoD has developed guidance for acquiring “open” systems



Key MOSA Concepts and Challenges (1 of 4)

Methodology Concept – Acquiring/ Developing a MOSA solution



Key MOSA Concepts and Challenges (2 of 4)

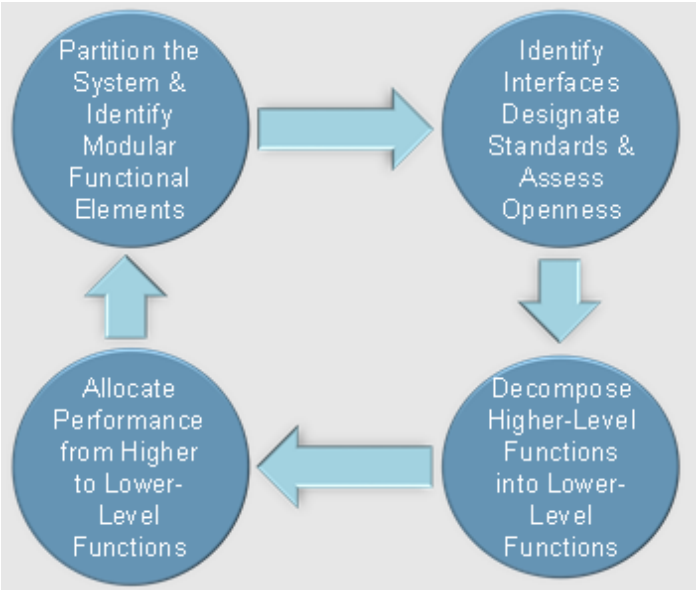
Openness of Interfaces

- **Business Aspects of Openness**
  - Intellectual Property (IP) and Data Rights
  - Balancing the Government's desire to own the technical baseline with the Contractors' need to create IP and profits
- **Technical Aspects of Openness**
  - Interfaces among System Elements
    - Standards-Based *or*
    - Well-Defined/ Fully Disclosed
- **Openness Measures are critical**

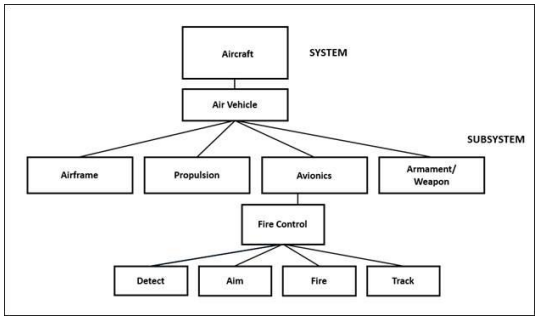
Key MOSA Concepts and Challenges (3 of 4)

Architecting for Modularity

- **Iterative & Recursive Architecture Design Process**
  - Results in an architecture partitioned into Modules
- **Architecture partitioning factors**
  - Disciplined definition of functional partitions
  - High Cohesion: Minimizing inter-partition dependencies
  - Loose Coupling: Functionality can be easily broken away from the rest of the architecture to enable change
  - Open Interfaces: Connect the Modules to each other
  - Technology insertion opportunities: Enabling ease of change; focus on critical/ most quickly changing areas
  - Measures of Cohesion and Coupling; how do we do this?



Key MOSA Concepts and Challenges (4 of 4)



Group 2 – Acquisition Tier example

System Group/ Taxonomies Considerations

- **The legislation specifies two different MOSA requirements sets for two different levels of operational systems.**
- **We propose considering MOSA requirements at three tiers or Groups:**
  - Group 1 – Mission Tier (Platform-to-Platform Interfaces)
  - Group 2 – Acquisition Tier (Major System-to-Major System Interfaces)
    - Focus on guidance found in Mil-STD 881 *Work Breakdown Structures for Defense Materiel Items*
  - Group 3 – Software (Computer Programs)
    - Unique requirements regarding definition of and control of interfaces, partitioning, and modularization;
    - Mil-STD-881 addresses software as CPCIs with the taxonomy to be defined by the designer
    - This is an area requiring further study

MOSA White Paper Organization

1	Introduction
2	Background/ Overview: Legislative Direction, Key Concepts, Definitions
3	Scope
4	MOSA Objectives and Perspectives
5	MOSA Business Objectives and Realities
6	MOSA Acquirer/Supplier Perspectives
7	Openness, Technical and Business aspects
8	Modularity, Technical and Business Aspects
9	System of System (SoS) Considerations
10	Related Perspectives & Goals: Digital Engineering Initiatives, Mission Engineering, Government Ownership of the Technical Baseline (GOTB)
11	Examples of MOSA-Related Initiatives
12	Examples of Existing MOSA full System Implementations
13	Conclusions
14	Recommendations
16	Future Topics

NDIA Architecture Committee MOSA Recommendations (1 of 10)

1. **Understand the Reasons for and Benefits of Applying MOSA. Apply MOSA to:**
   - Avoid cost, such as conditions warranting re-use of existing designs
   - Save cost over a system lifecycle, such as planned system upgrades and functionality improvements
   - Provide significant reductions in development and fielding timelines
   - Provide a defined path for technology refresh and upgrades
   - Provide a basis for more robust competition

NDIA Architecture Committee MOSA Recommendations (2 of 10)

2. **Define Levels of Detail in the SoS, with MOSA Call-outs Explicitly Made for Each Level of Design**
   - MOSA is highly dependent on the level of design under consideration; i.e. Joint Force level, Service-unique implementation, platform or system level
   - MOSA implementation architecture at a platform level is very different from the MOSA implementation for a detailed design level

NDIA Architecture Committee MOSA Recommendations (3 of 10)

3. Make Initial Acquisition Model Partitioning a Factor in a MOSA Strategy

- Plan the architectural partitioning of the various system elements with the MOSA Benefits in mind
- Proper MOSA application enables emerging acquisition including Ownership of the Technical Baseline, MBSE, and Acquisition Reference Models

NDIA Architecture Committee MOSA Recommendations (4 of 10)

4. **Incorporate cybersecurity strategy in a MOSA application at the time of initial design, not as a later addition**
   - How the system is architected and "modularized" from the start of a development will establish its robustness against cyber threats.
   - Incorporating cybersecurity techniques at later stages of design; i.e., "bolting them on", misses an opportunity to maximize security effectiveness and threatens the long-term viability of the modular design.

NDIA Architecture Committee MOSA Recommendations (5 of 10)

5. Define Interfaces in Terms of MIL-STD-881D Taxonomy Levels of Detail

- 2 and 3 Digit Level, i.e. Major System Levels. e.g. 4-digit level would be a radar system, air frame, propulsion, power, etc.
- MIL-STD-881D provides essential language and insight into the various major system types and associated design levels of implementation and provides a common taxonomy basis for developing a MOSA architecture

NDIA Architecture Committee MOSA Recommendations (6 of 10)

6. Incorporate MOSA in Technical Reviews

- Reviews should be adapted to examine the satisfaction of MOSA implementation requirements throughout the DoDi-5000.02 Acquisition Management System
- Technical reviews need to accommodate both acquirer perspectives and supplier perspectives

NDIA Architecture Committee MOSA Recommendations (7 of 10)

7. **Program managers and engineers should recognize and track the design disclosure of common modules at the various levels of functional design and allocation**
   - MOSA attributes evolve along with the technical solution's maturation; modules appear at different levels of the architecture
   - These attributes must be tracked across the system development lifecycle; MBSE should enable this process

NDIA Architecture Committee MOSA Recommendations (8 of 10)

NDIA

8. **Maintain a library of MOSA-compliant designs as a part of an Architectural Standard "Shared Library"**
   - As MOSA compliant systems are developed, they should be made available for reference
   - Design attributes should include the system architecture model as well as the ICDs and standards for the open interfaces
   - Benefits include speeding a subsequent system's development time and increased competition across industry

NDIA Architecture Committee MOSA Recommendations (9 of 10)

9. Produce Guidance Describing Use of Taxonomies

- Taxonomies should be consistent with 881D and provide structure for defining the MOSA partitioning
- Taxonomies should be developed by the acquiring organization and provide guidance for modularity principles to be used
- Lower level taxonomies and functional analysis should be completed by suppliers, defining modularity and reusability to be incorporated

NDIA Architecture Committee MOSA Recommendations (10 of 10)

NDIA

10. Consider Incentives for Implementing MOSA in order to Facilitate Acceptance by Acquirers and Suppliers

- Implementing MOSA will benefit the acquisition system but requires a culture change
- Resistance to change may come from both acquirers and suppliers
- Incentives, both positive and negative, should be considered to help overcome resistance to change and the perceived risks of implementing a new approach

Questions?

Backup

About the Presenter

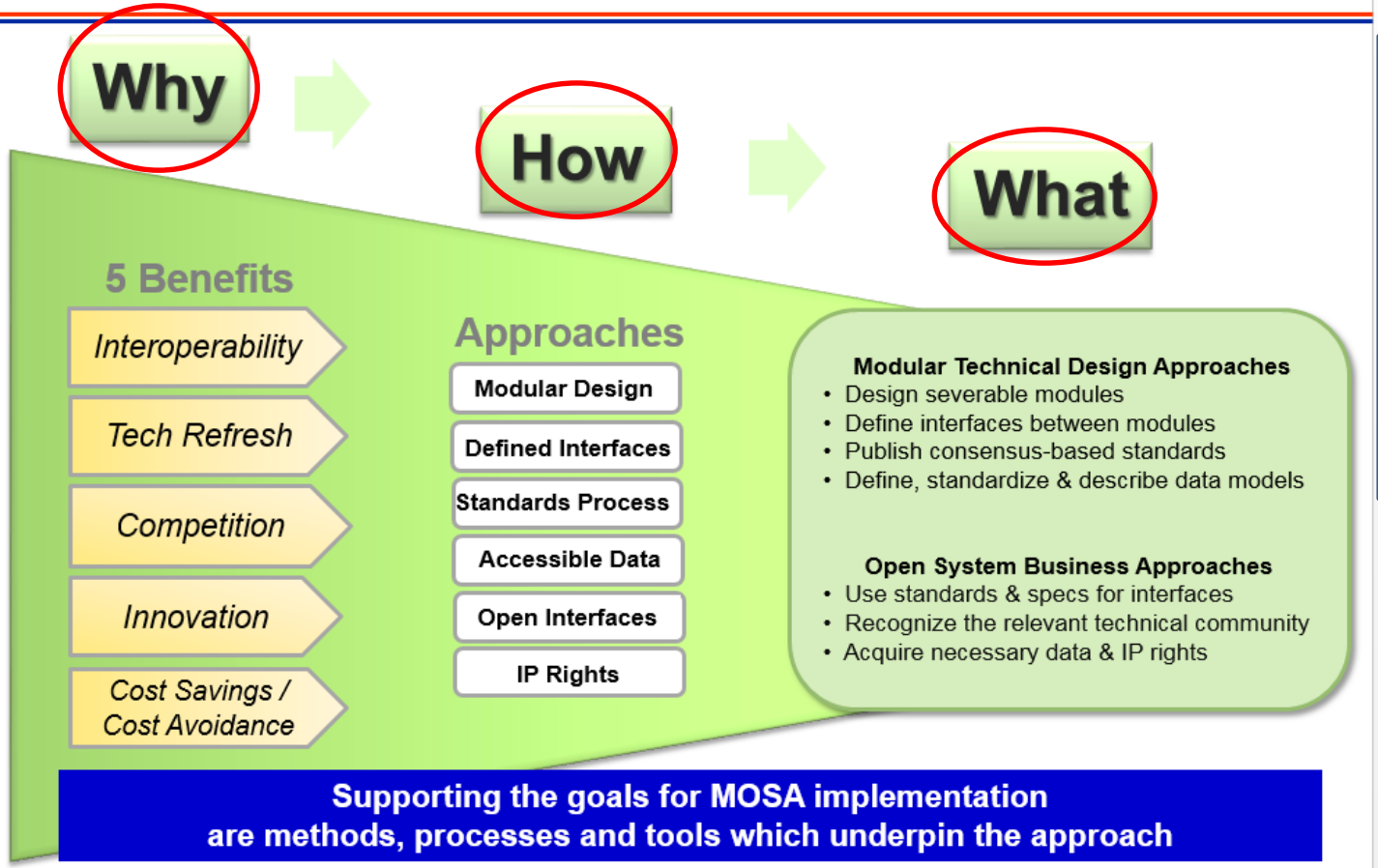
Ed Moshinsky
Systems Engineering & Architecture Leader
Lockheed Martin Space
Co-Chair, NDIA Architecture Committee

Ed Moshinsky is a senior Systems Engineering and Architecture leader with Lockheed Martin Space in Valley Forge Pennsylvania. Ed has 34 years of experience across the development lifecycle of complex software and hardware systems. Most recently, Ed leads key strategic technical initiatives and new business imperatives as a lead system architect.

During his career, Ed has worked across a diverse set of disciplines and has held key leadership positions as a program manager, chief engineer, chief architect, capture manager, operations manager, and even did a tour as a Human Resources director. Over the past several years, Ed has focused on enabling SE processes through the application of Enterprise Architecture, Model-Based Systems Engineering, Open Systems Architecture, and Enterprise Data Analytics.

Ed is active in the NDIA SE Division, serving as Co-Chair for the Architecture Committee. He has also been an active leader in INCOSE, and has served as director for the Delaware Valley INCOSE chapter. Ed holds a BS in Mechanical Engineering and an MBA from Penn State University, as well as a masters in Enterprise Architecture & Governance from Stevens Institute of Technology.

Modular Open Systems Approaches



Key MOSA Implementation Questions

- How can we measure Modularity of an Architecture?
- What are ways of measuring Openness of Interfaces?
- How do we maintain balance between Gov't ownership of Data Rights/ IP and Contractor investments?

An Approach to Measuring Openness of Architectural Interfaces

Technical Openness Values

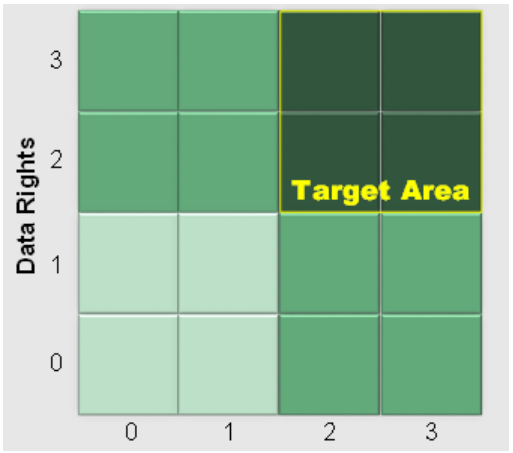
Value	Criteria
3	Commercial or DoD Standard
2	Fully disclosed with well-defined and documented design (e.g., program interface ICD)
1	Proprietary interface with good documentation (e.g., MS APIs)
0	Undisclosed Proprietary interface

Business (Data Rights) Openness Values

Value	Criteria
3	Unlimited data rights available with no IP claims
2	Government purpose data rights available
1	Proprietary interface with negotiated data rights
0	Proprietary interface with no data rights assessment

Horizontal Axis

Vertical Axis



Inspired by *Open Architecture Assessment Model* https://acc.dau.mil/CommunityBrowser.aspx?id=31395

An Approach to Measuring Modularity (1 of 2)

Technical Modularity Quality Indicator Values	
Value	**Criteria**
3 to 0	Use of Loosely Coupled Interfaces between Modules
3 to 0	Use of Interfaces of Low Complexity (Logical and Physical)
3 to 0	Use of Data Model (Conceptual Logical and Physical) use in Interface design and documentation
3 to 0	Overall minimization of Complexity of Inter-module Integration
3-Extensive 2--Moderate 1--Low 0--None	

Business Modularity Indicator Values	
Value	**Criteria (Contribution to Cost and Schedule Improvement)**
3 to 0	Facilitation of Technology Insertion
3 to 0	Reuse amonst product lines providing economy in production quantity
3 to 0	Modular independence sufficient to facilitate Competition for Module production
3 to 0	Reduces Complexity and Systems Integration Risk
3 to 0	Potential Reuse in other systems
3 to 0	Potential use or reuse in commercial systems
3-Significant 2--Moderate 1--Low 0--None	

An Approach to Measuring Modularity (2 of 2)

Technical Modularity Quality Indicator Values	
Value	**Criteria**
3 to 0	Use of Loosely Coupled Interfaces between Modules
3 to 0	Use of Interfacesof Low Complexity (Logical and Physical)
3 to 0	Data Model (Conceptual Logical and Physical) use in Interface design and documentation
3 to 0	Overall Complexity of Intermodule Integration
3-Extensive 2--Moderate 1--Low 0--None	

Horizontal Axis

Business Modularity Indicator Values	
Value	**Criteria (Contribution to Cost and Schedule reduction)**
3 to 0	Facilitation of Technology Insertion
3 to 0	Reuse amonst product lines providing economy in production quantity
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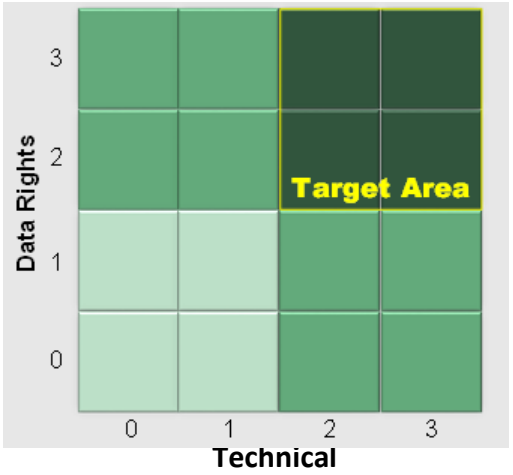

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Current Legislation Direction (1 of 3)

The current legislation affects many aspects of acquisition process. The following is from the current legislation:

(114 TH CONGRESS 2d Session, REPORT 114–840, NATIONAL DEFENSE AUTHORIZATION ACT FOR FISCAL YEAR 2017. CONFERENCE REPORT TO ACCOMPANY S. 2943, page 255)

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.

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:

(1) clearly describe the modular open system approach to be used for the program;

(2) differentiate between the major system platform and major system components being developed under the program, as well as major system components developed outside the program that will be integrated into the major defense acquisition program;

(3) clearly describe the evolution of major system components that are anticipated to be added, removed, or replaced in subsequent increments;

(4) identify additional major system components that may be added later in the life cycle of the major system platform;

(5) clearly describe how intellectual property and related issues, such as technical data deliverables, that are necessary to support a modular open system approach, will be addressed; and

(6) clearly describe the approach to systems integration and systems-level configuration management to ensure mission and information assurance.

Current Legislation Direction (2 of 3)

Request for Proposal 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.

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 that—

(1) in the case of a program that uses a modular open system approach:

(A) the program incorporates clearly defined major system interfaces between the major system platform and major system components, between major system components, and between major system platforms;

(B) such major system interfaces are consistent with the widely supported and consensus-based standards that exist at the time of the milestone decision, unless such standards are unavailable or unsuitable for particular major system interfaces; and

(C) the Government has arranged to obtain appropriate and necessary intellectual property rights with respect to such major system interfaces upon completion of the development of the major system platform; or

(2) in the case of a program that does not use a modular open system approach, that the use of a modular open system approach is not practicable.

Current Legislation Direction (3 of 3)

Requirements relating to availability of major system interfaces and support for modular open system approach

The Secretary of each military department shall:

1. coordinate with the other military departments, the defense agencies, defense and other private sector entities, national standards-setting organizations, and, when appropriate, with elements of the intelligence community with respect to the **specification, identification, development, and maintenance of major system interfaces and standards** for use in major system platforms, where practicable;
2. ensure that **major system interfaces incorporate commercial standards and other widely supported consensus-based standards** that are validated, published, and maintained by recognized standards organizations to the maximum extent practicable;
3. ensure that sufficient **systems engineering and development expertise and resources are available** to support the use of a modular open system approach in requirements development and acquisition program planning;
4. ensure that **necessary planning, programming, and budgeting resources** are provided to specify, identify, develop, and sustain the **modular open system approach, associated major system interfaces**, systems integration, and any additional program activities necessary to sustain innovation and interoperability; and
5. ensure that **adequate training** in the use of a modular open system approach is provided to members of the requirements and acquisition workforce