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Challenges to Implementing MOSA

Perspectives from the NDIA Architecture Committee

Ed Moshinsky - *NDIA Architecture Committee Co-chair*

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Topics

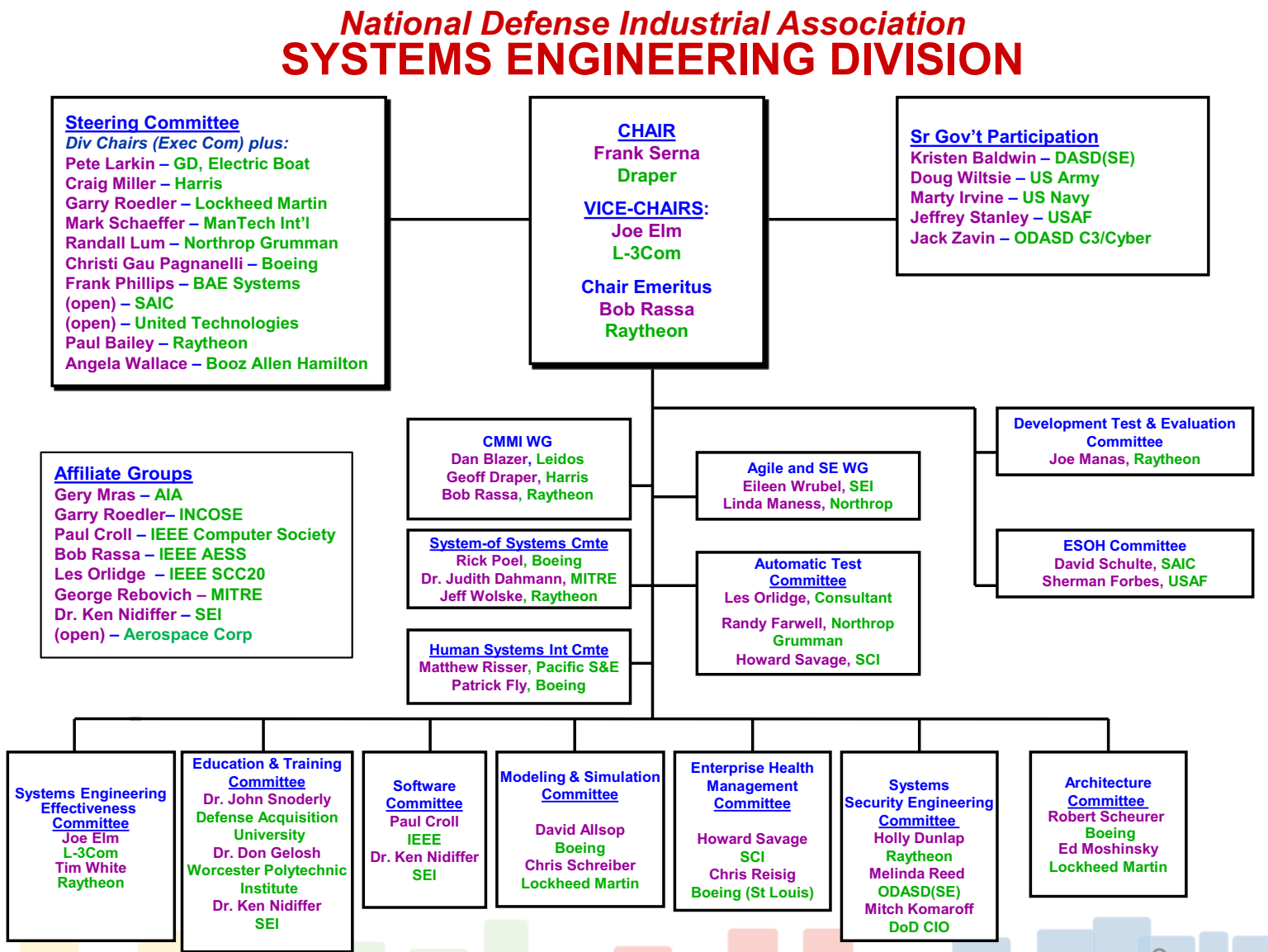
- NDIA Architecture Committee Overview
- Modular Open Systems Approach (MOSA)
  - Overview and Drivers
- Key MOSA Concepts and Challenges
  - Methodology Concept
  - Openness of Interfaces
  - Architecting for Modularity
  - System Group/ Taxonomies Considerations
- Committee Recommendations
- Questions for Further Consideration

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

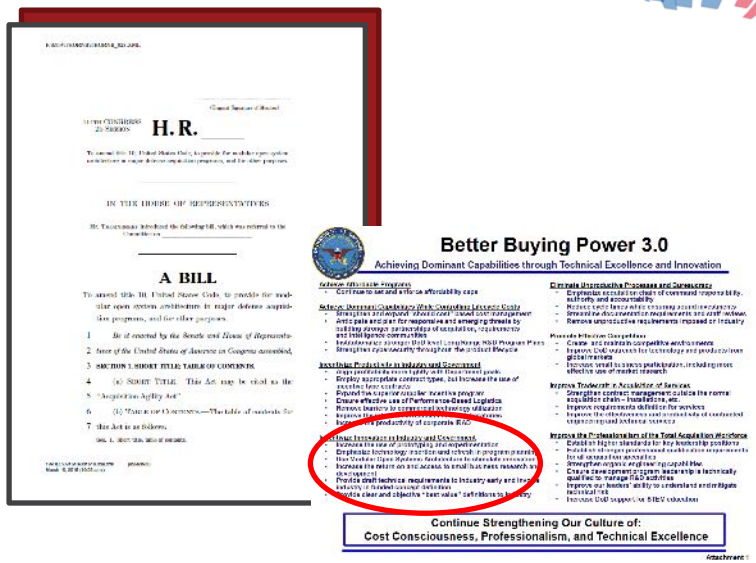
- Allows DoD to acquire warfighting capabilities, including systems, subsystems, software components, and services, with more flexibility and competition.
- MOSA implies the use of modular open systems architecture, a structure in which system interfaces share common, widely accepted standards, with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

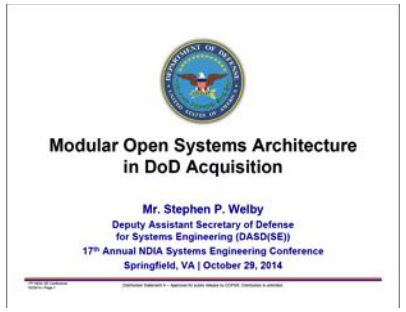
An integrated business and technical strategy to achieve competitive and affordable acquisition and sustainment over the system life cycle

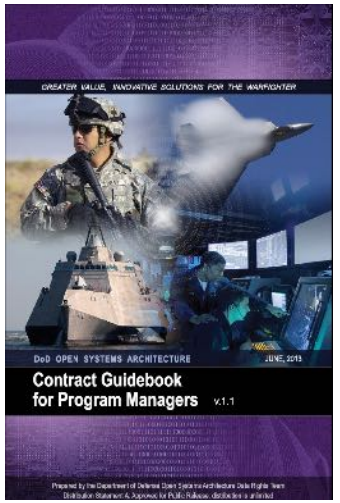
Source: *ODASD Systems Engineering website:* https://www.acq.osd.mil/se/initiatives/init_mosa.html

Drivers for MOSA Implementation

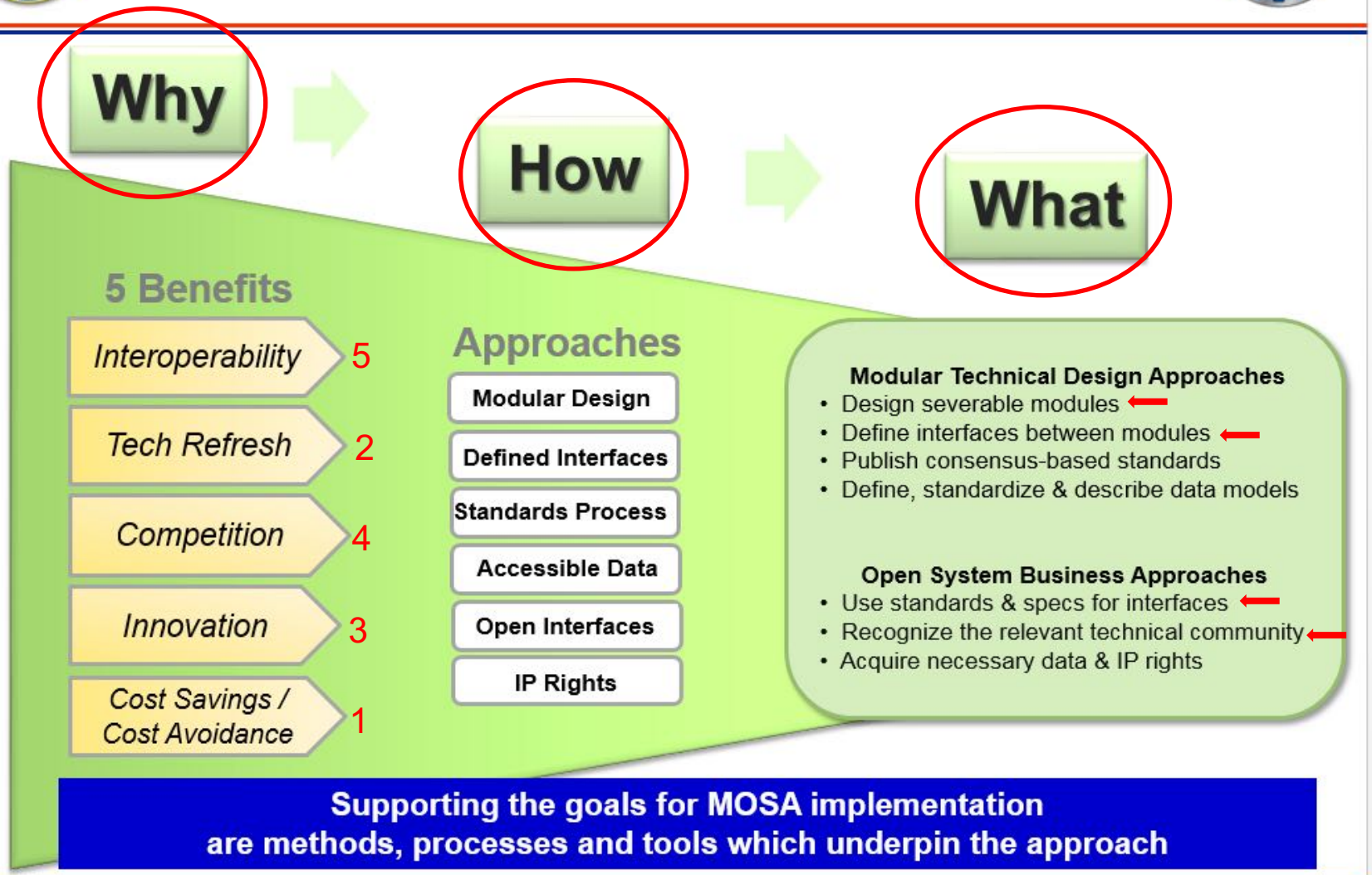
- Acquisition Reform driving Openness into DoD acquired systems
  - National Defense Authorization Act for 2017 requires implementation of MOSA for major DoD acquisitions by 2019
- DoD is implementing on Major Defense Acquisition Programs (MDAP)
  - Driven by rapid evolution in technology and threats 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







Modular Open Systems Approaches

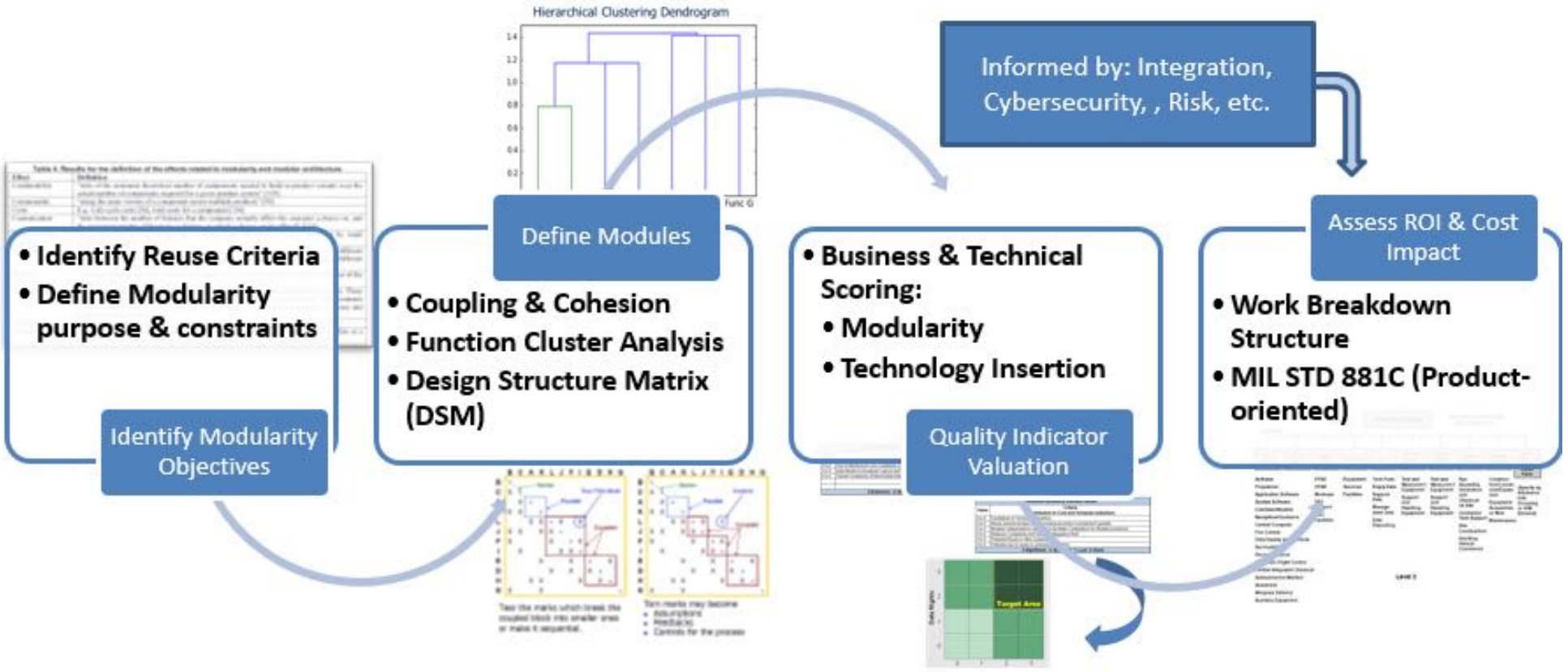


Key MOSA Implementation Questions

- 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?

Key MOSA Concepts and Challenges (1 of 4)

Methodology Concept – Acquiring/ Developing a MOSA solution



Key MOSA Concepts and Challenges (2 of 4)

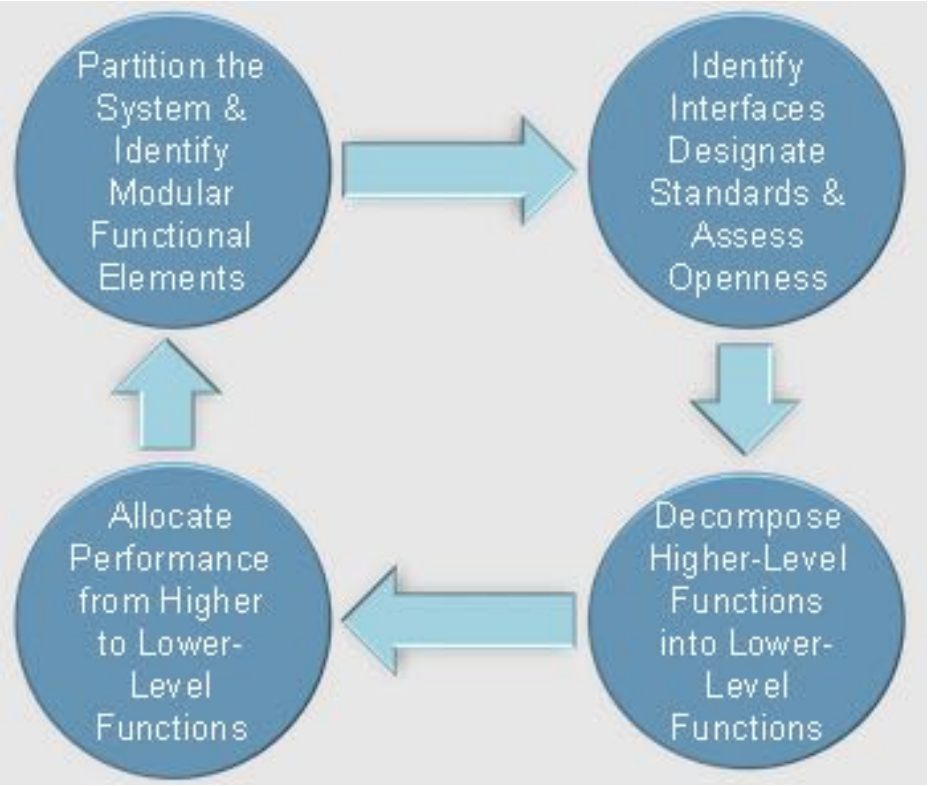
Openness of Interfaces

- 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

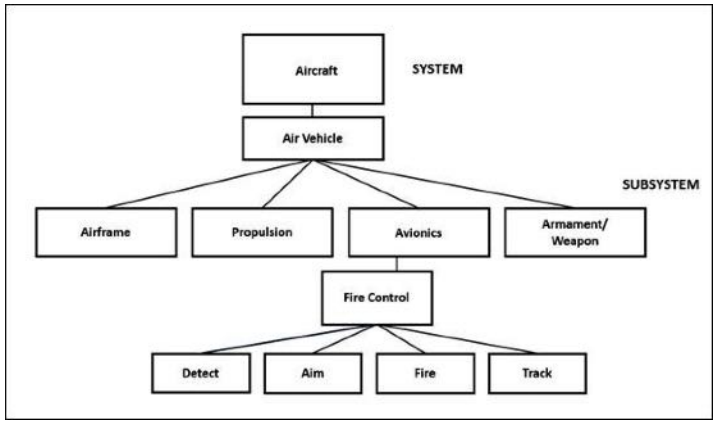
- Iterative & Recursive Architecture Design Process
  - Results in an architecture partitioned into Modules
- Architecture partitioning factors
  - Disciplined definition of functional partitions
  - High Cohesion: Minimizing inter-partition dependencies
  - Loose Coupling: Functionality can be easily 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)

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



Group 2 – Acquisition Tier example

Top Committee Recommendations (Preliminary)

1. Consider the MOSA Value Proposition for development programs.
    - Incentives (positive and negative) may need to be considered to facilitate universal acceptance.
2. Don't implement MOSA for the sake of MOSA.
    - Can lead to unintended consequences and more expensive outcomes, such as added cost to support development of a re-usable design which is never expected to be re-used.
3. Consider developing and maintaining a library of MOSA-compliant architectures.
    - Standardizing reusable functional modules should be the objective.

Top Committee Recommendations (Preliminary)

4. Develop MOSA system development maturity objectives.
   - Incorporate these into Program Technical Reviews.
   - Specify appropriate MOSA indicators and checklists at the design reviews. Provide guidance in the program Systems Engineering Plan.
5. Implement MOSA as part of a larger and more robust Digital Engineering strategy.
   - Modeling the system architecture enables objective measures of Openness and Modularity.
   - Detailed techniques need to be developed and shared among the DoD acquisition community.
6. Develop and publish detailed guidance for Architecting for Modularity and Openness.

Topics for Further Consideration

- Cybersecurity and MOSA
- Special considerations for Software Modularity and Openness

Questions?

Backup

About the Presenter

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

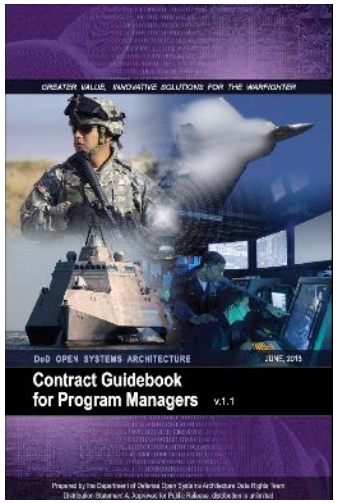
Ed Moshinsky is a senior Systems Engineering and Architecture leader with Lockheed Martin Space Systems Company in Valley Forge Pennsylvania. Ed has 34 years of experience across the development lifecycle of complex software and hardware systems. Most recently, he was the lead system architect for a key strategic missile programs for Lockheed Martin.

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.

Open Systems Architecture – Core Principles

1. Modular designs with loose coupling and high cohesion that allow for independent acquisition of system components, i.e., composability;
2. Continuous design disclosure and appropriate use of data rights allowing greater visibility into an unfolding design and flexibility in acquisition alternatives;
3. Enterprise investment strategies that maximize reuse of system designs and reduce total ownership costs (TOC);
4. Enhanced transparency of system design through Government, academia, and industry peer reviews;
5. Competition and collaboration through development of alternative solutions and sources;
6. Analysis to determine which components will provide the best return on investment (ROI) to OSA, i.e., which components will change most often due to technology upgrades or parts obsolescence and have the highest associated cost over the lifecycle.



- From *Open Systems Architecture Contract Guidebook for Program Managers, Version 1.1, May 2013.*

An Approach to Measuring Openness of Architectural Interfaces

Technical Openness Values

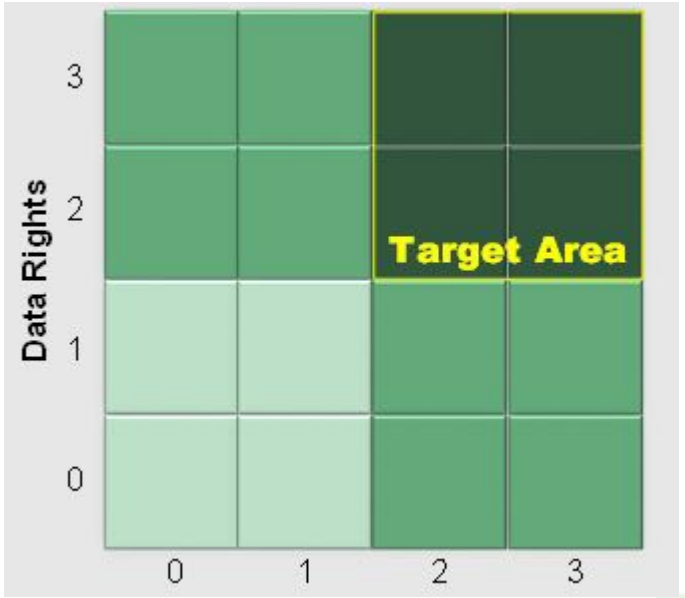
Value	Criteria
3	Commercial or DoD Standard
2	Fully disclosed with well-defined and documented design (e.g., program interface ICD)
1	Proprietary interface with good documentation (e.g., MS APIs)
0	Undisclosed Proprietary interface

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
3 to 0	Modular independence sufficient to facilitate Competition for Module production
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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

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