Improving Transition: Modular Open Systems Approach (MOSA) & Engineering Enablers

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‘Strategic’ Challenges

- **MOSA is not an all or nothing proposition**
  - Must tailor approach to expected MOSA outcomes
  - Permeates all aspects of systems engineering
  - Requires design trades based on near-term and long-term cost benefit

- **MOSA is more than just defining architectures and selecting standards**
  - Technical community
  - Business relationships

- **Governance and leadership matter**
  - Top cover for individual programs to succeed
  - Leadership and engineering where necessary across multiple programs

- **Industry must be an able and willing partner**
  - Design decisions, documentation, specifications, interfaces, tools, etc.
Modular Open Systems Complexity

- Today’s systems are complex in: size, interactions **between** components and subcomponents, and external interactions
- The **appropriate use of modular design techniques** and open systems standards can achieve the 5 MOSA benefits
  - Interoperability
  - Technology Refresh
  - Competition
  - Innovation
  - Cost Savings/Cost Avoidance

BEGIN...

...with the END in mind!
Modular Open Systems Approaches

**Why**

- Interoperability
- Tech Refresh
- Competition
- Innovation
- Cost Savings / Cost Avoidance

**How**

- Modular Design
- Defined Interfaces
- Standards Process
- Accessible Data
- Open Interfaces
- IP Rights

**What**

Modular Technical Design Approaches
- Design severable modules
- Define interfaces between modules
- Publish consensus-based standards
- Establish compliance testing activities
- Define, standardize & describe data models

Open System Business Approaches
- Recognize the relevant technical community
- Establish necessary business practices
- Use standards & specs for interfaces
- Acquire necessary data & IP rights

Supporting the goals for MOSA implementation are methods, processes and tools which underpin the approach.

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Improve Interoperability

• **Begin with the MOSA End Goal in Mind**
  – Enable systems (and software applications) to access and provide data + services using (open) interface definitions between components

• **Program Objectives**
  – Operational flexibility to support reconfigurable product configurations of existing capabilities to counter threats or enable different missions
  – Share and exchange data consistently between components (and system stakeholders) using defined data models
Enable Tech Refresh

• **Begin with the MOSA End Goal in Mind**
  – Enable periodic upgrades of technology to assure system supportability

• **Program Objectives**
  – Enable technical flexibility for rapid and effective system upgrades
  – Upgrade technology without changing all components in the entire system

- Flexible
- Upgradeable
- Severable
- Replaceable
- Adaptable
- Loose Coupling
Increase Competition

• **Begin with the MOSA End Goal in Mind**
  – Prevent vendor lock and increase options for replacement/refresh

• **Program Objectives**
  – Platform and vendor independence when hardware (and software) implement open industry standards
  – Ability to openly compete severable modules
  – Compete portable components with open (specifications or standards for interfaces, services, and supporting formats) across a wide range of systems from one or more suppliers
Incorporate Innovation

• **Begin with the MOSA End Goal in Mind**
  – Insert capabilities that provide technological innovation to the warfighter
  – Use business practices that encourage the relevant technical community to develop and insert new technologies

• **Program Objectives**
  – Take advantage of new advancements in technology
  – Enable technical agility to meet rapidly changing requirements
Improve Cost Savings/Avoidance

• Begin with the MOSA End Goal in Mind
  – Enable reduction in cost & time to decrease total cost of ownership

• Program Objectives
  – Achieve less expensive technical modifications
  – Additional capabilities and modifications desired without redesigning non-critical hardware or software
  – Ability to reuse previous investments: technology, modules or components across the acquisition lifecycle
What Next?

• Define modularity and openness (technical and programmatic) in the context of an ecosystem
• Address MOSA for component obsolescence and cases where there is a loss of critical suppliers
• Address how to plan for technology insertion and upgrades in tightly coupled, highly integrated systems
• Quantify the costs, benefits, and risks of MOSA across multiple dimensions (e.g. using tradespace exploration)
• Map beneficial elements of MOSA strategies to appropriate acquisition processes that encourage adoption
• Implement FY17 National Defense Authorization Act Sections 805-809
Acquisition Agility
2017 NDAA Sections 805-809

• **Improve our ability to evolve weapon systems**

  – Requirement documents designate where Major Defense Acquisition Programs (MDAPs) should evolve to meet changing threats, enhance interoperability, and rapidly employ new tech

  – (MDAPs) use MOSA, where practical, to enable that evolution, including cost savings, competition, and technology refresh

  – Military Services establish prototyping investments targeted to mature technologies suited to meet program evolution needs

  – Independent risk assessments confirm that technical and manufacturing risks are low

  – Improve technical data rights, for government purposes, suitable for MOSA

  – Reaffirms SECDEF role in establishing cost, schedule, and performance goals for MDAPS

  – Establishes new milestone reports to be provided by Milestone Decision Authorities to Congress for greater transparency
NDAA FY17 view of Acquisition Agility

SECDEF establishes:
- program cost targets
- fielding target
- performance goals

Independent Technical Risk Assessment

Major System Platform
- Major System Interfaces
- Major System Components
- Component
- Prototype

Weapon System w/MOSA
- Major System Platform
- External Interfaces
- MilDeps
- MilDeps Oversight Boards

Weapon System w/o MOSA
- Weapon System Platform
- Prototype
- Component
- Prototype

MilDeps Projects

MilDeps Oversight Boards

Program Capability Documents
- Req’ts
- CDD
- CPD

Mission Integration Management
- CAS
- ISR
- JS & SECDEF

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Moving From Automation to Autonomy

Automation

- limited operator involvement
- limited to specific actions
- well-defined tasks
- predetermined responses

Autonomy

- intelligence-based
- responds in unanticipated situations
- not pre-programmed
- self-government
- self-directed behavior
- human’s proxy for decisions

From AFRL Autonomy S&T Strategy
Adopted by OSD Autonomy COI
TEV&V strategy
Engineering Challenges In Transitioning Autonomy

**• Challenge**

- Lack of experience in the engineering and acquisition communities
- Inconsistent terminology and expression
- Inability to test and evaluate autonomy
- Need for in-situ T&E
- Lack of comprehensive HSI approaches
- Need for rapid evolution
- Vulnerabilities of computer-based technologies

**• Opportunity**

- Focused experimentation; Body of Knowledge, WF competencies & training
- Establish ontology and lexicon
- Invest research in SE approaches for testing
- Establish SE practices for in-situ T&E architectures
- Engage HSI community alongside Engineering
- Base functionality in SW & MOSA
- Establish cyber practices for autonomous computing
1. Methods, Metrics, and Tools Assisting in Requirements Development and Analysis:
   • Precise, structured standards to automate requirement evaluation for testability, traceability, and consistency

2. Evidence-Based Design and Implementation
   • Assurance of appropriate decisions with traceable evidence at every level to reduce the T&E burden

3. Cumulative Evidence through Research, Development, and Operational Testing:
   • Progressive sequential modeling, simulation, test, and evaluation to record, aggregate, leverage, and reuse M&S/T&E results throughout engineering lifecycle

4. Run-time Behavior Prediction and Recovery:
   • Real time monitoring, just-in-time prediction, and mitigation of undesired decisions and behaviors

5. Assurance Arguments for Autonomous Systems:
   • Reusable assurance case-based on previously evidenced “building blocks”
Systems Engineering: Critical to Defense Acquisition

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

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