Modularity and Open Systems: Meaningful Distinctions

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DASD, Systems Engineering

DASD, Systems Engineering
Stephen Welby
Principal Deputy Kristen Baldwin

Major Program Support
James Thompson

Supporting USD(AT&L) Decisions with Independent Engineering Expertise

- **Engineering Assessment / Mentoring of Major Defense Programs**
- **Program Support Assessments**
- **Overarching Integrated Product Team and Defense Acquisition Board Support**
- **Systems Engineering Plans**
- **Systemic Root Cause Analysis**
- **Development Planning/Early SE**
- **Program Protection**

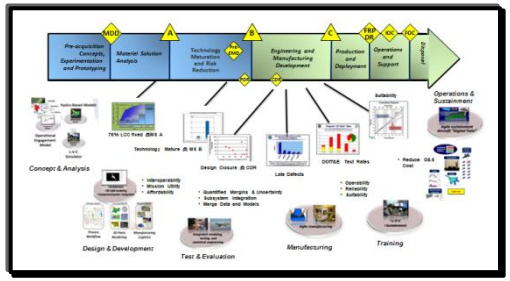
Engineering Enterprise
Robert Gold

Leading Systems Engineering Practice in DoD and Industry

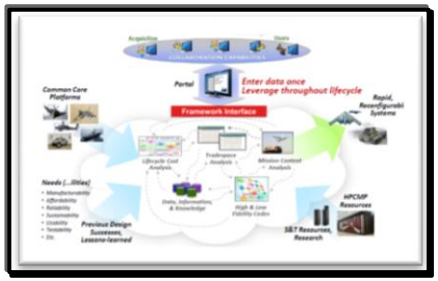
- **Systems Engineering Policy and Guidance**
- **Technical Workforce Development**
- **Specialty Engineering (System Safety, Reliability and Maintainability, Quality, Manufacturing, Producibility, Human Systems Integration)**
- **Security, Anti-Tamper, Counterfeit Prevention**
- **Standardization**
- **Engineering Tools and Environments**

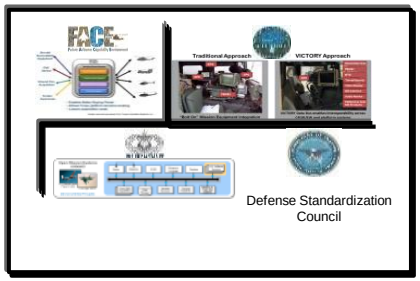
Providing technical support and systems engineering leadership and oversight to USD(AT&L) in support of planned and ongoing acquisition programs

Overview of Engineering Tools and Environments



- **Digital System Model/Digital Thread**
- **Education**
- **Policy & Guidance**
- **Data Rights**





- **BBP 3.0**
- **Technical Standards**
- **Curriculum Development**

Digital Engineering Design

Transforming DoD towards model-centric practices by shifting away from a linear, document-centric acquisition process towards a dynamic digital model-centric ecosystem

- Digital System Model: Develop a structure to for organizing programs' technical data

Engineered Resilient System

Developing integrated suite of modern engineering tools: models and related capabilities, tradespace assessment and visualization tools; all within an architecture aligned with acquisition and operational business processes.

Modular Open Systems Architecture

Identifying Data, Standards, and Tools for Modular and Open Systems Design

Identifying acquisition approaches and support for more capable, modular, and rapidly upgradeable systems

Engineering processes, tools and techniques incorporating the latest digital practices for making informed decisions throughout the acquisition lifecycle

Various Aspects of MOSA

- **MOSA Definitions**
  - Modularity
    - Allows tasks, both design tasks and production tasks, to be divided among groups, which can work independently and not have to be part of the same firm. Compatibility among modules is ensured by "design rules" that govern the architecture, the interfaces, and the standardization tests of the system.
      - Baldwin, C. Y., & Clark, K. B. (2004). Modularity in the Design of Complex Engineering Systems.
  - Modular Design
    - A design where functionality is partitioned into discrete, cohesive, and self-contained units with well-defined interfaces that permit substitution of such units with similar components or products from alternate sources with minimum impact on existing units.
      - Open System Joint Task Force, 2004
  - Modular Open Systems Approach
    - DoD's implementation of Open Systems. Within the MOSA context, programs design their system based on adherence to the following five MOSA principles: establish an enabling environment, employ modular design, designate key interfaces, use open standards and certify conformance.
      - OSA Contract Guidebook for Program Managers, v1.1, June 2013
  - Open System Approach
    - An integrated business and technical strategy that employs modular design and where appropriate, defines key interfaces using widely supported, consensus-based standards that are published and maintained by a recognized standards organization.
      - OSA Contract Guidebook for Program Managers, v1.1, June 2013

Various Aspects of MOSA cont'd

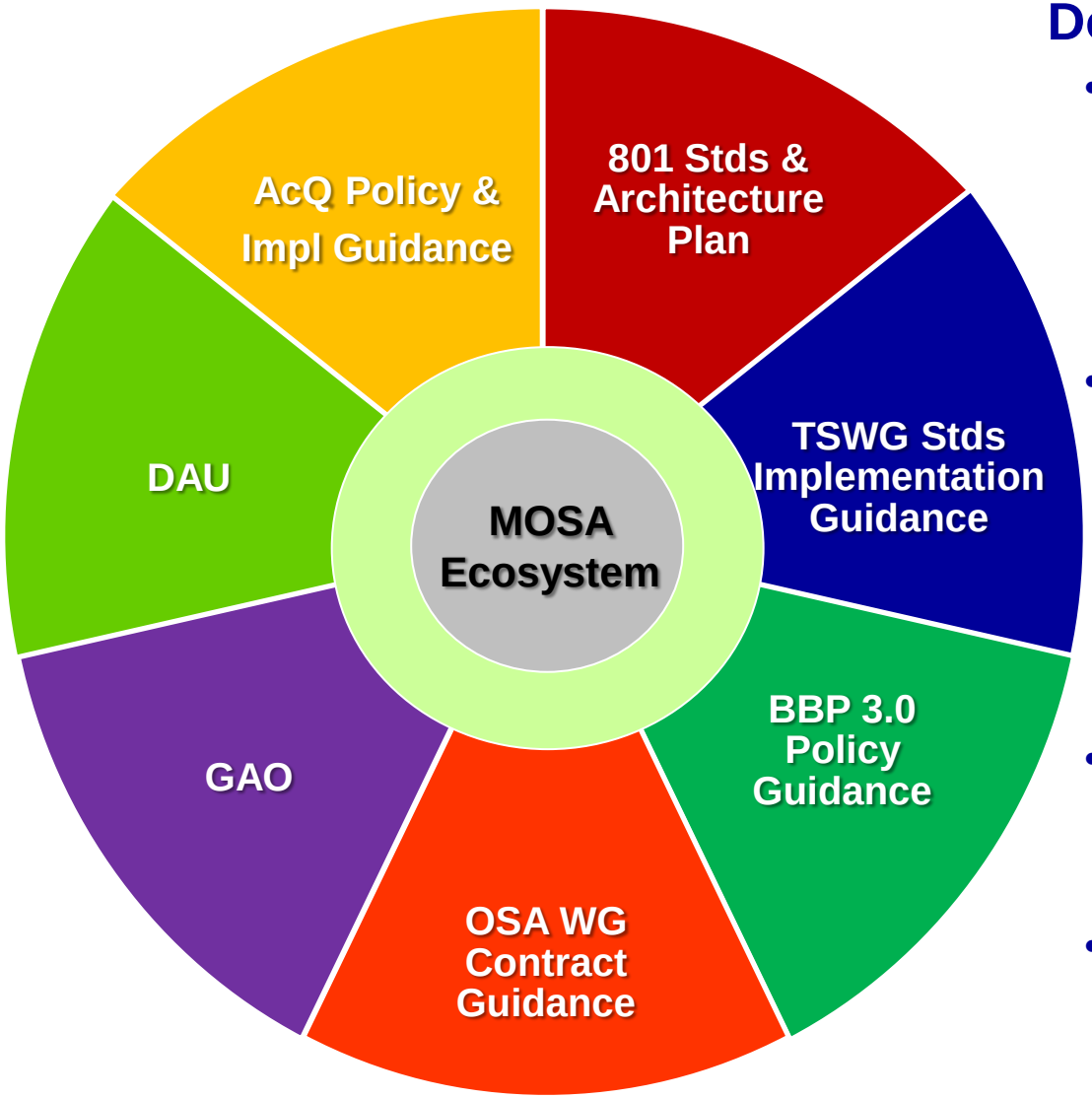
- **MOSA Definitions**
  - Open Systems
    - Employs modular design, uses widely supported and consensus based standards for its key interfaces, and has been subjected to successful validation and verification tests to ensure the openness of its key interfaces.
      - AcqNotes
  - Open Architecture
    - A technical architecture that adopts open standards supporting a modular, loosely coupled and highly cohesive system structure that includes publishing of key interfaces within the system and full design disclosure
      - OSA Contract Guidebook for Program Managers, v1.1, June 2013
  - Open System Architecture
    - Vendor-independent, non-proprietary, computer system or device design based on official and/or popular standards. It allows all vendors (in competition with one another) to create add-on products that increase a system's (or device's) flexibility, functionality, interoperability, potential use, and useful life. And enables the users to customize and extend a system's (or device's) capabilities to suit individual requirements. Also called open architecture.
      - http://www.businessdictionary.com/definition/open-system-arcdhitecture.html#ixzz3kawDavCV

Open Collaboration

Stakeholders

- **Program Management**
  - Guidance on how to implement MOSA
- **Systems Engineering**
  - Plan for Developing Standards and Architectures
  - MOSA Best Practices / Technical Enablers
- **Contracting**
  - IP / Data Rights Guidance
  - MOSA Training
- **Industry**
  - Partnerships between Government and Industry
  - Consortiums promoting MOSA implementations

MOSA Ecosystem



DoD Community

- **Technical**
  - DSC TSWG & OSA WG
  - BBP 3.0 IPT Tech Enablers
  - Sec. 801 Standardization Plan
  - Industry & Gov Consortiums
- **Policy & Guidance**
  - DoD guidance for AT&L Services
    - DoD 5000.02 & DAG
    - AcQ Strat – OSA WG IP Strategy
    - SEP & LCSP
  - Contracting P&G
  - BBP 3.0 Implementation Guidance
- **Acquisition Governance**
  - FY15 NDAA Sec. 801 Review
  - AcQ Lifecycle Reviews
- **Training**
  - DAU Education
  - Service AcQ/Contr'ng Trng

Modular / Open Systems

Why → **How** → **What**

Goals

- *Interoperability*
- *Tech Refresh*
- *Competition*
- *Innovation*
- *Cost Savings*

Approaches

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

Modular Technical Design Approaches

- Design severable modules
- Define interfaces between modules
- Publish consensus-based standards
- Define, standardize & describe data models

Open System Business Approaches

- Use open standards & specs for interfaces
- Acquire necessary data & license rights

Interoperability

- **Adopting modular technical design (and open system) approaches enables:**
  - Severable software and hardware modules to be changed independently
  - Components (and system stakeholders) to share and exchange data consistently using defined data models
  - Systems (and software applications) to access and provide data + services using open interface definitions between components

Modular Design

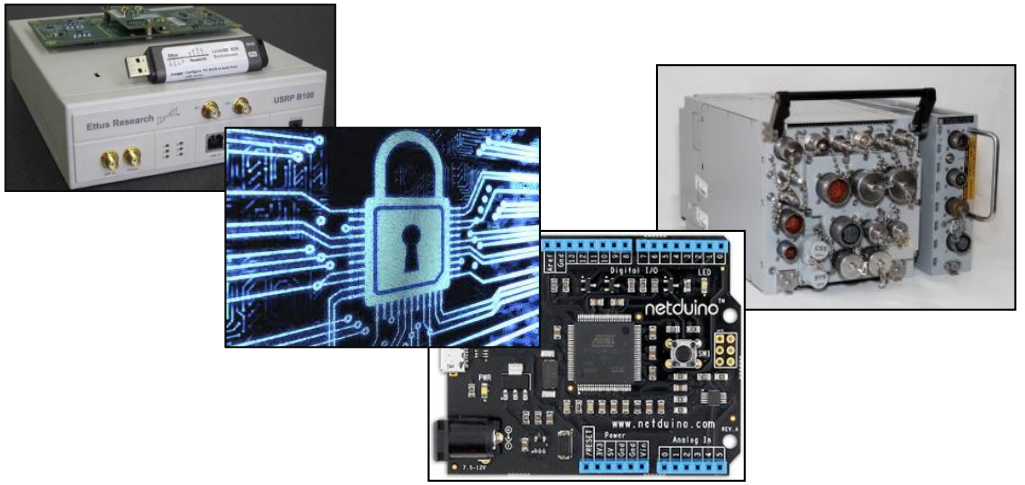
Defined Interfaces

Standards Process

Accessible Data

Open Interfaces

IP Rights



Tech Refresh

- **Adopting modular technical design (and open system) approaches enables:**
  - Technical flexibility for rapid and effective technical upgrades of systems
  - Opportunities for technology insertion
  - Delivery of new capabilities or replacement technology without changing all components in the entire system

Modular Design

Defined Interfaces

Standards Process

Accessible Data

Open Interfaces

IP Rights

Competition

- **Adopting modular technical design (and open system) approaches enables:**
  - Platform and vendor independence when hardware (and software) implement open industry standards
  - Severable modules to be openly competed
  - Portable components with open (specifications or standards for interfaces, services, and supporting formats) to be competed across a wide range of systems from one or more suppliers

Modular Design

Defined Interfaces

Standards Process

Accessible Data

Open Interfaces

IP Rights

Innovation

- **Adopting modular technical design (and open system) approaches enables:**
  - Commercial flexibility to achieve value and innovation in procurement
  - 3rd party developers to offer SW development kits (SDKs) and system development tools that includes source code and documentation
  - Operational flexibility to configure and reconfigure available assets to meet rapidly changing operational requirements

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

Cost Savings

- **Adopting modular technical design (and open system) approaches enables:**
  - Less expensive technical modifications
  - Additional capabilities and modifications without redesigning hardware or software
  - Reuse of technology, modules and/or components from any supplier across the acquisition lifecycle

Modular Design

Defined Interfaces

Standards Process

Accessible Data

Open Interfaces

IP Rights

Next Steps

- Establish MOSA ecosystem, relevant stakeholders, and research needs
- Update policy and guidance to support MOSA implementation with Better Buying Power (BBP) 3.0 updates
- Refresh DAU and Service-specific acquisition and contracting training
- Address gaps in standards selection and implementation guidance
- Promote technical reviews of MOSA throughout acquisition lifecycle
- Continue Systems Engineering Research Center (SERC) efforts and identify effective ways to design MOSA systems
- Identify the elements of a successful MOSA framework

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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