



MOSA Domain Overlay - Status Update

20 March 2024

Richard Wise
Senior Research Engineer
richard.wise@gtri.gatech.edu

Your participation please...

Imaginary Estates Homeowners Association Rules and Regulations

Article III: Pet Ownership

Section 8: Pet Requirements

Subparagraph 9: Every homeowner shall own a cuddly pet.



Which example is compliant to the regulation?

MOSA: Modular Open Systems Approach

A Modular Open Systems Approach (MOSA) “is an **integrated business and technical** strategy to achieve competitive and affordable acquisition and sustainment over the system lifecycle.”



Key Principles/Tenets:

- Establish an Enabling Environment
- Employ Modular Design
- Designate Key Interfaces
- Use Open Standards
- Certify Conformance

(Modular Open Systems Approach – DoD Research & Engineering, OUSD(R&E), n.d.; Modular Open Systems Approach (MOSA) - AcqNotes, n.d.)

U.S.C. Title 10 §4401 MOSA Requirement



Office of the Law Revision Counsel
UNITED STATES CODE



10 USC 4401 - Requirement for modular open system approach in major defense acquisition

*“A major defense acquisition program that receives Milestone A or Milestone B approval after January 1, 2019, shall be designed and developed, to the maximum extent practicable, with a **modular open system approach** to enable incremental development and enhance competition, innovation, and interoperability.”*

(Office of Law Revision Council, United States Code, n.d.)



Additional MOSA Statutes, Policy, and Guidance

- Statutory:

- 10 USC 4402
- 10 USC 4403
- 10 USC 3771
- 10 USC 3772
- 10 USC 3774
- 10 USC 3775
- 10 USC 2222
- 10 USC 2223
- 10 USC 2224

- Policy:

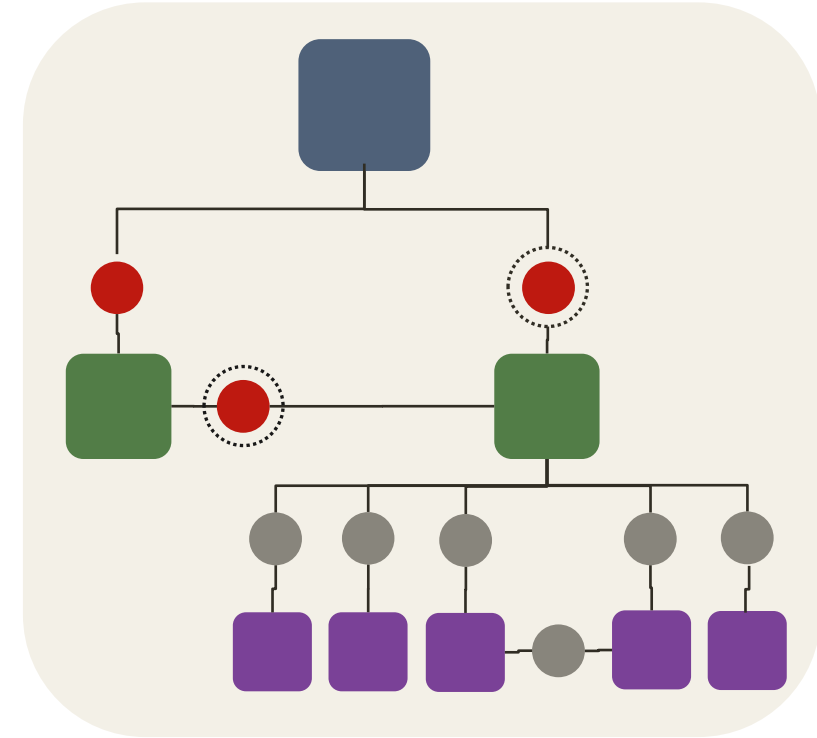
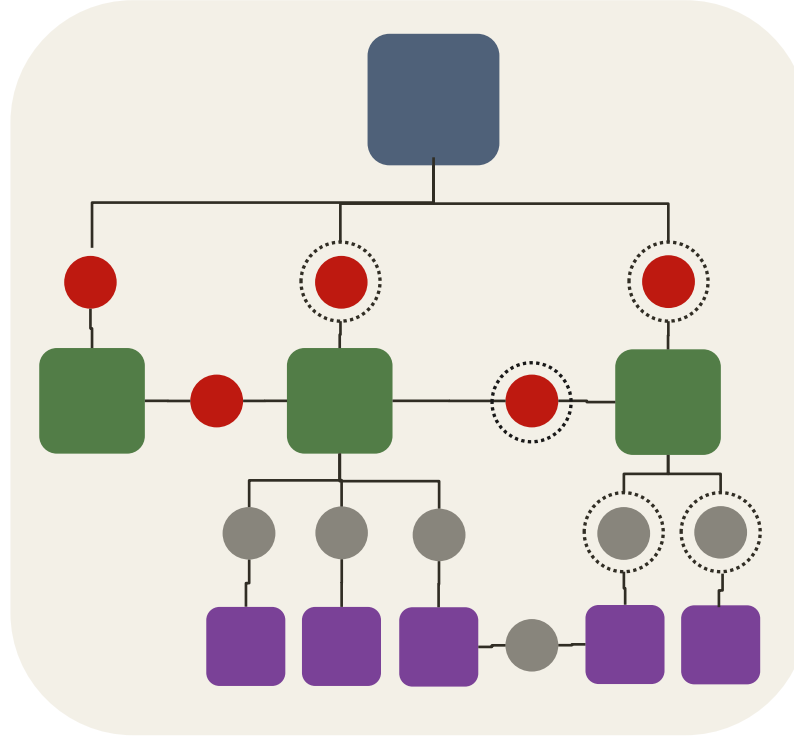
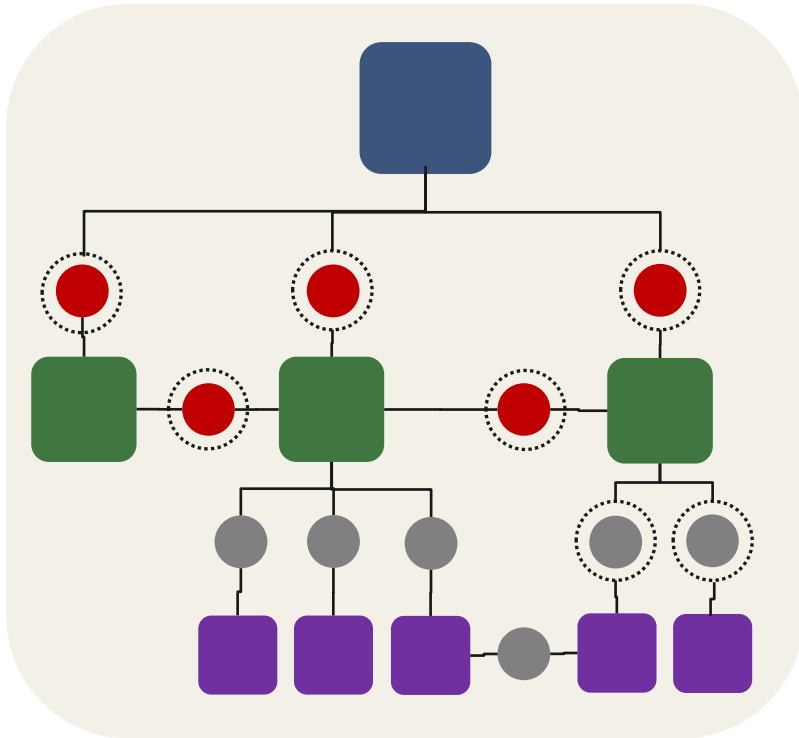
- MOSA Tri-Services Memo
- DoD Directive 5000.x
- DoD 5000.2-R
- DoD 5000.88

- Guidance:

- DoD Open Systems Architecture Contract Guidebook for Program Managers
- MOSA Reference Frameworks in Defense Acquisition Programs
- PEO Aviation MOSA Implementation Guide
- Air Force Data Rights Guidebook
- AFMC Guidebook for Implementing MOSA in Weapon Systems

(Geier, 2022; Henry et al., 2023; Modular Open Systems Approach – DoD Research & Engineering, OUSD(R&E), n.d.)

Which MOSA Implementation is Compliant?



MOSA

- Major System Platform
- Major System Component
- Component

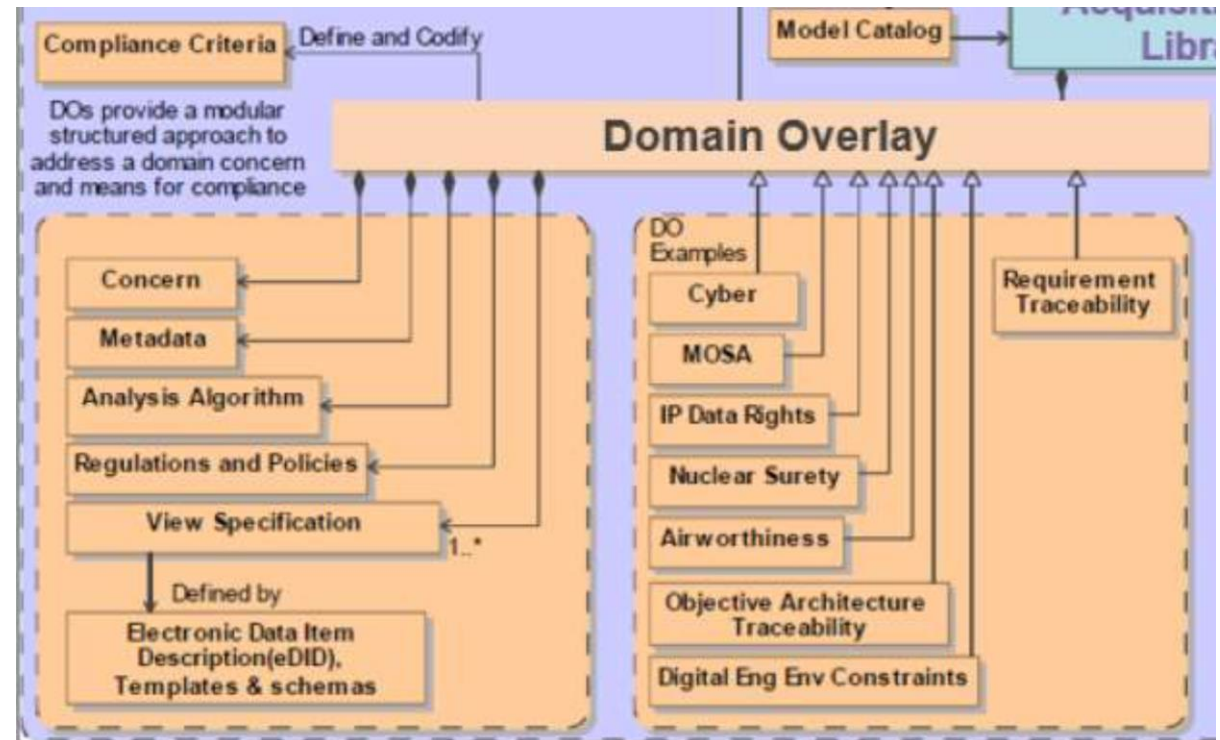
OSA

- Key Interface
- Interface
- Open Interface

(Zimmerman et al., 2019)

Domain Overlay

- Part of Model-Based Acquisition RFP
- A collection of constructs needed to support analysis for a domain specific concern using a standardized approach.
- Characteristics:



- Usually has associated regulations, governance that can be treated as pseudo requirements or constraints
- Cross-cutting both viewpoints/rows & aspects/columns
- Supports specific analysis associated with a Domain-Specific concern
- Can be created independent of a specific solution architecture description
- Can be applied or removed from a specific architecture description without impacting the AD, hence an overlay

(Hart & Anderson, 2022; Hart & Hause, 2023)

NDIA Systems Engineering Division, Architecture Committee

NDIA

Modular Open Systems Approach

Implementation Challenges and Opportunities

A Successor Report to the July 2020 NDIA SE Architecture Committee White Paper
"MOSA Considerations Impacting Both Acquirer and Supplier Adoption"

National Defense Industrial Association
Systems Engineering Architecture Committee

Release Date: October 16, 2023

DISCLAIMER: The ideas and findings in this report should not be construed to be official positions of any of the organizations listed as contributors or the membership of NDIA. It is published in the interest of an information exchange between government and industry, pursuant to the mission of NDIA.

MOSA Implementation Considerations, Information Needs and Metrics

National Defense Industrial Association

NDIA

Systems Engineering Division, Architecture Committee

Version 1.0

16 Oct 2023

Author/Editors

Steve Henry
Consultant
tamu1971@gmail.com

Bob Scheurer
Boeing
Robert.P.Scheurer@boeing.com

Joseph Bradley
Leading Change LLC
josphbradley@leadingchange.com

Dr. Robert Raygan, PHD
Defense Acquisition University
Robert.Raygan@dau.edu

DISCLAIMER: The ideas and findings in this report should not be construed to be official positions of any of the organizations listed as contributors or the membership of NDIA. It is published in the interest of an information exchange between government and industry, pursuant to the mission of NDIA.
General Use: Permission to reproduce, use this document or parts thereof, and to prepare derivative works from this document and attachments is granted, with attribution to NDIA and the original author(s), provided this copyright notice is included with all reproductions and derivative works.

MOSA Implementation Considerations, Information Needs and Metrics, Version 1.0, 16 Oct 23
© 2023 National Defense Industrial Association. All rights reserved.

1

Attachment A MOSA Metrics Selection Master List

MOSA is an integrated technical and business technical strategy to enable development, enhance competition, innovation, and interoperability, an acquisition approach that needs design and development schedule.

Appendix B MOSA Systems Engineering Processes and Solution Implementation Metrics

Table of Contents

- 1.0 Integrating
- 2.0 Systems En
- 3.0 Selecting M
- 4.1.1 Acq
- 4.1.2 Sup
- 4.2 Organize
- 4.2.1 Life
- 4.2.2 Infra
- 4.2.3 Port
- 4.2.4 Hum
- 4.2.5 Qual
- 4.2.6 Kno
- 4.3 Techni
- 4.3.1 Prod
- 4.3.4 Risk
- 4.3.5 Cont
- 4.3.6 Info
- 4.3.7 Mea
- 4.4 Techni
- Appendix B M
- © 2023 Nation

Practical Software and Systems Measurement Continuous Iterative Development Measurement Framework Part 2: Measurement Specifications: NDIA MOSA Product Value Derivative Work - PSM Product Value Specification Version 2.1, April 15, 2021 NDIA Version 12, 21 Sep 2023

Developed and Published by Members of NDIA System Engineering Architecture Committee

Attachment A, N
© 2023 Nation

Appendix D Modular Open System Approach (MOSA) Reuse of SW and HW Use Case

Contents

- 1.0 DoD MOSA R
- 2.0 Desired MOS
- 3.0 MOSA Impl
- 4.0 MOSA Meas
- 4.1 Reuse Ba
- 4.2 MOSA Eng
- 4.3 MOSA Cate
- 5.0 Related an
- 1.0 DoD MC
- Enable cost sav
- across the acq
- 2.0 Desired
- Enable t
- reductio
- Employ Modul
- reuse of hardw
- Design
- Optimize
- software
- product
- Verify th
- 3.0 MOSA I
- Employ th
- the mos
- interoper
- Appendix D M
- © 2023 Nation

Appendix E Navy CANES MOSA Acquisition and Technology Refresh Strategy

DoD MOSA R
Enhance compete
Desired MOS
• Enhanc
Consolid

1. Navy
2. Navy
Appendix E M
© 2023 Nation

Appendix F USAF GATM Acquisition and Technology Refresh Strategy

DoD MOSA Benefit Category:
Enhance competition open architecture with severable modules, allowing components to be openly competed
Desired MOSA Benefit Outcome:
• Enhance competition to achieve cost savings
Global Air Traffic Management (GATM) MOSA Implementation Strategy Example:
1. Provided Governance: Established a program office that centralizes engineering and technical expertise for Communication, Navigation, and Surveillance (CNS) capability acquisitions and modifications to ensure that all AF aircraft, Unmanned Aerial Systems (UAS) and Remotely Piloted Aircraft (RPA) comply with appropriate CNS/ATM and Navigation safety performance standards and requirements enabling access to U.S. and international nation/state managed airspace.
a. Supported AF aircraft and UAS CNS/ATM acquisitions as the AF's centralized focal point (Center of Excellence) for identifying, analyzing, and evaluating internationally accepted civil aviation authority operational airspace rules, procedures and requirements worldwide.
i. Analyzed and evaluated internationally accepted civil aviation authority operational airspace rules, procedures and requirements worldwide.
ii. Identified, analyzed, and evaluated the technical performance standards and requirements of the prescribed CNS capabilities and supported platform program offices in the design and integration of the capabilities required to ensure access to civil airspace worldwide.
b. Verified the system's end-to-end performance for each CNS capability integrated into AF platforms complies with these internationally accepted rules and standards
i. Provided accreditation guidance and engineering support to aircraft GATM integration efforts
ii. Provided GATM accreditations for aircraft GATM implementations
c. Assessed dual-use capabilities of avionics to satisfy both civil CNS/ATM and military unique capability requirements such as interoperability
i. To facilitate development, integration, interoperability, and exploration of dual-use technologies, a reconfigurable cockpit and avionics test bed (RCAT) was developed.
ii. Provided support of evolution of new generation capabilities.
d. Provided projections, studies and prototype efforts necessary to ensure AF aviation weapon systems are postured to meet civil standards and future changes to the civil standards leading to free flight.
i. Participated in standards bodies to advocate DoD interest in next generation requirements and capabilities
ii. The GATM MOSA based acquisition strategy, implemented in 1997 is still active and effective.
i. 0302099F Global Air Traffic Management (GATM) R02 - February 2000
Appendix F GATM Acquisition and Technical Refresh Strategy, V4, 12 Oct 23

Appendix G Army PEO Aviation MOSA Guidance

1. Overview:
The Army PEO Aviat has published guid approach through th transformation proc

Contents

- 1.0 Overview
- 2.0 Technical Review R
- 3.0 Technical Readiness
- 3.1 Alternative Syst
- 3.2 Systems Require
- 3.3 System Function
- 3.4 Preliminary Des
- 3.5 Critical Design R
- 3.6 Test Readiness R
- 3.7 System Verificati
- 3.8 Physical Configu
- 3.9 Sustainment/In
- 1.0 Overview
- DoD 5000.01 Express
- Mission Engineering, SR
- required to assure cost
- conformance with the pr
- design review (CDR). To
- implement a digital cost
- control, and curate prod
- A key planning docum
- foundational engineering
- Acquisition Program (EA
- SEP approval authority
- development, which bo
- mission needs. The best
- the maximum extent pr
- document the technical
- Appendix G Army PE
- © 2023 Nation

Appendix H - Technical Review Questions

DoD MOSA Benefit Category:
Enhance compete
severable soft
Desired MOS
• Enhanc
MOSA Impl

Appendix I Enhanced Interoperability and Mission Integration

DoD MOSA Benefit Category:
Enhance compete
severable soft
Desired MOS
• Enhanc
MOSA Impl

Appendix J Modular Open System Approach (MOSA) Use Case

Methods and assessment criteria to quantitatively evaluate MOSA in designs, tech approach and business strategies

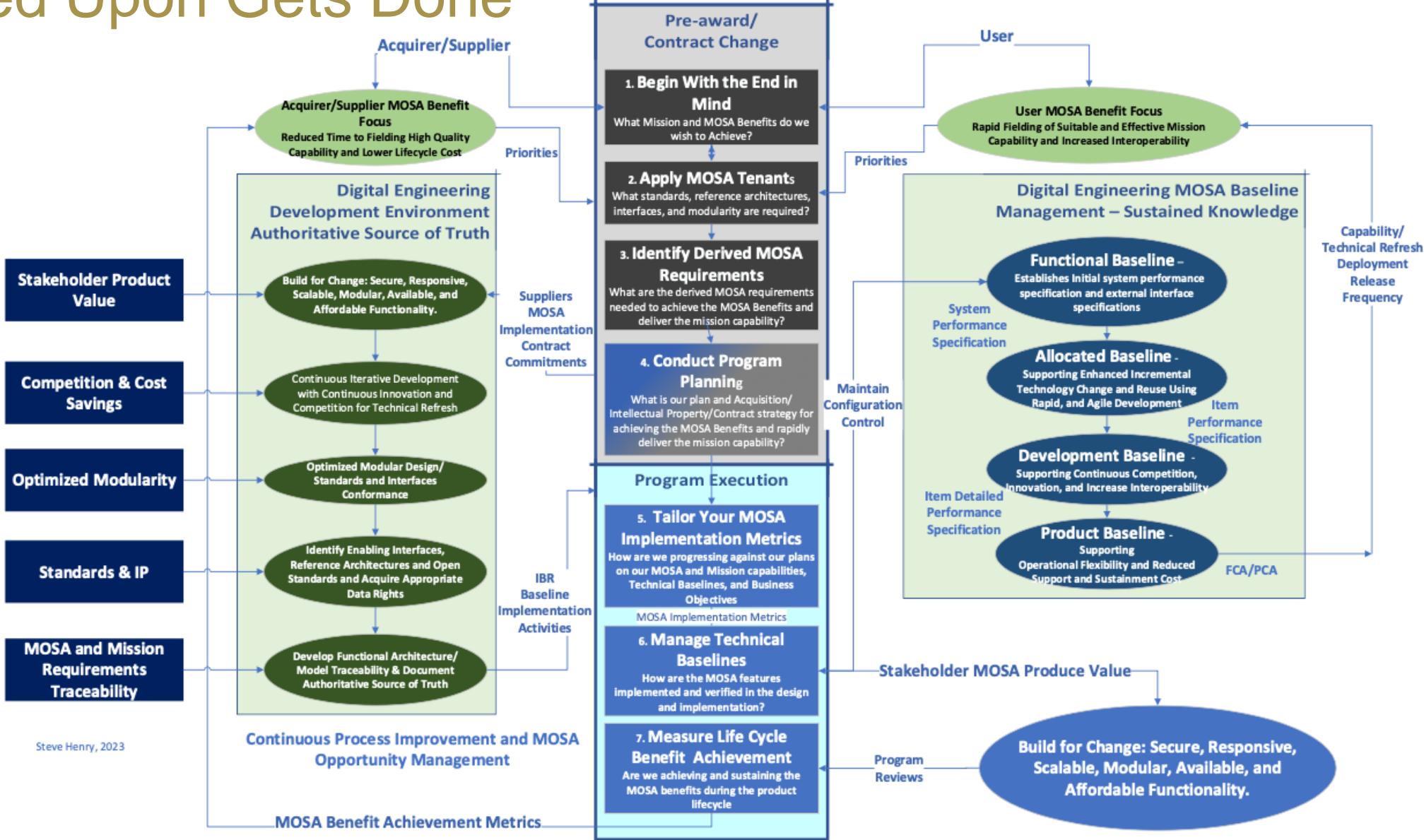
Appendix K Modular Open System Approach (MOSA) Enhanced Competition Strategy and Metrics Use Case

DoD MOSA Benefit Category:
Enhance competition open architecture with severable modules, allowing components to be openly competed
Desired MOSA Benefit Outcome:
• Enhance competition to achieve cost savings
MOSA Implementation Strategy:
• Design a modular open system architecture at levels needed to enable competition for system cost drivers and facilitate change or replacement of technology without changing of the components
o Designate key interfaces supported by open standards
o Optimize the level of system and component modularity for desired competition and affordability/innovation competitive opportunities
o Verify the conformance to selected standards
• Clearly define the derived MOSA architecture requirements needed to achieve the desired MOSA outcome and allocate them to the technical baseline
o Responsiveness
o Scalability
o Modularity
o Availability
o Affordability
o Functionality
• Create a business case that sustains continuous competition for high value components and subsystems throughout the system life cycle
o Provide a product roadmap, regular competition and opportunities for insertion of affordability improvements
• Provide the budget that supports the product roadmap
• Maintain a defined competition schedule (high probability of occurrence)
• Provide enterprise and contract agility to enable exploitation of opportunities to compete for new technology and innovation opportunities
o Provide value in source selections for supplier modular open system approaches that enable cost savings from continuous competition for high value components and sub systems
o Measure the success of the MOSA competition over time
• Business Value: Ability of a product, system, or capability, to satisfy customer initial and total cost targets; supplier contract performance, including product delivery when promised; and supplier financial expectations throughout its lifecycle.
Modular Open System Approach (MOSA) Enhanced Competition Strategy and Metrics, V4, 12 Oct 23
© 2023 National Defense Industrial Association. All rights reserved.

(Henry et al., 2023; National Defense Industrial Association, 2023)



Effective MOSA Implementations - What Gets Measured and Acted Upon Gets Done



Steve Henry, 2023

(Henry et al., 2023)

Everything is connected...

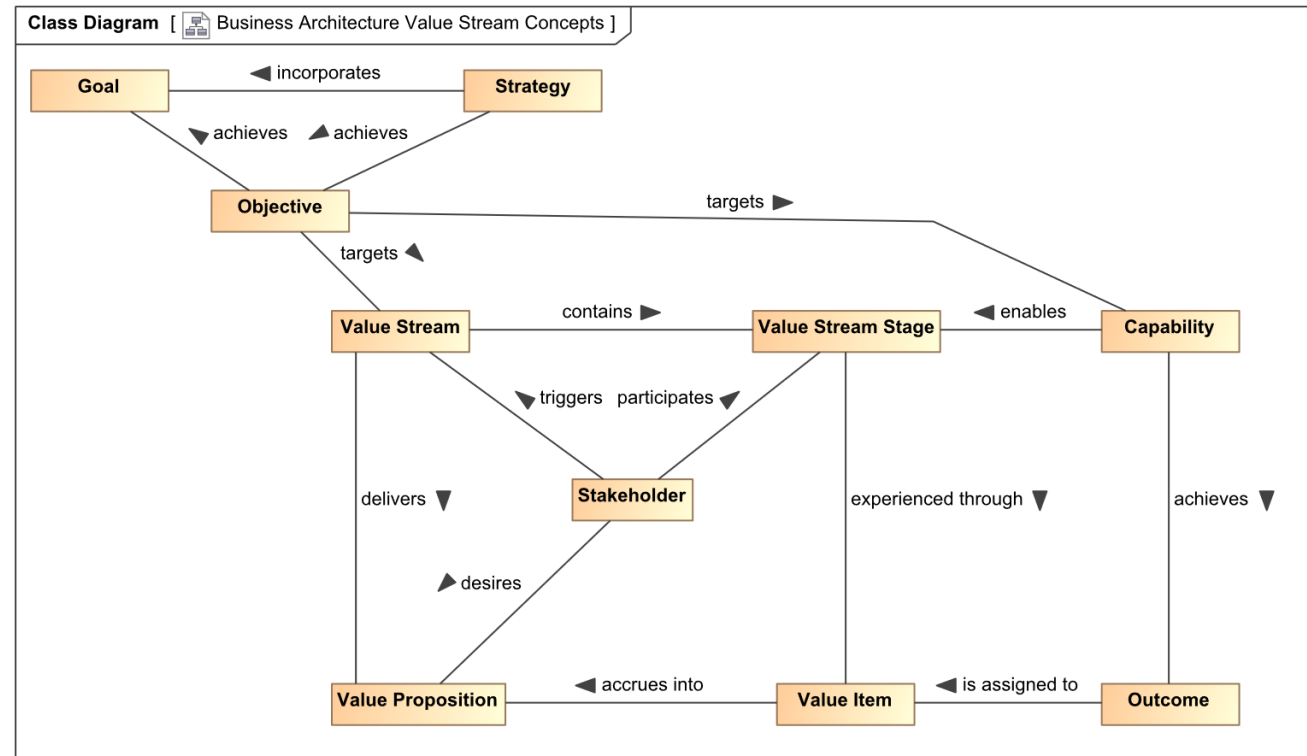


Business Architecture Body of Knowledge - BIZBOK



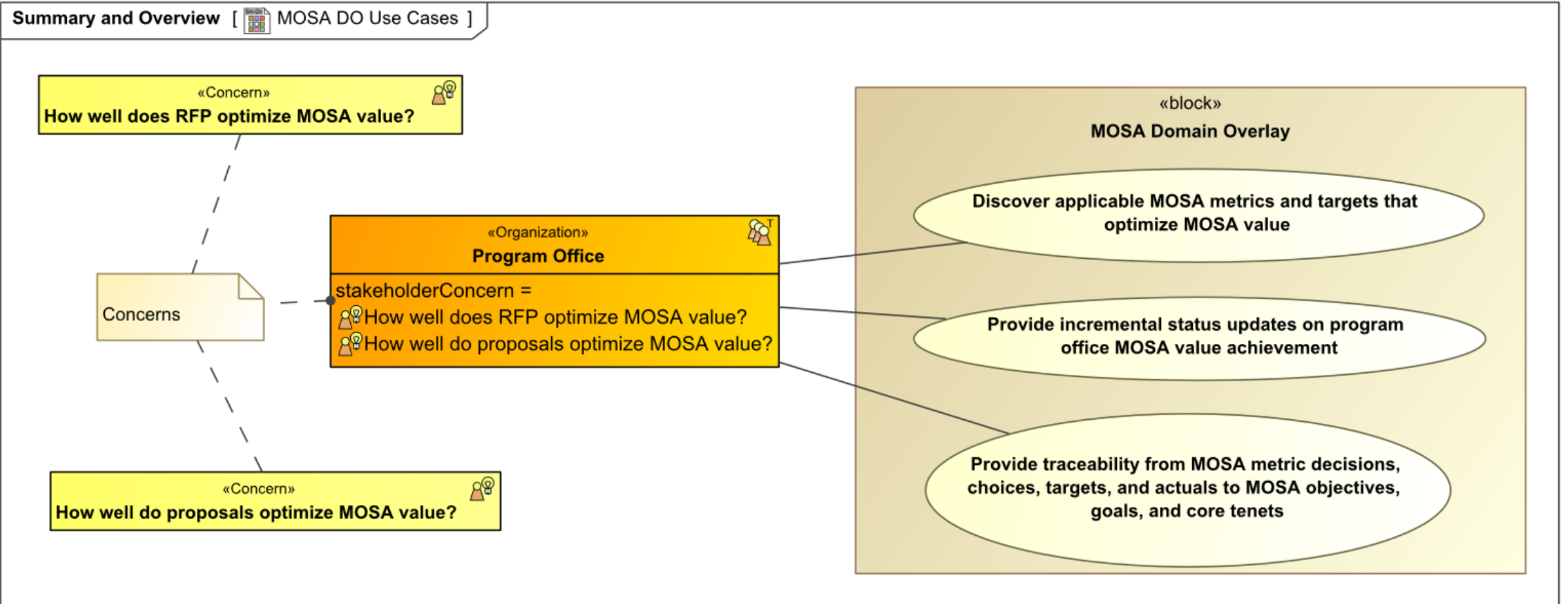
“Value can be defined as the ‘benefit that is derived by an organization’s stakeholder while interacting with that organization.’ Value is fundamental to everything that an organization does. In fact, the only reason an organization exists is that it provides value to one or more stakeholders.”

Value is expressed in terms of Value Items:
“The judgment of worth, made by an individual or organization, attached to something tangible or intangible and attained in the course of a particular interaction with one or more parties.”



(Business Architecture Guild, 2023)

MOSA Domain Overlay Use Cases



MOSA Domain Overlay Goals



Modular

Library of common, reusable, and traced elements

Follow established guidance

Guided workflow, systematic process

Promote information discovery

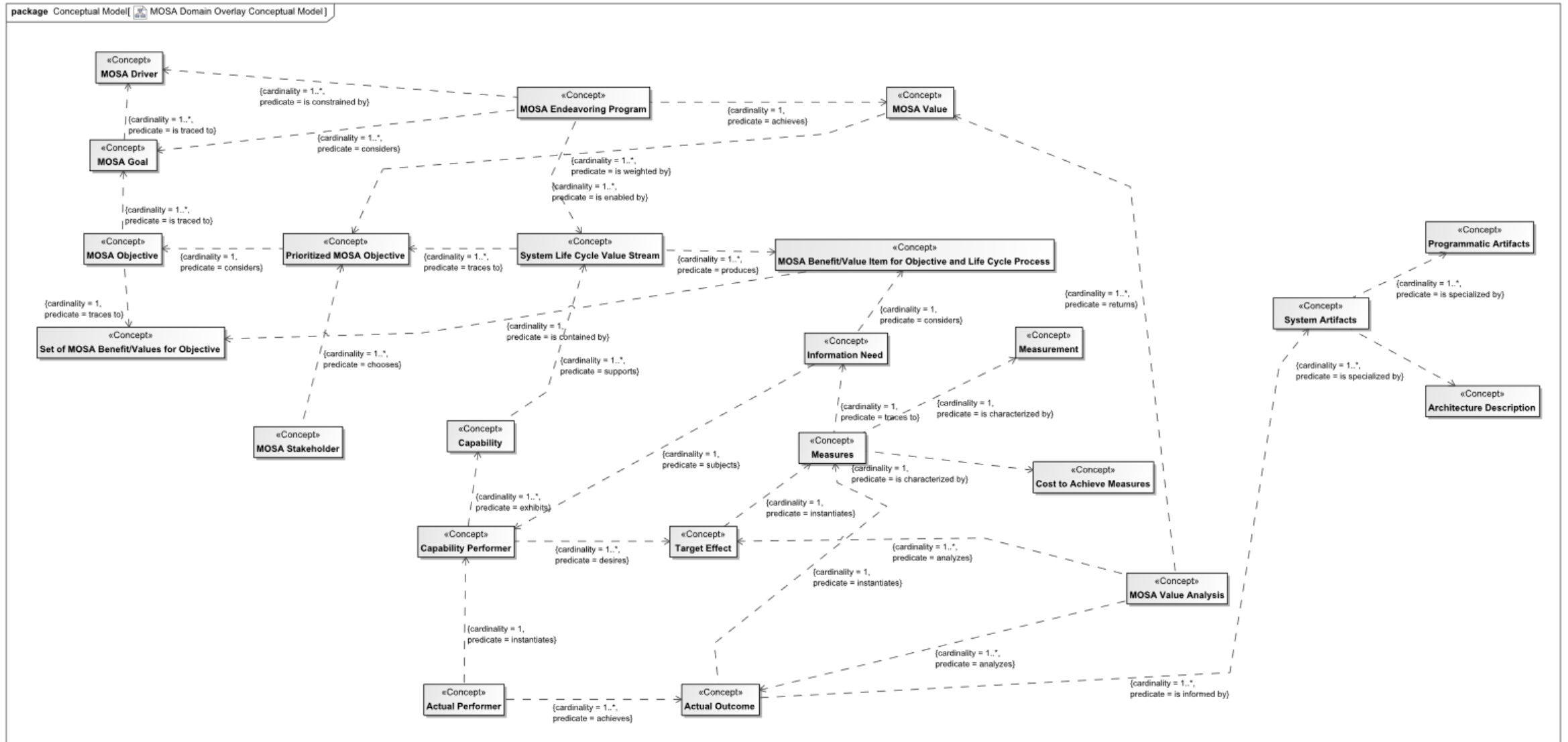
Analysis capability

Fit-for-purpose views












































Tailorable

Traceable and defensible

MOSA Domain Overlay Conceptual Model



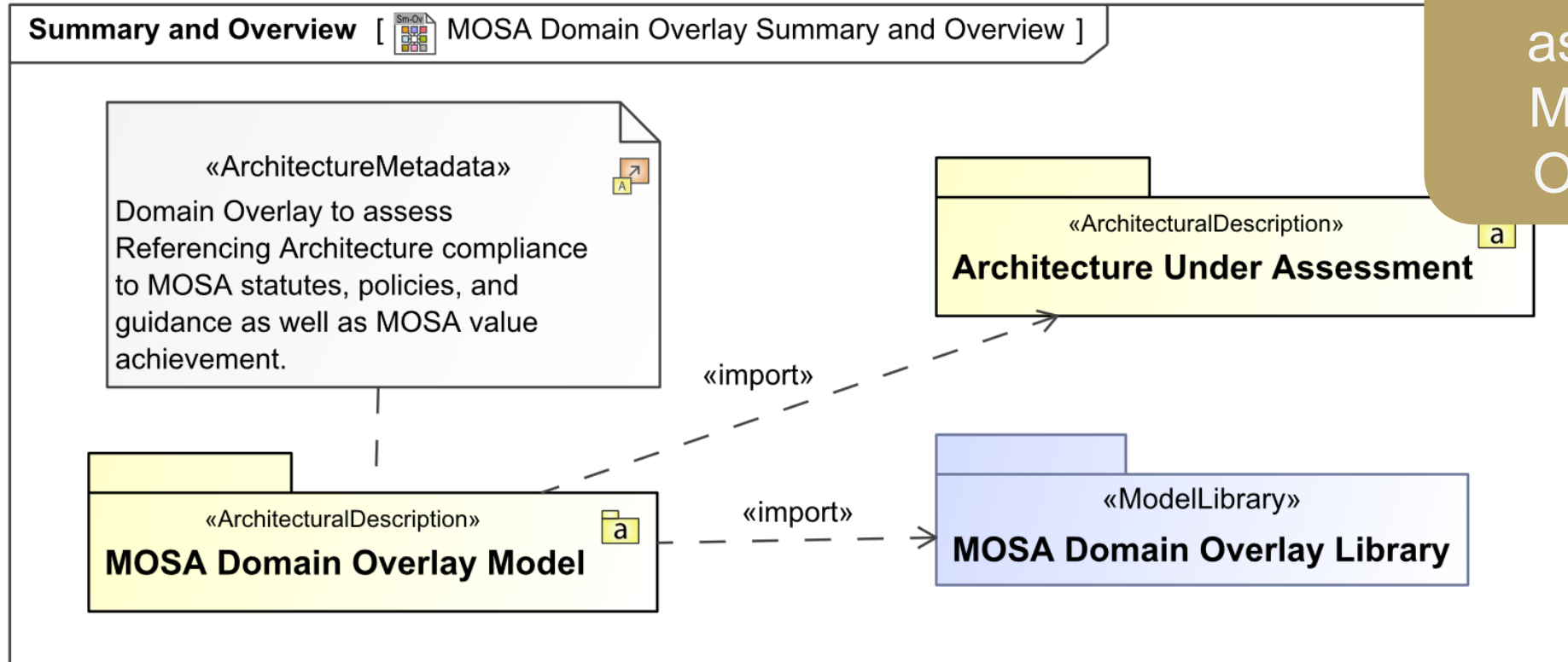
MOSA Domain Overlay Concepts to UAF Mapping

#	△ Name	Mapped UAF Stereotype
1	 Actual Outcome	 ActualOutcome [InstanceSpecification]
2	 Actual Performer	 ActualResource [InstanceSpecification]
3	 Architecture Description	 ArchitecturalDescription [Package]
4	 Capability	 Capability [Class]
5	 Capability Performer	 <i>ResourcePerformer [Class]</i>
6	 Cost to Achieve Measures	 Measurement [Property]
7	 Information Need	 Concern [Class]
8	 Measurement	 Measurement [Property]
9	 Measures	 Effect [Class]
10	 MOSA Benefit/Value Item for Objective and Life Cycle Process	 ValueItem [DataType]
11	 MOSA Driver	 Driver [Class]
12	 MOSA Endeavoring Program	 WholeLifeEnterprise [InstanceSpecification]
13	 MOSA Goal	 EnterpriseGoal [Class]
14	 MOSA Objective	 EnterpriseObjective [Class]
15	 MOSA Stakeholder	 <i>OrganizationalResource [Class]</i>
16	 MOSA Value	 Measurement [Property]
17	 MOSA Value Analysis	
18	 Prioritized MOSA Objective	 Measurement [Property]
19	 Programmatic Artifacts	
20	 Set of MOSA Benefit/Values for Objective	 EnterpriseObjective [Class]
21	 System Artifacts	
22	 System Life Cycle Value Stream	 ValueStream [InstanceSpecification]
23	 Target Effect	 ActualEffect [InstanceSpecification]

MOSA Domain Overlay Concept Relationships to UAF Mapping

#	Client	Predicate	Supplier	Mapped UAF Stereotype
1	Actual Outcome	instantiates	Measures	
2	Actual Outcome	is informed by	System Artifacts	
3	Actual Performer	achieves	Actual Outcome	Achieves [Dependency]
4	Actual Performer	instantiates	Capability Performer	
5	Capability	supports	System Life Cycle Value Stream	Phases [Abstraction]
6	Capability Performer	exhibits	Capability	Exhibits [Abstraction]
7	Capability Performer	desires	Target Effect	Desires [Dependency]
8	Information Need	subjects	Capability Performer	
9	Information Need	considers	MOSA Benefit/Value Item for Objective and Life Cycle Process	
10	Measures	is characterized by	Cost to Achieve Measures	
11	Measures	traces to	Information Need	
12	Measures	is characterized by	Measurement	
13	MOSA Benefit/Value Item for Objective and Life Cycle Process	is contained by	Set of MOSA Benefit/Values for Objective	
14	MOSA Endeavoring Program	is constrained by	MOSA Driver	Phases [Abstraction]
15	MOSA Endeavoring Program	considers	MOSA Goal	Phases [Abstraction]
16	MOSA Endeavoring Program	achieves	MOSA Value	
17	MOSA Endeavoring Program	is enabled by	System Life Cycle Value Stream	
18	MOSA Goal	is traced to	MOSA Driver	MotivatedBy [Dependency]
19	MOSA Objective	is traced to	MOSA Goal	Trace [Abstraction]
20	MOSA Objective	traces to	Set of MOSA Benefit/Values for Objective	
21	MOSA Stakeholder	chooses	Prioritized MOSA Objective	
22	MOSA Value	is weighted by	Prioritized MOSA Objective	
23	MOSA Value Analysis	analyzes	Actual Outcome	
24	MOSA Value Analysis	returns	MOSA Value	
25	MOSA Value Analysis	analyzes	Target Effect	
26	Prioritized MOSA Objective	considers	MOSA Objective	
27	System Artifacts	is specialized by	Architecture Description	
28	System Artifacts	is specialized by	Programmatic Artifacts	
29	System Life Cycle Value Stream	produces	MOSA Benefit/Value Item for Objective and Life Cycle Process	Creates [Dependency]
30	System Life Cycle Value Stream	traces to	Prioritized MOSA Objective	Phases [Abstraction]
31	Target Effect	instantiates	Measures	

MOSA Domain Overlay Model



Architecture under
assessment by
MOSA Domain
Overlay Model

MOSA Domain Overlay Library

Library of reusable elements to support use of MOSA Domain Overlay Model

pkg [Strategy] Strategy [Strategy Package Overview]

Strategic Motivation

- MOSA Drivers
- MOSA Goals
- MOSA Objectives
- MOSA Objectives to MOSA Drivers Traceability
- Strategic Motivation

Strategic Structure

- COPY ME - Actual MOSA Strategic Structure
- Typical MOSA Strategic Structure

Strategic Processes

- MOSA Information Needs
- MOSA Planning Phase Value Streams
- MOSA Value Items

Strategic Taxonomy

- MOSA Enabling Capabilities
- Data Management
- Mission Capability
- Mission Capability in Architecture Definition Phase
- Mission Capability in Business or Mission Analysis Phase
- Mission Capability in Design Phase
- Mission Capability in Stakeholder Needs and Requirements Definition Phase
- Mission Capability in System Requirements Definition Phase
- Operations and Support
- Program Management
- System Integration, Assembly, Test, and Checkout
- System Life Cycle Management
- System Test and Evaluation
- Systems Engineering
- Training

Strategic States

- MOSA Measures
- Operations and Support Measures
- Technical Risk Assessments Measures
- MOSA Measures

pkg [Resources] Resources [Resources Package Overview]

Resources Taxonomy

- Resources Taxonomy
- Automated Test Coverage
- Mission Capability in Business Or Mission Analysis Phase

Actual Resources

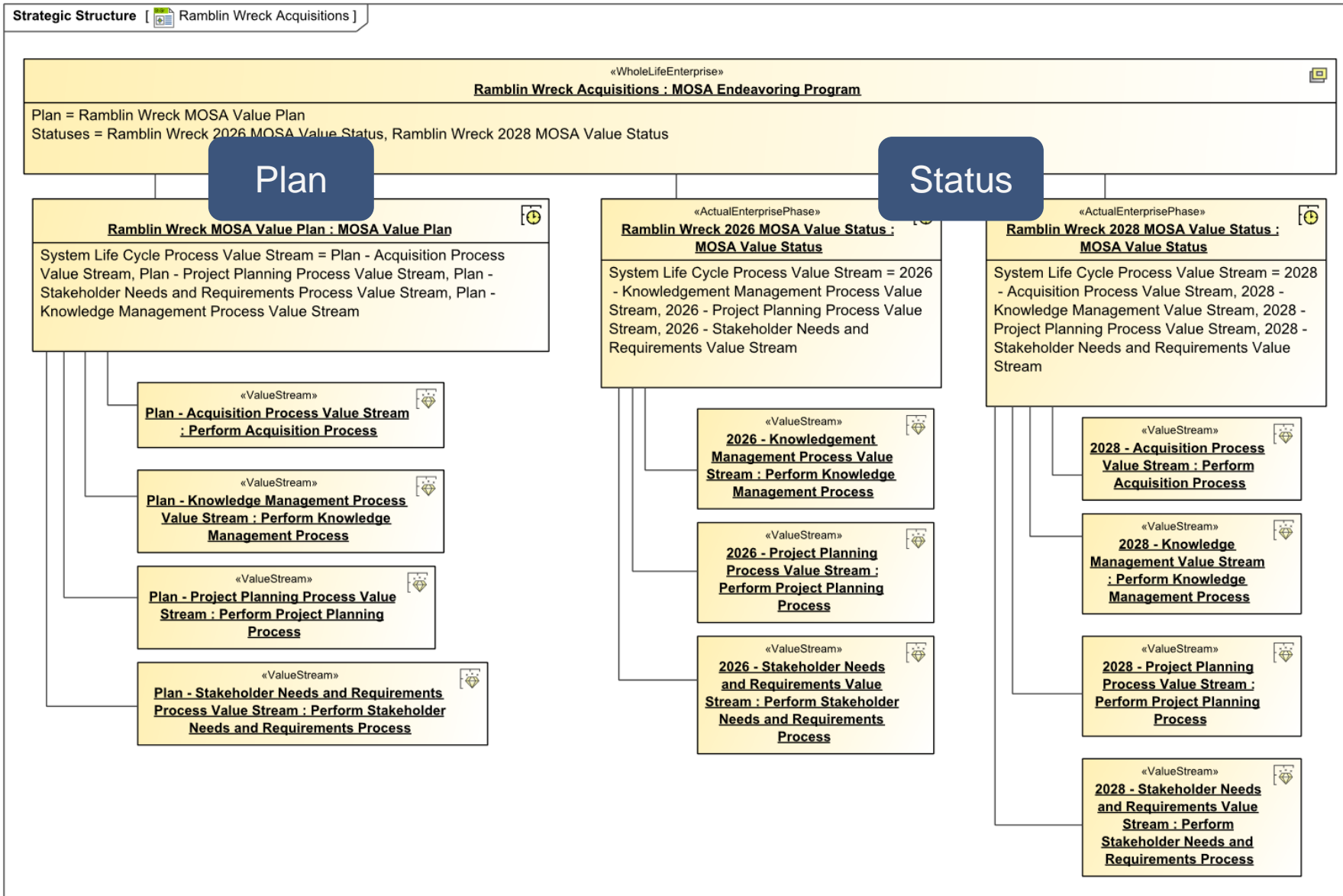
- Actual Resources Taxonomy
- Actual Resources Structure
- Actual Resources Connectivity
- Actual Resources Parameters

Resources Traceability

- Resources to Capabilities Mapping Matrix

Elements and relationships reflect conceptual model

MOSA Domain Overlay as (Abbreviated) Business Architecture



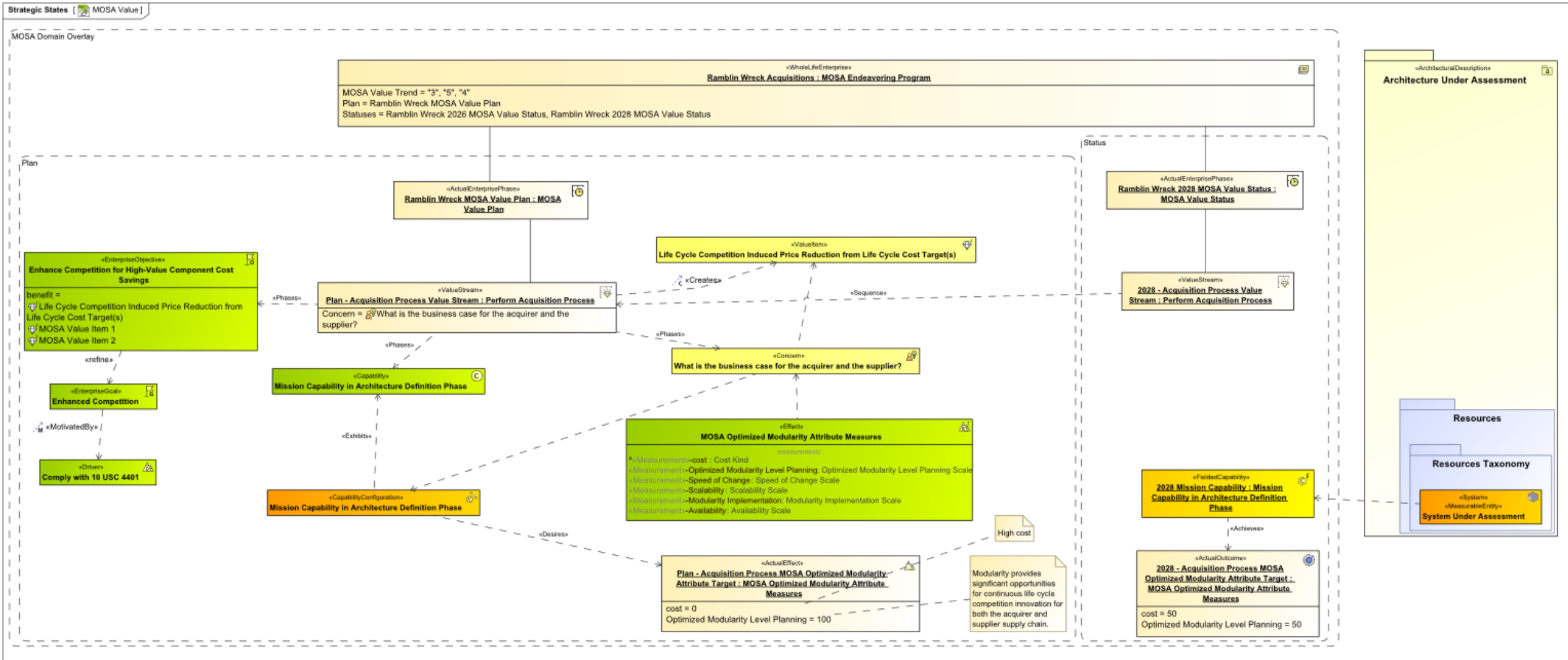
Two types of phases in a MOSA Endeavoring Program: Plan and Status

Value delivered through system life cycle processes modeled as value streams

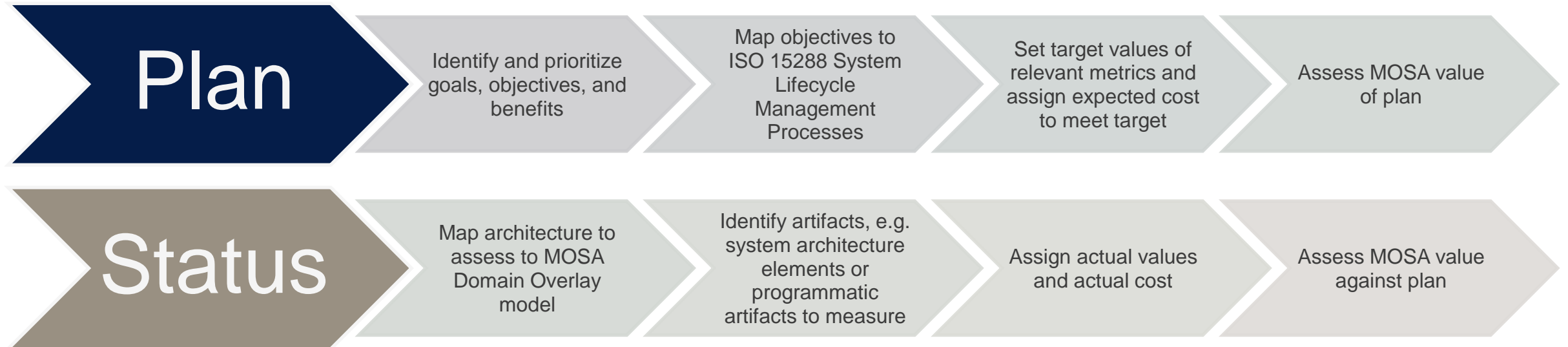
Develop value plan as much as possible

Take incremental status snapshots and assess MOSA value against current state of plan

Work in Progress

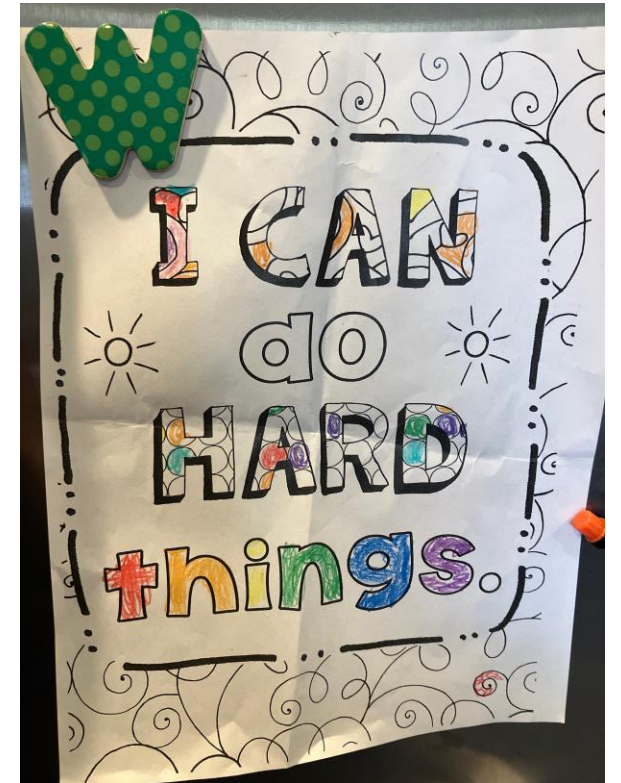


Simplified Process



Summary and Next Steps

- A Modular Open Systems Approach (MOSA) “is an **integrated business and technical** strategy to achieve competitive and affordable acquisition and sustainment over the system lifecycle.”
- Business architecture, specifically value delivery and measurement, is a useful way of thinking about MOSA compliance
 - What matters gets measured, what’s measured and acted upon gets done
- UAF can model most business architecture concepts
 - Not sure yet if it can accommodate context-specific relationships
- The MOSA Domain Overlay aims to provide defensible and justifiable metrics and target values for optimizing MOSA value and assessing MOSA value achievement over the life cycle of a system
- Next steps
 - Establish metamodel with validation rules to constrain the creation and use of MOSA DO model
 - Build library of reusable MOSA elements and relationships
 - Create guided workflow in model
 - Validate model against example system acquisition program



(Modular Open Systems Approach – DoD Research & Engineering, OUSD(R&E), n.d)

References

- Business Architecture Guild. (2023a). *A Guide to the Business Architecture Body of Knowledge (BIZBOK Guide)* (Version 12.0). <https://view.businessarchitectureguild.org/MBXxHC>
- Business Architecture Guild. (2023b). Section 2.4: Value Mapping. In *A Guide to the Business Architecture Body of Knowledge (BIZBOK Guide)* (p. 141).
- Geier, N. (2022). *OUSD(R&E) Review of MOSA Tools and Practices*.
- Hart, L., & Anderson, R. (2022). *OMG UAF Model-based Acquisition Analytic Viewpoint Overlays (AVO)*.
- Hart, L., & Hause, M. (2023). 1. *Model-Based Acquisition (MBAcq): Uniting Government and Industry around a Common Standard*. <https://incose.onlinelibrary.wiley.com/doi/epdf/10.1002/iis2.13078>
- Henry, S., Scheurer, B., Bradley, J., & Raygan, R. (2023). *MOSA Implementation Considerations, Information Needs and Metrics*. National Defense Industrial Association.
- *Modular Open Systems Approach – DoD Research & Engineering, OUSD(R&E)*. (n.d.). Retrieved March 14, 2024, from <https://www.cto.mil/sea/mosa/>
- *Modular Open Systems Approach (MOSA)—AcqNotes*. (n.d.). Retrieved March 14, 2024, from <https://acqnotes.com/acqnote/careerfields/modular-open-systems-approach>
- National Defense Industrial Association. (2023). *Modular Open Systems Approach, Implementation Challenges and Opportunities*.
- *Office of Law Revision Council, United States Code*. (n.d.). OLRC Home. Retrieved March 15, 2023, from <https://uscode.house.gov/browse/prelim@title10/subtitleA/part5/subpartF/chapter327/subchapter1&edition=prelim>
- Zimmerman, P., Ofori, M., Barrett, D., Soler, J., & Harriman, A. (2019). Considerations and examples of a modular open systems approach in defense systems. *The Journal of Defense Modeling and Simulation*, 16(4), 373–388. <https://doi.org/10.1177/1548512917751281>

Abstract

Developing a system architecture that embodies Modular Open Systems Approach (MOSA) principles is not an easy task. There are numerous technical considerations, each with potentially significant business impacts. What works for one program office may not work for another, thus making a “one-size-fits-all” MOSA strategy impractical if not impossible. Any assessment of how well a system architecture is applying MOSA principles is, in practice, specific to how an organization wants to maximize the value of a MOSA (i.e., its strategy). Achieving maximum MOSA value for a given program or organization doesn’t necessarily mean everything modular and everything open. Selection of appropriate MOSA metrics to assess MOSA compliance is highly contextual and requires defensible justification.

This presentation will provide a status update of the MOSA Domain Overlay being developed in collaboration with the Model-Based Acquisition User Group and the NDIA SE Architecture Committee. The presentation will explore and discuss the suitability of UAF in expressing the MOSA value proposition of an enterprise. A key aspect that will be discussed are potential gaps due to what works in the language and framework “out-of-the-box” versus what must be created and included to meet the MOSA Domain Overlay objectives. Lastly, the presentation will conclude with a discussion on an approach for the systematic identification of relevant MOSA metrics based on contextualized and justifiable business considerations.