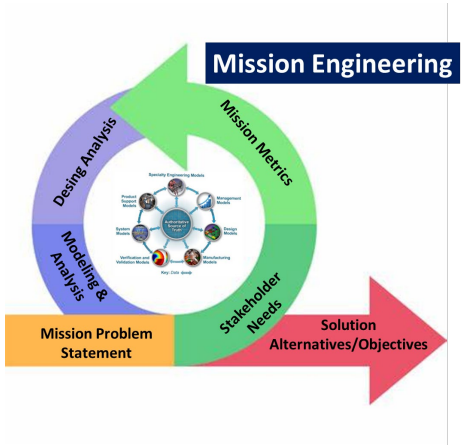
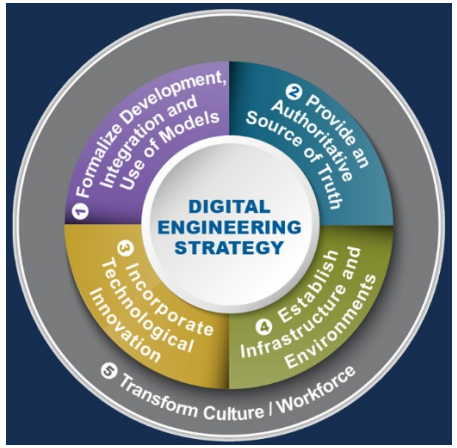
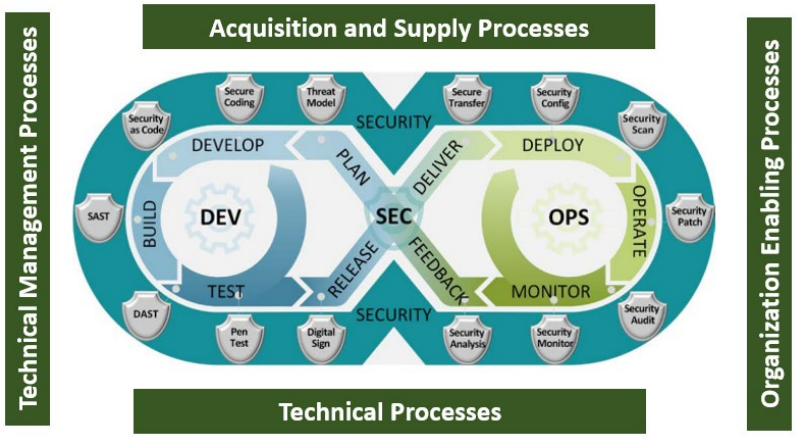


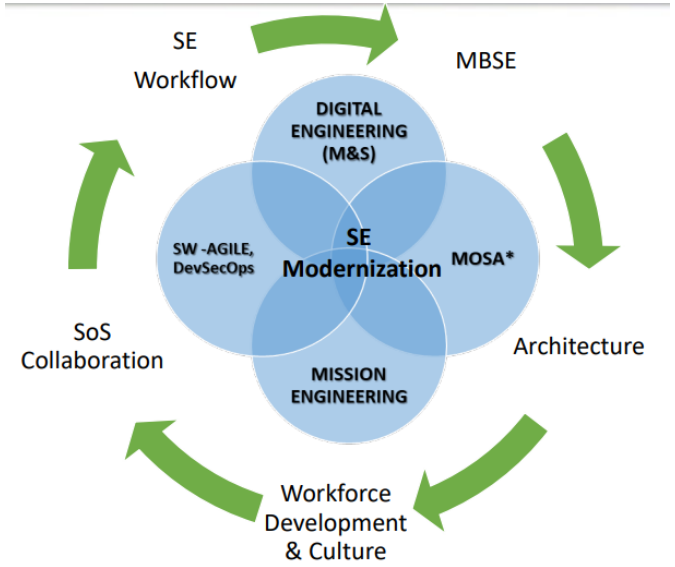




Program MOSA Transformation

Information Needs and Metrics

Measuring MOSA Implementation and MOSA Product Value/Success



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NDIA SE Division 27 Jul 23

Overview

- **MOSA Implementations Considerations Information Needs and Metrics Content and Approach**
  - Breath and Depth of NDIA MOSA Metrics Project
- **7 Step Approach to Implement MOSA and Measure Achievement of MOSA Benefits**
- **MOSA Implementation Considerations, Information Needs and Metrics Use Case Appendices Content – Appendices Summary**
  - Appendix A - MOSA Metrics Mater Selection List
  - Appendix B - MOSA Systems Engineering Processes and Solution Implementation Metrics
  - Appendix C - NDIA MOSA Product Value
  - Appendix D NASA SW Reuse Readiness Levels Assessment Tool
- **Discussions and Selected Deep Dives on Topics of Interest**
- **Backup**
  - **MOSA Success Stories**
    - Appendix F GATM Acquisition Strategy Use Case 1998 - Present
    - Appendix E Navy CANES MOSA Acquistion Strategy 2008 - Present
    - Appendix G Army PEO Aviation MOSA Guidance 2021 - Present

MOSA Implementation Iceberg Challenge

Business Approach

usiness
bjective

Reduced Time to Field Capability and Lifecycle Cost

Build for Change: Secure, Responsive, Scalable, Modular, Available, and Affordable Functionality.

Optimized Modular Design/ Verified Interfaces

Identify Enabling Interfaces, Reference Architectures and Open Standards and Acquire Appropriate Data Rights

Develop Functional Architecture/**Model Traceability & Document Authoritative Source of Truth**

Technical Approach

Suitable and Effective Mission Capability

Mission Objective

Product Baseline - Supporting Operational Flexibility and Reduced Support and Sustainment Cost

Digital Twin - Supporting Continuous Competition, Innovation, and Increase Interoperability

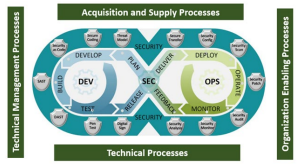
Allocated Baseline - Supporting Enhanced Incremental Technology Change and Reuse Using Rapid, and Agile Development

Functional Baseline – Establishes Initial system performance specification and external interface specifications

Progress

Measure MOSA Implementation Progress and Objective Achievement Measures

NDIA MOSA Metrics Deliverables



RRL Attribute Focus	Detailed Reuse Readiness Level Analysis	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Information that describes the software asset and how to use it.	Documentation	5	0	0	0
The ability of the asset to be grown beyond its current context.	Extensibility	0	0	0	0
The legal rights for obtaining, using, modifying and distributing the asset.	Intellectual Property	0	0	0	0
The degree of segregation and containment of an asset or components of an asset.	Modularity	0	0	0	0
The methodology and technology for assembling and encapsulating the components of a software asset.	Packaging	0	0	0	0
The independence of an asset from platform-specific technologies	Portability	0	0	0	0
The adherence of an asset to accepted technology definitions.	Standards Compliance	0	0	0	0
The amount and type of assistance available to users of the asset.	Support	0	0	0	0
The degree to which the functionality and applicability of the asset has been demonstrated.	Verification and Validation	0	0	0	0

Today's topic is this outline.

MOSA Implementation Considerations (Published through NDIA)

SW Reuse Excel Worksheet

Appendices A - K

Appendix C is in PSM Product Value Specification format.

- **Introduction**
- **MOSA Seven Step Information Needs**
- **MOSA Use Case Examples Descriptions**
- **MOSA References**

BLUF – Measure MOSA Implementation and MOSA Objective Success

Steve Henry, V8,
24 Jul 2023

Step 1: Begin with The End MOSA Objective in Mind

Step 2: Apply MOSA Tenants to Define the Required Standards, Interfaces, and Modularity

Step 3: Identify Derived MOSA Implementation Requirements

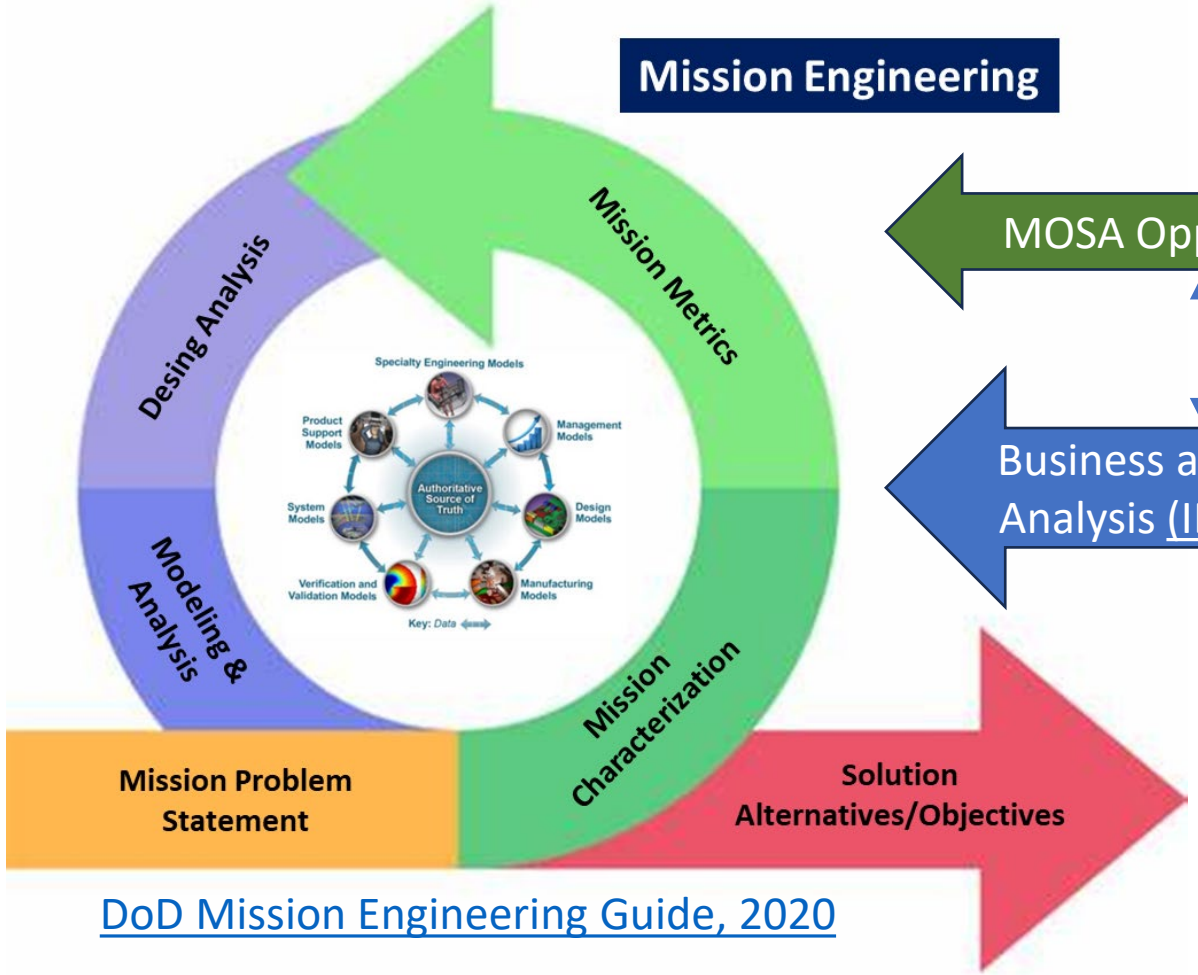
Step 4: Conduct Program Planning/ Contracting – MOSA Information Needs and Metrics

Step 5: How to Status of MOSA Implementation (MOSA Metrics)

Step 6: Managing MOSA In Technical Baselines – Information Needs and Metrics

Step 7: Measuring Lifecyle MOSA Benefit Achievement (MOSA Metrics)

Step 1 – Begin with the End in Mind



DoD Mission Engineering Guide, 2020

MOSA Opportunities

Business and Mission Analysis (IEEE 15288)

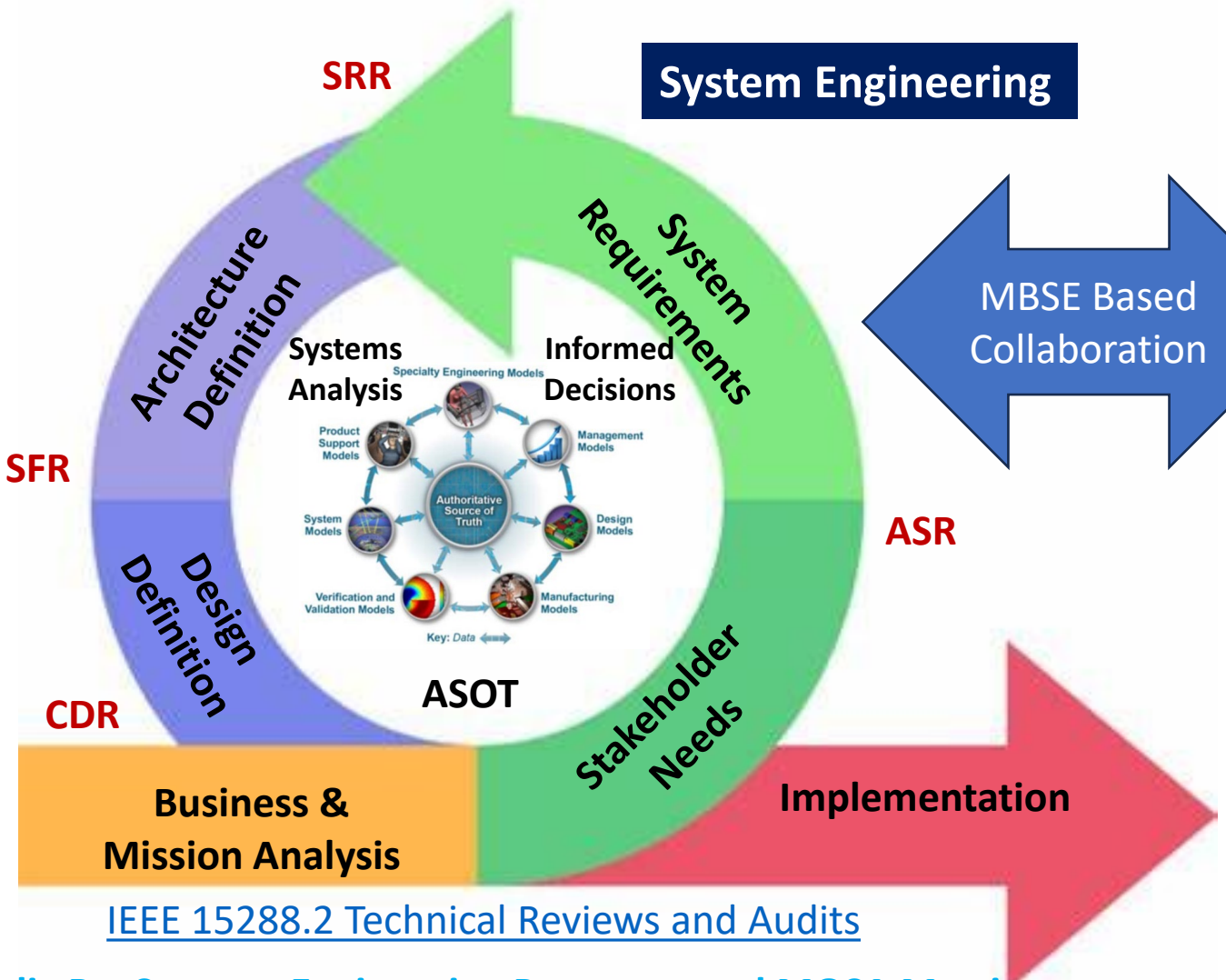
MOSA Objectives

DoD MOSA Reference Frameworks in Defense Acquisition Programs, 2020

What Mission Capabilities and MOSA Benefits do we wish to achieve?

→ Army PEO Aviation MOSA Objectives Exemplar Example

Step 2 - Apply MOSA Tenants to Define the Required Standards, Interfaces, and Modularity



MBSE Based Collaboration

Enduring Authoritative Source of Truth (ASOT)

Collaborate Knowledge Transfer

IEEE 15288.2 Technical Reviews and Audits

Appendix B – Systems Engineering Processes and MOSA Metrics

Appendix H – Systems Engineering Technical Review Questions

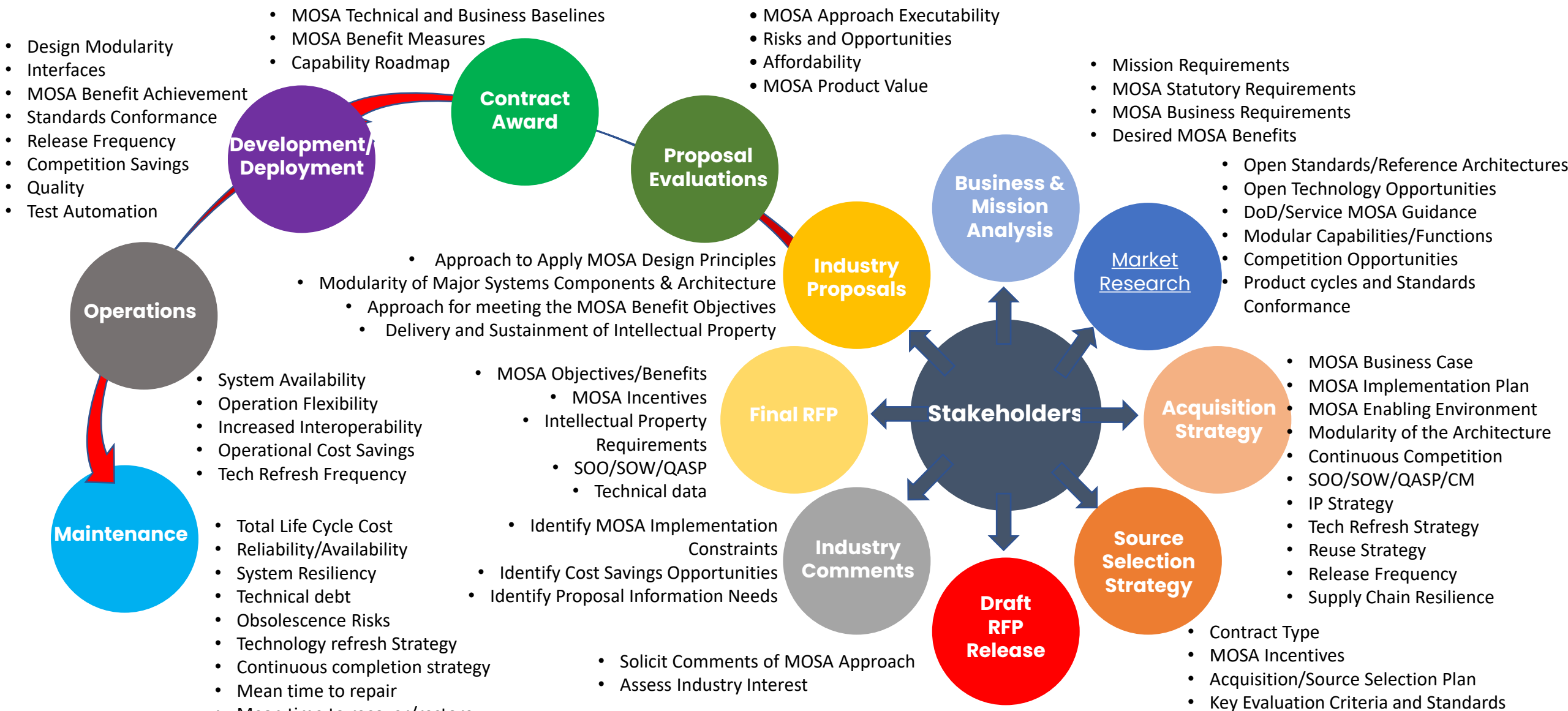
Step 3 Identify Derived MOSA Implementation Requirements Open Architecture Technical Approach and Processes

- **Adopt an Open Architecture Approach**
  - **Incorporate appropriate considerations** for reconfigurability, portability, maintainability, technology insertion, vendor independence, reusability, scalability, interoperability, upgradeability, and life cycle supportability
  - **Document the intended implementation** of identified of open standards, interfaces and/or Technical Reference Frameworks
  - **Address the means for ensuring adherence or conformance** to open standards and open architectural principles throughout the development process.
- **Optimize Architecture Modularity to Support Competition and Change**
  - **Describe in detail proposed system architecture** and how it is robust, layered, modular, adaptable and makes maximum use of existing Government-Off-the-Shelf (GOTS) hardware and software, Commercial CSCIs including Commercial-Off-the-Shelf (COTS) software, COTS hardware, operating systems, and middleware
  - **Reduce module coupling and increases module cohesion**
  - **Describe how the level of modularity supports MOSA and Mission Objectives**

Open System Management Plan, DI-MGMT-82099

Appendix A Master MOSA Metrics List, Appendix H, Technical Review Questions
Appendix D – Modular Open System Approach (MOSA) Reuse of SW and HW Use Case

Step 4 – MOSA Business Strategy Implementation



Adapted: DAU Acquisition of Services

Appendix J - Methods and Assessment Criteria to Quantitatively Evaluate MOSA
Appendix K MOSA Enhance Competition Strategy and Metrics

Step 4 – IEEE 15288 Project Planning Process

Project Planning Process The project planning process produces and coordinates effective and workable MOSA implementation plan that meets both the mission and MOSA objectives. (IEEE 15288)	
MOSA Information Need	**Sample Application of Metrics for MOSA**

• Determine the appropriateness of MOSA by considering software constraints, security requirements, and procedures, availability and cost of data rights, life cycle affordability and reliability of widely supported and consensus-based standards, as well as other relevant factors such as environmental constraints (e.g., temperature, humidity) and Environment, Safety, and Occupational Health (ESOH) considerations
• MOSA modularity and openness objectives
• What are the MOSA objectives that drive modularity decisions to support the operational and lifecycle needs?
• MOSA resources and services necessary to achieve the objectives are formally requested and committed
• Plans for the execution of the project are activated and maintained
• How do MOSA requirements with respect to how they support the stakeholder's lifecycle business and technical objectives.
• External development dependencies
• Planned evolution of the major system components
• What is the Intellectual Property Strategy?
• How IP and related issues will be addressed
• MOSA Implementation Plan
• MOSA implementation roles, repsonbilities and authorities
• Approach to testing and evaluation for the implementation and conformance to the MOSA requirements of the program
• How do the MOSA requirements enable the different aspects of a product support strategy throughout its lifecycle?
	• MOSA Product Value (Secure, Responsive, Scalable, Modular, Available, and Affordable)
	• Committed vs Delivered/Competed
	  ○ Modularity
	  ○ External Developed Component and Interfaces
	  ○ Intellectual Property
	  ○ Reuse Components
	  ○ Performance/MOSA Benefits
	• Burndown
	  ○ MOSA implementation risks
	  ○ Interface Implementation
	• Technical Debt
	• Technical Performance Measures
	• Schedule Risks Assessment
	• Cost Risk Assessment
	• Critical Path Schedule Margin
	• Cost Margin Trends
	• Schedule Margin Trends
	• Affordability
	  ○ Life cycle Cost Trends
	  ○ Operations and Support (O&S) Cost Estimating Guide
	  ○ DOD COST ESTIMATING GUIDE, V 2.0 2 Feb 2022
	  ○ Reuse Cost Savings Trends
	  ○ Cost vs Budget by Year (Disconnects)
	  ○ Team Velocity

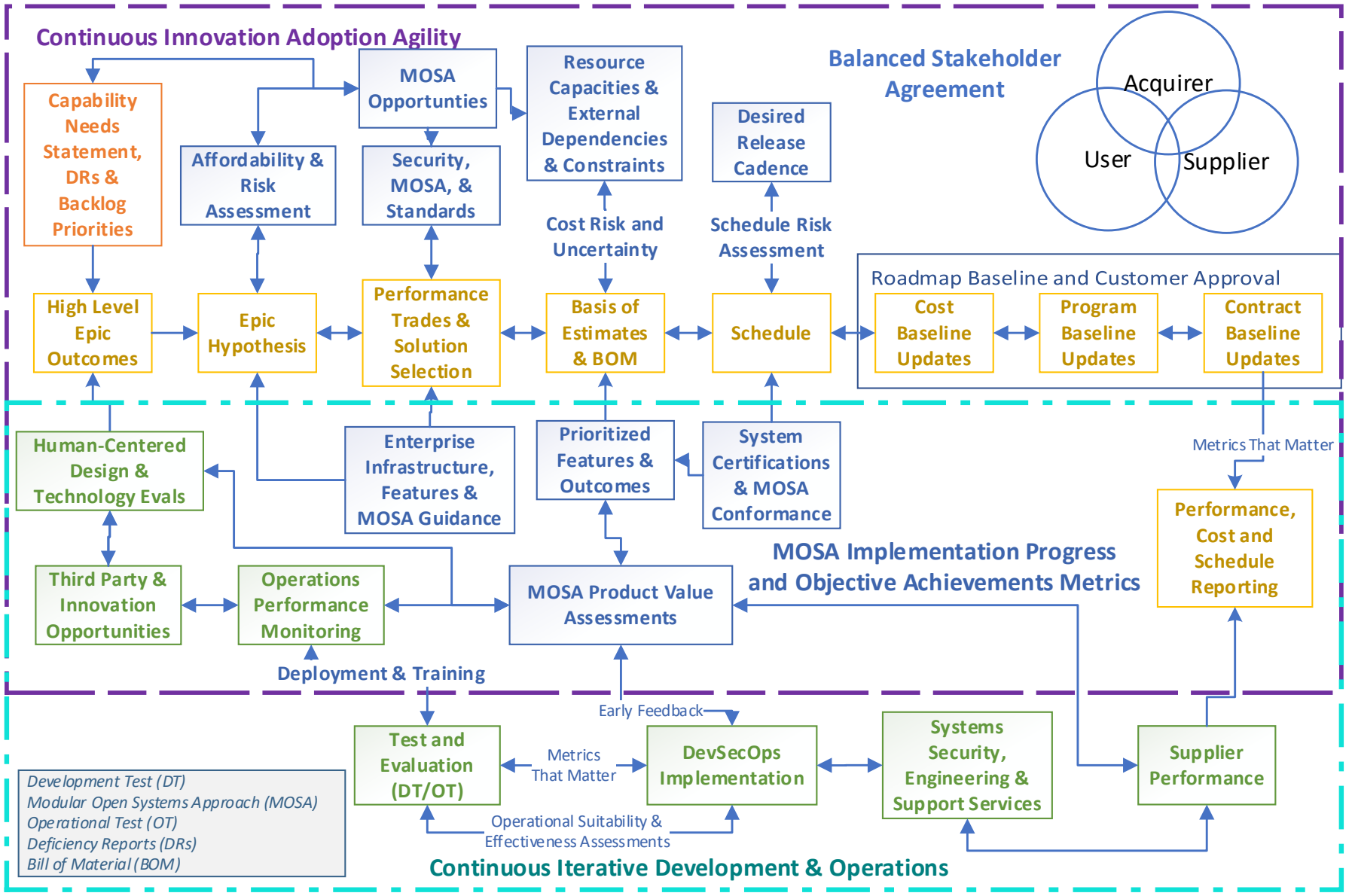
Step 4 Program Planning

MOSA Product Value

- **Optimized Modularity**
- **Functionality/ Performance**
- **Dependability**
- **Security**
- **Business Value**

KEY MOSA Planning Considerations

Product Acquisition Planning – MOSA Integrated Business and Technical Strategy



Appendix J - Methods and Assessment Criteria to Quantitatively Evaluate MOSA

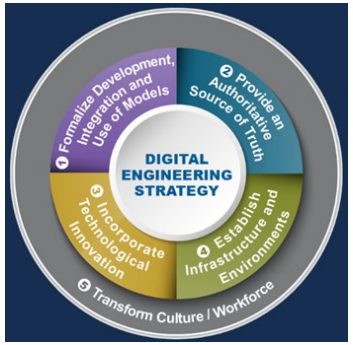
Appendix K - MOSA Enhance Competition Strategy and Metrics

Step 5 – Tailor Your Measurement of MOSA Implementation

Continuous Iterative Development	Digital Engineering	Technical Risk Assessments	Business and Financial	Operations and Support
MOSA Product Value (Secure, Responsive, Scalable, Modular, Available, and Affordable)				
Automated Test Coverage	Functional Architecture Completeness and Volatility (8.1)	Technology Readiness Levels	Trend Line Chart	Reliability and Maintainability
Burndown	Model Traceability (8.2)	Integration Readiness Levels	Cost Risk Assessments	Mean time Between Failures
Committed vs Delivered/ Completed	Product Size (8.3)	Reuse Readiness Levels (NASA)	Schedule Risk Assessments	Operational Availability
Cumulative Flow	Digital Engineering (DE) Anomalies (8.4)	Manufacturing Readiness Levels	Market Share/Revenue Growth	Corrective Maintenance Time (CMT)
Cycle Time/Lead Time	Adaptability and Rework (8.5)	System Complexity Levels	Return on Investment (ROI)	Key Performance Parameters (KPP)
Defect Detection	Product Automation (8.6)	Change Failure Rates	Profit Margin	Change Failure Rates
Defect Resolution		Reliability and Maintainability	Probability of Competition (Pgo)	Lifecycle Cost Trends
Mean Time to Detect (MTTD) and Mean Time to Restore (MTTR)		Technical Performance Measures	Probability of Win (Pwin)	MOE/MOPS
Release or Deployment Frequency			Competition Effectiveness	
Team Velocity			Change Failure Rates	
Technical Debt			Lifecycle Cost Trends	

Appendix A - Master MOSA Metrics List

Step 6 – Manage Technical Baselines
Align MOSA Implementation With SE Process



Technical Baselines Key Information

- **Functional**
  - System Performance Specification
  - External Interfaces Specifications/Standards
  - Functional Architecture
- **Allocated**
  - Item Performance Specifications
  - Internal Interfaces Specifications/ Standards
  - Physical Architecture
- **Production**
  - Item Details Specifications
  - Physical Architecture
  - Technical Architecture

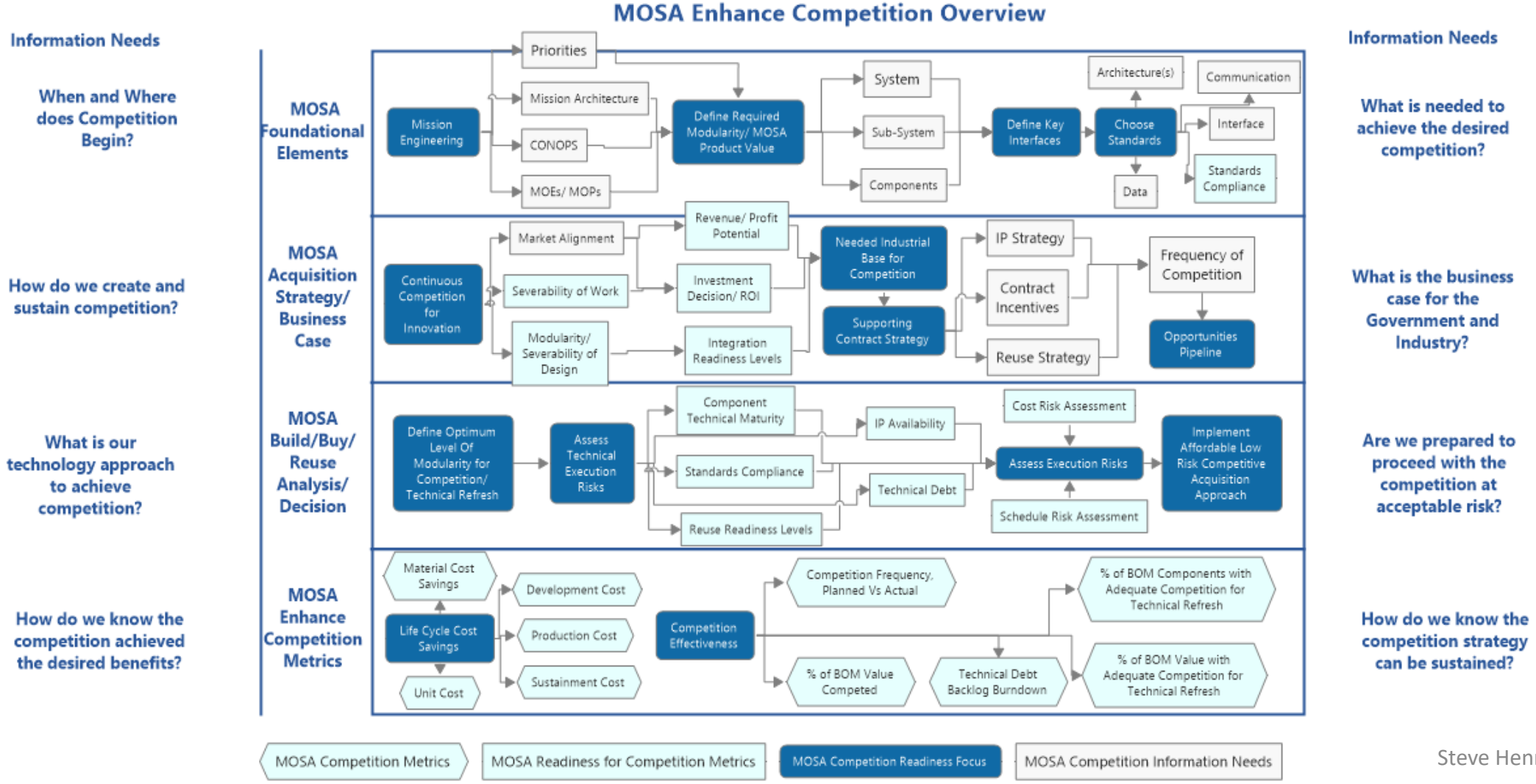
MOSA features are implemented and verified in the design and implementation?

Technical Baseline Purpose

- The **functional baseline** is the required system functionality describing functional and interface characteristics of the overall system, and the verification required to demonstrate the achievement of those specified functional characteristics.
- The **allocated baseline** is the configuration items making up a system, and then how system function and performance requirements are allocated across lower-level configuration items (hence the term allocated baseline).
- The **product baseline** is the documentation describing all of the necessary functional and physical characteristics of a configuration item; the selected functional and physical characteristics designated for production acceptance testing; and tests necessary for deployment/installation, operation, support, training, and disposal of the configuration item.

DAU Technical Baselines

Step 7 Measure Lifecycle Benefit Achievements Swimlane 4 – MOSA Competition Success Measures



Steve Henry, V8, 24 Jul 2023

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

NDIA MOSA Implementation Considerations, Information Needs and Metrics Use Case Appendices Content

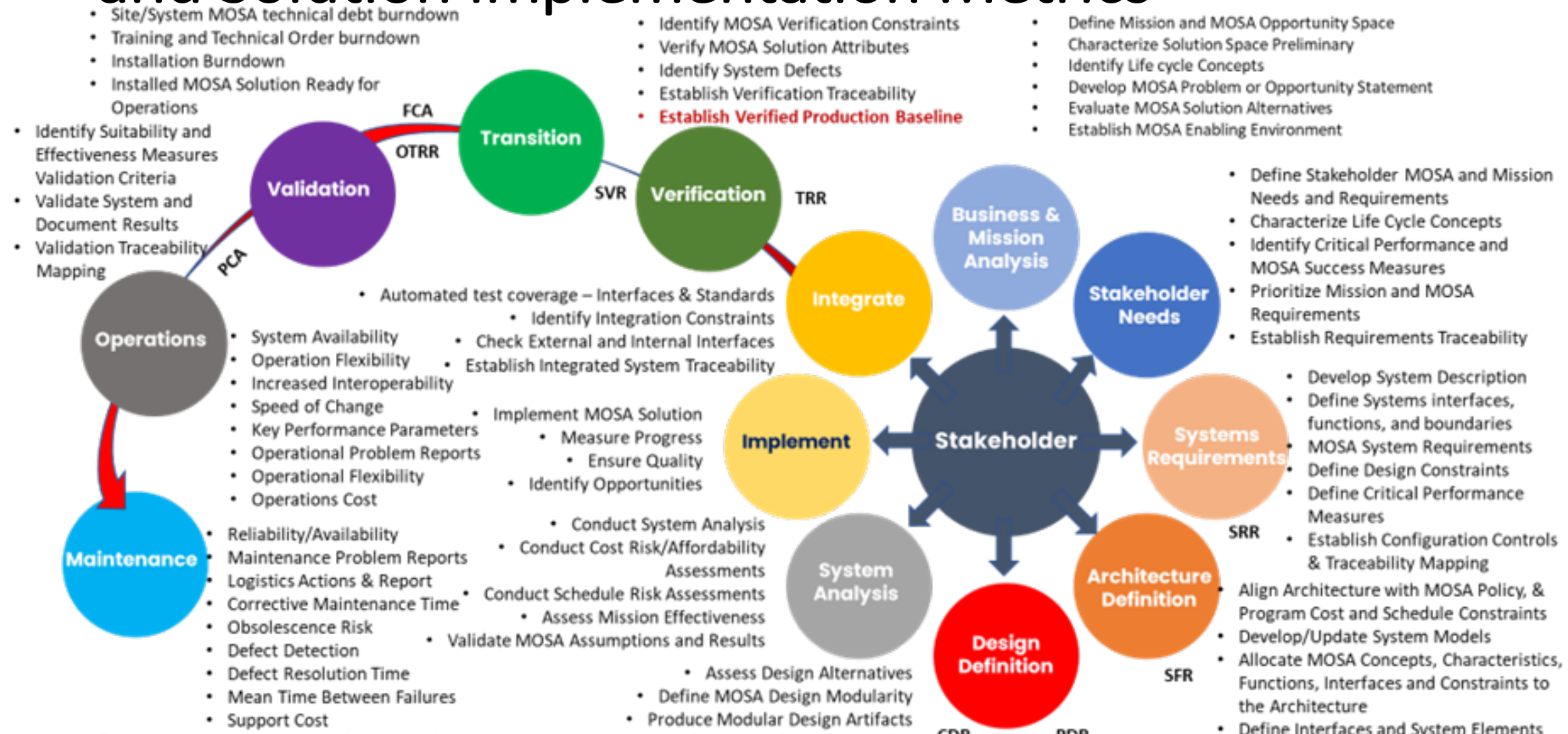
Appendix A – Master MOSA Metrics List

Metric	Information Need	Examples MOSA Application of Measures

MOSA Product Value – Optimized Product Modularity
CID 9A
	What value is MOSA providing the program, product, capability, or system?	**Optimized Modularity:** Modularity provides significant opportunities for continuous life cycle competition innovation for both the acquirer and supplier supply chain. Modularity and data and intellectual property fully support the product roadmap evolution path, technical refresh plans, and operational reconfiguration flexibility and achieves desired MOSA benefits:
		• → Significant cost savings or avoidance
		  ○ → Life Cycle Cost Reductions
		  ○ → Reuse cost saving/avoidance
		  ○ → Reduced Production Cost
		  ○ → Reduced Maintenance Costs
		• → Schedule reductions
		  ○ → Reduced lead and cycle times
		  ○ → Faster release frequency
		• → Opportunities for technical upgrades
		  ○ → Reduced obsolescence
		  ○ → Technical performance measures
		• → Increased interoperability, including system of systems interoperability and mission integration; or other benefits during the sustainment phase of a major weapon system

MOSA Product Value – User **Stakeholder Value** CID 9B1		**User:** • → Rapid on demand deployment frequency • → Combat operational configuration flexibility • → Increased interoperability • → High system availability • → Increase readiness with increased cyber resiliency • → Lower operations and support cost
MOSA Product Value – **Acquirer Stakeholder Value** CID 9B2		**Acquirer:** • → Increased affordability: Avoid vendor lock, increase competition, and enable reuse (develop & certify once, deploy many) and reduce lifecycle costs. • → Reduce supply chain risk: Competitive options, obsolescence mitigations, and simplified logistics tail

Appendix B - MOSA Systems Engineering Processes and Solution Implementation Metrics



Adapted Best Practices for Using Systems Engineering Standards (ISO/IEC/IEEE 15288, IEEE 15288.1, and IEEE 15288.2) on Contracts for Department of Defense Acquisition Programs

Appendix B

MOSA Systems Engineering Processes and Solution Implementation Metrics

Portfolio Management Process The portfolio management process commits the investment of adequate organization funding and resources, and sanctions the authorities needed to establish selected projects. It performs continued qualification of projects to confirm they justify, or can be redirected to justify, continued investment. (IEEE 15288)	
MOSA Information Need	**Sample Application of Metrics for MOSA**

• What are the supportive requirements; business practices; and technology development, acquisition, T&E, and product support strategies for effective development of open systems in the portfolio?
• Are the portfolio MOSA projects being implemented in accordance with established MOSA policies and contract requirements?
• What investment(s) are required to effectively implement the MOSA strategy?
• What is the cost and schedule of realizing the MOSA investment(s)
• What is the new MOSA opportunity backlog?
  ○ Commonality
  ○ Reuse
  ○ Other…
• What is the current mission and MOSA requirement priorities?
• What is the return on investment for MOSA opportunities?
• What is the status of implementing MOSA interfaces, components, and required portfolio reference architectures and standards?
	• Committed vs Delivered/Completed
	• Cumulative Flow
	• Burndown
	• Cost Risk Assessment
	• Schedule Risk Assessment
	• Return on Investment (ROI)
	• Burndown

Realizing MOSA Product Value

MOSA Product Value Affordability Assessment Criteria Example

1.0 Affordability: Will the system, product, or capability, improve mission needs and achieve MOSA benefits while meeting or exceeding project budget constraints? - Degree by which the system, product, or capability will improve the mission capability and yet stay within budget constraints using a MOSA approach. Set the value 0-100. Recommended as part of a minimal set of attributes.¶
Recommended Stakeholders: Acquirer; and Supplier.¶

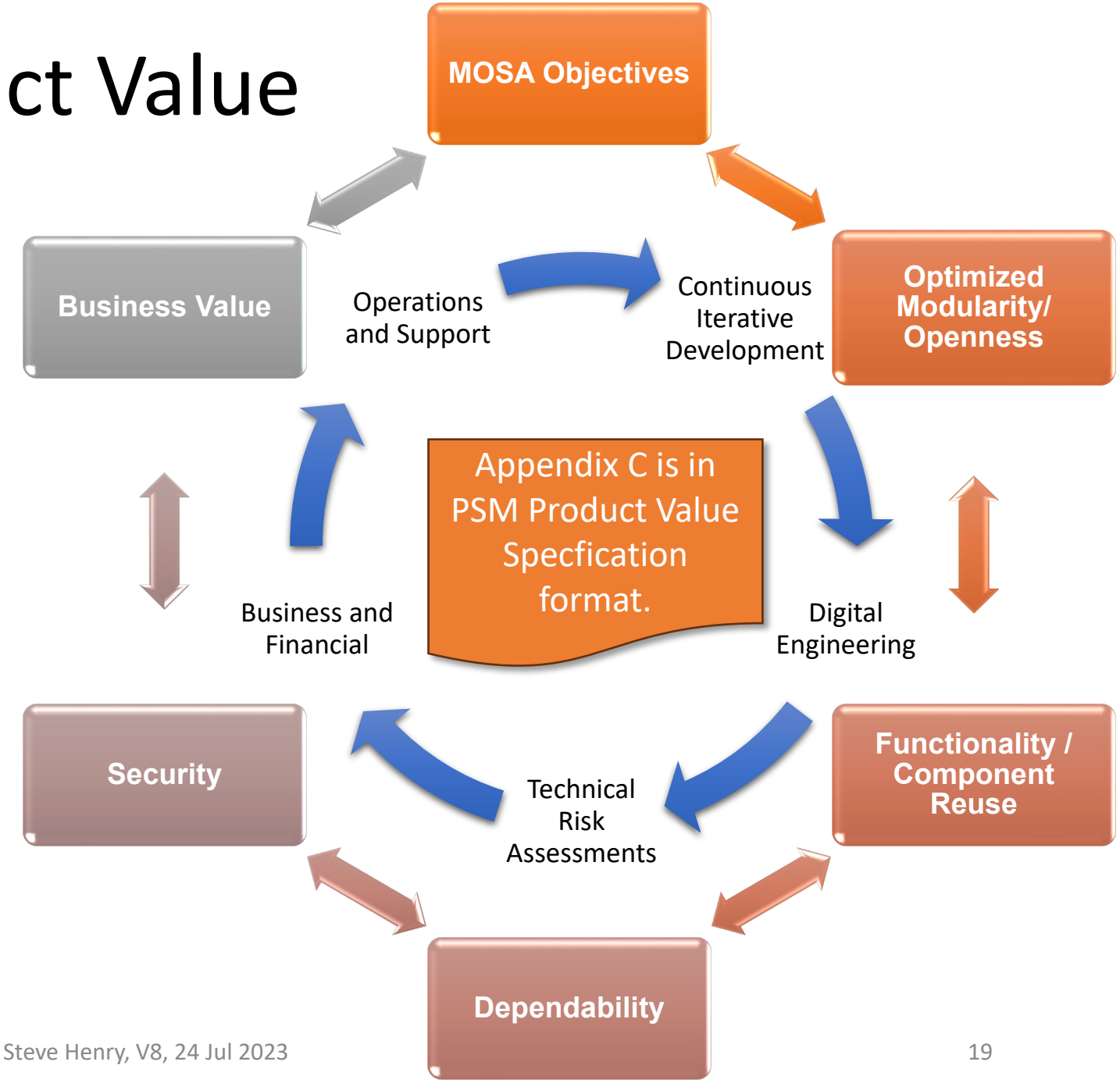
0 = The system, product, or capability does not improve mission needs and is not expected to perform to budget constraints. Competition does not exist or minimal competition cost saving can be achieved. In planning or execution, the program has no cost or schedule margin and has numerous risks. Reuse options are limited. Support cost/repair costs exceed available budget and desired cycle repair time.¶

50 = The system, product, or capability may improve mission needs but not perform to budget or may perform to budget but not improve mission needs. Competition opportunities exist that can lead to cost savings. Implementation of MOSA attributes and automation can provide integration cost and schedule savings. Reuse opportunities are available.¶

100 = The system, product, or capability will improve mission needs and is expected to perform well within budget constraints. MOSA enables continuous competition for technology refresh numerous standards-based reuse opportunities.¶

Information Needs and Measures:¶

- → Technical Performance Measures¶
- → Performance/MOSA Benefits Committed vs Delivered¶
- → Schedule Risks Assessment¶



Appendix C – MOSA Product Value Specification

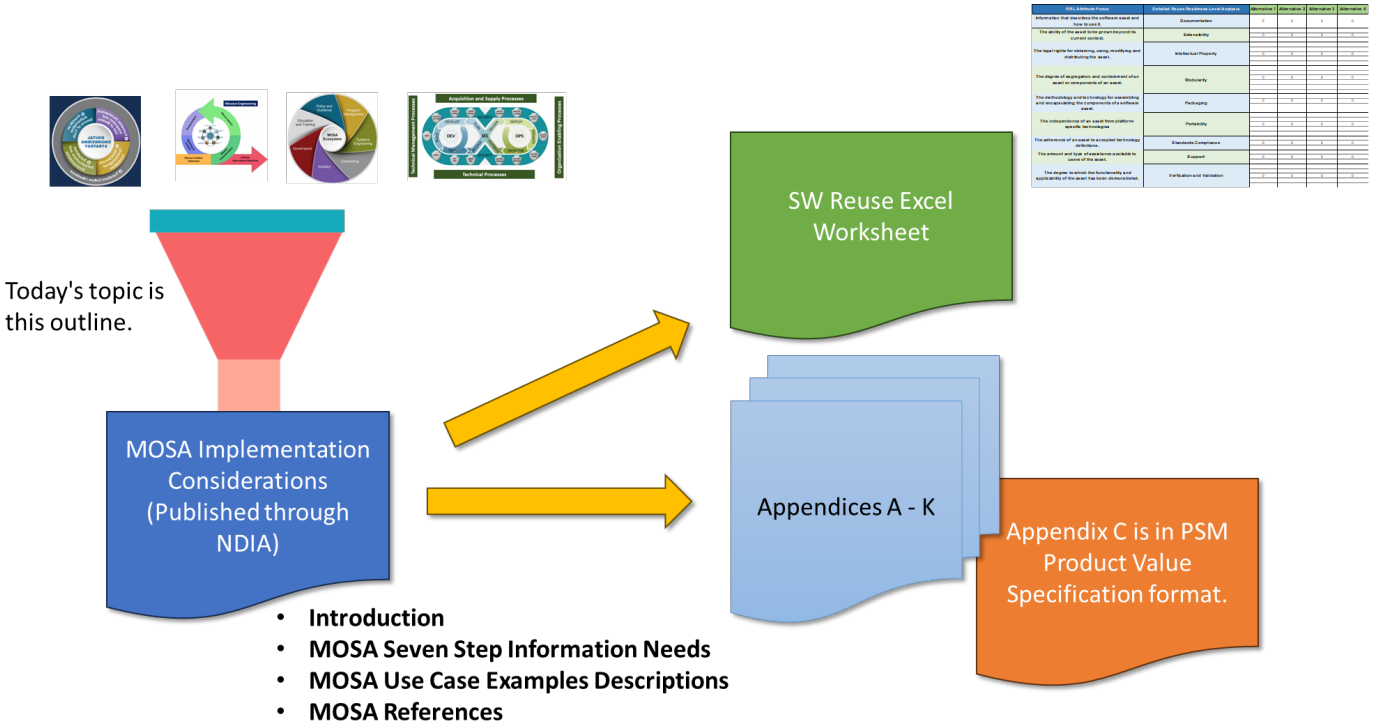
Appendix D – Software Reuse Readiness Levels Assessment Criteria (What are the Program risks?)

Reuse Readiness Level Attributes	RRL Attribute Focus
Documentation	**Information that describes the software asset and how to use it.**
Extensibility	**The ability of the asset to be grown beyond its current context.**
Intellectual Property	**The legal rights for obtaining, using, modifying and distributing the asset.**
Modularity	**The degree of segregation and containment of an asset or components of an asset.**
Packaging	**The methodology and technology for assembling and encapsulating the components of a software asset.**
Portability	**The independence of an asset from platform-specific technologies**
Standards Compliance	**The adherence of an asset to accepted technology definitions.**
Support	**The amount and type of assistance available to users of the asset.**
Verification and Validation	**The degree to which the functionality and applicability of the asset has been demonstrated.**

Adapted: (NASA Reuse Readiness Levels)

Appendix D
Reuse Readiness Level Assessment Tool

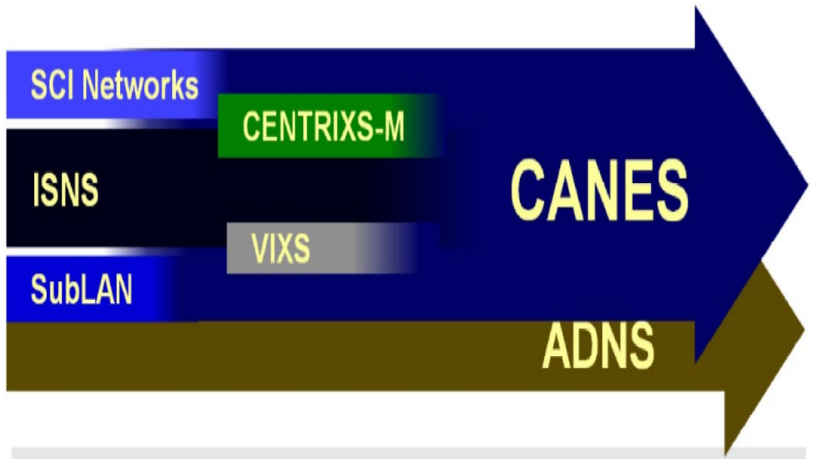
RRL Attribute Focus	Detailed Reuse Readiness Level Analysis	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Information that describes the software asset and how to use it.	Documentation	5	5	8	6
The ability of the asset to be grown beyond its current context.	Extensibility	6	3	6	2
The legal rights for obtaining, using, modifying and distributing the asset.	Intellectual Property	5	3	6	7
The degree of segregation and containment of an asset or components of an asset.	Modularity	4	7	3	7
The methodology and technology for assembling and encapsulating the components of a software asset.	Packaging	5	6	4	7
The independence of an asset from platform-specific technologies	Portability	5	7	8	7
The adherence of an asset to accepted technology definitions.	Standards Compliance	5	6	7	4
The amount and type of assistance available to users of the asset.	Support	4	6	6	7
The degree to which the functionality and applicability of the asset has been demonstrated.	Verfication and Validation	7	6	5	8



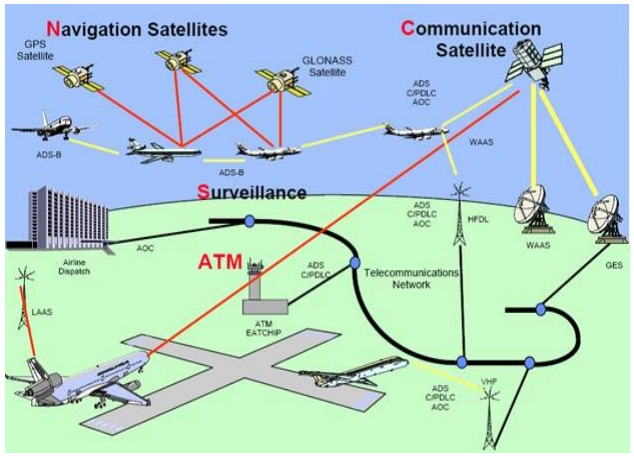
MOSA Metrics Discussions

Questions?

BACKUP



Navy CANES



USAF GATM

Army PEO Aviation

MOSA Program Successes

Appendix E Navy CANES MOSA Acquistion Strategy

Appendix F GATM Acquisition Strategy (In Backup)

Appendix G Army PEO Aviation MOSA Guidance

Appendix E
Navy CANES MOSA Acquisition Strategy 2007

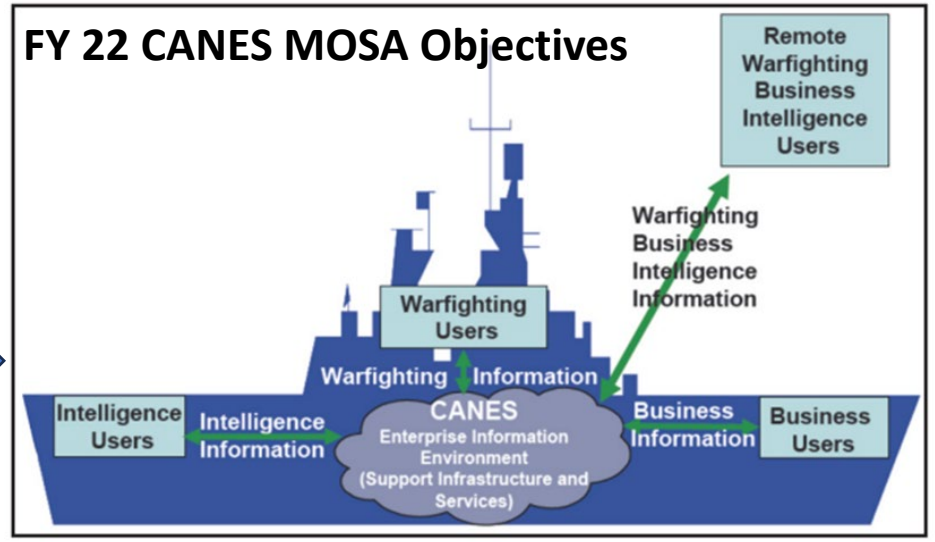
- **Adapt to evolving requirements and threats** as identified by the Government
- **Enhance interoperability and the ability to integrate new capabilities** without redesign of entire systems or large portions
- **Accelerate transition from science and technology** into acquisition and deployment;
- **Facilitate systems reconfiguration and integration**
- **Reduce the development cycle time and total life-cycle cost**
- Plans for **integrating the systems** both internally and with external systems (System of Systems)
- Provide a means for **ensuring conformance to open standards and profiles**
- Develop a technical approach that ensures having access to **mature as well as the latest technologies** by establishing **a robust, modular, and evolving architecture based on open standards**.
- Develop a **strategy for maintaining the currency of technology** (e.g., through COTS or reusable NDI insertion, technology refresh strategies
- Maintain continued **access to cutting edge technologies and products from multiple suppliers**; and
- **Mitigate the risks associated with reliance on a single source of supply over the life of the system**, to include, but be not limited to, technology obsolescence and dependence on proprietary or vendor-unique technology.

Navy CANE MOSA Benefit Evolution

CANES 2012 MOSA Baseline

- **Maximize Competition: CANES** strategy maximizes competition throughout program's lifecycle
- **Open Standards**: CANES specifications promote further competition
- **CANES MOSA Strategy:** CANES Life-Cycle Support Approach
  - **Modular Open System Approach (MOSA) Open Systems Architecture Requirements**
  - **Reference Architecture:** The CANES system developed in accordance with the NESI Implementation Framework
  - **Standards Conformance:** Validated development the program in compliance with NESI standards and mission capabilities
  - **Intellectual Property:** Secured full data rights.

Continued MOSA Benefits



- Provide a **secure afloat network** required for Naval and Joint Operations
- Consolidate and **reduce the number of afloat networks** through the use of **Common Computing Environment** and mature cross domain Technologies
- **Reduce the infrastructure footprint and associated Logistics, Sustainment, and Training Costs**
- **Increase reliability, security, interoperability and application hosting** to meet current and projected Warfighter requirements

CANES Application Integration effort provides common software governance, testing, processes, and tools to application developers.

Appendix E Navy CANES MOSA Acquistion Strategy

Appendix E
Navy CANES MOSA Acquisition Strategy 2022

- **Upgrade cybersecurity, command and control, communications and intelligence systems afloat, and by replacing unaffordable and obsolete networks.**
  - Provide a **secure afloat network** required for Naval and Joint Operations
  - Consolidate and **reduce the number of afloat networks** through the use of **Common Computing Environment** and **mature cross domain Technologies**
  - **Reduce the infrastructure footprint and associated Logistics, Sustainment, and Training Costs**
  - **Increase reliability, security, interoperability and application host**ing to meet current and projected Warfighter requirements
- CANES P-40 Exhibit FY 2021, OPN BA2 BOOK - MOSA Product Value
  - Deploy to the Fleet as quickly as possible to mitigate cyber security threats **(Responsiveness)**
  - Keep pace with increased computing requirements for hosted applications **(Scalability)**
  - Remove End of Life (EOL) **(Dependability and Security)**

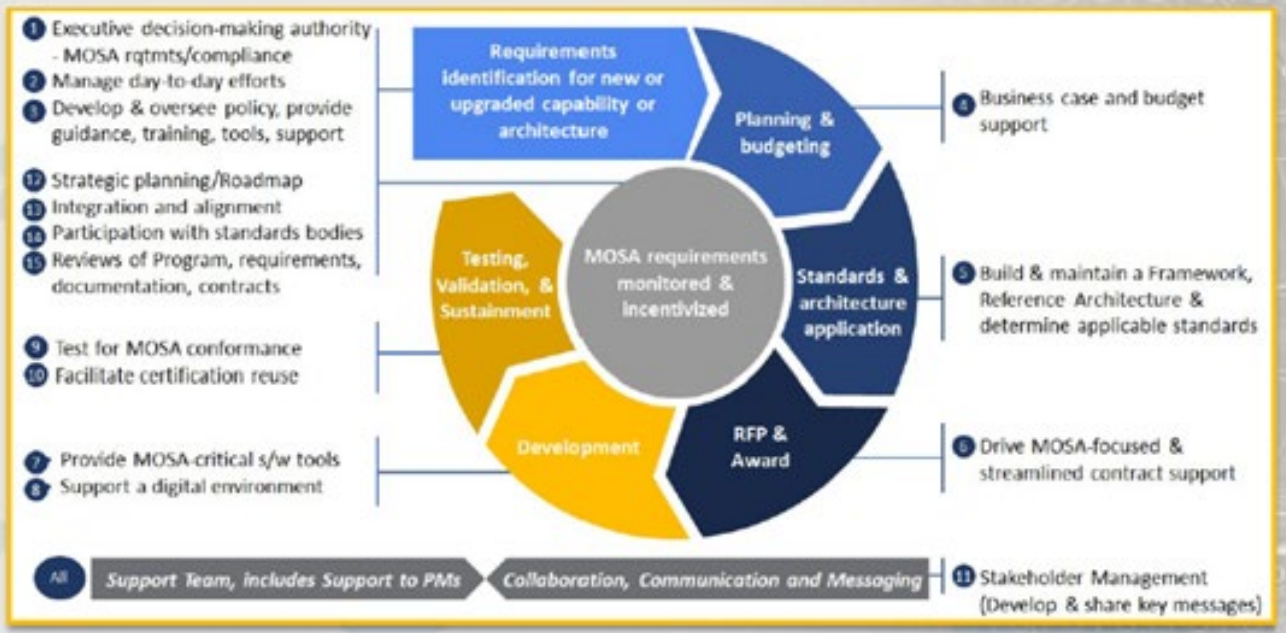
The 2022 CANES Initiative Is Reaping MOSA Benefits from the Original MOSA Implementation

PEO Aviation Governance and Management

UNCLASSIFIED

MOSA Governance and Management

- PEO Aviation established a MOSA Transformation Office (TO), which reports to the PEO/ DPEO. The TO is responsible for, and has authority over, the MOSA mission. In addition to establishing goals and roadmaps and performing routine assessments against those goals, until MOSA is a PEO Aviation standard practice, the MOSA TO will provide MOSA implementation assistance to the PMs.
- The MOSA TO manages the coordination of multiple working groups to develop & maintain the various MOSA policy and modeling products (e.g. Enterprise Architecture Framework and the Reference Architecture).
- Conformance with Reference Architecture and established policy will be reviewed and enforced through Quarterly Reviews and Working Groups.



PEO Aviation is committing full dedicated staff & necessary POC's from other organizations beginning in FY21. The TO plans to endure a few years, after which its processes, procedures, policy, & authorities will be absolved back into other areas of the PEO. MOSA will become centric to how PEO Aviation does business without an additional substantial staff, management, or oversight element.

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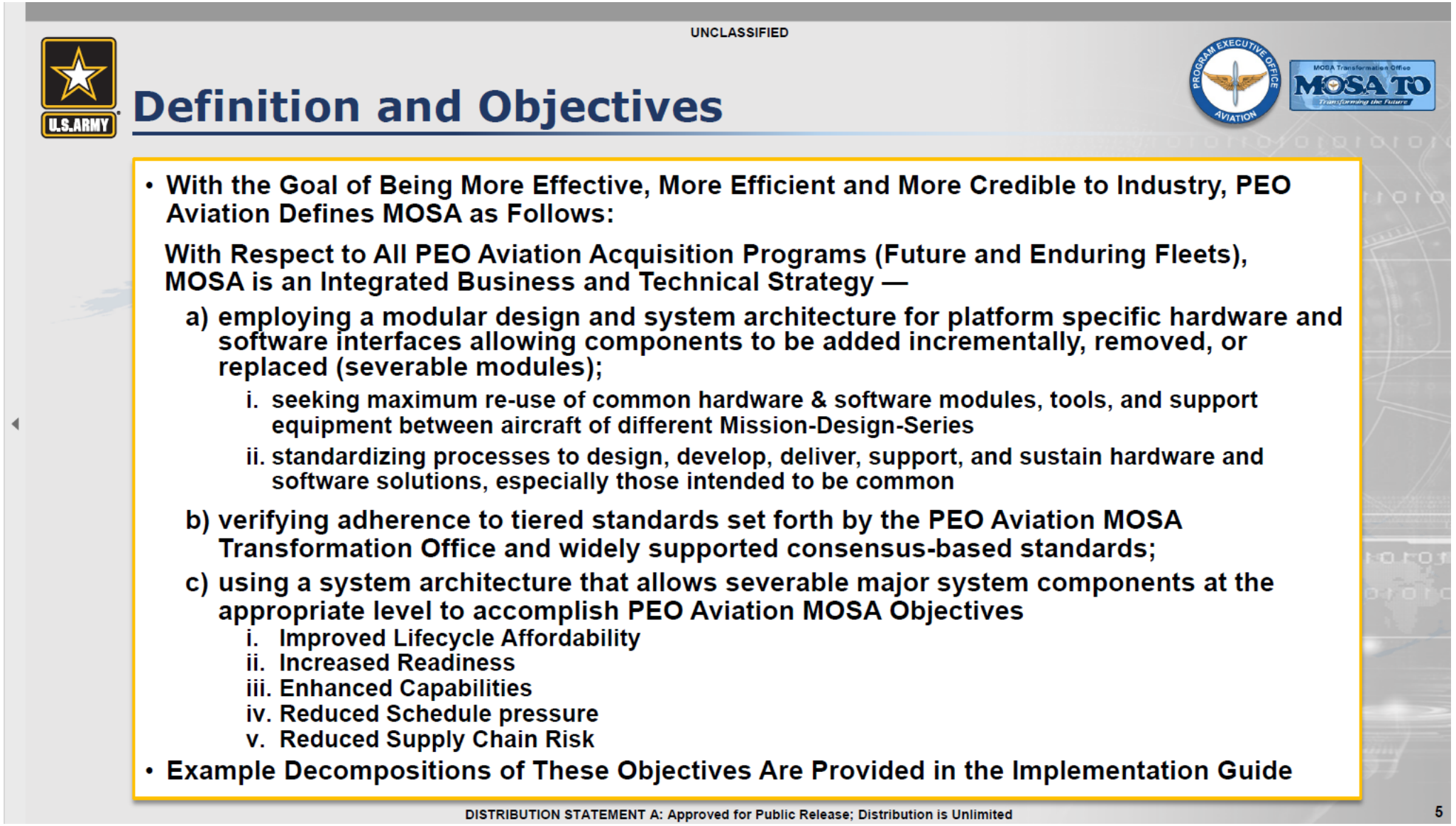
PEO Aviation MOSA Definitions and Benefit Objectives



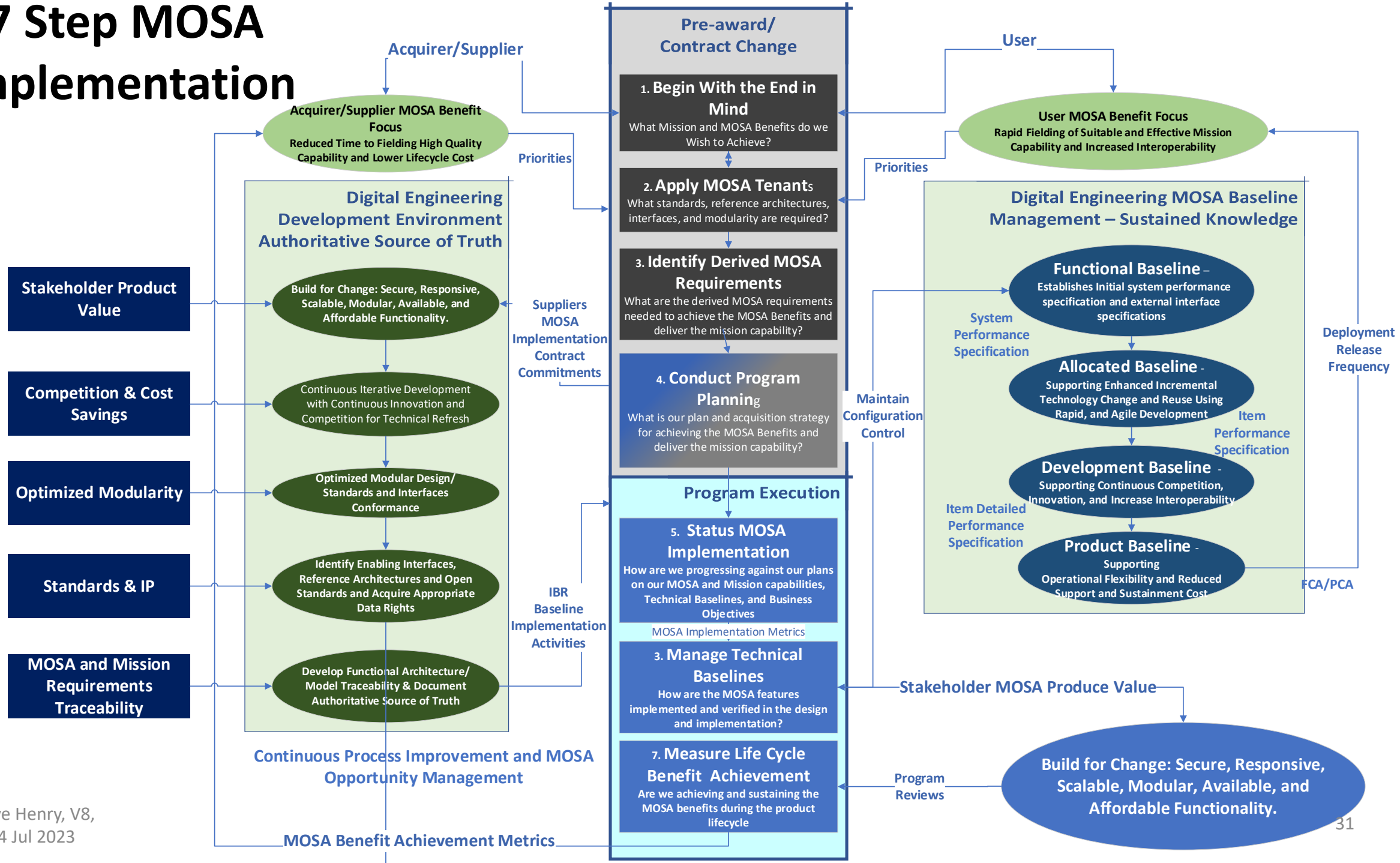
[PEO Aviation MOSA Implementation Guide Skinny]

Step 7 Measure Lifecycle Benefit Achievements

(Measure MOSA Success Against the Objectives Chosen in Step 1)

NDIA Example (Not PEO Aviation) Mapping of Canidate Metrics to Army PEO Aviation MOSA Objectives				
Improved Live Cycle Affordability	**Increased Readiness**	**Enhanced Capabilities**	**Reduced Schedule Pressure**	**Reduced Supply Chain Risk**
MOSA Product Value				
Life Cycle Cost Trends	Reliability & Maintainability	Competition Frequency	Lead Time	Functional Architecture Completeness and Volatility (8.1)
Material Cost Trends	Operational Availability	Opportunity Pipeline	Cycle Time	Model Traceability (8.2)
Unit Cost Trends	Change Rate Failure	Investment Trends	Release Frequency	Committed vs Delivered
Touch Labor Trends	MOEs/MOPs	Return on Investment	Team Velocity	Release Frequency
Competition Effectiveness	Defect Detection	Budget Trends	Automated test Coverage	TRL/IRL/MRL
Cost Risk Assessments	Defect Resolution	Key Performance Parameters)KPPS)	Defect Detection	Reuse Readiness Levels
Reliability & Maintainability		MOEs/MOPs	Defect Resolution	System Complexity Levels
Cost Risk Assessments		Reuse Readiness Levels	Schedule Risk Assessments	Change Failure Rate
Reuse Readiness Level		Technical Debt	Mean Time to Detect/ Restore	Automated test Coverage

7 Step MOSA Implementation



GATM Air Force Scientific Advisory Board Finding – Cost Avoidance Benefit

- **Architecture selection based on reducing the costs of designing and installing modifications instead of minimizing initial installation costs can significantly reduce life-cycle costs**
- **If the Air Force invests in installing an open architecture, it will save on modification installation and integration costs**
  - Current industry results show a **30 percent to 40 percent reduction of installation and integration costs for open modular systems**.
  - Current estimates have the integration costs at 10 to 20 times the hardware costs for federated systems.
- SPDs must reexamine their modification programs to **leverage the synergism of combining requirements to implement the individual Global Access, Navigation, and Safety program to minimize platform downtime and cost**.
  - Installing combined systems and an open modular architecture can decrease Future modifications costs by 30 percent or more and pay back the investment in 4 years

Appendix F – USAF GATM MOSA Acquisition Strategy

GATM Air Force Scientific Advisory Board Finding – Open Integrated Modular Architecture Benefits

- Civilian design and implementation for nonmilitary-unique requirements; **share initial and change development costs with civilian air fleets**
  - **Proven Open standards and continuous competition for components**
  - **Planned product software upgrades** to support CNS/ATM evolution and product support
  - **Air Force compliance and conformance to CNS/ATM requirements**
- **Modular and open architecture for new systems when supported by life-cycle cost estimates**;
  - **Lower regression cost for certification or flight qualification releases**
- Hardware **(card)** updates or replacements to upgrade technology (for modular systems)
  - Replace low-MTBF parts or obsolescent components with new technology
  - **Reduce depot infrastructure but increase initial integration and installation costs**
  - **Decrease overall integration and installation costs for modifications**
- **Reliability, maintainability, and availability savings** from avionics modernization to fund other parts of Global Access, Navigation, and Safety
  - Squadron **O&M potentially reduced by 25 percent or more**

USAF Scientific Advisory Board Findings, Report on Global Air Navigations, Volume 2, Detailed Findings, SAB-TR97-02, Sep 1998

GATM Use Case Enterprise Architecture and Objectives

Mission Engineering

Communications
- **More direct and efficient air -ground linkages**
- Improved data handling
- Reduced channel congestion
- Reduced communications errors
- **Interoperability across applications**
- Reduced workload

Navigation
- High-integrity, high-reliability, all-weather navigation services worldwide
- Improved four-dimensional navigation accuracy
- **Cost savings from reduction or non -implementation of ground based navigation aids**
- Better airport and runway utilization
- Provision of non -precision approach/precision approach (NPA/PA) capabilities at presently non -equipped airports
- Reduced pilot workload

Surveillance
- Reduced error in position reports
- Surveillance in non -radar airspace
- **Cost savings**
- Higher degree of controller responsiveness to flight profile changes
- Conformance monitoring
- Improved emergency assistance

* MOSA Benefits

Determine MOSA Based Implementation Strategy

Governance Standards & Reference Architectures

MOSA Based Acquisition Strategy

- **Integrated Technical and Business Lifecyle Strategy to Rapidly Deliver/Sustain Mission and MOSA Benefits**
  - Program Office managed integration
  - **Single focal point for procurement of GATM Group B and sustainment**
  - **Quantity buys and discounts**
  - **Single supply chain with multiple vendors**
  - **Single USAF accreditation organization**
  - Consolidated GATM expertise
  - **Enable commonality across platforms**
  - Available to all DoD
  - **Increase Interoperability**
- **MOSA GATM ID/IQ Contracts**
  - **Multiple Selections/ Increased Competition to lower cost**
  - **Enable Rapid Replacement (24 hour turn)**
  - **Extended Warranty Lower Support Cost**
  - **Facilitate Tech Refresh and Product Evolution**
  - **Conformance to Open Standards Conformance**
- **Provide Governance**
  - **Enterprise level configuration control visibility**
  - **GATM IDE/Web Digital Environment for ordering and exchange of technical information**
  - Free Technical Support
  - **Published GATM Accreditation Process**
  - **Integrated Enterprise level POM Support**
  - Integration Source Selection Support
- **Key Objectives**
  - Meet CNS/ATM Requirements
  - **Rapid delivery and Refresh timelines**
  - **Competition and Lifecycle cost savings**
  - **Improved Interoperability and commonality**
  - County Acceptance of GATM Certification

Appendix F

Steve Henry, V8, 24 Jul 2023

Global Air Traffic Management (GATM) MOSA Strategy Implementation and Evolution

USAF Scientific Advisory Board Findings, Report on Global Air Navigations, Volume 2, Detailed Findings, SAB-TR97-02, Sep 1998

0305099F Global Air Traffic Management (GATM), RD2 – February 2000

0305099F Global Air Traffic Management (GATM), RD-2, Feb 2015

0305099F Global Air Traffic Management (GATM), RD-2, May 2021

Appendix F GATM Acquisition Strategy

Steve Henry,
V8, 24 Jul 2023

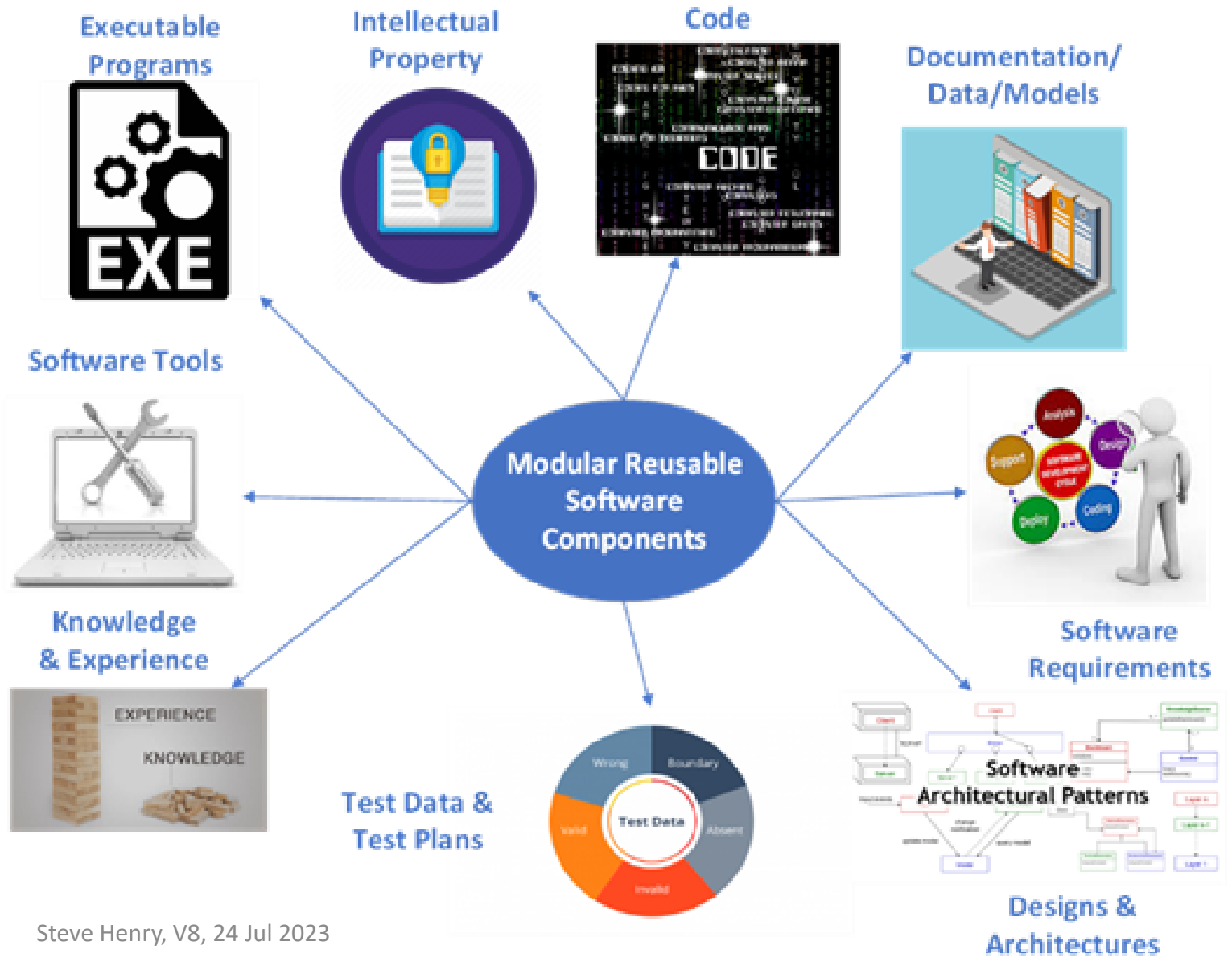
GATM Stakeholder MOSA Success Metrics

GATM Program Office	Aircraft Program Office	Major Command
GATM Acquisition Capability Time Lines • Cycle Time (Time from RFP Release to Contract Award) – component availability • Competition Frequency Planned vs Actual	**Aircraft GATM Integration/ Deployment Timelines** • On time GATM Component Delivery vs need • Aircraft GATM Integration Cycle Times	**Aircraft GATM Deployment Timelines** • GATM Equipage % by Fleet Burndown • Denied Airspace Access Backlog

Competition Cost Savings
• Component Unit Pricing Catalog versus IDIQ Bid Prices
• Component Unit Pricing Trends over time
• Component Repair Cost
• Quantity Buy Savings
• Integration Competition Cost Savings
	Aircraft GATM equipage cost
	• Aircraft Integration Cost Funding Shortfalls
	  • Integration Competition Cost Savings
	  • Integration Cost Avoidance
	• GATM Component Unit Pricing Trends over time
	• GATM Component Repair Cost
		Total GATM Program Cost
		• Aircraft Integration Cost vs Committed
		• Sustainment Cost Reductions
		  • Mean Time Between Failures
		  • Mean Time to Repair
		• GATM Competition Cost Savings
		• Commonality Across Platforms
		• Lifecycle Cost

Speed of Delivery • Delivery Time vs Contract • Mean Time to Repair and Return • Surge Repair Delivery Times	**Speed of Delivery** • Average GATM Component Delivery time from time of order • Aircraft GATM Modification Cycle Time Trends	**Speed of Delivery** • Aircraft GATM Equipage vs Need Timelines • Mean Time to Repair and Return
Aircraft Conformance to GATM Standards • USAF GATM Conformance Requirements • Component Standards Conformance • Aircraft GATM Conformance burn down	**Aircraft Conformance to GATM Standards** • Aircraft GATM Conformance burn down • Aircraft Safety Standards Conformance • System Suitability and Effectiveness Measures	**Aircraft Conformance to GATM Standards** • Airspace Access Standards Conformance • Mission Limitations Burndown • Operations That Can Be Executed vs Committed

Appendix D - Modular Open System Approach Enhance HW- SW Reuse



What are the Hardware Reuse Opportunities and Associated MOSA Benefits?

- Common Parts Quantity Buys
- Fewer Parts – Design for Assembly
- Common Parts Smaller Logistics Footprint
- …

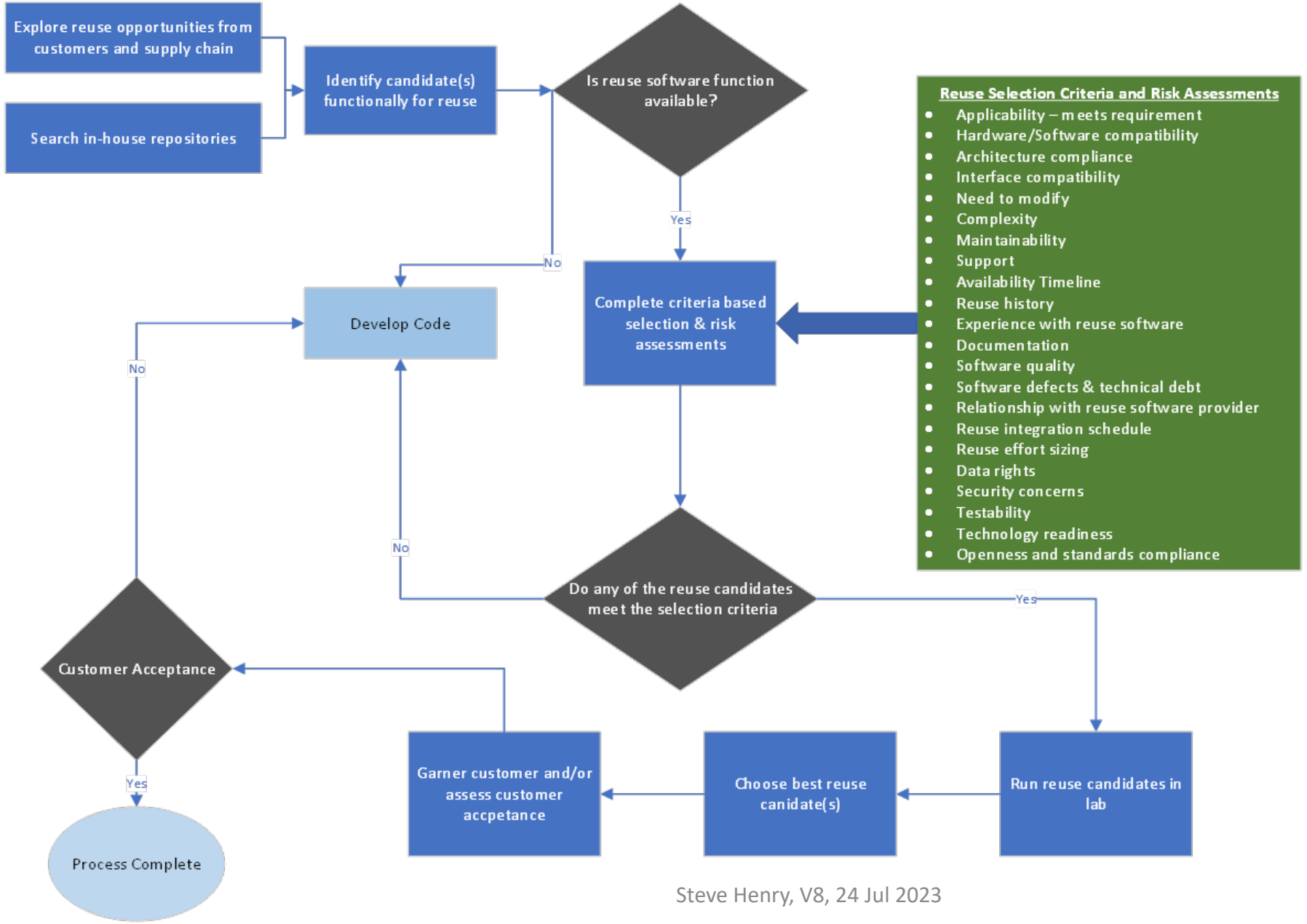
Appendix D - Reuse Readiness Level Score Card Detailed Scoring Example

Reuse Readiness Attribute Defintions				
Reuse Readiness Attribute	**Resue Readiness Atttribute Defnition**	**RRL 1**	**RRL 2**	**RRL 3**
Documentation	**Information that describes the software asset and how to use it.** **MOSA Benefit:** Documentation enables potential adopters to determine whether the software addresses the need and informs adopters how to utilize the software and reduce the risks and costs of reuse. Documentation includes descriptions of interfaces and capabilities, information about the execution environment, and instructions for the consumer on the purpose of the asset and on ways in can be reused. Documentation also describes plans for subsequent releases and future development.	Little or no internal or external documentation available	Partially to fully commented source code available	Basic external documentation for sophisticated users available
		Source code is available, with little or no useful internal or external documentation	Source code is available and fully commented, but no other documentation is provided	For example, a README file, a "man" page, or command line usage examples
			It may be challenging for a good programmer to determine how to reuse the software	This type of documentation would be sufficient for a sophisticated user to figure out how to use the software, but probably not a general user.

Reuse Readiness Levels
Detailed Criteria by Level by Attribute & MOSA Benefit

Reuse Readiness Attribute Defintions		Readiness Attribute Characteristics								
Reuse Readiness Attribute	**Resue Readiness Atttribute Defnition**	**RRL 1**	**RRL 2**	**RRL 3**	**RRL 4**	**RRL 5**	**RRL 6**	**RRL 7**	**RRL 8**	**RRL 9**
Documentation	**Information that describes the software asset and how to use it.** **MOSA Benefit:** Documentation enables potential adopters to determine whether the software addresses the need and informs adopters how to utilize the software and reduce the risks and costs of reuse. Documentation includes descriptions of interfaces and capabilities, information about the execution environment, and instructions for the consumer on the purpose of the asset and on ways in can be reused. Documentation also describes plans for subsequent releases and future development.	Little or no internal or external documentation available	Partially to fully commented source code available	Basic external documentation for sophisticated users available	Reference manual available	User manual available	Tutorials available	Interface guide available	Extension guide and/or design/developers guide available	Documentation on design, customization, testing, use, and reuse is available
		Source code is available, with little or no useful internal or external documentation	Source code is available and fully commented, but no other documentation is provided	For example, a README file, a "man" page, or command line usage examples	Reference manual provides complete documentation on use of the software, but may not be easily approached or accessed by general users	User manual allows a "normal" or general user to understand how to use and possibly customize aspects of the software	Step-by-step walkthroughs of how the software is customized and used in various scenarios, demos, etc	Documentation describes how to customize and interface the software with other software, programmatic interfaces, APIs, etc., so that it can more easily be embedded in a larger system.	The extension guide provides information on how to customize and add to the software, add plugins and the like, use internal programming "languages", etc	An extension guide provides information on how to customize and add to the software, add plugins and the like, use internal programming "languages", etc
			It may be challenging for a good programmer to determine how to reuse the software	This type of documentation would be sufficient for a sophisticated user to figure out how to use the software, but probably not a general user.	Some documentation relevant to customization is available.		Available training makes it very easy to understand/teach the software and use it in a new project		The design/developers guide provides a description of internals, design documentation, internal documentation, etc. that is sufficient for someone "skilled in the art" to contribute to the development of the software or take over maintenance of the software.	A design/developers guide provides a description of internals, design documentation, internal documentation, etc. that is sufficient for someone "skilled in the art" or third party to contribute to the development of the software or take over maintenance of the software
Extensibility	**The ability of the asset to be grown beyond its current context.** **MOSA Benefit:** The implementation takes into consideration future growth and ease of extending function. A measure of the ability to extend a system and the level of effort required to implement the extension. Extensions, or expandability, can apply to re-engineering or during runtime. Extensibility is an important dimension to be able to incorporate an asset and add to or modify its functionality.	No ability to extend or modify program behavior	Partially to fully commented source code available	Extending the software is difficult, even for application contexts similar to the original application domain.	Some extensibility is possible through configuration changes and/or moderate software modification.	Consideration for future extensibility designed into the system for a moderate range of application contexts; extensibility approach defined and at least partially documented	Designed to allow extensibility across a moderate to broad range of application contexts, provides many points of extensibility, and a thorough and detailed extensibility plan exists	Demonstrated to be extensible by an external development team in a similar context	Demonstrated extensibility on an external program, clear approach for modifying and extending features across a broad range of application domains	Demonstrated extensibility in multiple scenarios, provides specific documentation and features to build extensions which are used across a range of domains by multiple user groups
		Source code is not available; execution parameters cannot be changed	Source code is available and fully commented, but no other documentation is provided	Minimal consideration to extensibility is included in the design, through use of methods such as object-oriented design or other tools which provide logical cohesion	Consideration to extensibility to some range of application contexts is included in the design though means such as: - Use of configuration files - Isolation of configuration parameters and constants in clearly identified sections of source code (distinct from logic and display code) - Some documentation of the effects of changes to these parameters and the allowed values for these parameters - Effective use of programming practices designed to enable reuse, such as object oriented design.	The procedures for extending the software are defined, whether by source code modification (e.g., object-oriented design) or through the provision of some type of extension functionality (e.g., callback hooks or scripting capabilities).	The extensibility capability for the software is well defined, sufficient to enable an experienced developer generally familiar with the project to extend the software.	The software has been extended and applied to a similar application context to the original	The software has been extended by at least one group of users outside the original development group using existing documentation and with no assistance from the original development team	The software is regularly extended externally by users across multiple applications using available documentation
		It is not possible to extend the functionality of the software, even for application contexts similar to the original application domain	It may be challenging for a good programmer to determine how to reuse the software	Where source code is available, the software has some structure, but may have a high number of independent logical paths, minimal comments and documentation, and/or a low degree of cohesion.		Where source code modification is part of the extension plan, the software is well-structured, has a moderate to high level of cohesion, and has configuration elements clearly separated from logic and display elements. Internal and external documentation are sufficient to allow an experienced programmer to understand program flow and logic with moderate effort.	Documentation should include clear information about the range of application contexts to which the software can be extended as well as potential limitations on expansion.	This extension may have been done by an external team using extension documentation, by may have involved substantial assistance from the original development team members		There may be a library and/or digital engineering artifacts available of user-generated content for extensions

Appendix D – Software Reuse Selection Process



Adapted: Recommendations for Managing Software Reuse, MITRE, 2009