

Naval Postgraduate School Acquisition Research Symposium

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Systems Engineering (SE) – Digital Engineering (DE) Relationships

Digital Engineering Policy & Guidance

- DE Strategy (2018)
- Data Strategy (2020)
- DODI 5000.97 (2023)
- DODI 5000.61 (2024)



...digital engineering represents a transformation in how programs conduct systems engineering (INCOSE SEBOK)

SE Modernization

SETR Modernization

- Test Continuum
- R&M MBSE Initiatives
- Digital Contracting – MBAcq
- SWE Modernization
- Mission Engineering
- Sustainment
- Technology Development

Model-based systems engineering (MBSE) is a subset of digital engineering. MBSE supports the systems engineering activities of requirements, architecture, design, verification, and validation. (INCOSE SEBOK)



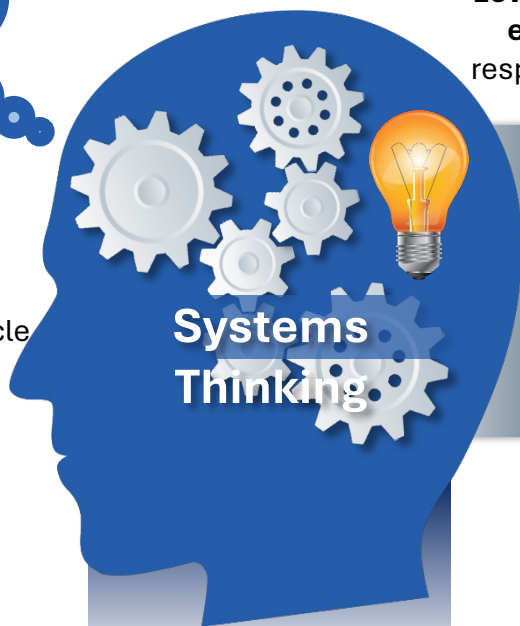
So...How Do We Enable SE Modernization?

Here's How...

SE Supra-System

describes 3 concurrent processes:

- SE life cycle
- Data and model life cycle
- Engineering life cycle



SE Modernization is a continuous process that is iterative with a seamless and efficient transfer of data and models.

Leverage SW Modernization as an exemplar of Agile practices – responsive to changing stakeholder needs

New
Mental
Model

Agile Mind-
Set

Model-
Based

Data
Centric

Collaboration

Use **Ontologies** to build common understanding

Iterative Approach to SE Processes with **data and models across the lifecycle**

Exemplar Reference implementations will provide templates to help programs get started

“Knowledge needs to be liberated from the artifacts”

Dr. Steve Jenkins
JPL/NASA (Retired)

Vision: Seamless & Efficient Acquisition/Engineering Process Integration Across the System Lifecycle



ABSTRACT

Technology Transition is referred to as the “valley of death” due to commonly experienced lack of successful transition to the next phase of system development. The high risk of technology development can cause a delay or cancellation that can be mitigated by Modular Open Systems Approaches (MOSA) principles.

MOSA enables technology transition by providing a framework for integrating, upgrading, and replacing components with minimal disruption. By addressing these MOSA principles early in the development cycle, technology transition is more predictable and manageable:

(1) Modular Architecture

Provides plug-and-play capability, where system components adhere to defined standards and interfaces.

Supports incremental upgrades, enabling individual modules to be updated or replaced as technology evolves and parallel development for specified (potentially high-risk) components.

(2) Interface Management

Consensus Based Open Standards with Well-Defined Interfaces to facilitate integration, component reuse

(3) Enabling Environment

Model Based Systems Engineering (MBSE) tools and processes with access to data



Technology Transition Challenges

Problem Statement

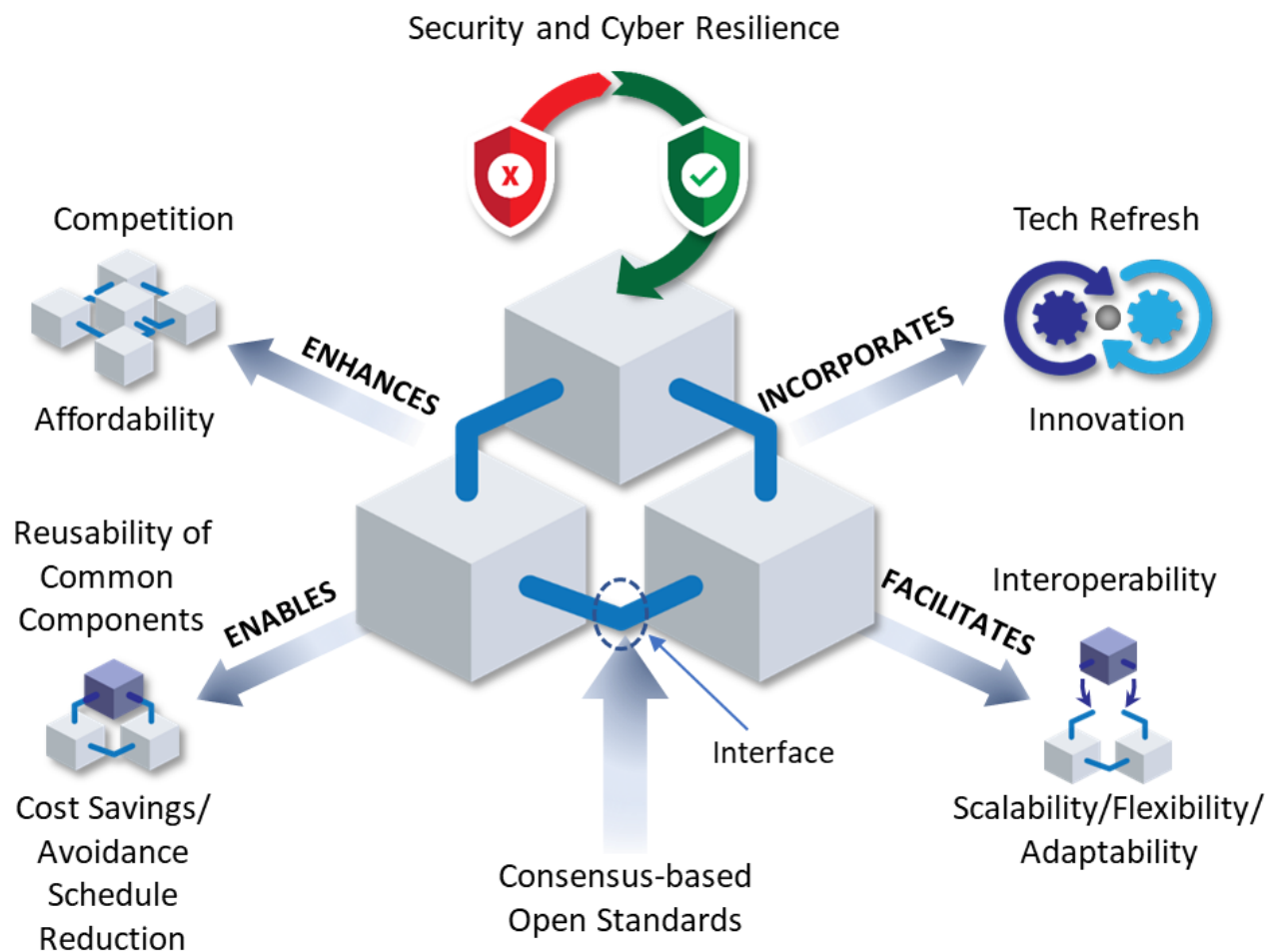
“The transition from an S&T program to an acquisition program or technology transition is often referred to as the **“valley of death”** because of the commonly experienced lack of successful transition between these phases. However, none of these programs explicitly address the role that a MOSA can bring to the Defense Innovation Ecosystem.

Common Technology Transition Challenges

- **Integration:** Systems can require extensive modification and testing to incorporate new technologies once the S&T effort is complete resulting in increased costs and transition delays.
- **Proprietary components** that may become unavailable or unsupported during an upgrade or development effort. Proprietary systems also restrict access to alternative suppliers, increasing costs and reducing innovation opportunities.
- **Custom-built, closed systems** require significant investment in development, integration, and sustainment



How MOSA can address these challenges





Alignment of MOSA Benefits to Technology Transition Challenges

Technology Transition Challenge	MOSA Benefit	MOSA Pillar
Integration challenges that slow capability deployment – Rigid architectures and lengthy integration and interoperability efforts delay the fielding of critical capabilities	Interoperability through modularity – Standardized interfaces and modular design enable faster integration of new components.	Standardized interfaces Modularity Open standards
Reliance on Proprietary Components – can result in components that may become unavailable or unsupported	Technology Refresh & Lifecycle Agility – Open architectures allow for incremental upgrades and replacement of obsolete parts without overhauling entire systems.	Open architecture Modularity
Custom built closed systems Proprietary systems restrict access to alternative suppliers, increasing costs and reducing innovation	Open Market & Competition – open interfaces foster a competitive supplier base, driving innovation and cost savings Rapid Fielding & Iterative Upgrades – Open, modular systems support incremental enhancements and faster certification through predefined compliance criteria.	Open interfaces Modular Open Standards



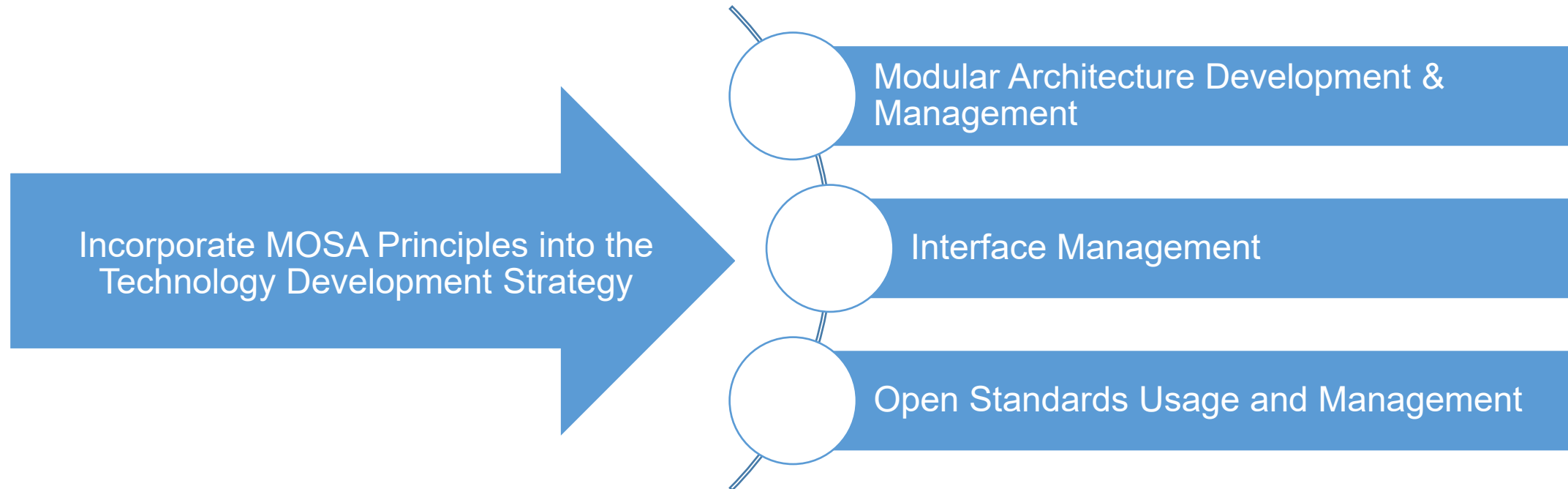
MOSA Considerations During Technology Development

- **Architecture Development & Management planning** that uses MBSE tools to manage model-based systems engineering (MBSE) to consider optional solutions.
- **Interface Management** that supports integration & interoperability goals to include reuse strategies such as product line architecture.
- **Plan for Consensus-based Open Standards** that facilitate future upgrades and technology refresh cycles
- **Architecture Development & Management planning** that uses MBSE tools to manage Use model-based systems engineering (MBSE) to consider optional solutions.
- **Interface Management** that supports integration & interoperability goals to include reuse strategies such as product line architecture.
- **Plan for Consensus-based Open Standards** that facilitate future upgrades and technology refresh cycles



MOSA ALIGNED – TECHNOLOGY TRANSITION FRAMEWORK

MOSA ALIGNED – TECHNOLOGY TRANSITION FRAMEWORK





CONCLUSIONS

- MOSA offers a viable set of principles that can benefit technology transition
- These principles must be addressed in the technology development approach/strategy to reap MOSA benefits
- Additional study with use cases will provide specific implementations
- Additional MOSA Resources at
 - www.cto.mil



Contact

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