Welcome to the 2019 System of Systems Engineering Collaborators Information Exchange (SoSECIE)

We will start at 11AM Eastern Time
Skype Meeting +1 (703) 983-2020, 46013573#
You can download today’s presentation from the OUSD(R&E) Website:
https://www.acq.osd.mil/se/outreach/sosecollab.html
To add/remove yourself from the email list or suggest a future topic or speaker, send an email to knharrington@mitre.org
NDIA System of Systems SE Committee

• Mission
  – To provide a forum where government, industry, and academia can share lessons learned, promote best practices, address issues, and advocate systems engineering for Systems of Systems (SoS)
  – To identify successful strategies for applying systems engineering principles to systems engineering of SoS

• Operating Practices
  – Face to face and virtual SoS Committee meetings are held in conjunction with NDIA SE Division meetings that occur in February, April, June, and August
  – SoS Track at NDIA 22nd Annual Systems Engineering Conference, Grand Hilton Tampa Downtown, Tampa, FL, October 21-24, 2019

  • Conference Info: http://www.ndia.org/events/2019/10/21/22nd-annual-systems-and-mission-engineering-conference

NDIA SE Division SoS Committee Industry Chairs:
Mr. Rick Poel, Boeing
Ms. Jennie Horne, Raytheon
OSD Liaison:
Dr. Judith Dahmann, MITRE
Simple Rules of Engagement

- I have muted all participant lines for this introduction and the briefing.
- If you need to contact me during the briefing, send me an e-mail at knharrington@mitre.org.
- Download the presentation so you can follow along on your own.
- We will hold all questions until the end:
  - I will start with questions submitted online via the CHAT window in Skype.
  - I will then take questions via telephone; State your name, organization, and question clearly.
- If a question requires more discussion, the speaker(s) contact info is in the brief.
Disclaimer

- MITRE, NDIA, and The Office of the Under Secretary of Defense for Research and Engineering makes no claims, promises or guarantees about the accuracy, completeness or adequacy of the contents of this presentation and expressly disclaims liability for errors and omissions in its contents.

- No warranty of any kind, implied, expressed or statutory, including but not limited to the warranties of non-infringement of third party rights, title, merchantability, fitness for a particular purpose and freedom from computer virus, is given with respect to the contents of this presentation or its hyperlinks to other Internet resources.

- Reference in any presentation to any specific commercial products, processes, or services, or the use of any trade, firm or corporation name is for the information and convenience of the participants and subscribers, and does not constitute endorsement, recommendation, or favoring by the Department of Defense or USD.
2019 System of Systems Engineering Collaborators Information Exchange Webinars
Sponsored by OUSD(R&E) and NDIA SE Division

January 8, 2019
Lead Systems Integration (LSI)
Dr. Warren Vaneman, CAPT, USN (Ret.) Professor, Naval Postgraduate School

January 22, 2019
Systems of Systems Model Building and Acausal Simulation Environment
Peter Menegay, SynaptiCAD

February 5, 2019
Development of New Standards for Systems of Systems Engineering
Dr. Mike Yokell, Lockheed Martin Fellow and Deputy Director, Systems Engineering

February 19, 2019
Systems of Systems Engineering Managerial and Operational Affinity
Dr. Mike Yokell, Lockheed Martin Fellow and Deputy Director, Systems Engineering

March 12, 2019
Mission Engineering Competency Model
Dr. Nicole A. Hutchison, Stevens Institute of Technology
March 26, 2019
Practical Modeling Concepts for Engineering Emergence in Systems of Systems
Dr. Judith Dahmann, The MITRE Corporation
Ms. Philomena Zimmerman, OUSD(R&E)

April 16, 2019
Mission Analysis and Operational Architectures
Mr. Zane Scott, Vitech Corporation

April 30, 2019
Digital Engineering Transformation
Mr. Thomas McDermott, Georgia Tech Research Institute, SERC

May 14, 2019
Toward Scaling Model-based Engineering for Systems of Systems
Dr. Ryan B. Jacobs, The MITRE Corporation
Lead Systems Integration

Presented to
System of Systems Engineering
Collaborators Information Exchange (SoSECIE)
January 8, 2019

Dr. Warren Vaneman
CAPT, USN (Ret.)
Professor of Practice
Email: wvaneman@nps.edu

Prof. Ron Carlson
CAPT, USN (Ret.)
Professor of Practice
Email: rrcarlso@nps.edu
“Our current system is like a machine to which we just keep adding important and wanted items but without a cohesive strategy for an elegant, interwoven system. Considered on their own, the addition and growth of individual elements may be useful. But when ownership organizations do not see how their contribution fits into the whole and think their element is an end-state in itself, effective communication and execution are inhibited.”

- ADM William Gortney, ADM Harry Harris, USNI Proceedings, May 2014
Common Causes of SoS Acquisition Failures

- Misalignment of objectives among systems.
- Limited span of control of the SoS on the constituent systems.
- Inflexibility of the constituent system’s design.
- Emergent behavior reveals hidden dependencies within the constituent systems.
- Real or perceived complexity within the SoS or constituent systems.

In 2008 Public Law 110-181, Congress directed Secretary of Defense to:
- Size and Train the workforce to perform Inherently governmental functions.
- Minimize and eventually eliminate contractors as LSI.

**Lead Systems Integration** – An acquisition strategy that employs a series of methods, practices, and principles to increase the span of both management and engineering acquisition authority and control to acquire SoS or highly complex systems.
LSI Function - Assert and execute system, SoS, and stakeholder trade space to affordably optimize Integrated Warfighting Capabilities across the SoS lifecycle.

- The roles of the LSI are similar to the roles of any Systems Engineer (SE) or System Integrator (SI). The primary difference is the span of design and integration authority that persists throughout system or SoS acquisition and lifecycle.

Key objectives: Affordability; Speed to the Warfighter; Agility; Maximize the Value of Complex System.
LSI Mission: Affordably Optimize Integrated Warfighting Capabilities across the Systems of Systems Lifecycle

Empower decisions (organizational authority and conflict resolution) via governance to achieve capability – using Universal Enabling Resources aligned to LSI touchpoints within the context of the Stakeholder Architecture

Align and leverage resources to enable LSI functions

Understanding organizational dependencies Internal and External

Who is involved and their equities, interests, relationships, or impacts

How an LSI makes decisions and enacts those decisions – through LSI governance to achieve capability – using Universal Enabling Resources aligned to LSI touchpoints within the context of the Stakeholder Architecture

Four universal and inter-related elements span every level and affect every Key LSI Touch point / product for the LSI function
Descriptions of layers

- **Component Boundary** (Allocated Sub-system level)
- **Program Boundary** (Weapons / Air Platform / System Level)
- **Mission Boundary** (Mission Wholeness Level)
- **Enterprise Boundary** (Enterprise Capability Level)

LSI may apply at multiple levels across multiple programs and stakeholders with operational / managerial independence.
LSI Touchpoints: highest payoff points of control or influence – aligned across the enterprise
Lead Systems Integration (LSI) Touchpoints

LSI Process Management
- Communications
- Acquisition Strategy
- Resource Allocation / Re-Allocation
- Funding & Schedule Alignment
- Risk Management
- Configuration Management
- Technical Integration / Interface Control
- Architecture Definition
- Requirements Management / CONEMPS Development
- System Deficiency Management (Labs / Flight Test)
- Operations & Sustainment (Man / Train / Equip)

Typical Organizational Functions
- Management Function

LSI Function
- Assert & execute system, systems of systems, and stakeholder trade space to affordably optimize integrated war fighting capabilities across the systems of systems life cycle

Business Functions
- Legal
- Acquisition
- Business/Finance
- Contracts
- Cost Analysis

Engineering Functions
- Systems Engineering
- Technical Analysis
- Requirements Analysis
- Architecture

Test Functions
- Verification & Validation

Logistics Functions
- Facilities
- Manning / Training
- Maintenance
- Supply

Control or Influence
- Assert & execute system, systems of systems, and stakeholder trade space to affordably optimize integrated war fighting capabilities across the systems of systems life cycle
Stakeholder Architecture Management in the LSI Enterprise Framework

1. Align control or influence of key LSI Activities across the Enterprise

2. Understand organizational dependencies
   - Internal and External
   - “Who is involved and their equities, interests, relationships, or impacts”

“LSI Touchpoints: What any LSI does”

Stakeholder “Architecture” / Management: Who is involved and their equities, interests, relationships, or impacts
Stakeholder “Architecture” in the Enterprise LSI Framework provides a resource for the LSI to identify and manage stakeholders both horizontally and vertically.

Stakeholder “Architecture” supports LSI-unique execution across any of the LSI touch points…and what resources they trade or use to support the LSI effort.
• **Enterprise Architecture** - The Process of translating vision and strategy into an effective and cohesive enterprise by communicating and improving the key requirements, principles and models that describe the enterprise’s future state and enable its evolution.

• **SoS Architecture** - The process of describing the structure of a SoS, its decomposition into constituent systems, the relationship between this systems, and the relationship with the external environment.

• **Systems Architecture** - The structure of components, their relationships, and the principles and guidelines governing their design and evolution over time.
Constituent systems are developed asynchronously.

SoS architecture and documents must guide and inform simultaneous and distributed concept development, technology development, and system engineering and manufacturing.

Universal Enabling Resources in the LSI Enterprise Framework

1. Align control or influence of key LSI Activities across the Enterprise

2. Understand organizational dependencies
   - Internal and External
   - "Who is involved and their equities, interests, relationships, or impacts"

3. Align and leverage resources to enable LSI functions

Universal Enabling Resources: four universal and inter-related elements span every level and affect every LSI touch point required for the LSI function and mission
• “Universal Enabling Resources” are resources any LSI uses to support LSI-unique execution at each of the “LSI touchpoints” – to assert and execute trade space.
• These four fundamental enablers apply at any level in the LSI Enterprise Framework.
Empower decisions (organizational authority and conflict resolution) via governance to achieve capability – using Universal Enabling Resources aligned to LSI touch points - within the context of the Stakeholder Architecture

- **Distribution of Authority** - focused on acquisition of capabilities.
- **Conflict Resolution** - arbitrated by key stakeholders most capable to address enterprise goals.
- **Maintaining Stakeholder “Architecture”** - since governance flows directly from stakeholder relationships.
- **Communication** – LSI as the conduit of authoritative data – “shared common understanding.”
- **LSI Governance Charter** - documents roles, responsibilities, authority, conflict resolution plans, and agreements - including empowered resource management authority - to incentivize stakeholders to think and act differently.
“Governance is the structure and relationships among key stakeholders that determine an organization’s direction and performance.”

- Provide the set of decision-making criteria, policies, processes, and actions that guide the responsible organizations (within the stakeholder architecture) to achieve Enterprise SoS goals and objectives

- Define communication paths and decision authority within the stakeholder “architecture” for conflict resolution

- Charter decision bodies to alter the actions of individuals and organizations in support of the LSI effort

- Governance derives from the agreements between key stakeholders, at all levels of LSI, on how to achieve a common goal

LSI should understand distributed autonomy and decision making to ensure integrity and consistency of effort across the SoS.
The LSI Enterprise Framework in Review

1. Align control or influence of key LSI Activities across the Enterprise

2. Understand organizational dependencies
   - Internal and External
   - “Who is involved and their equities, interests, relationships, or impacts”

3. Align and leverage resources to enable LSI functions
   - “Four universal and inter-related elements span every level and affect every Key LSI Touch point / product for the LSI function”

4. Empower decisions (organizational authority and conflict resolution) via governance to achieve capability – using Universal Enabling Resources aligned to LSI touch points - within the context of the Stakeholder Architecture
   - “LSI Touch points: What any LSI does
   - “How an LSI makes decisions and enacts those decisions”

Typical Organizational Functions:
- Management
- Business
- Engineering
- Test
- Logistics

LSI Functions:
- LSI Process Management
- Communications
- Acquisition Strategy
- Risk Management
- Configuration Management
- Technical Integration
- Interface Control
- Schedule Management
- CONOPS Development
- System Deficiency Management (Labs / Flight Test)
- Operations & Sustainment (Man / Train / Equip)

LSI Touchpoints:
- LSI Touchpoints
- Mission Capability
- System Capability
- LSI

Universal Enabling Resources:
- Staffing & Workforce Development
- Authoritative Data in Context
- Policy
- Resource Management

Stakeholder Architecture:
- Enterprise Capability
- Mission Capability
- System Capability
- LSI

LSI Governance:
- Allocated Sub-system Level
- System Level
- Program Boundary
- Mission Boundary
- Enterprise Boundary
- System Wholeness Level
- LSI Capability

Stakeholder Architecture:
- Who is involved and their equities, interests, relationships, or impacts

LSI Touchpoints:
- Mission Capability
- System Capability
- LSI
Summary

- LSI allows for the definition and control of a Managed SoS baseline that directly tracks to delivered capabilities.

- LSI can provide an established SoS Test, Evaluation and Certification methodology to evaluate delivered capabilities in context of mission performance.

- LSI will provide a formal method of Governance and change control that puts discipline & rigor into investment decisions at the enterprise-level.

Lead Systems Integration puts systems engineering rigor & discipline into Acquisition & Sustainment decision.