SoSECIE Webinar

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: <u>https://www.acq.osd.mil/se/outreach/sosecollab.html</u> To add/remove yourself from the email list or suggest a future topic or speaker, send an email to <u>knharrington@mitre.org</u>

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: <u>http://www.ndia.org/events/2019/10/21/22nd-annual-systems-and-mission-engineering-</u> <u>conference</u>

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 <u>knharrington@mitre.org</u>.
- 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.

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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

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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, Georgie 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

The Problem Plainly Stated



"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.

SOURCE: Rendon, R.G., T.V. Huynh, and J.S. Osmundson (2012). *Contracting Process and Structures for Systems-of-Systems Acquisition*. Systems Engineering, Vol 15, No. 4.



Lead Systems Integration (LSI)

- 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.



Lead Systems Integration (LSI)



Graphic Source: www.meicompany.com

- 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



LSI Applications Across Multiple Levels



<u>Descriptions of layers</u>

- 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.

1 LSI Touchpoints in the LSI Enterprise Framework



LSI Touchpoints: highest payoff points of control or influence – aligned across the enterprise

Lead Systems Integration (LSI) Touchpoints





Stakeholder Architecture Management in the LSI Enterprise Framework



Stakeholder "Architecture" / Management: Who is involved and their equities, interests, relationships, or impacts



Stakeholder "Architecture" / Management Overview



- 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.

Architectures: {Enterprise vs. SoS vs. System}

- 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.









LSI Architecture Challenge



- 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.

SOURCE: Herdlick, B. (2012). Establishing an Operational Context for early System-of-Systems Engineering Activities

Universal Enabling Resources in the LSI Enterprise Framework



Universal LSI Enablers



- "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.

4 Governance in the LSI Enterprise Framework



- **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.

4 Governance Objectives in the LSI Enterprise Framework

"Governance is the structure and relationships among key stakeholders that determine an organization's direction and performance."

Invigorating Defense Governance, A Beyond Goldwater-Nichols Phase 4 Report: Kathleen H. Hicks, March 2008

- 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



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.



NAVAL POSTGRADUATE SCHOOL Systems Engineering (EST. 2002)

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