Managing Complex System Engineering and Acquisition through Lead Systems Integration

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"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."

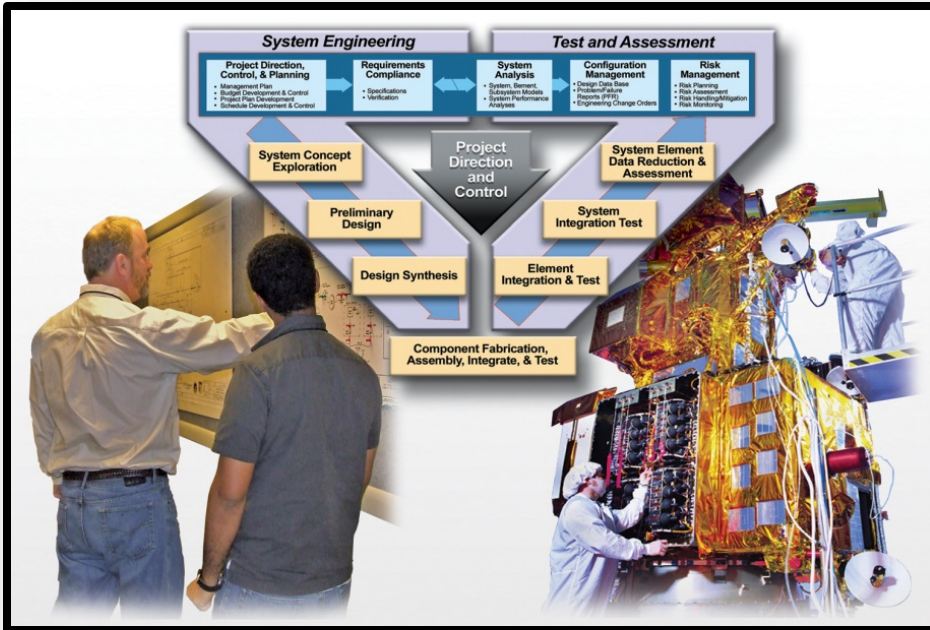- ADM William Gortney, ADM Harry Harris, USNI Proceedings, May 2014

Lead Systems Integration (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.

- 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 (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.
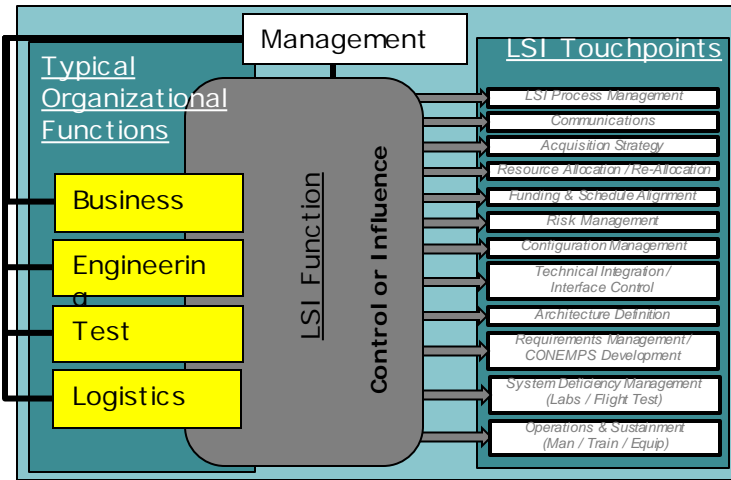
Key objectives: Affordability; Speed to the Warfighter; Agility; Maximize the Value of Complex System.

LSI Framework

Align control influence of key LSI Activities across the Enterprise

Understand organizational dependencies
Internal and External

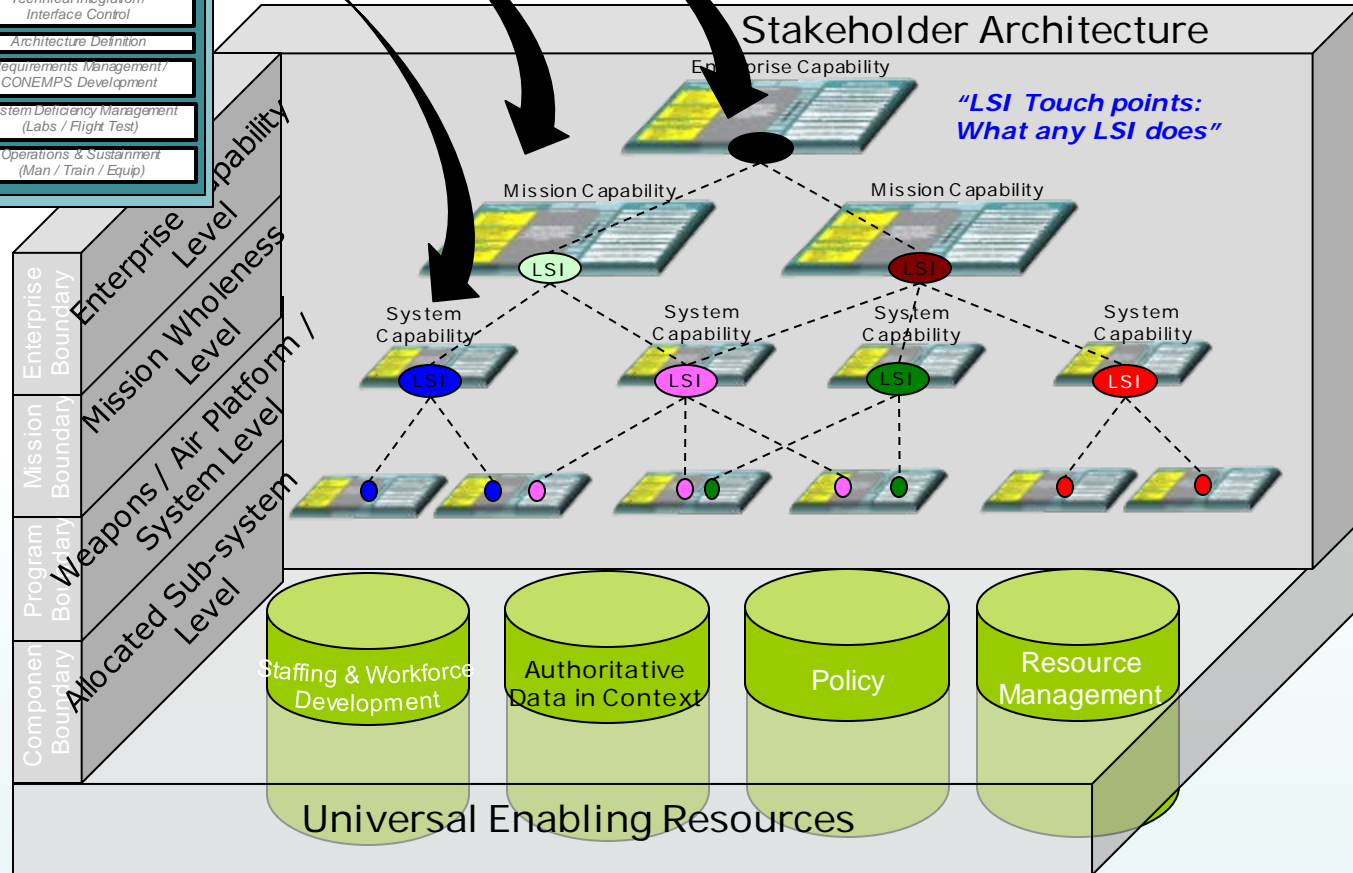*"Who is involved and their equities, interests, relationships, or impacts"*

"LSI Touch points: What any LSI does"

Typical Organizational Functions

- Management
- Business
- Engineering
- Test
- Logistics

LSI Function — Control or Influence

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)

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

Align and leverage resources to enable LSI functions

LSI Governance

"How an LSI makes decisions and enacts those decisions"

Enterprise Capability Level
Mission Wholeness Level
Weapons / Air Platform / System Level
Allocated Sub-system Level

Enterprise Boundary
Mission Boundary
Program Boundary
Component Boundary

Stakeholder Architecture

Enterprise Capability

Mission Capability — Mission Capability

System Capability — System Capability — System Capability — System Capability

Universal Enabling Resources

- Staffing & Workforce Development
- Authoritative Data in Context
- Policy
- Resource Management

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

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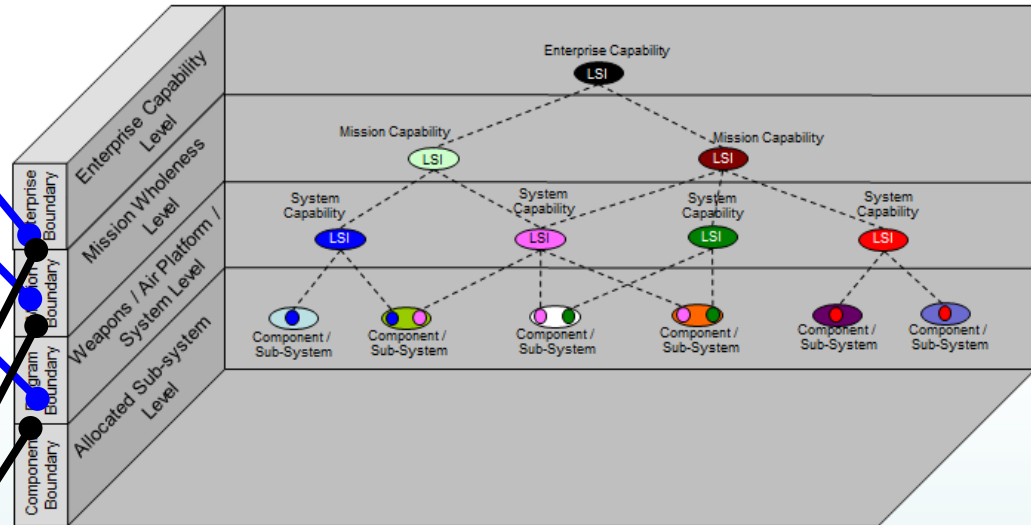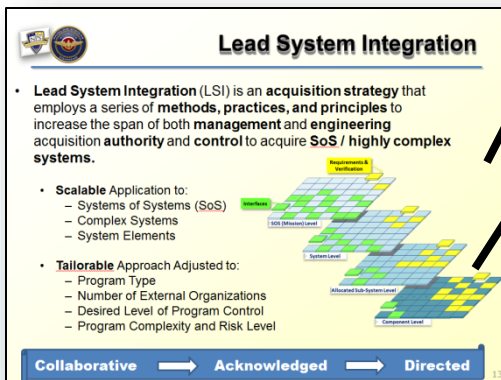**Enterprise LSI Framework "Levels"**
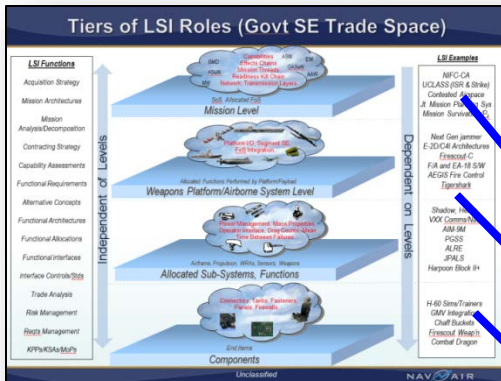
LSI Vision Statement / Purpose: "Why an LSI exists"

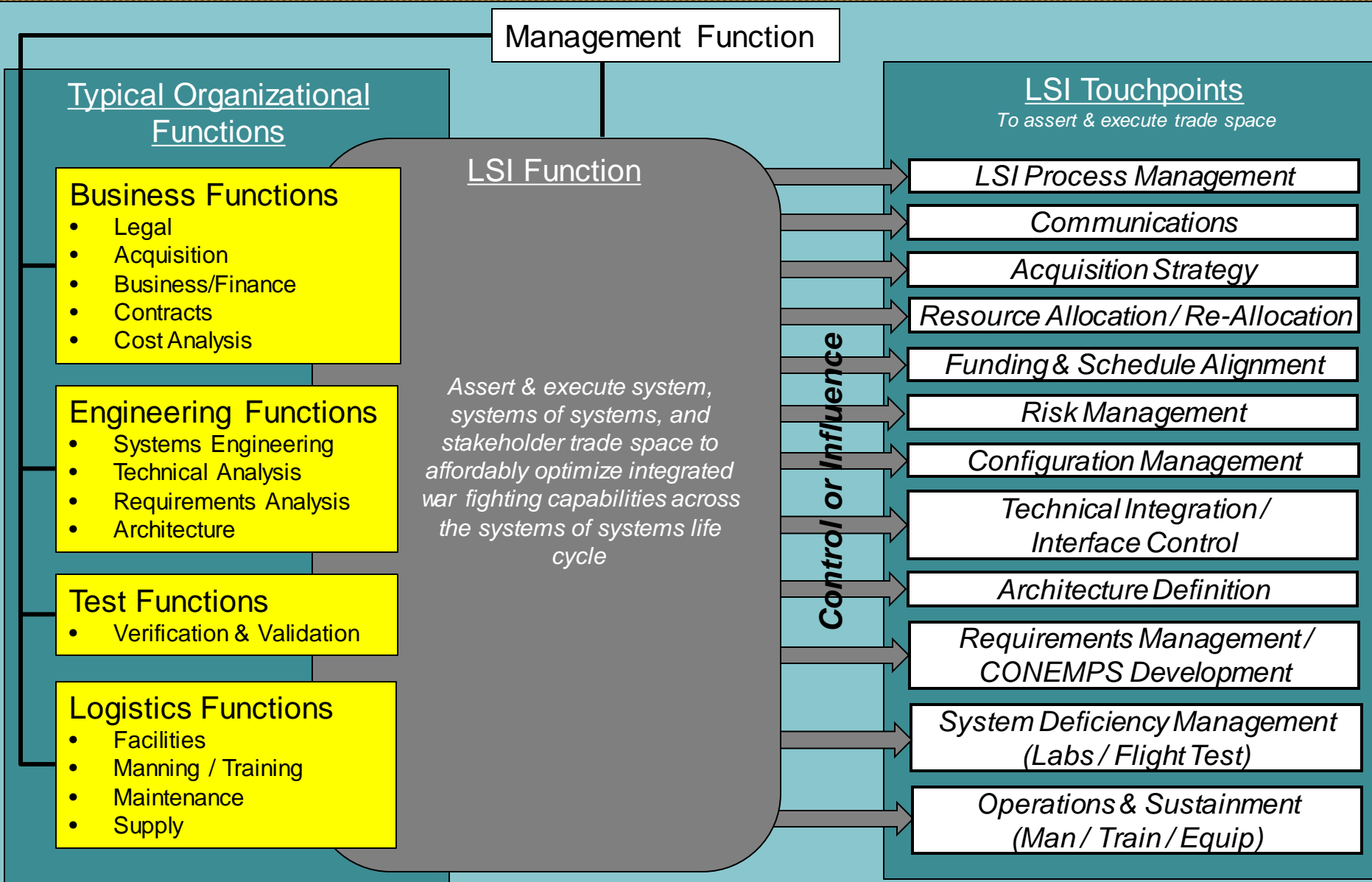"Affordably Optimize Integrated Warfighting Capabilities across the Systems of Systems Life Cycle"

Government LSI may apply at multiple levels across multiple programs and stakeholders with operational / managerial dependence
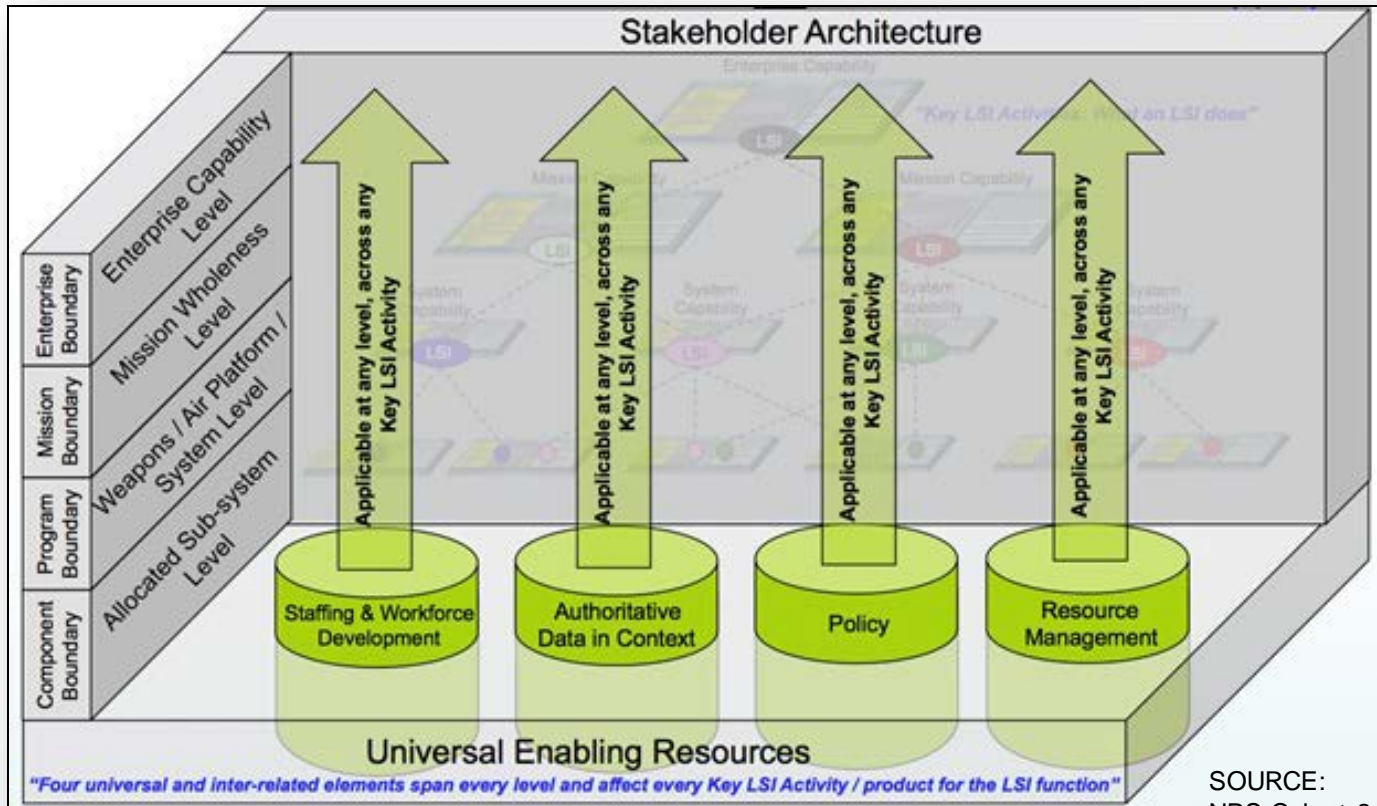
- **Descriptions of layers**
  - **Component Boundary** (Allocated Sub-system level)
  - **Program Boundary** (Weapons / Air Platform / System Level)
  - **Mission Boundary** (Mission Wholeness Level)
  - **Enterprise Boundary** (Enterprise Capability Level)

SOURCE: NPS Cohort 2 Report, 2015

Lead System Integration Touchpoints

Management Function

Typical Organizational Functions

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

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

Control or Influence

LSI Touchpoints
To assert & execute trade space

- *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)*

Universal LSI Enablers

SOURCE: NPS Cohort 2 Report, 2015

- "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 Enterprise LSI Framework

LSI Research Issue

- The U.S. Navy has been exploring, and developing strategies and approaches to address the engineering and acquisition challenges associated with SoS and complex systems. Strategies to date:
  - Lead Systems Integration (LSI)
  - Navy Integration and Interoperability (I&I)
  - Marine Corps I&I
  - Information Technology Technical Authority (IT TA)

While each strategy offers insights and partial solutions to the challenges posed by the SoS, and complex systems, development and acquisition environment, none address the complete problem.

Naval Processes for SoS and Complex Systems

| Process	Primary Use	Notes
Lead Systems Integration (LSI)	NAVAIR	1. NUWC, Newport and MARCORSYSCOM (Orlando) have employees in NPS LSI Cohort #4. 2. SPAWAR, MARCORSYSCOM (Quantico), and Strategic Systems Program (SSP) have expresses interest in LSI process and certificate. 3. NPS LSI certificate program is going to be presented to NAVSEA CHENGs on 16 Nov. 4. SSP has not adopted any of the Navy processes, therefore may be ripe for LSI adoption.
Navy Integration and Interoperability (I&I)	SPAWAR	1. NAVAIR, NAVSEA, SPAWAR, and MARCORSYSCOM are Navy I&I signatories. 2. Each signatory has an I&I lead. However, only SPAWAR appears to employ the process.
Marine Corps Integration and Interoperability	MARCORSYSCOM	1. MARCOSYSCOM has identified that there are significant differences between USMC I&I and Navy I&I. Currently, no I&I process is used. 2. USMC Combat Development & Integration (CD&I) is focusing efforts on implementing the Marine Corps Operating Concept (MOC). 3. USMC does not have a standardized process for developing SoS or complex systems, therefore LSI may be ripe for adoption.
Information Technology Technical Authority (IT TA)	SPAWAR HQ	1. SPAWAR HQ defined IT TA for acquisition and development of SoS during the 2010-2012 timeframe. 2. The current status of IT TA is unknown.

- The purpose of this research is to further explore the strengths of each development and acquisition concepts and provide a framework that will better define LSI across the SoS and complex system lifecycle.

- Research questions:
    - What is the correlation between Navy I&I, USMC I&I, IT TA, and LSI?
    - How can correlating the various development and acquisition processes for SoS, and complex systems, facilitate acquisition strategies that improve the belonging, connectivity, and integration of SoS and complex systems to better satisfy mission objectives?
    - How does the correlated LSI model apply across non-Navy development and acquisition, and within the Department of Defense?

To be successful in improving Naval SoS, and complex system development, each organization must be able to relate their processes to these concepts.
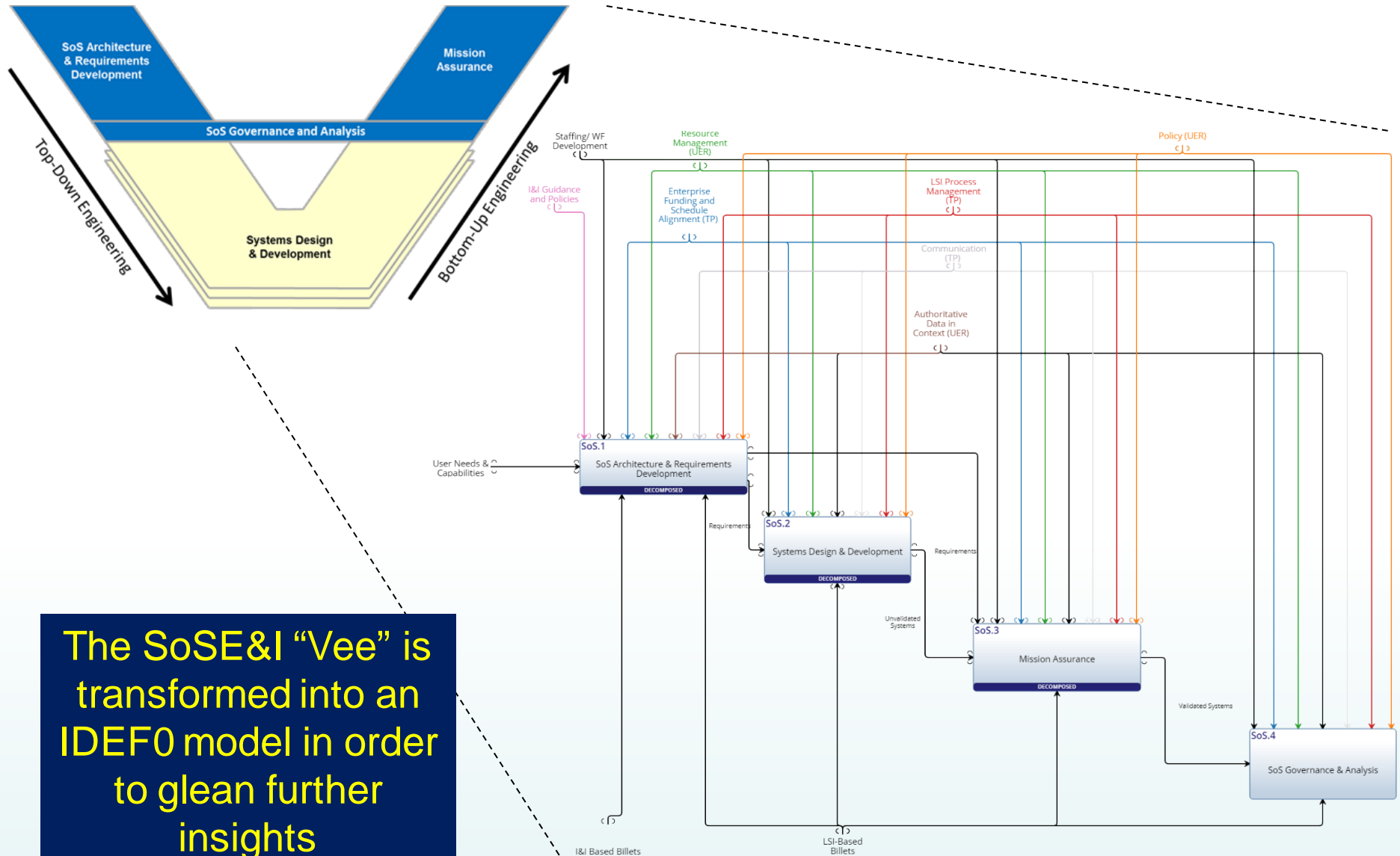
The SoSE&I "Vee": A Common Foundation
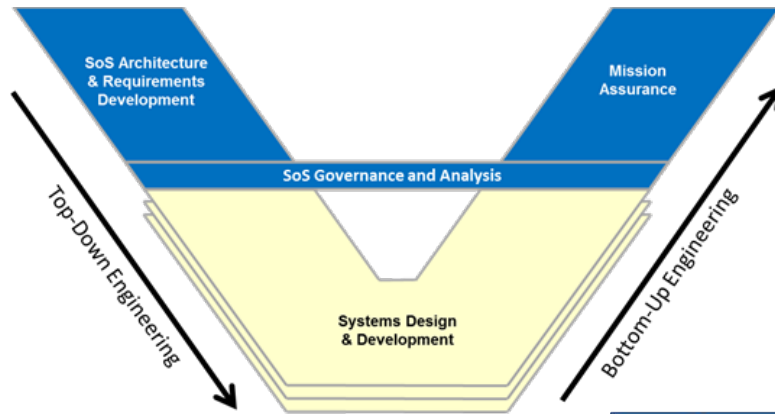
System of Systems Engineering and Integration (SoSE&I) is the planning, analyzing, organizing, and integrating the capabilities of a mix of existing and new constituent systems into an SoS capability greater than the sum of the capabilities of the constituent systems.
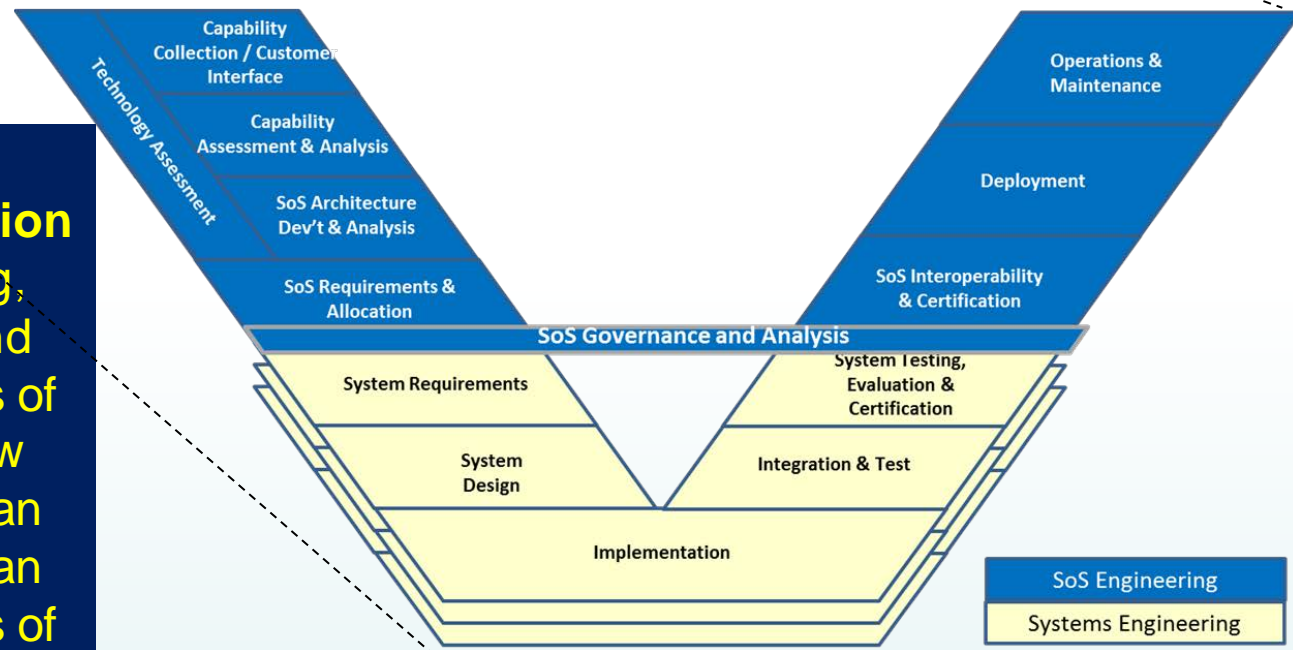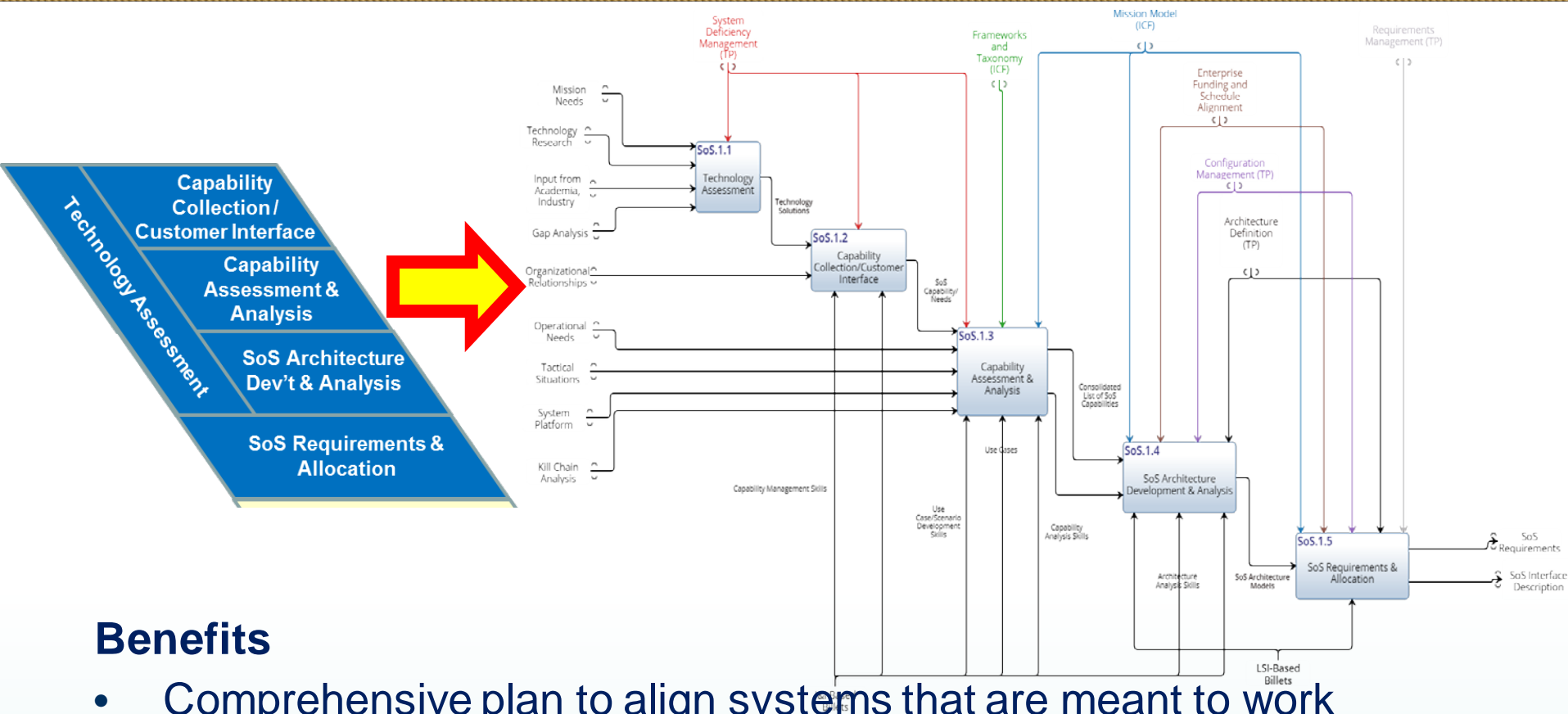
The SoSE&I "Vee" Viewed as an IDEF0 Model

The SoSE&I "Vee" is transformed into an IDEF0 model in order to glean further insights
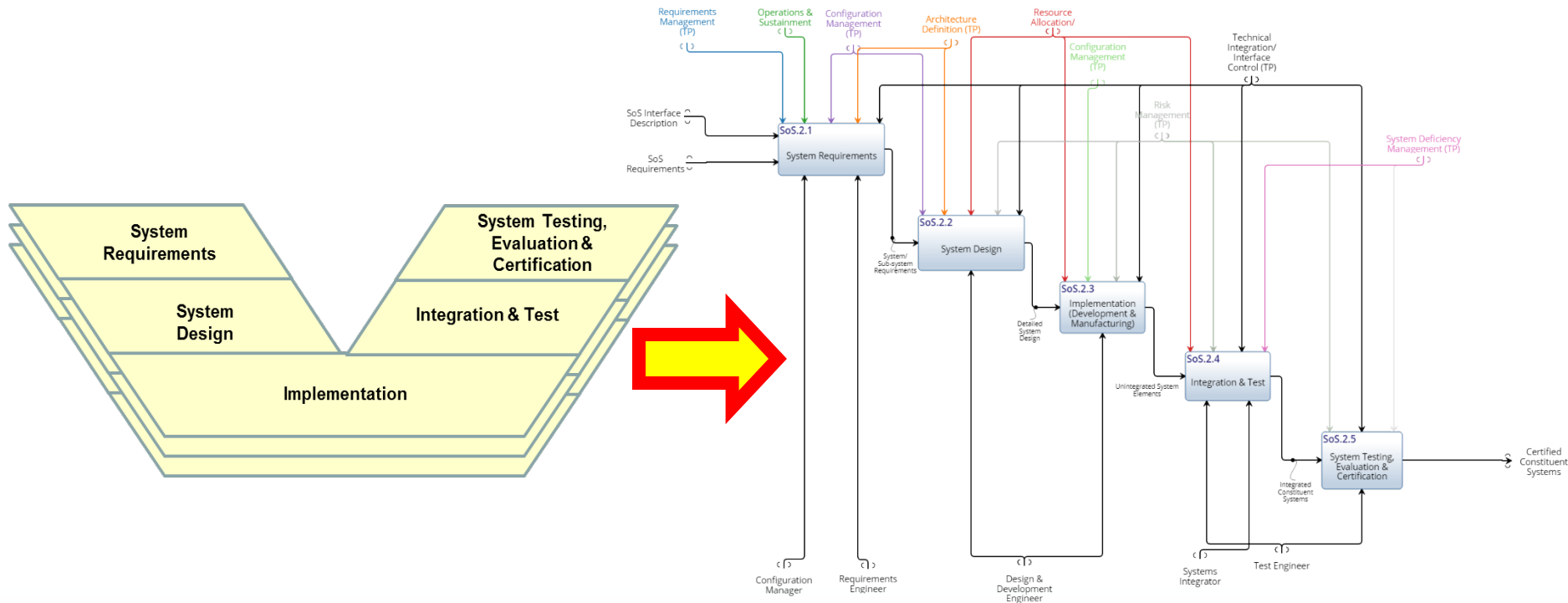
Benefits

- Comprehensive plan to align systems that are meant to work together for mission success

- Provides a foundation from which Resource Sponsors can prioritize user needs and budget issues

- Establishes Overarching Requirements Baseline to improve Integration & Interoperability across the SoS
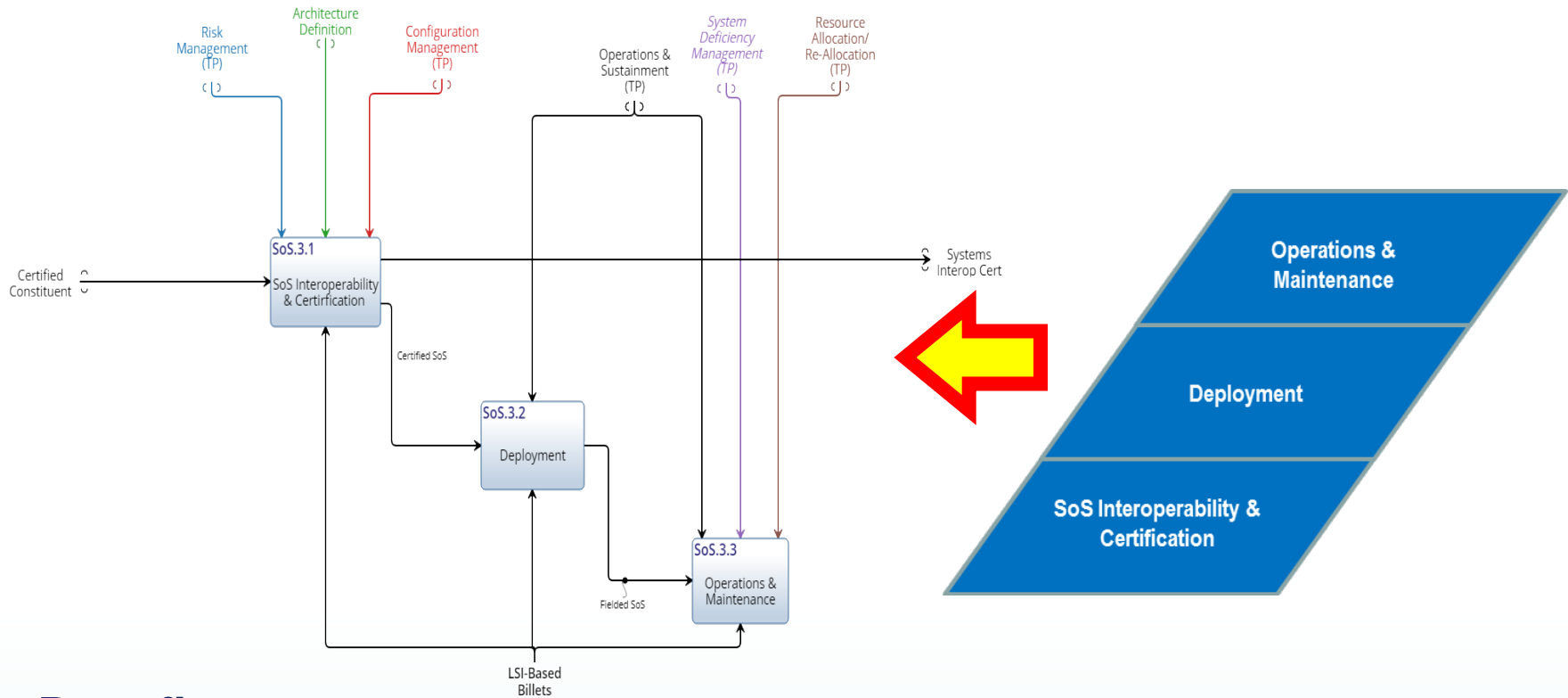
Benefits

- Provides a focus SoS mission success vice system optimization
- Establishes a framework for better coordination among individuals systems and programs

Benefits

- Understanding of SoS performance in context of mission success to shape acquisition planning.

- Develops a comprehensive operations and maintenance to better align constituent system operations within the SoS.

Questions

Supplemental Slides
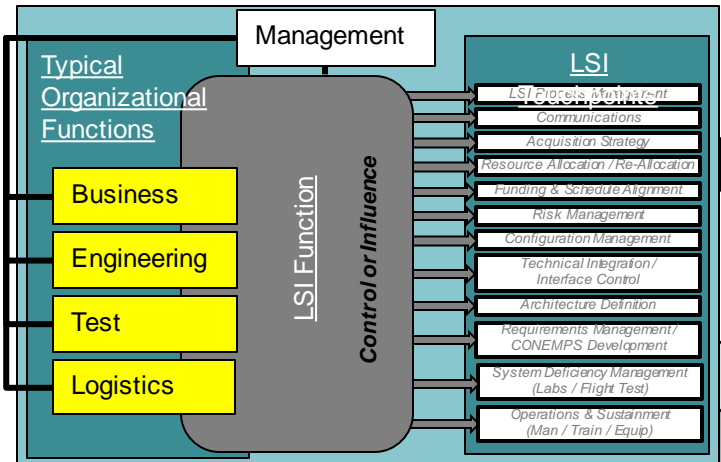
- *What is the correlation between Navy I&I, USMC I&I, IT TA, and LSI?*

- **Develop a model that correlates the concepts of SOSE&I, I&I, and LSI. The model will include inputs and outputs of each phase within the SoS lifecycle. The model will be generated by a review of existing documentation and collaboration with the SYSCOMS. This model will serve as the baseline for further research tasks, and can be tailored to individual organizations.**

- *How can correlating the various development and acquisition processes for SoS, and complex systems, facilitate acquisition strategies that improve the belonging, connectivity, and integration of SoS and complex systems to better satisfy mission objectives?*

- **Using case studies, derived from SYSCOM interactions, examine how the model will improve the engineering and acquisition of SoS and complex systems. Revise the model as necessary. This analysis will allow the research team to test the generic model against specific cases.**
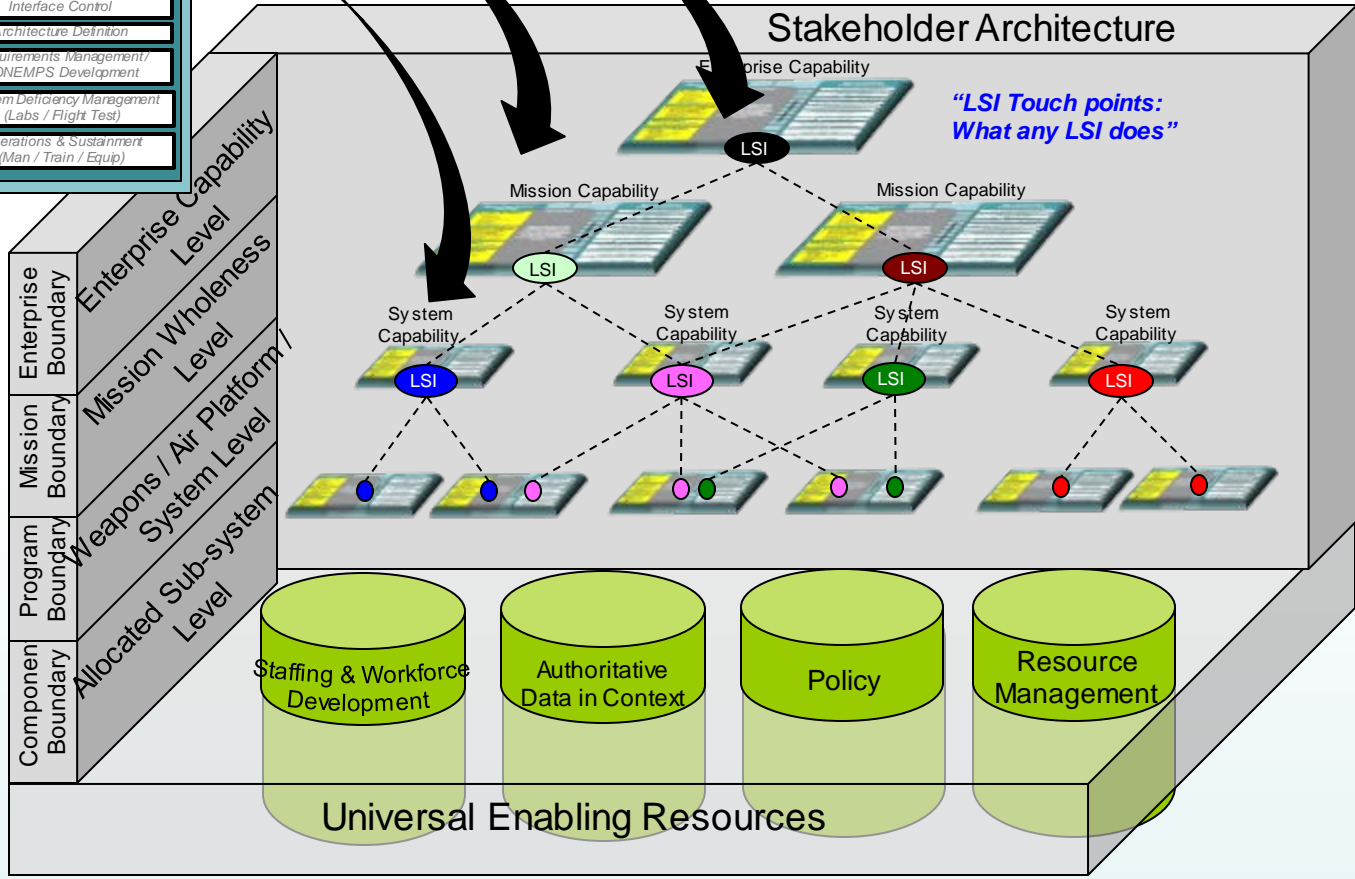
- *How does the correlated LSI model apply across non-Navy development and acquisition, and within the Department of Defense?*

- **Apply the LSI model, and lessons learned, to at least one non-Navy organization within the Department of Defense. Revise and tailor the model as necessary. This analysis will allow the research team to demonstrate that the model is extensible within DoD.**

LSI Mission: Affordably Optimize Integrated Warfighting Capabilities across the Systems of Systems Life Cycle

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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"

Stakeholder Architecture

Enterprise Capability

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Mission Capability   Mission Capability

System Capability

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Universal Enabling Resources

3 **Align and leverage resources** to enable LSI functions

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