



Addressing Mission Engineering from a Lead Systems Integration Perspective

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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 (mission) 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

Mission Level System of Systems

- **Mission Level Systems of Systems** – A collection of interoperable platforms and nodes acting as a single system to perform a mission or achieve a mission capability.



Accomplishing a mission has always been a SoS endeavor, but “knitting” the multiple systems together has frequently been left to small communities of systems or to the operators themselves.

Mission Engineering

- “Mission engineering is the deliberate planning, analyzing, organizing, and integrating of current operational and system capabilities to achieve desired mission effects”

Gould, 2016



Mission engineering is based on military planning process; Lead Systems Integration (LSI) is based on systems engineering and acquisition process designed to manage the complexities of a System of Systems.

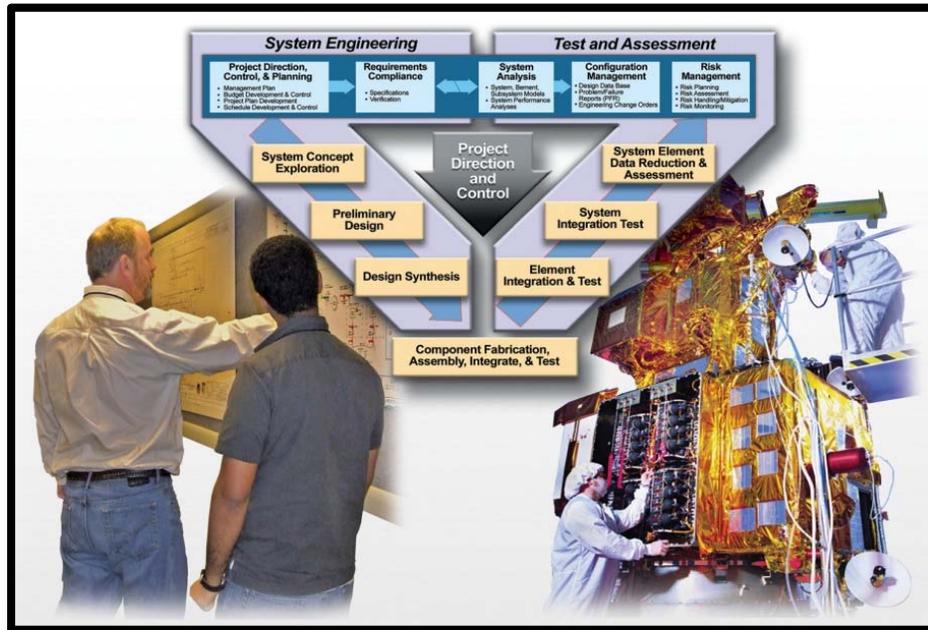
Lead Systems Integration (LSI)

- **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 System of Systems 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)

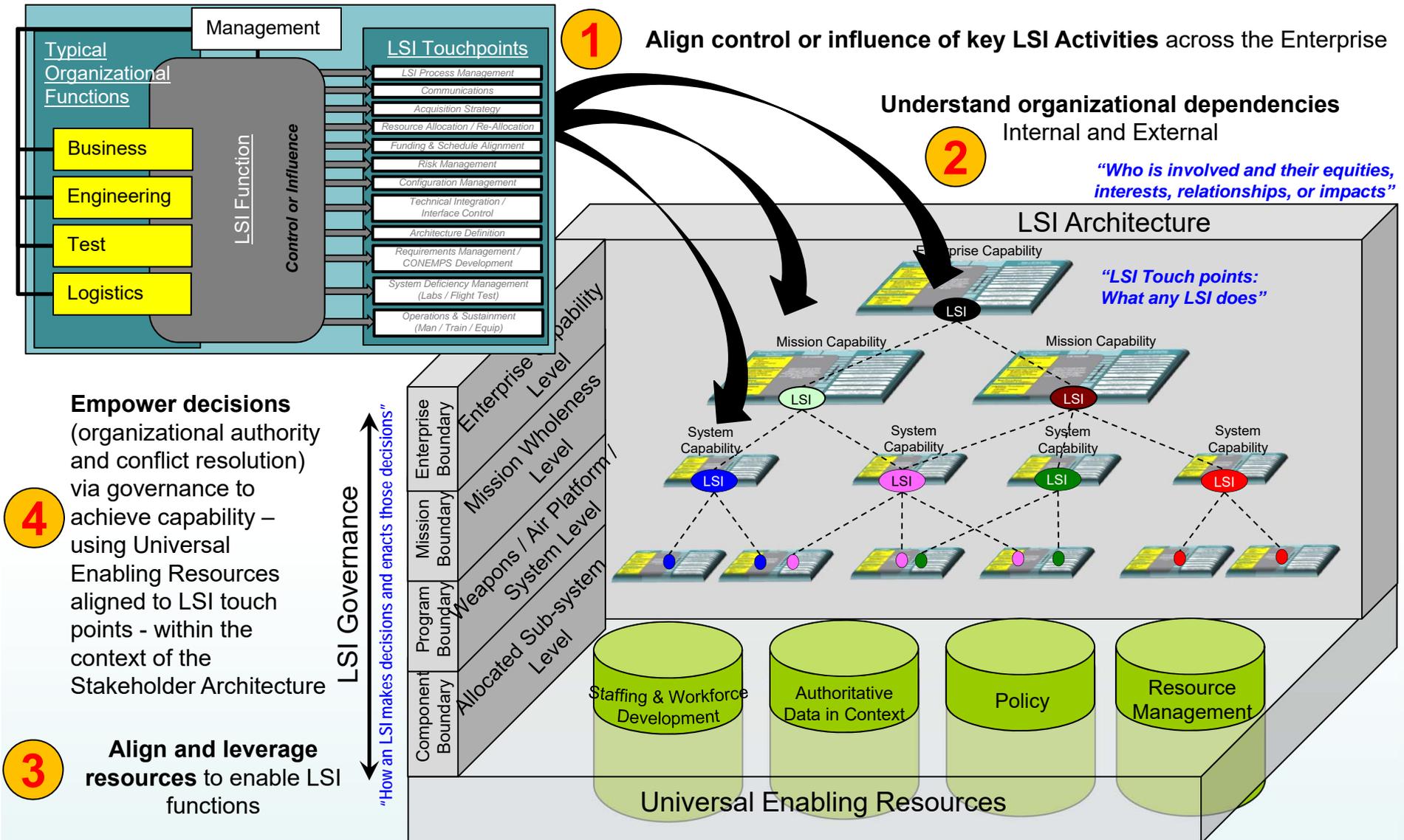
- **LSI Function** - Assert and execute system, SoS, and stakeholder trade space to affordably optimize Integrated Warfighting Capabilities across the SoS lifecycle.
 - The roles of the LSI are similar to the roles of any Systems Engineer (SE) or System Integrator (SI). The primary difference is the span of design and integration authority that persists throughout system or SoS acquisition and lifecycle.



Graphic Source: www.meicompany.com

Key objectives: Affordability; Speed to the Warfighter; Agility; Maximize the Value of Complex Systems.

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 Touch points: What any LSI does"

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

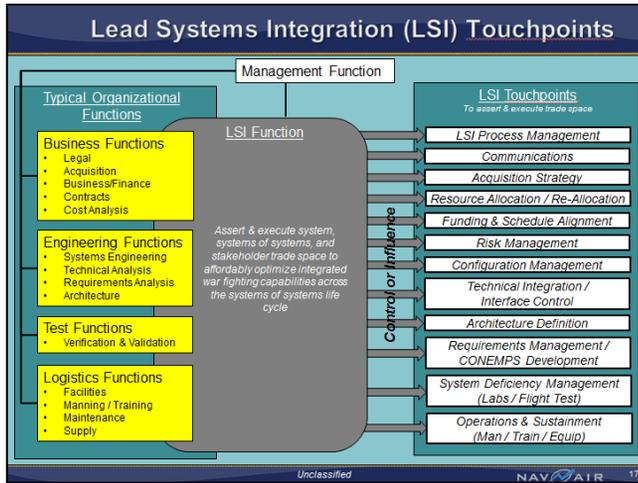
3 Align and leverage resources to enable LSI functions

LSI Governance
 "How an LSI makes decisions and enacts those decisions"

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

1

Lead Systems Integration (LSI) Touchpoints



LSI Touchpoint Attributes and Principles

LSI Touchpoints (1)

- LSI Process Management
 - Accountable for mission wholeness, the LSI should define how

LSI Touchpoints (2)

- "Super-" Acquisition Strategy
 - LSI should define & implement

LSI Touchpoints (3)

- Enterprise Funding & Schedule Alignment
 - LSI should consider dynamic funding changes across multiple programs it may not control
 - LSI must align multiple asynchronous schedules it may not control
 - LSI may create and use a resource loaded Integrated Master Schedule
- Codependent Systems of Systems Risk Management
 - LSI visibility to risks, issues, and opportunities across sub-programs / sub-systems making up the capability enables SoS trade space management
 - LSI should have a way to combine & normalize risks across different program risk rating systems to inform trade space management

LSI Touchpoints (4)

- Asynchronous Configuration Management
 - LSI must establish/maintain overall SoS CM for system

LSI Touchpoints (5)

- Enterprise Architecture Definition
 - LSI should "own" overall architecture
 - Architecture defines LSI interfaces for

LSI Touchpoints (6)

- Systems of Systems Deficiency Management (Labs / Flight Test)
 - Laboratory, flight test, & V&V activities are key challenge in complex SoS environments
 - LSI must determine impact of deficiencies at the SoS level from constituent systems and stakeholders deficiency management systems
 - Adoption of existing laboratory / simulation / Live, Virtual, Constructive (LVC) environments system deficiency management methodologies & tools is an LSI enabler
- Operations and Sustainment (Man / Train / Equip)
 - Support system architecture equally as critical as engineering-based functional, operational, or mission architectures
 - Assess existing stakeholder / constituent system DOTMLPF synergies to minimize logistics footprint
 - Resource and monitor sustainment cost evaluations continually during systems of systems development and throughout lifecycle

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LSI Touchpoint Methods & Practices: "Roles & Responsibilities"

LSI Roles and Responsibilities (2)

Function	LSI Unique role (*)	LSI Touchpoints	Products	Tools
Legal	Similar role as traditional acquisition but with agreements (data rights/licensing) by competing SoS			
Acquisition (PM)	EXPANDED role to embrace a gov. LSI Strategy with a clear identified LSI goal and empower team to be actively managing OSIP trade space SoS at varying ac. cycles			
BFM	Similar role as traditional acquisition but for SoS budgets/financial systems at various phases with different color/year/amount			
Contracts	Similar role as traditional acquisition but for multiple SoS contracts requiring enhanced visibility and control of subcontractor selection/performance.			
Cost	Similar role as traditional acquisition but for complex and multiple SoS with acquisition phases with different color/year/amount of money			
Engineering	EXPANDED role from typical Systems Engineer to include increased and early participation/ownership in SoS: DevOps Mgmt, Risk Decomposition, Architect Integration, Baselines (C, F, A, P) control, CONEMPS Risk and Trade Space			

LSI Roles and Responsibilities (3)

Function	LSI Unique role (*)	LSI Touchpoints	Products	Tools
Test	EXPANDED role from typical T&E Engineer to include multiple SoS Test Planning, Test Conduct Mgmt, or Multiple SoS Test events using extensive LVC and modeling to capture holistic SoS test results.	LSI Process Mgmt, Acq. Strategy, Comm. Resource Allocation, Funding/Schedule, Risk, System Deficiency Management (Labs / Flight Test)	TEMP Test Plan, Test Reports, Live Fire Waiver/report, Interoperability Certification, ISD	MS office, MS Project, DOORS, Risk Exchange, Test TMRT, Report, eShare
Logistics	Similar role as traditional acquisition but for complex SoS which includes multiple systems with various supply, support and training requirements.	LSI Process Mgmt, Acq. Strategy, Comm. Resource Allocation, Funding/Schedule, Risk, CM, Ops & Sustainment	Supportability/Analysis Plan, Life Cycle Support Plan	MS office, MS Project, Integrated Data Environment (full access to vendor data) DECKPLATE, Project

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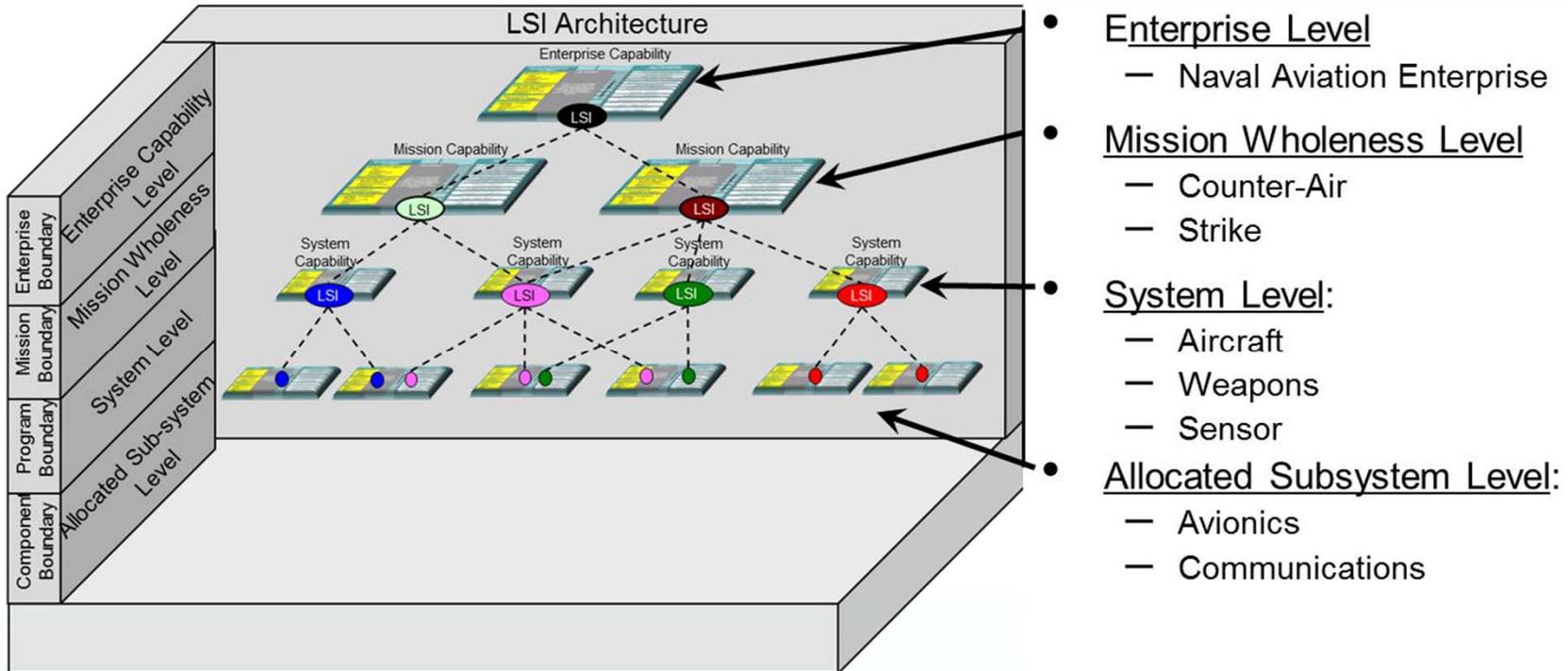
Multidisciplinary – apply at any “level” of LSI

Identifies highest payoff points of LSI control or influence to assert and execute trade space – aligned across the enterprise

Enables organizational agility

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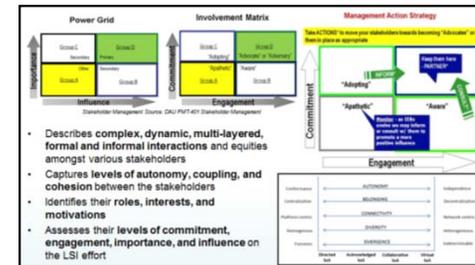
The Multiple Levels of the LSI Architecture



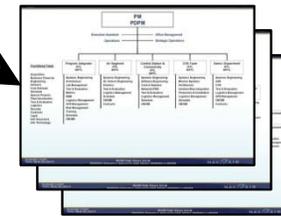
Mission engineering requires analysis at several levels of the LSI Architecture simultaneously.

LSI Architecture Core Elements

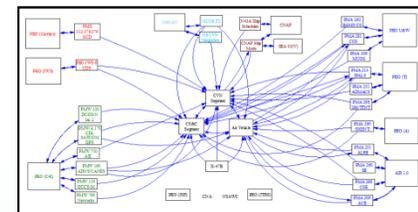
- Stakeholder Definition / Characterization
 - Define and characterize all stakeholders via PMT-401 stakeholder analysis matrix and SoS coupling/cohesion analysis
- Stakeholder “Physical Architecture” model
 - Aggregation of static organizational charts which define levels of formalized / administrative stakeholder interactions & empowerment
- Stakeholder “Functional Architecture” model
 - Dynamic Systems model that aggregates actual stakeholder interactions and data flows
- Stakeholder “Process Model”
 - Enables governance framework, processes, and adjudication methods
 - Includes layered enterprise coordination/communication strategy, “battle rhythm,” and LSI “control” or “influence” touchpoints
- Stakeholder Charter
 - Defines roles/responsibilities to enable enterprise governance decisions within the Enterprise LSI Framework



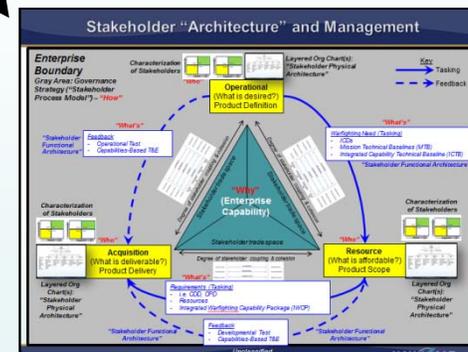
Stakeholder Identification / Characterization
 Source: DAU PMT-401 Stakeholder Management, SoS coupling/cohesion



Stakeholder “Physical Architecture” model
 Existing formal organizational charts...



Stakeholder “Functional Architecture” model
 e.g. Dynamic systems modeling

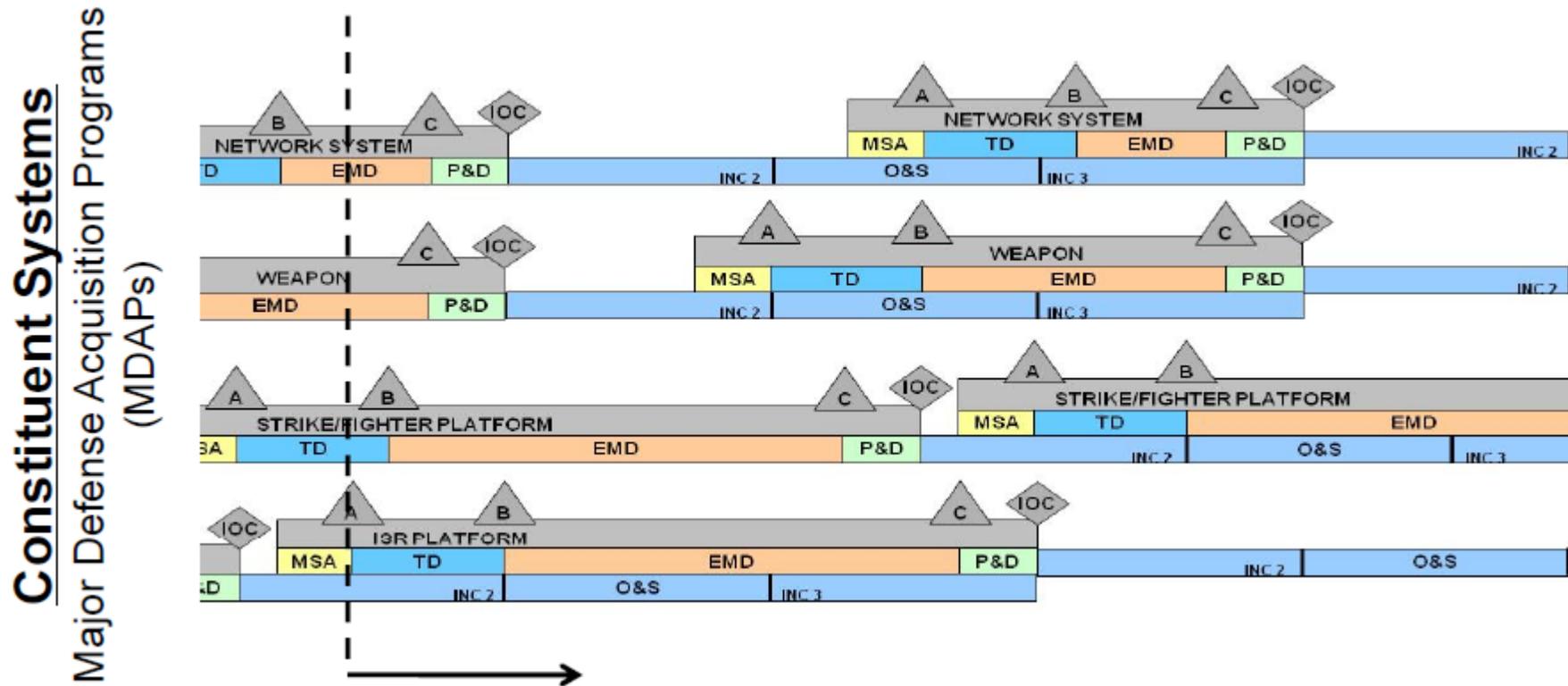


Stakeholder “Process Model”
 Combination of steps 1 through 3, applied at any level of the LSI effort across a “Stakeholder trade space”

The Architecture informs LSI processes, communication methods, and governance strategies in order to best influence trade space

SOURCE: NPS Cohort 2 Report, 2015

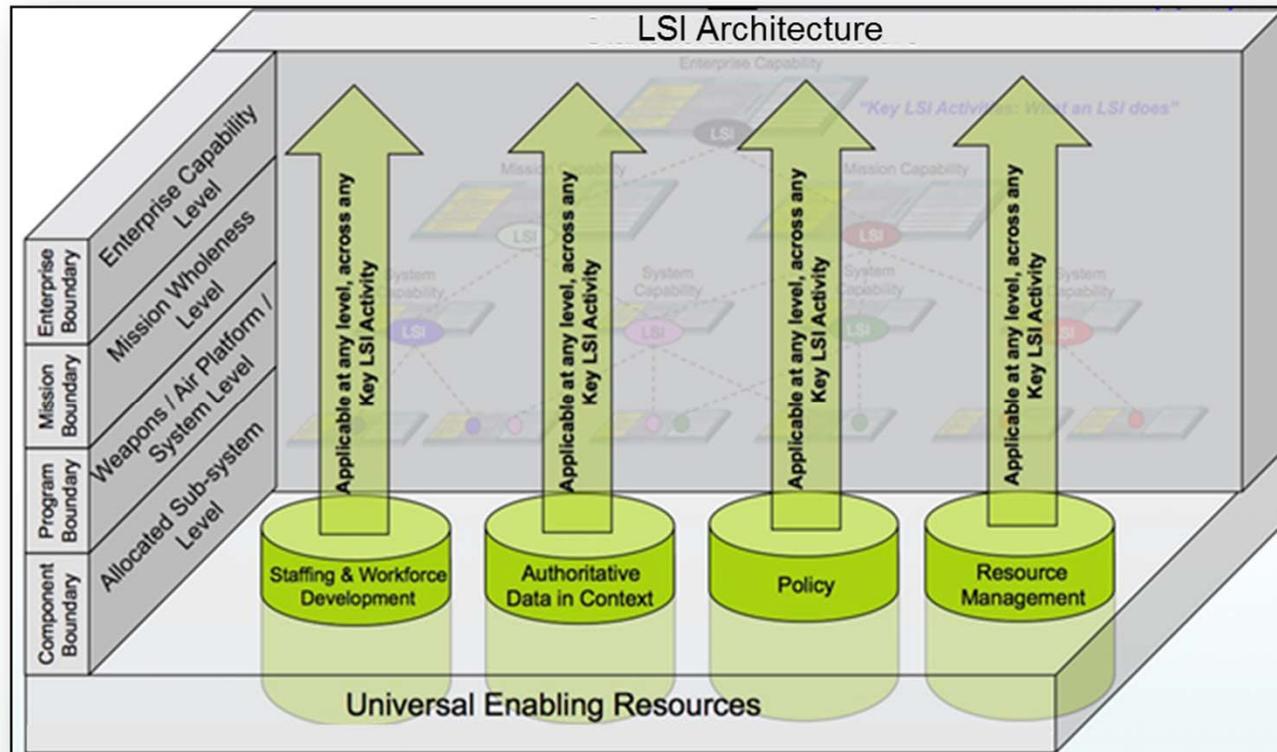
LSI Architecture Challenge



- Constituent systems are developed asynchronously
- LSI architecture must guide and inform simultaneous and distributed concept development, technology development, and system engineering and manufacturing.

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

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 Enterprise LSI Framework

SOURCE: NPS Cohort 2 Report, 2015

Governance Objectives in the Enterprise LSI Framework

“Governance is the structure and relationships among key stakeholders that determine an organization’s direction and performance.”

Invigoring 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 Governance Challenges (1)

LSI will struggle or fail to achieve its goals unless new sets of rules are established at all levels of the organization. The governance structure existing today procures platforms. It will not be effective for the purpose of efficiently developing and acquiring capabilities.

“Acquisition practices have allowed capabilities to be developed in isolation and based on a system architecture built simply for compliance, and have resulted in systems that fall short of the expected military utility. Emerging DoD and Navy policies require acquisition practices that ensure systems will integrate into an enterprise architecture.”

Navy Integration and Interoperability (NII) Integrated Capability Framework (ICF), Operational Concept Document, March 2012

“Many proposed changes have faltered because they failed to account for and find ways to alter the likely behavior of individuals and organizations. As Goldwater-Nichols taught, the ability to affect incentive structures is the most indispensable ingredient of any successful reform. Attempts to simply rework organizational wiring diagrams or create new and seemingly more nimble processes will fail unless they are buttressed by changes in the underlying incentives that motivate individual and organizational actions.”

“Governance in DOD strongly favors the provider, who is typically better staffed, resourced, and represented than customers in key forums and processes.”

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

LSI Governance Challenges (2)

The attributes of a systems of systems enterprise makes governing difficult. From the enterprise down to the programs, the LSI must manage the scale and complexity of SoS, the Title 10 supply and demand division between providers and customers*, and the dynamics of a diverse stakeholder community.

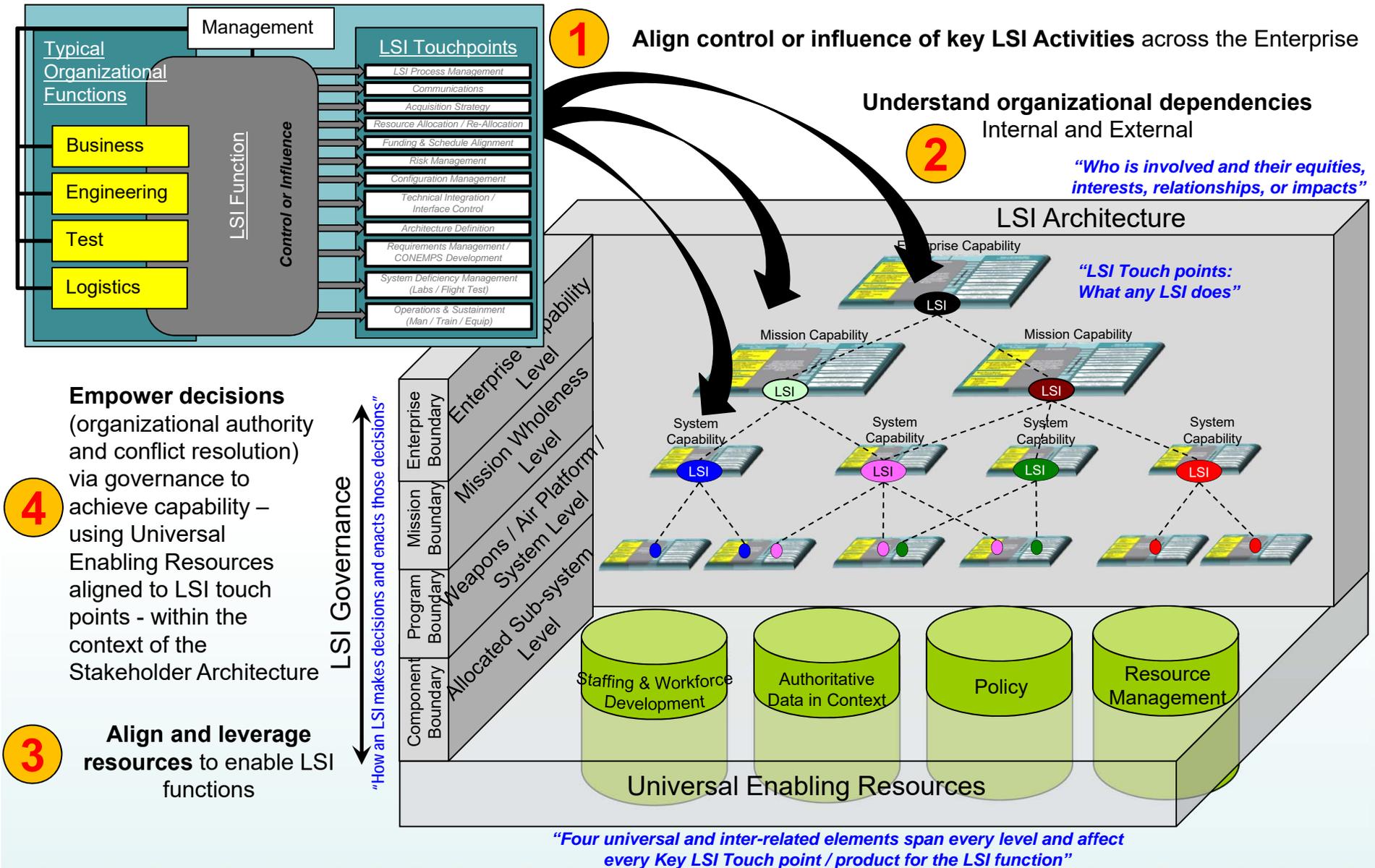
* Invigoring Defense Governance, A Beyond Goldwater-Nichols Phase 4 Report: Kathleen H. Hicks, March 2008

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Governance Considerations: “The Framework in Motion”
How any LSI makes decisions and enacts those decisions

SOURCE: NPS Cohort 2 Report, 2015

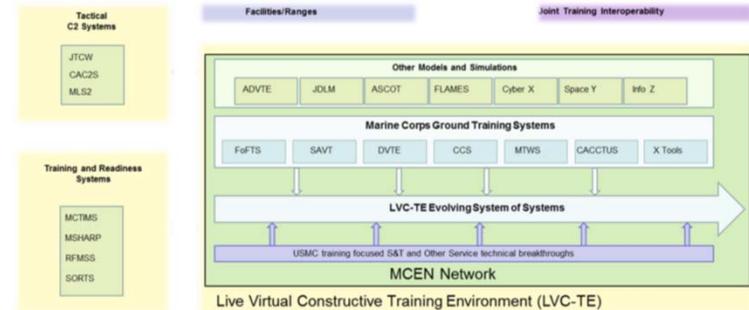
The LSI Enterprise Framework in Review



Summary

The LSI Enterprise Framework: A potential Government LSI enabler to “think and act differently”

- **Align control or influence of key LSI activities** across vertical and horizontal organizational boundaries via common, “high payoff” LSI touchpoints
- **Understand organizational interdependencies** via Stakeholder “Architecture” / Management
- **Align and leverage organizational resources** to enable inherently governmental LSI functions
- **Empower decisions** via governance (authority and conflict resolution)





NAVAL POSTGRADUATE SCHOOL

SYSTEMS ENGINEERING

EST. 2002

