# Defining a System of Systems Engineering and Integration Approach to Address the Navy's Information Technology Technical Authority

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# Navy Drivers for Change

- Modern warfare has become critically dependent upon accurate and timely information for situational awareness and operational effectiveness.
- Naval operations today require integration and interoperability among interdependent platforms and supporting assets, increasing reliance on information, network, and communication systems for enhanced coordination and execution.
- The Navy Acquisition Model acquires systems through multiple program executive offices that must then be integrated into a common platform to support operations.


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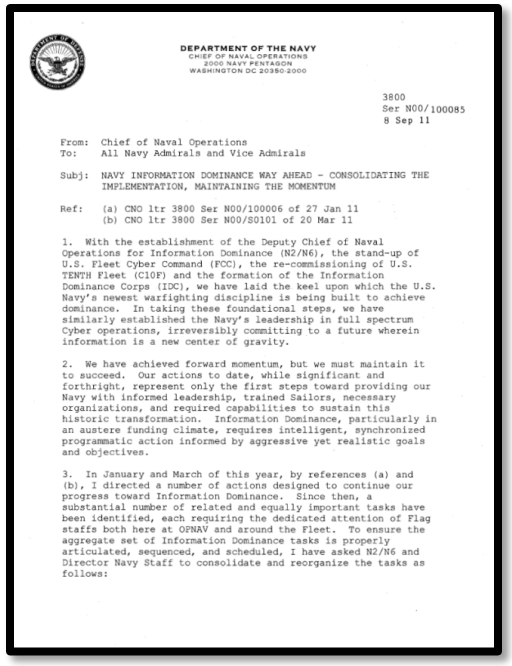
# Navy Solution: System of Systems Engineering and Integration

- ***System of Systems Engineering and Integration (SoSE&I)*** approach to coordinate Navy IT development across all Naval System Commands and all Navy platforms
- SPAWAR SYSCOM has the responsibility for the Navy IT SoSE&I approach
- Establishing the organization and developing the processes & tools to begin executing the approach starting Oct 1, 2013 is underway



DEPARTMENT OF THE NAVY
CHIEF OF NAVAL OPERATIONS
2000 NAVY PENTAGON
WASHINGTON DC 20350-2000

3800
Ser N00/100085
8 Sep 11

From: Chief of Naval Operations
To: All Navy Admirals and Vice Admirals

Subj: NAVY INFORMATION DOMINANCE WAY AHEAD - CONSOLIDATING THE IMPLEMENTATION, MAINTAINING THE MOMENTUM

Ref: (a) CNO ltr 3800 Ser N00/100006 of 27 Jan 11
(b) CNO ltr 3800 Ser N00/S0101 of 20 Mar 11

1. With the establishment of the Deputy Chief of Naval Operations for Information Dominance (N2/N6), the stand-up of U.S. Fleet Cyber Command (FCC), the re-commissioning of U.S. TENTH Fleet (C10F) and the formation of the Information Dominance Corps (IDC), we have laid the keel upon which the U.S. Navy's newest warfighting discipline is being built to achieve dominance. In taking these foundational steps, we have similarly established the Navy's leadership in full spectrum Cyber operations, irreversibly committing to a future wherein information is a new center of gravity.

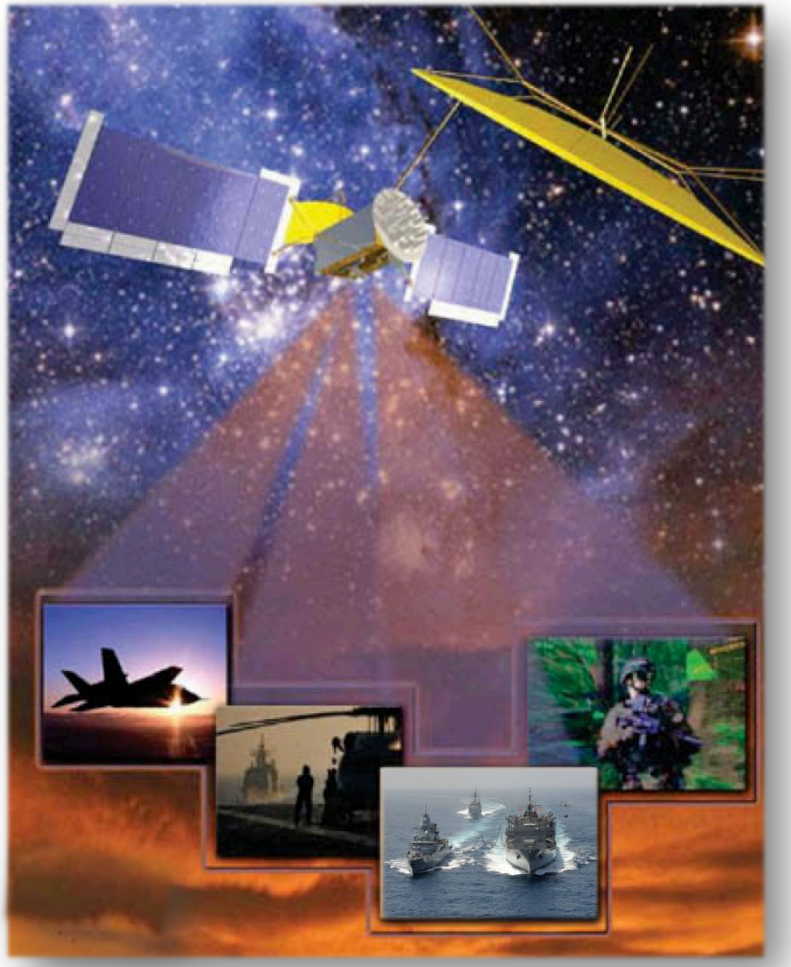
2. We have achieved forward momentum, but we must maintain it to succeed. Our actions to date, while significant and forthright, represent only the first steps toward providing our Navy with informed leadership, trained Sailors, necessary organizations, and required capabilities to sustain this historic transformation. Information Dominance, particularly in an austere funding climate, requires intelligent, synchronized programmatic action informed by aggressive yet realistic goals and objectives.

3. In January and March of this year, by references (a) and (b), I directed a number of actions designed to continue our progress toward Information Dominance. Since then, a substantial number of related and equally important tasks have been identified, each requiring the dedicated attention of Flag staffs both here at OPNAV and around the Fleet. To ensure the aggregate set of Information Dominance tasks is properly articulated, sequenced, and scheduled, I have asked N2/N6 and Director Navy Staff to consolidate and reorganize the tasks as follows:

***Expanding role and responsibility to enhance integration and interoperability of information, network, and communications systems***

# SoS Definition

- **System of Systems (SoS)-** a set or arrangement of system that results when independent, and task-oriented systems are integrated into a larger systems construct, that delivers unique capabilities and functions in support of missions that cannot be achieved by individual systems alone.



# Types of SoS

Virtual

Collaborative

Acknowledged

Directed

No Centralized Management Authority

Centralized Management Authority

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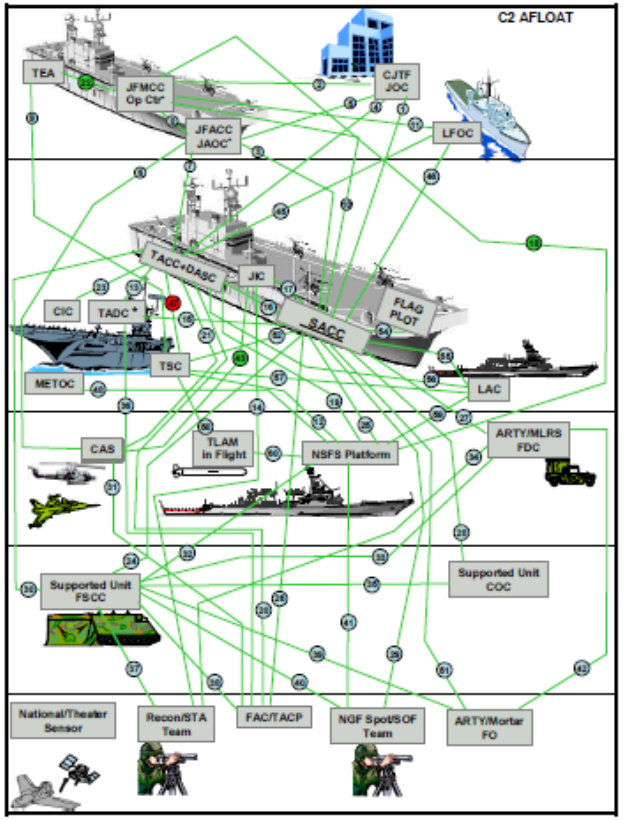
# Key Elements of SPAWAR SoSE&I

- Definition and control of a ***Managed SoS baseline*** that directly tracks to delivered capabilities
- Formal method of ***Governance*** and change control that puts discipline & rigor into investment decisions at the enterprise-level
- An established ***SoS Test, Evaluation and Certification methodology*** to evaluate delivered capabilities in context of mission performance




***SoSE&I approach puts systems engineering rigor & discipline into every Navy IT Acquisition & Sustainment decision***

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# Why a SoSE&I approach?


- Provides a single framework for driving integration, interoperability & standards into and across the Navy IT enterprise
- Provides enterprise-level control of the Navy's IT Architecture & Requirements Baseline
- Risk & Opportunity management for technical, cost & schedule elements for every program in the Navy IT Portfolio

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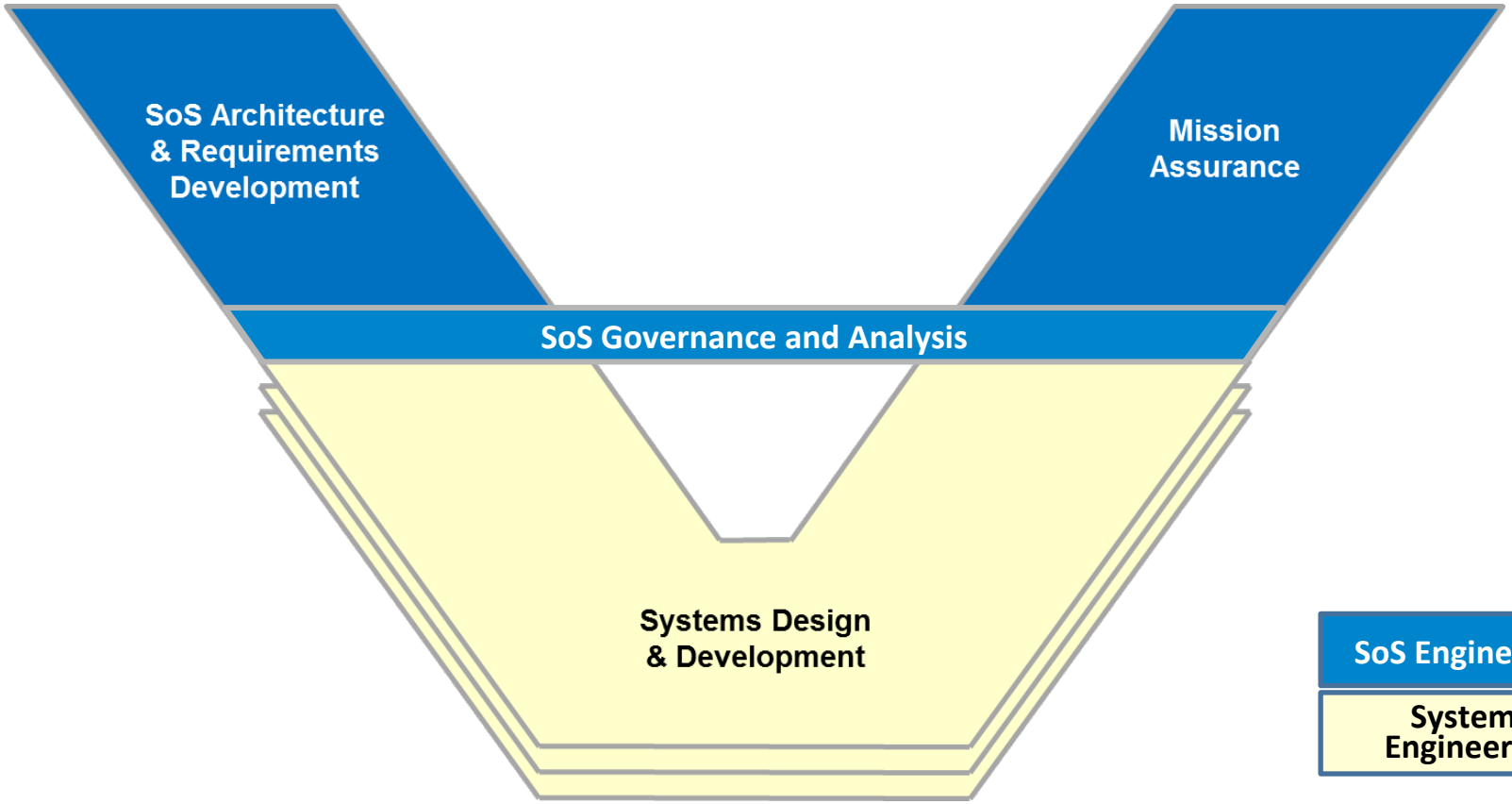
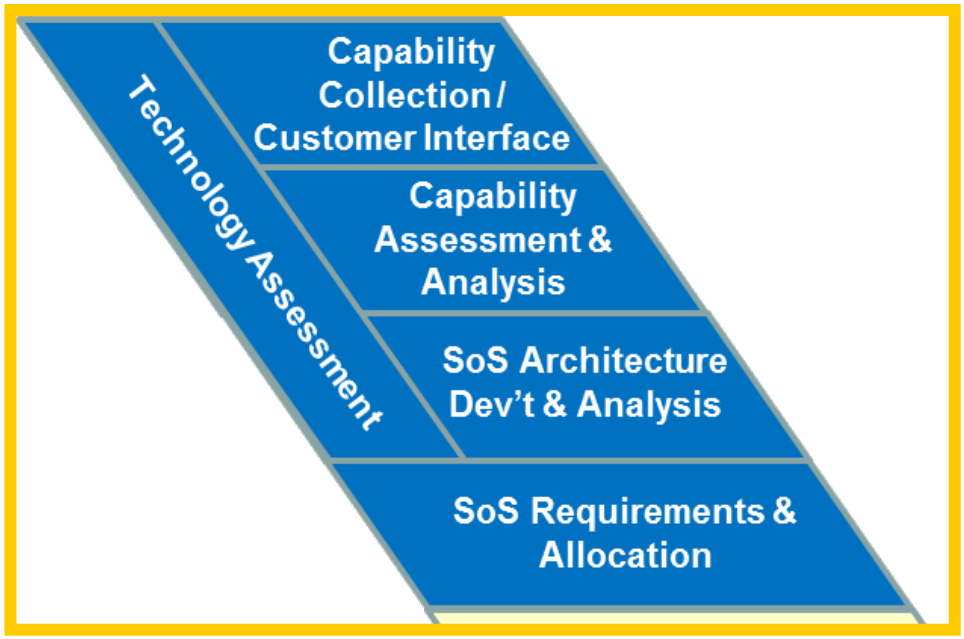
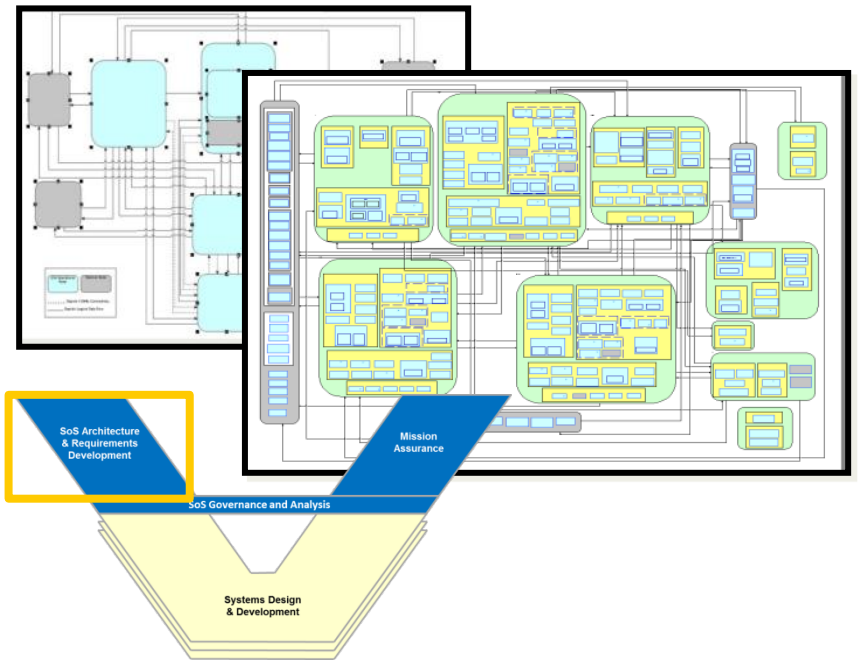
# SoSE&I "Vee"


SoS Architecture & Requirements Development
Mission Assurance
SoS Governance and Analysis
Systems Design & Development
SoS Engineering
Systems Engineering

# SoS Architecture & Requirements Development




## Benefits

- Comprehensive plan to align systems that are meant to work together for mission success
- Provides a foundation from which Navy Resource Sponsors can prioritize user needs and budget issues
- Establishes Overarching Requirements Baseline to improve Integration & Interoperability across the IT Acquisition Portfolio

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# SoS Architecture & Requirements Development

| | | |
|---|---|---|
| Warfare Mission Needs |  | **Fleet IT Users** (e.g., FLTCYBERFOR) |
| Information Dominance Mission Needs Document | | **IT Acquisition Decision Makers** (e.g., OPNAV) |
| Information Dominance SoS Architecture & Requirements | | |
| Portfolio Requirements & Interface Control Doc's | Portfolio A; Portfolio B; Portfolio C; Interface Control | **SPAWAR CHENG** |
| System Requirements & Interface Control Doc's | | |

***SPAWAR's SoS baseline is the engineering/integration bridge at the enterprise-level to provide orderly flow-down of user needs to implemented platform baselines***

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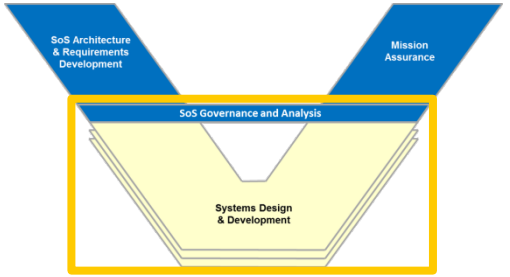
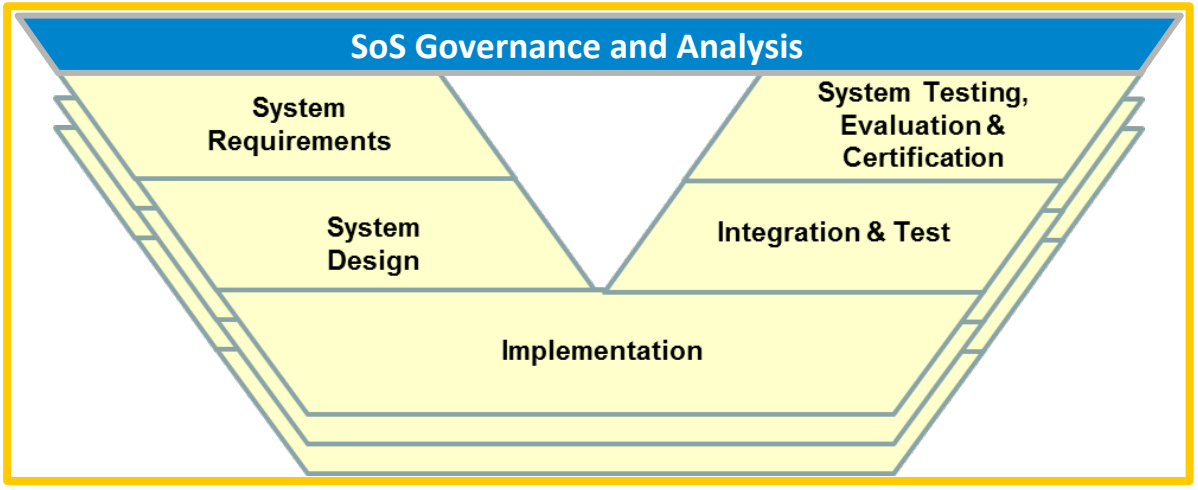
# SoSE&I Role in Systems Design & Development

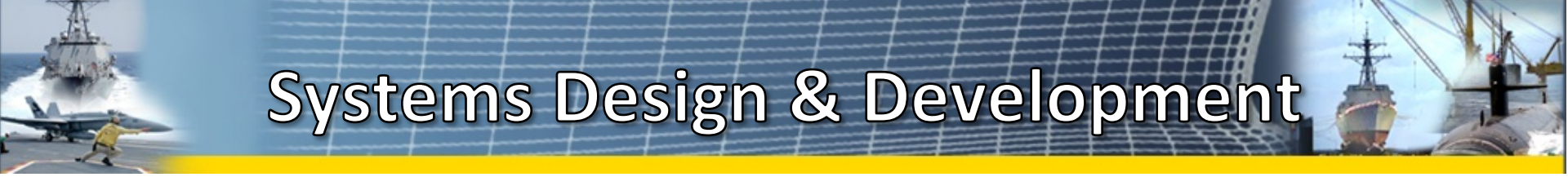
## Benefits

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




# Systems Design & Development



Warfare Mission Needs

**Fleet IT Users**
(e.g., FLTCYBERFOR)

Information Dominance
Mission Needs Document

**IT Acquisition Decision Makers**
(e.g., OPNAV)

Information Dominance SoS
Architecture & Requirements

Portfolio Requirements &
Interface Control Doc's

Portfolio A | Portfolio B | Portfolio C | Interface Control

**SPAWAR**
**CHENG**

System Requirements &
Interface Control Doc's

Mission Segments

Services

Systems

CI ("box" design)

**IT Acquisition & Sustainment**
(e.g., PEO, PMW)

Warfare Mission Operations

**Fleet IT Users**
(e.g., Fleet Units)

***Assured traceability from mission needs to implementation …***
***Jointly monitored across the development lifecycle***

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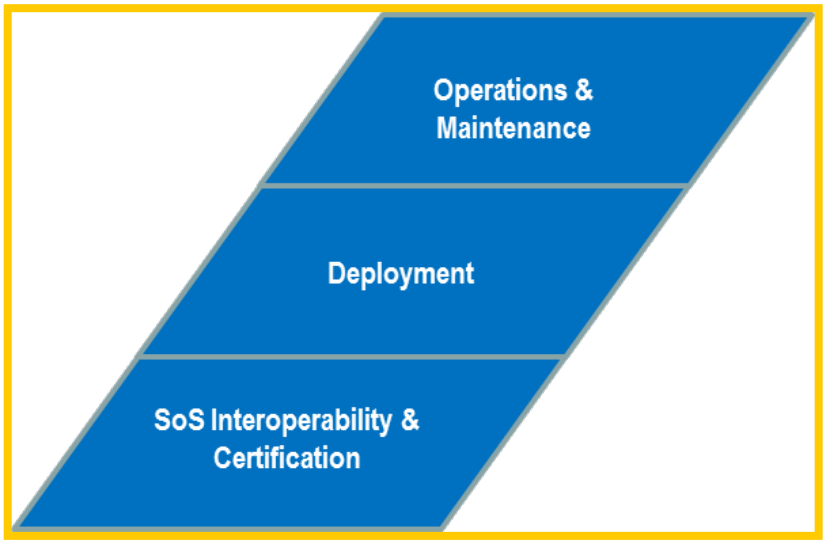
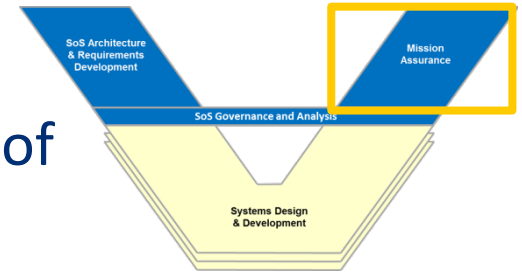
# Mission Assurance




## Benefits

- Understanding of SoS performance in context of mission success to shape acquisition planning
- Develops a comprehensive operations and maintenance to better align IT baselines in the Fleet

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# Mission Assurance Example

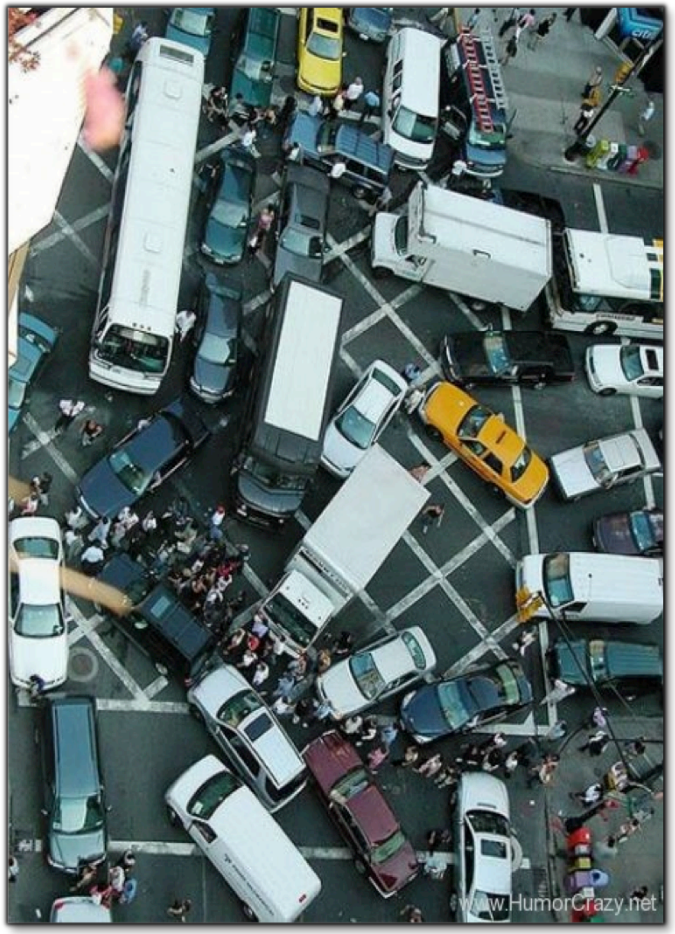
- SoS Test & Evaluation performed by analysis
  - Leverage Fleet Exercises and Experiments
  - Identify and mitigate Interoperability problems ahead of Deployment
- Multiple IT baselines exist in the fleet today

- Managing IT from a SoSE&I approach could eventually consolidate the number of baselines in the fleet.
- Designation of SPAWAR as IT TA will give IT issues a voice when considering afloat availability.

# SoS Governance

**Governance –** the set of rules, policies, and decision-making criteria that will guide the SoS to achieving its goals and objectives.

- A cornerstone of effective System of Systems (SoS) is a sound governance structure.
- Governance is well represented in the IT world, but a discussion of how to apply it to an SoS is absent.



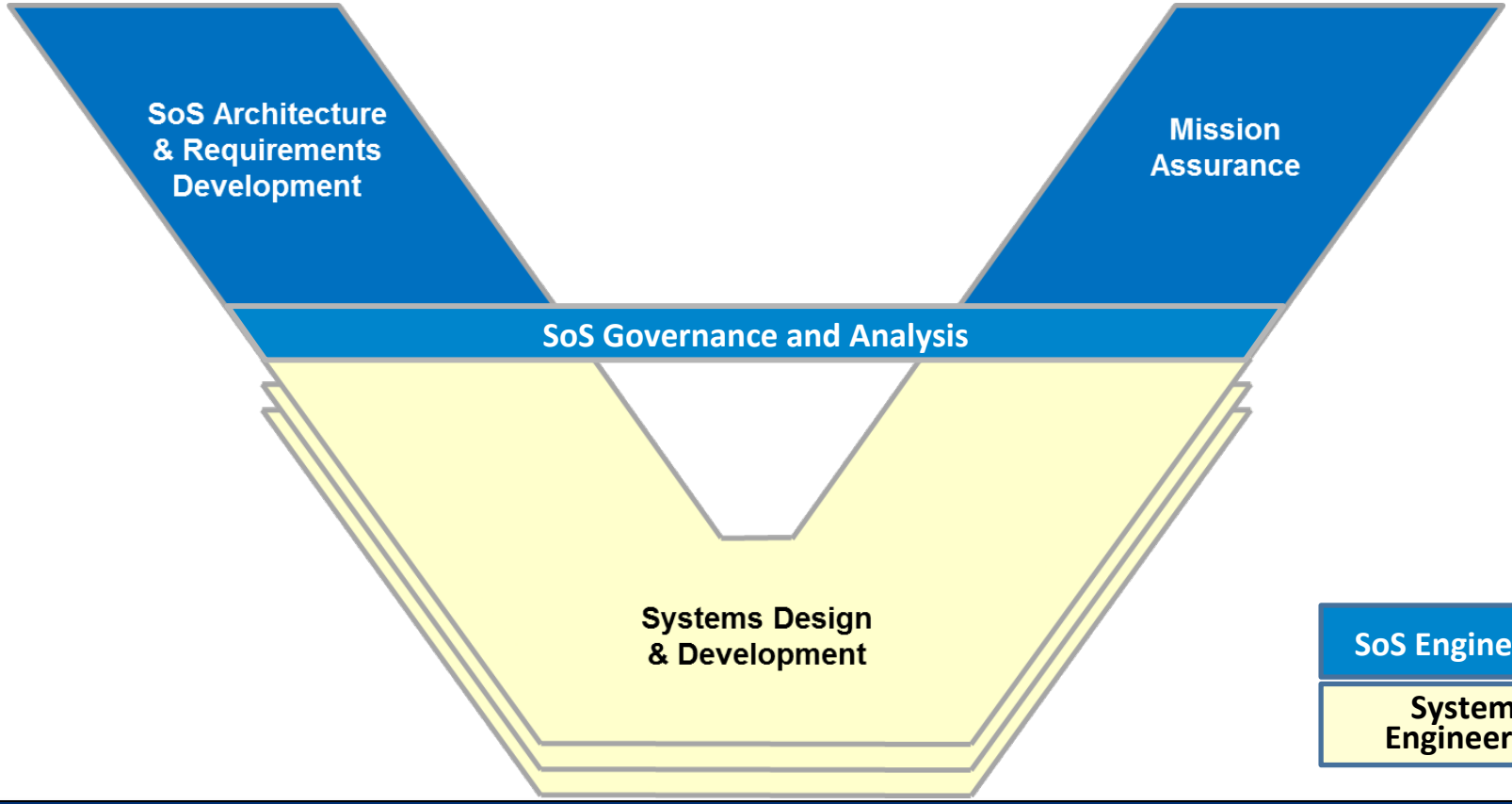
# Criteria-Based Governance Framework

- **Criteria 1: Organizational Structure, Standards and Policies**
  - The organizational structure, standards, policies, and the management environment must be understood to develop effective governance.
  - To be successful, the governance must be consistent with the organization.
    - Virtual SoS (such as the Internet) organizational structures are loosely defined, therefore the governance is limited to standards bodies.
    - Directed SoS (such as a Space SoS) organizational structures are very well defined, therefore governance tightly couples the constituent systems.
- **Criteria 2: Governance Composition and Principles**
  - Determines the degree of participation, responsiveness, consensus, inclusiveness, and accountability needed in the governance strategy.
    - Virtual SoS, participation is limited to standards committees. Typical SoS participants not included in the decisions of suggested changes.
    - Directed SoS, a high degree of participation, inclusiveness, responsiveness, and consensus.

# Criteria-Based Governance Framework

- **Criteria 3: Encapsulation**
  - Refers to how transparent the governance decisions are, and how enforcement is managed within the SoS.
    - Virtual SoS, the governance and decisions are made by a small number of stakeholders. Most stakeholders don't care how decisions are made or how the rules are enforced as long as they can achieve their missions and goals.
    - Directed SoS, stakeholders are closer to the decision-making process. Therefore, the governance strategy is required to be more inclusive and transparent.
- **Criteria 4: Governance Effectiveness and Interoperability**
  - Determines the effectiveness and interoperability attributes of the SoS
    - Virtual SoS, participation use the SoS for their own purposes, therefore governance effectiveness and interoperability should favor independence, decentralization, and heterogeneity.
    - Directed SoS, are designed to work together to achieve a common objective, therefore governance effectiveness and interoperability should focus on engineered effectiveness standards and tightly controlled interface standards.

# SoSE&I "Vee" In Review




***Coordinated effort across Navy Stakeholders to ensure User Needs are effectively translated into Interoperable Solutions***

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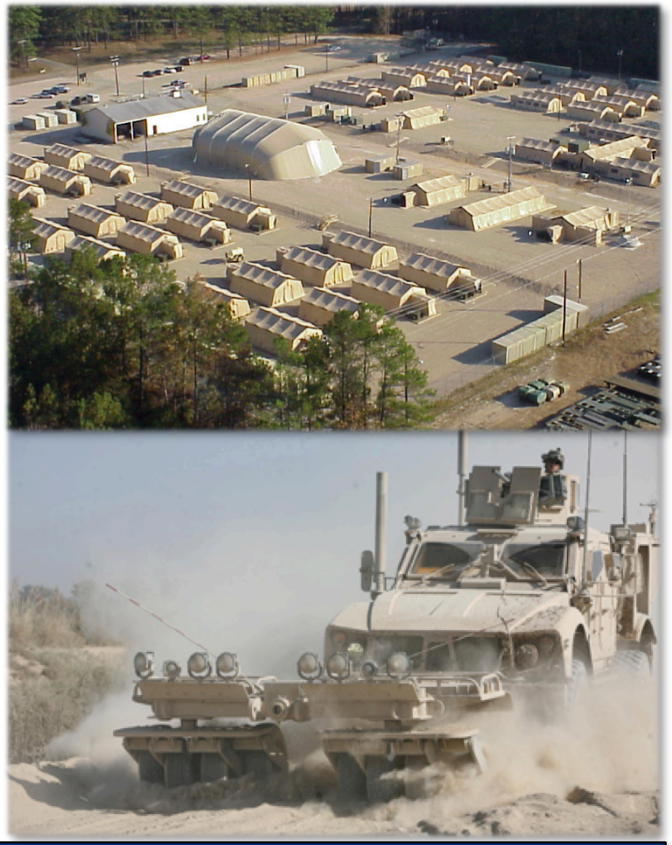
# Conclusions

- SoSE&I is a disciplined approach to successfully guide simultaneous, complex acquisition and operations of Navy IT
- Approach is applicable beyond the Navy and can be extended to other SoS Applications
- Governance is crucial to SoS success, but requires further exploration and analysis for effective implementation



***Managing and Governing the SoS throughout the development lifecycle is critical to Mission Success***

# Questions