ASN (RDA)
Chief Systems Engineer

NDIA
8th Annual Science Engineering Technology Conference

Systems Engineering View of Naval Warfighting Systems Development

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Bottom Line, Up Front

The real issue is a lack of a Navy-wide System Engineering & Analysis Process

System Engineering & Analysis applied horizontally across programs enables determination of appropriate modularity

RDA CHENG Charter *

RDA CHIEF SYSTEMS ENGINEER

Mission

Senior Advisor to ASN (RDA) for System Engineering, Software Development and Net-Centric Integration and Interoperability

Duties / Responsibilities / Authorities

System Engineering / Software Development

- Application and assignment of policies, processes, practices
- Application of new techniques and practices
- Participate in milestones reviews
- Health of Workforce
- OSD, Joint and Coalition representatives

Net-Centric Integration and Interoperability

- Policies, processes and practices
- C4I and IT systems overall combat weapon architectures
- Develop I&I processes
- OSD, Joint and Coalition and Federal representation

Other

- Modeling and Simulation
- Technology Protection

* Updated, in review with ASNRDA

Capability-Based System Engineering Complexity

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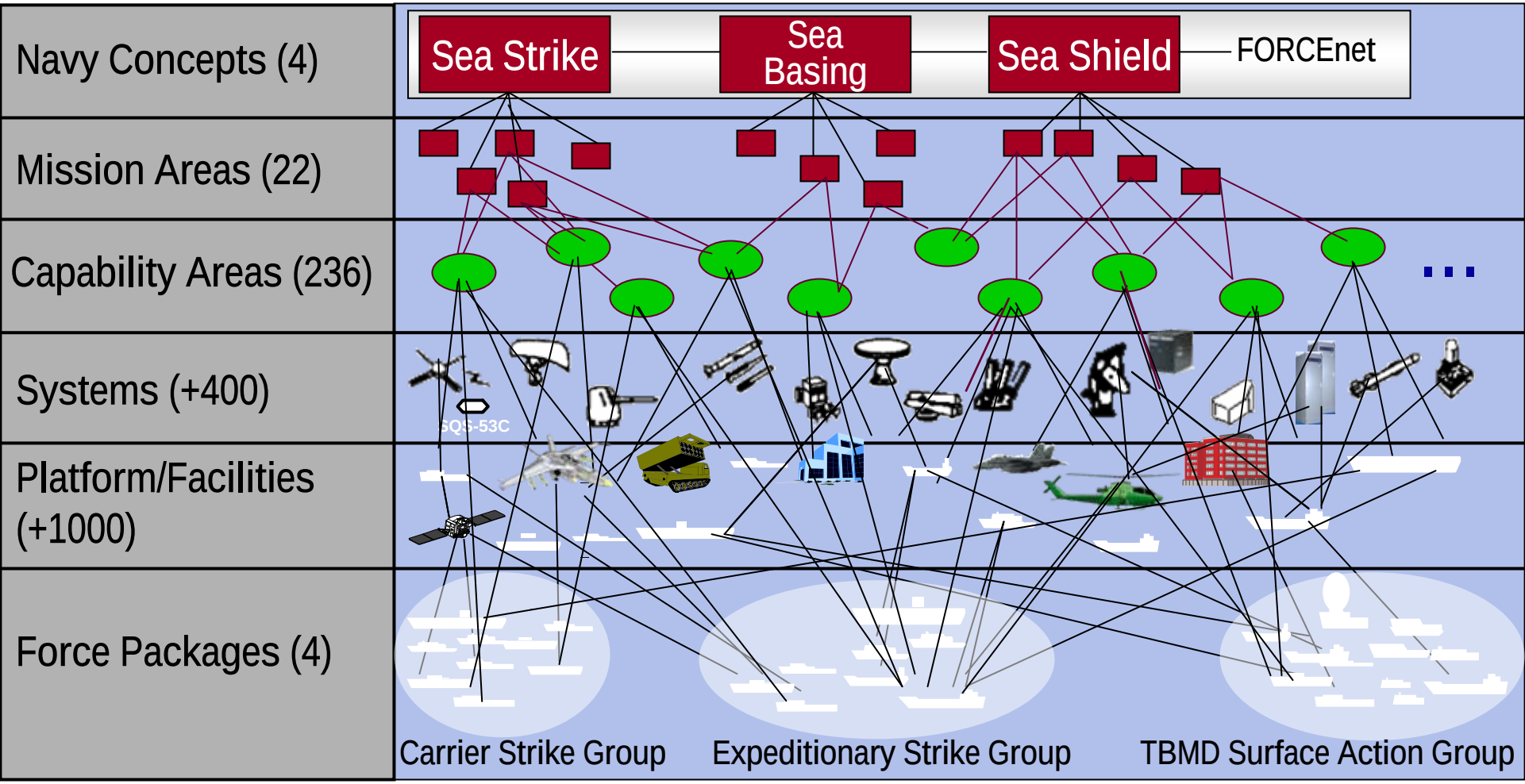

Globally Networked, Distributed Combat Force

Composed of: Multimission systems on multimission units deployed in multiple force packages

Joint Interoperability Challenge

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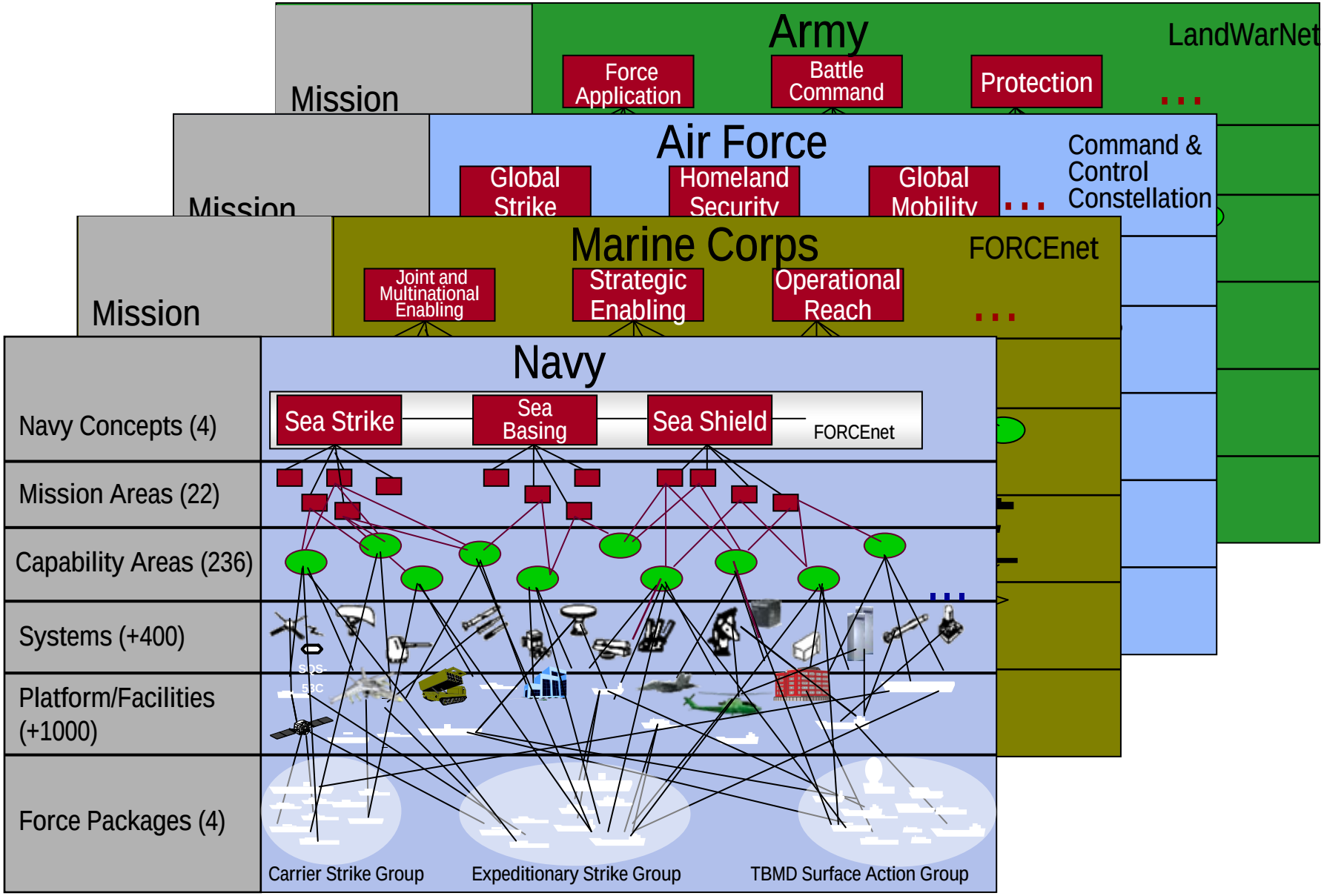

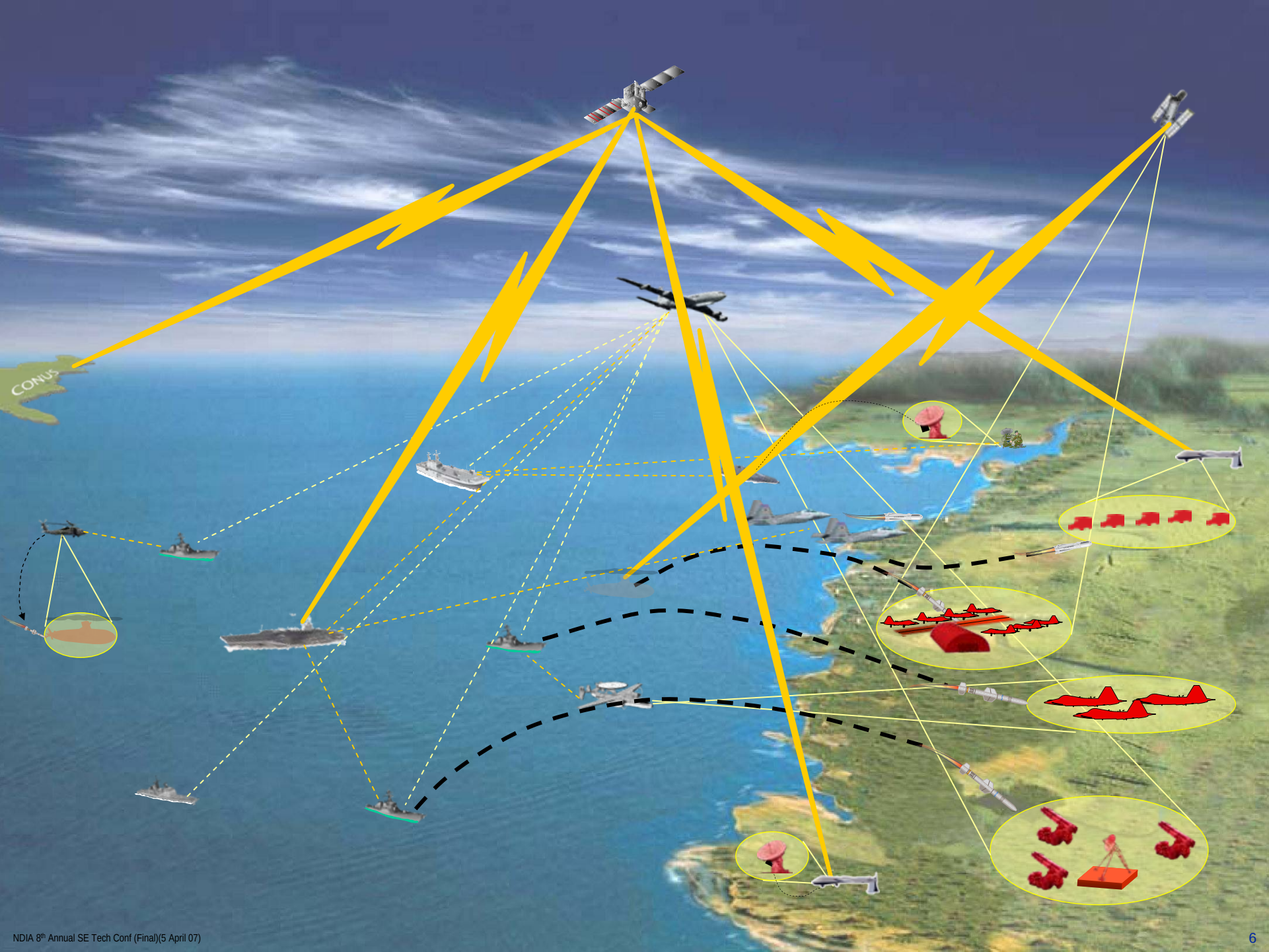
CONUS

...	Fire Control	Deconfliction	Situational Awareness	Combat ID	Common Operational Picture	Persistent ISR
Joint Access and Denial						
Joint Land Operations						
Joint Maritime / Littoral Operations						
Joint Air Operations						
...						

Recommendations

- ASN (RD&A), with VCNO and ACMC, take lead in ***developing a Naval-wide System-of Systems Engineering function*** that follows a top-down, interactive, recursive, system synthesis & analysis process to define requirements.

- CNO & CMC ***identify driving factors*** for modularity and develop Naval policy and guidance for implementing modularity.

- CNR ***lead as technology change agent*** for:
  - Development of methodologies for understanding complex systems, enabling modular design
  - Experimentation with modular systems to support acquisition spirals
  - Development of M&S tools to enable system of systems engineering analysis
  - Development of advanced concepts & tools for software optimization & reuse

Capability-Based System Engineering

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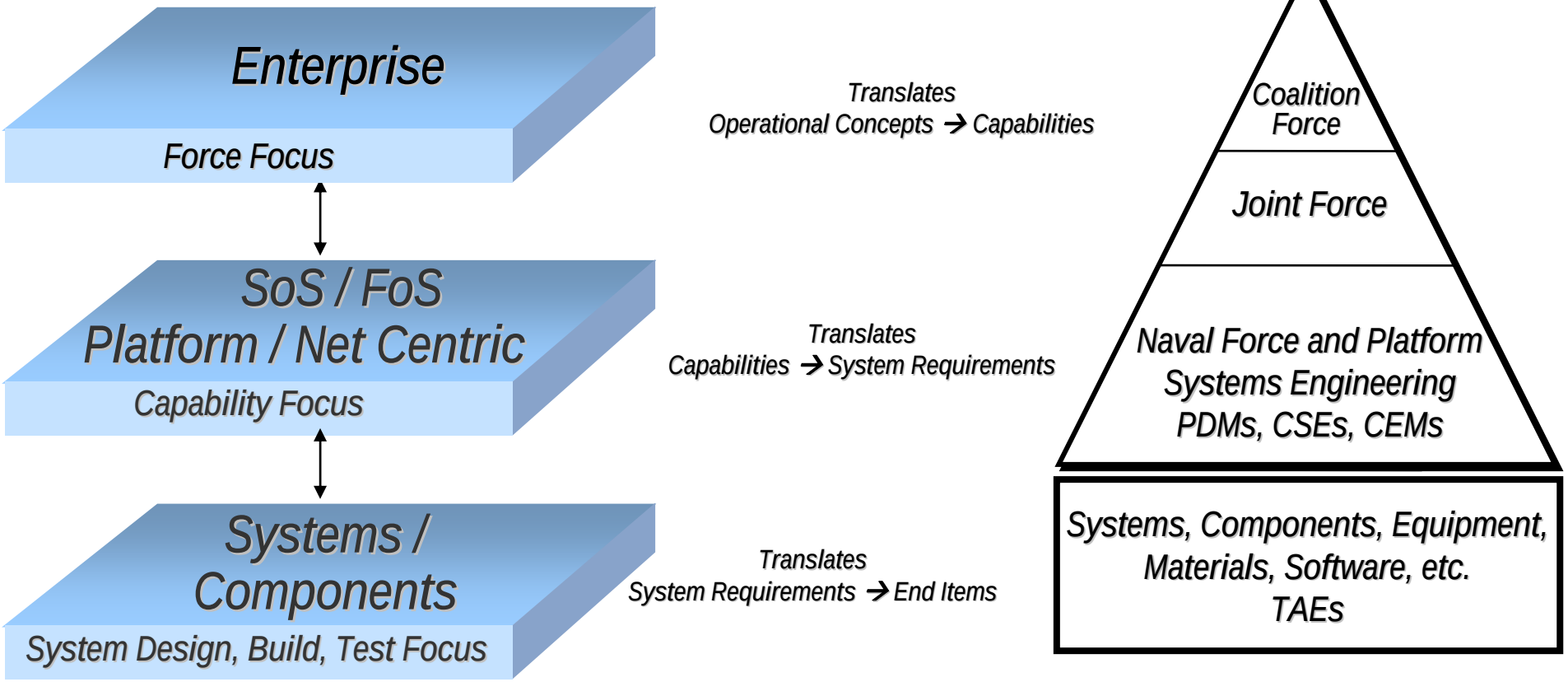

Requires Alignment of Multiple Processes, Process Owners and Products

System Engineering Process

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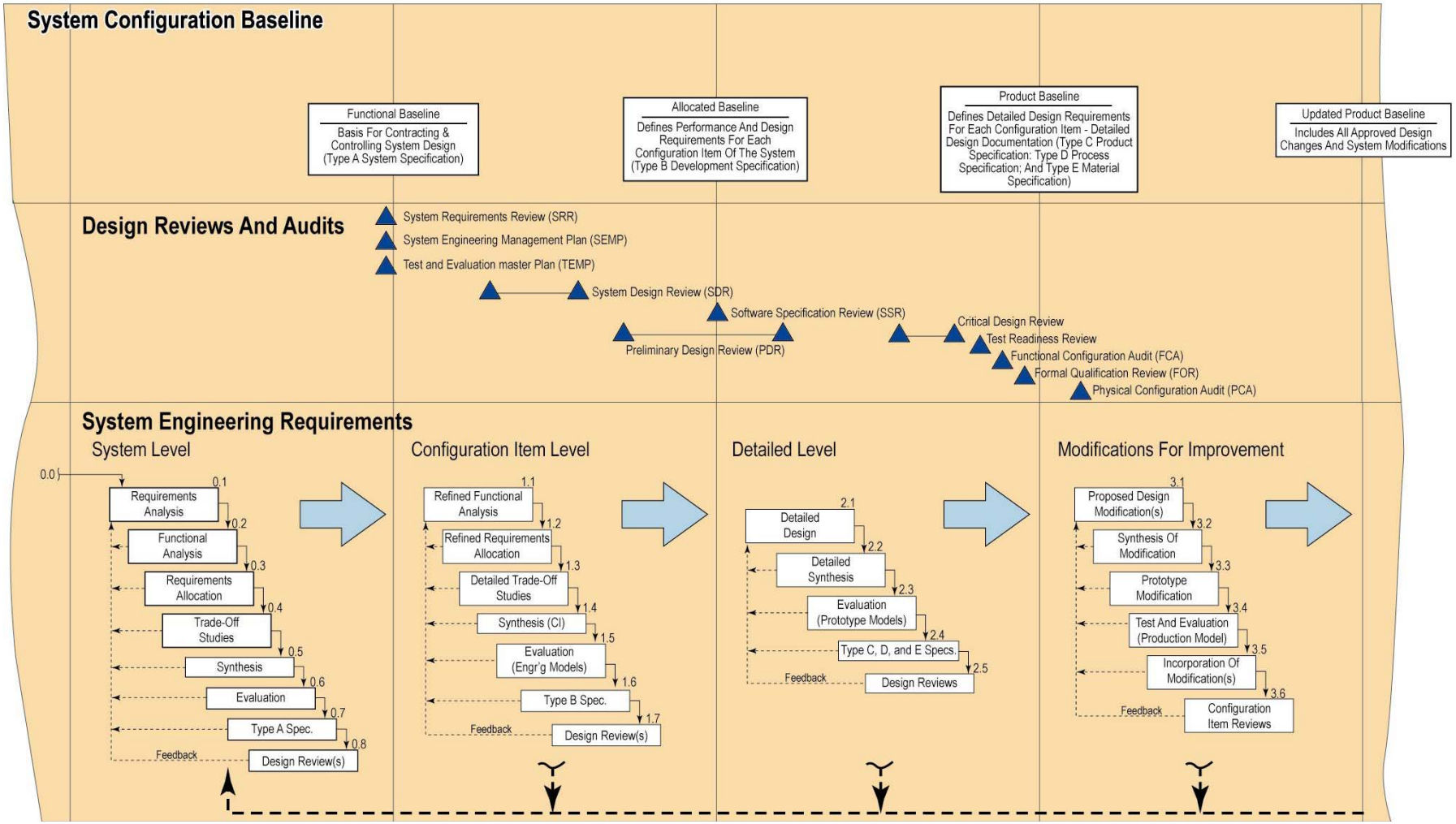

Engineering Enterprise - SoS - System

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Mission Concept Refinement	I	Capability Maturity	II	System of Systems Development & Demonstration Systems Integration / Capability Demonstration	III	Deployment Mission Execution	Operations & Support Sustainment / Disposal

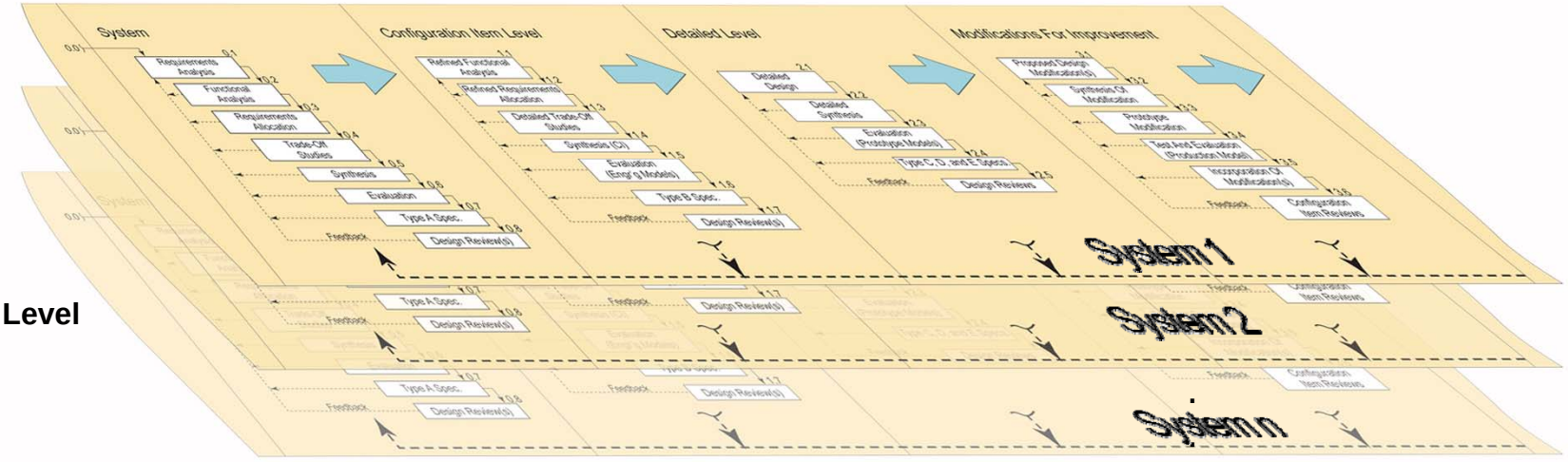
Proposed SoS Process

Enterprise Level

System-of-Systems Level

Acquisition Portfolio

System Level

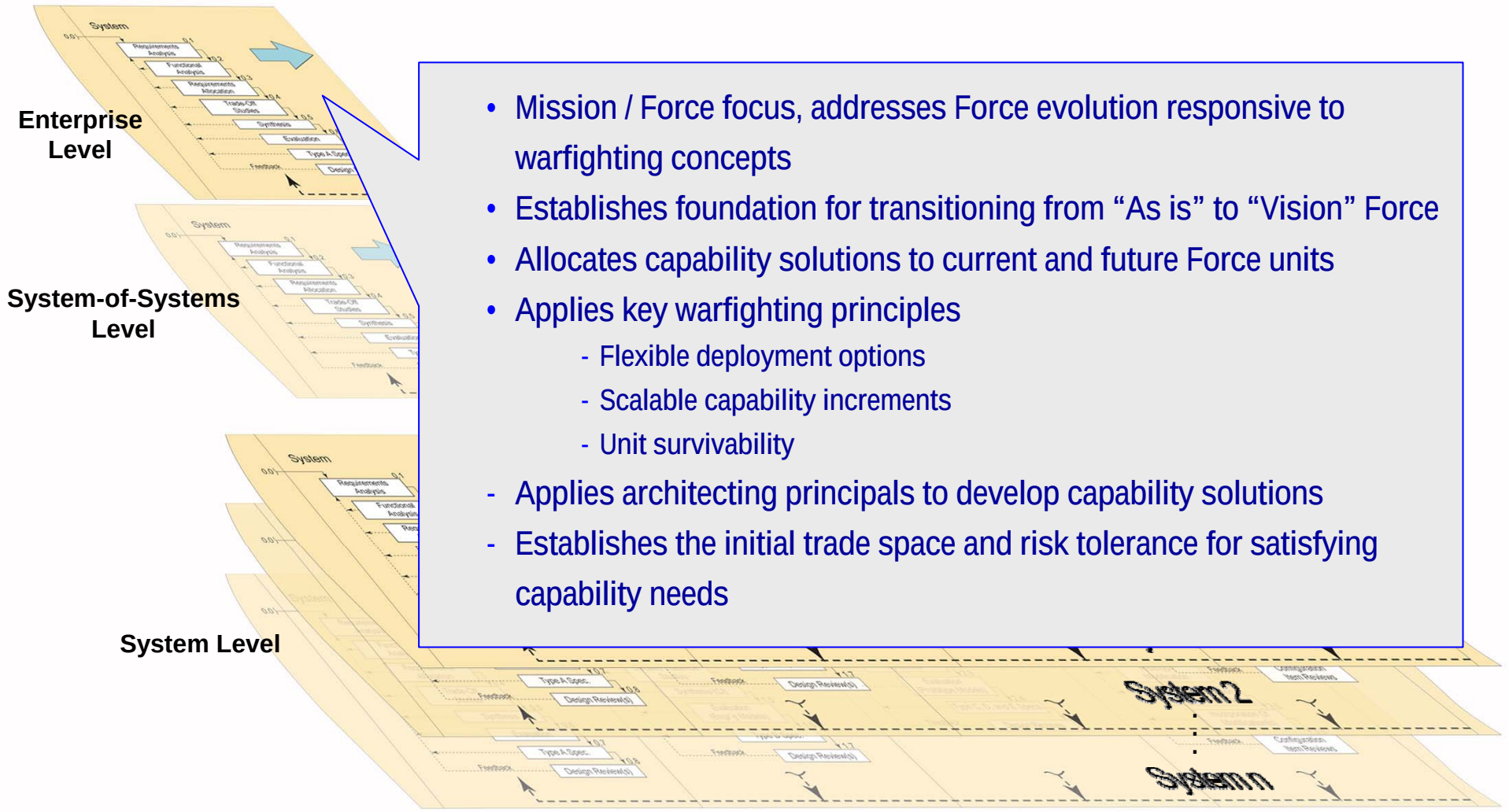


DoD 5000

Functional Area Analysis	Functional Needs Analysis	Functional Solutions Analysis	Analysis of Alternatives	A	Technology Development	B	System Development	C	Production

System Engineering: Enterprise Level

RDA CHIEF SYSTEMS ENGINEER



- Mission / Force focus, addresses Force evolution responsive to warfighting concepts
- Establishes foundation for transitioning from “As is” to “Vision” Force
- Allocates capability solutions to current and future Force units
- Applies key warfighting principles
  - Flexible deployment options
  - Scalable capability increments
  - Unit survivability
- Applies architecting principals to develop capability solutions
- Establishes the initial trade space and risk tolerance for satisfying capability needs

System Engineering: Enterprise Level

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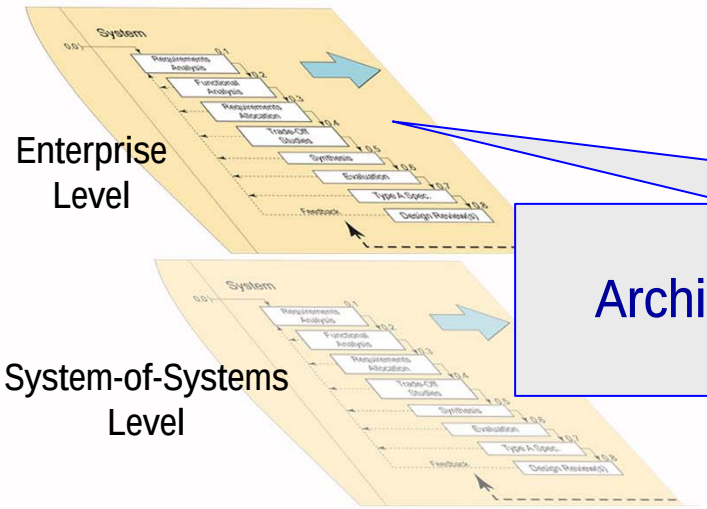
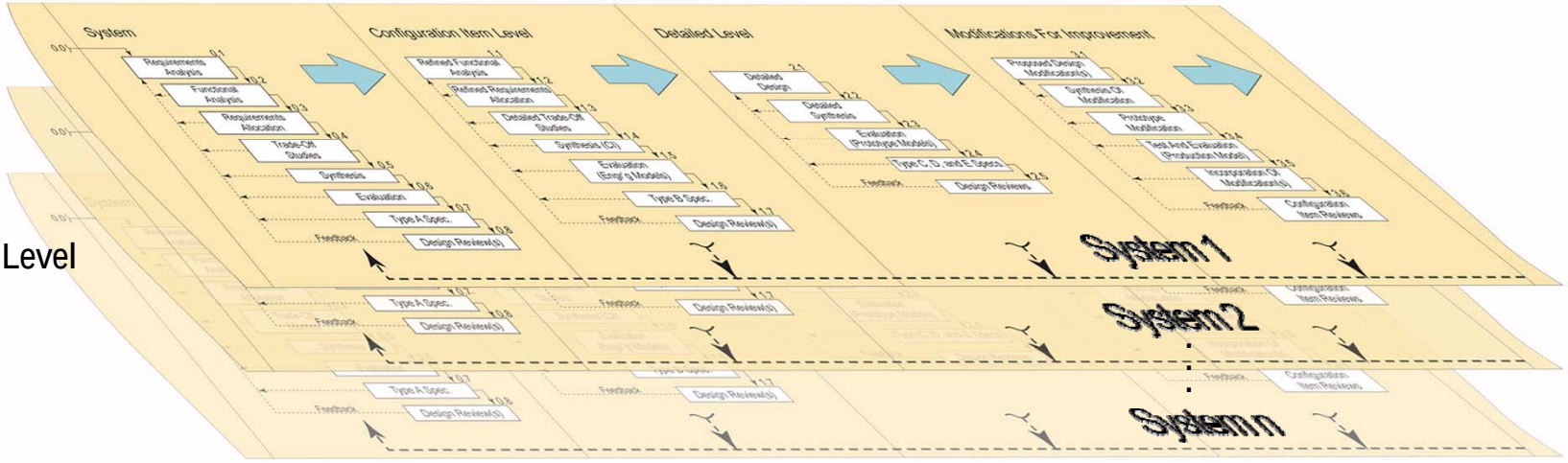


Architecting the fuzzy front-end of System Engineering

Portfolio of Systems



Evolution Planning

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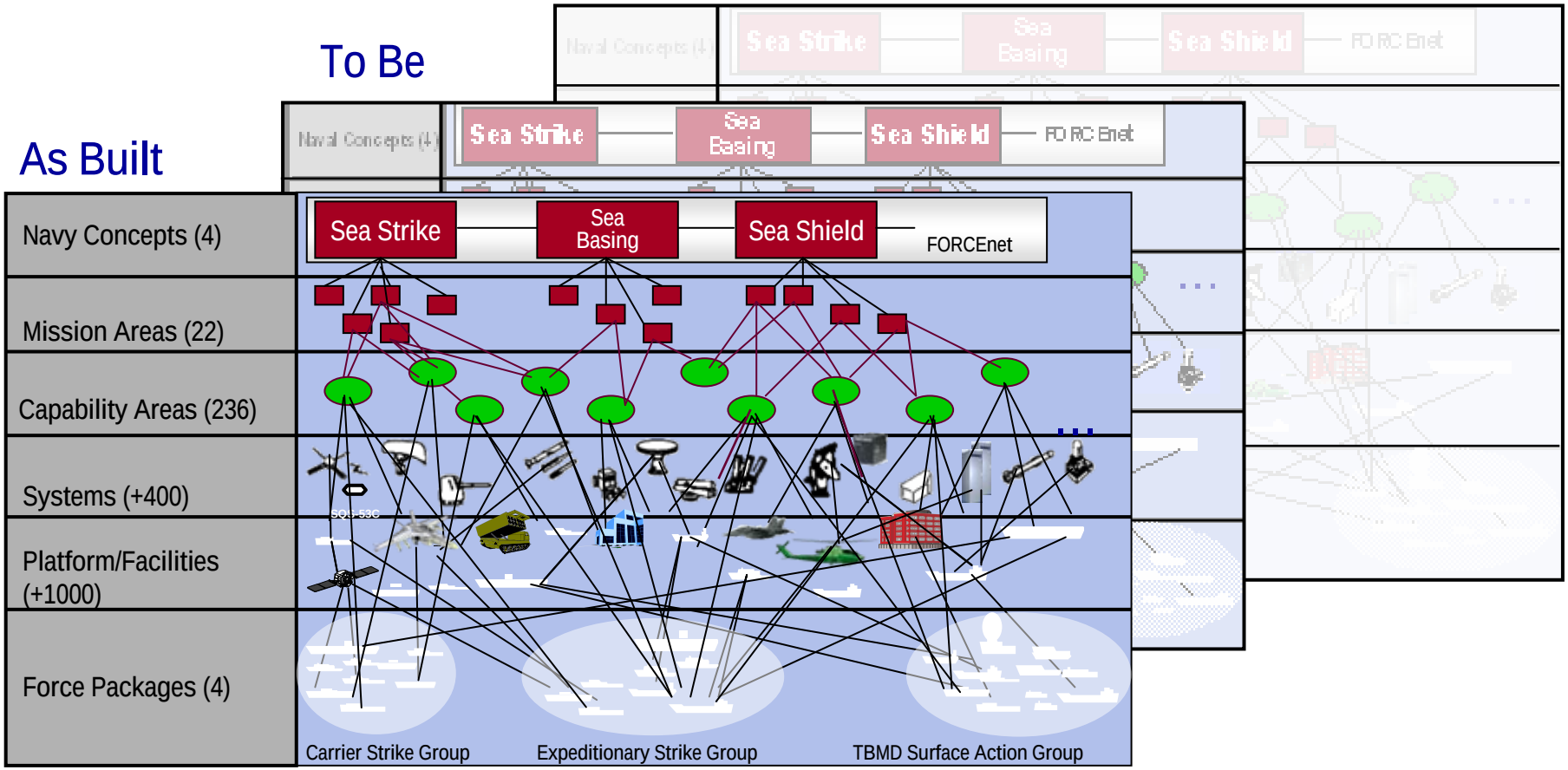
Vision

To Be

As Built



Align Capability and System / Unit Evolution Paths

Operational Architecting Principles

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- Flexibility — Constitute and Re-constitute Force
- Survivability — Fight and Survive or fight hurt
- Multi-mission — Assign / reassign Missions in Real/time
- Scalability — Support range of Operations/OPTEMPO

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System Architecting Principles

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• Modularity	Loosely Coupled Federation
• Connectivity	Only essential communications between elements
• Simplicity	Best for operation and acquisition
• Economy	People, material and funding
• Correspondence	Best match to Navy structure, mission, operations
• Continuity	Consistent Information, decision Rules
• Layering	Support Hierarchy – Command Thru Weapons
• Sustainability	Maintain capability, survival and readiness
• Compatibility	Constructive to existing systems
• Security	Must be sign in

System Engineering: SoS Level

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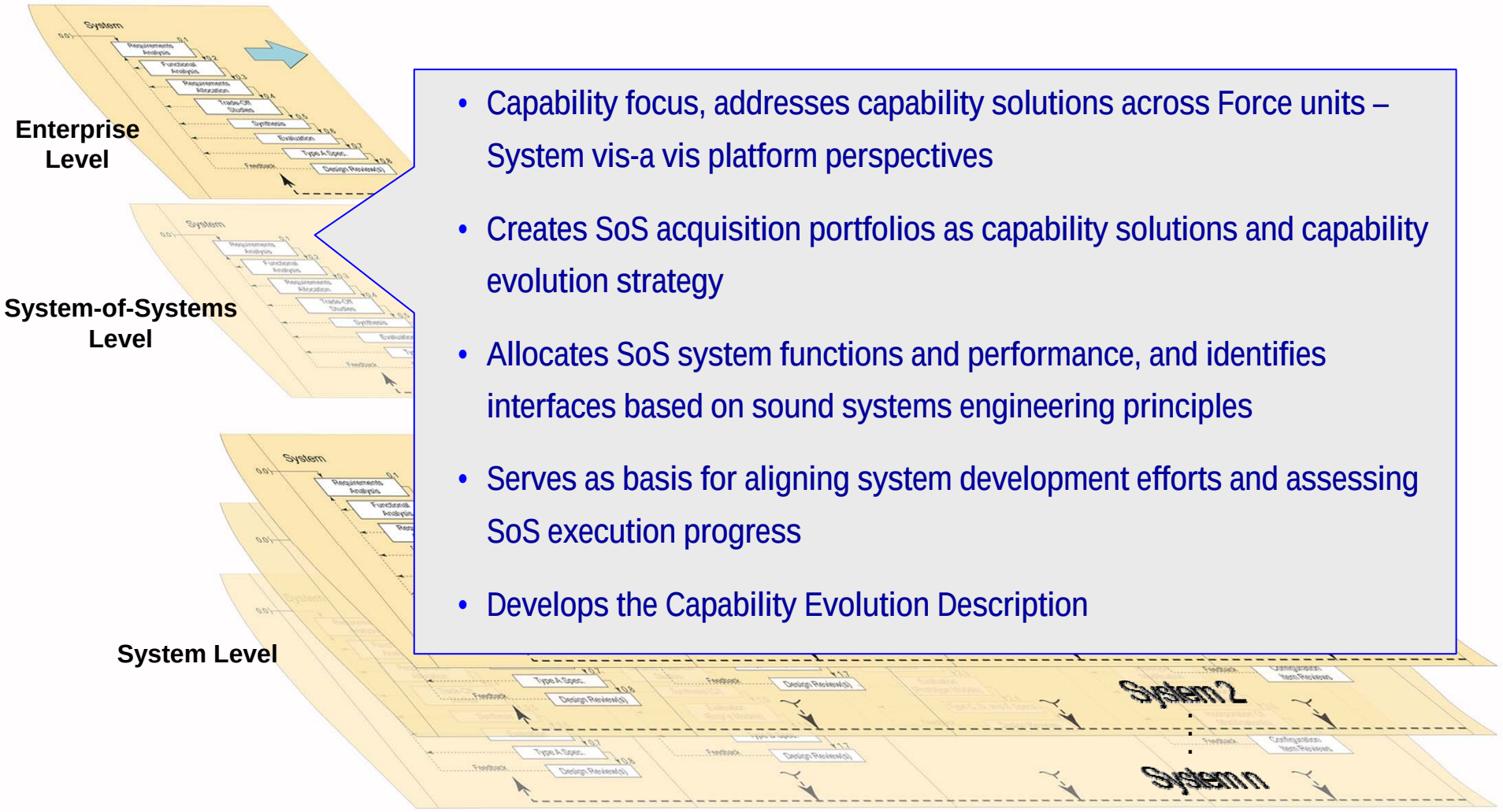

- Capability focus, addresses capability solutions across Force units – System vis-a vis platform perspectives
- Creates SoS acquisition portfolios as capability solutions and capability evolution strategy
- Allocates SoS system functions and performance, and identifies interfaces based on sound systems engineering principles
- Serves as basis for aligning system development efforts and assessing SoS execution progress
- Develops the Capability Evolution Description

System Engineering: SoS Level

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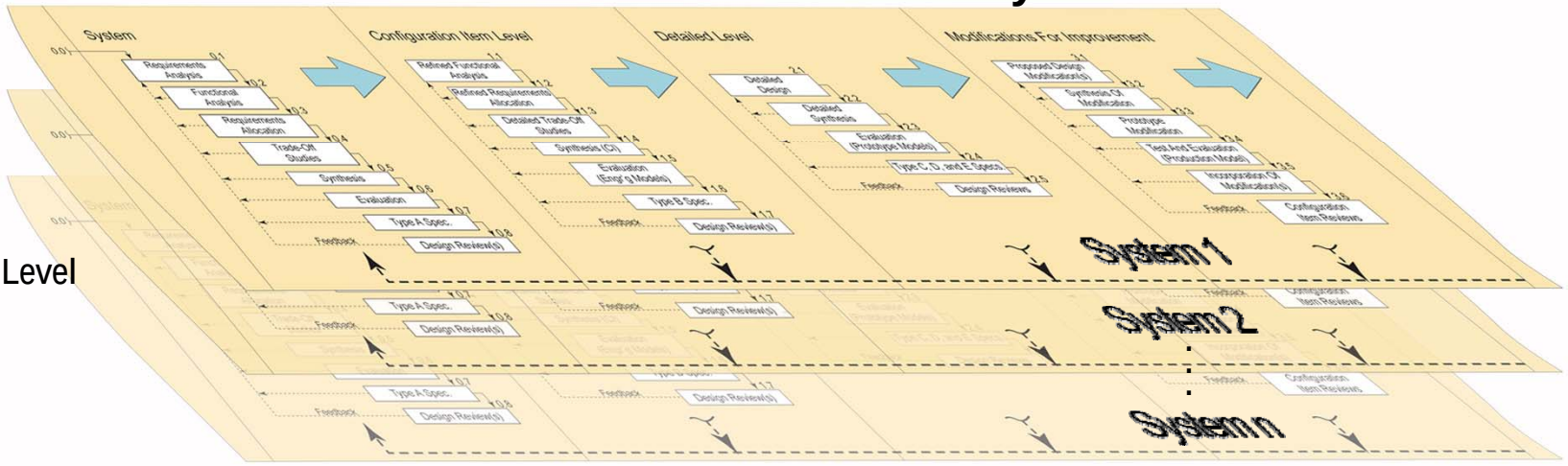
Enterprise Level

System-of-Systems Level

Portfolio Engineering: The bridge to systems
- Functional analysis
- Operating state and mode analysis
- Sequence and timing analysis
- Manning training and logistics concepts

Portfolio of Systems

System Level



Engineering Capability…

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- Time Allocations
- Error Budgets
- Fault Tolerance / Reconstitution
- Human System Integration
- Integrated Team Training
- Safety
  - –
  - –
  - –

Horizontally Across Platforms and Systems

System of Systems Engineering

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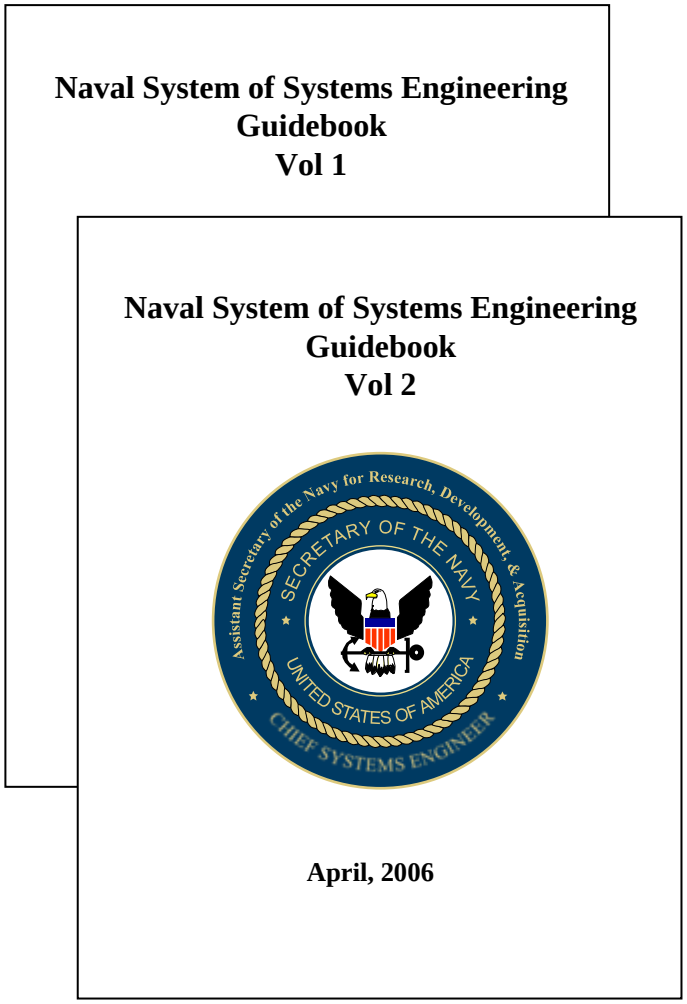

Naval SoSE Guidebook

- Developed to support Mission level capability-based acquisition decision making
- Presents best practices for capability-based acquisition and systems engineering
- Provides processes, methods, and tools to aid interoperable and integrated systems
- Particularly suited to System of Systems or Family of Systems
- Supports Naval or Joint Force Operations

Relationship to System Documentation

RDA CHIEF SYSTEMS ENGINEER

System Performance Document

Table of Contents

1.0 SCOPE
- 1.1 IDENTIFICATION
- 1.2 SYSTEM OVERVIEW
- 1.3 DOCUMENT OVERVIEW

2.0 APPLICABLE DOCUMENTS

3.0 REQUIREMENTS
- 3.1 REQUIRED STATES AND ROLES
- 3.2 SYSTEM CAPABILITY REQUIREMENTS
- 3.3 SYSTEM EXTERNAL INTERFACE REQUIREMENTS
- 3.4 SYSTEM INTERNAL DATA REQUIREMENTS
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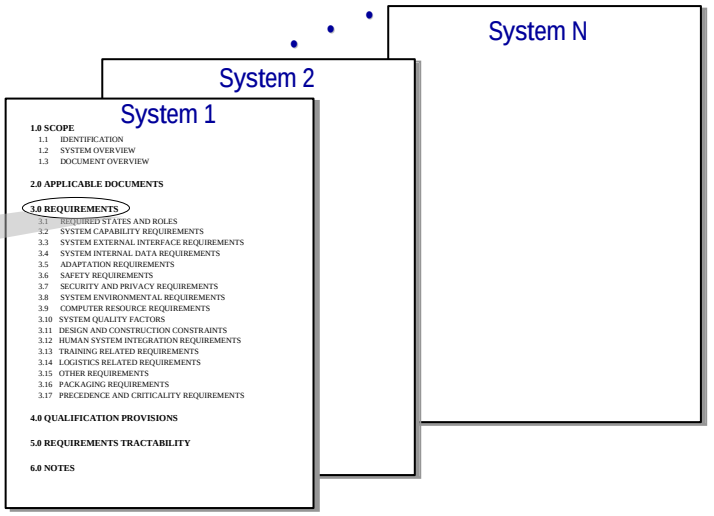
- 3.6 SAFETY REQUIREMENTS
- 3.7 SECURITY AND PRIVACY REQUIREMENTS
- 3.8 SYSTEM ENVIRONMENTAL REQUIREMENTS
- 3.9 COMPUTER RESOURCE REQUIREMENTS
- 3.10 SYSTEM QUALITY FACTORS
- 3.11 DESIGN AND CONSTRUCTION CONSTRAINTS
- 3.12 HUMAN SYSTEM INTEGRATION REQUIREMENTS
- 3.13 TRAINING RELATED REQUIREMENTS
- 3.14 LOGISTICS RELATED REQUIREMENTS
- 3.15 OTHER REQUIREMENTS
- 3.16 PACKAGING REQUIREMENTS
- 3.17 PRECEDENCE AND CRITICALITY REQUIREMENTS

4.0 QUALIFICATION PROVISIONS

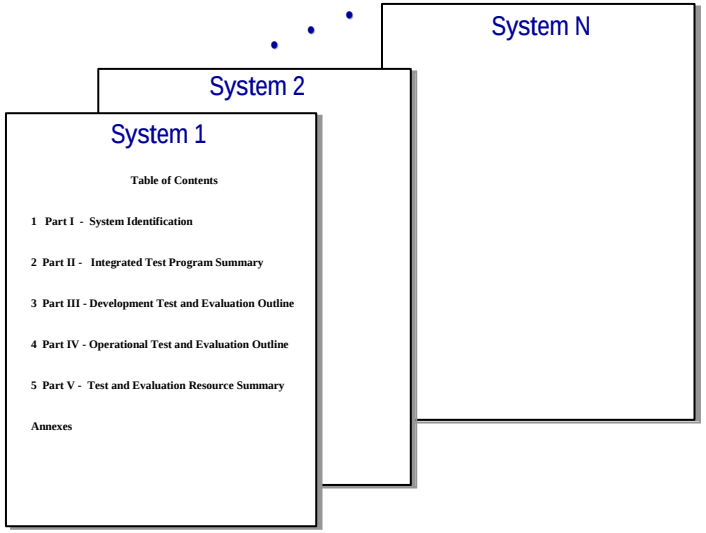
5.0 REQUIREMENTS TRACTABILITY

6.0 NOTES

System Specifications



Test and Evaluation Master Plan



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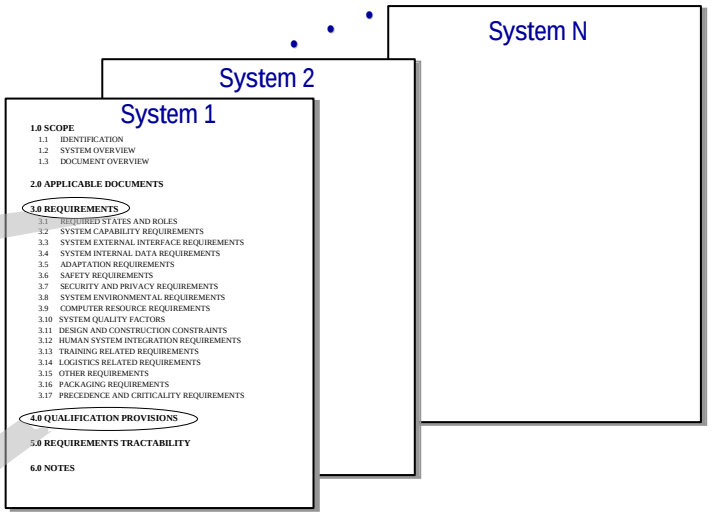

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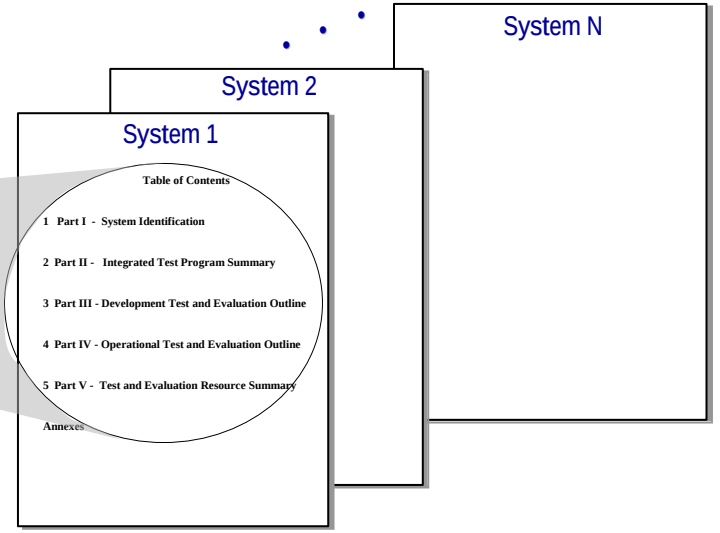

Large Scale SoS Capability Evaluations

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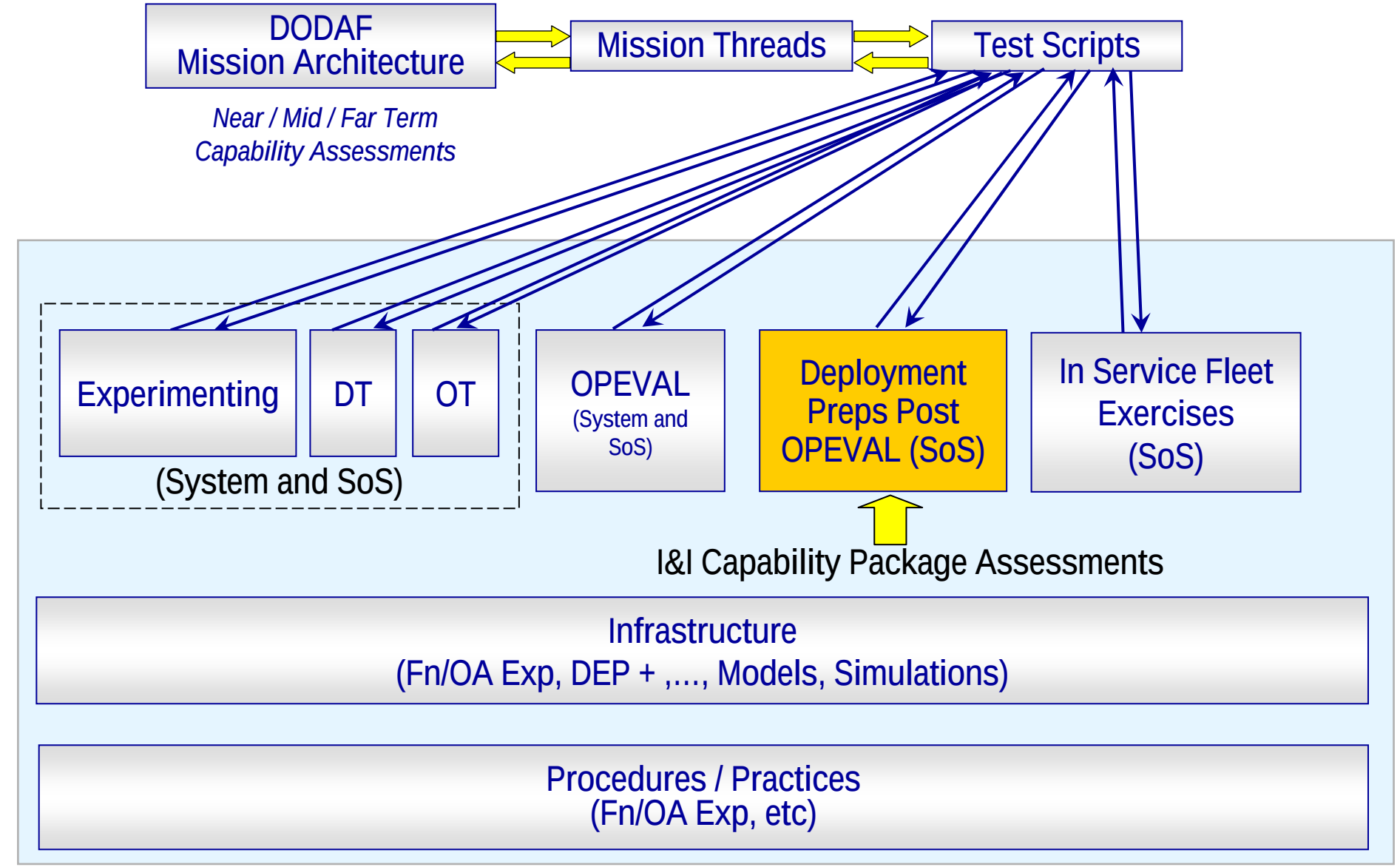

Integrated SoS Life Cycle Interoperability Test Strategy

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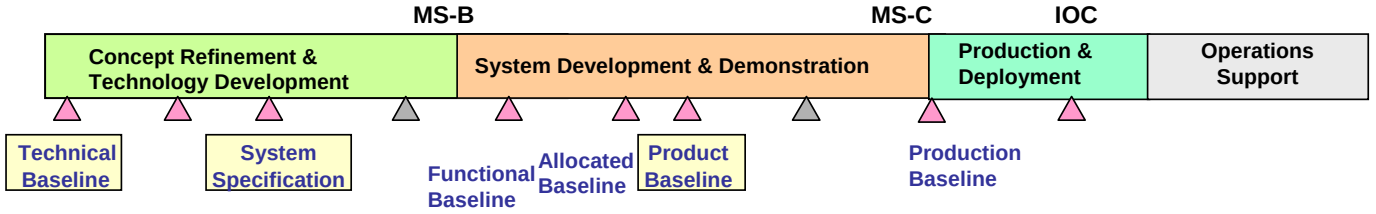
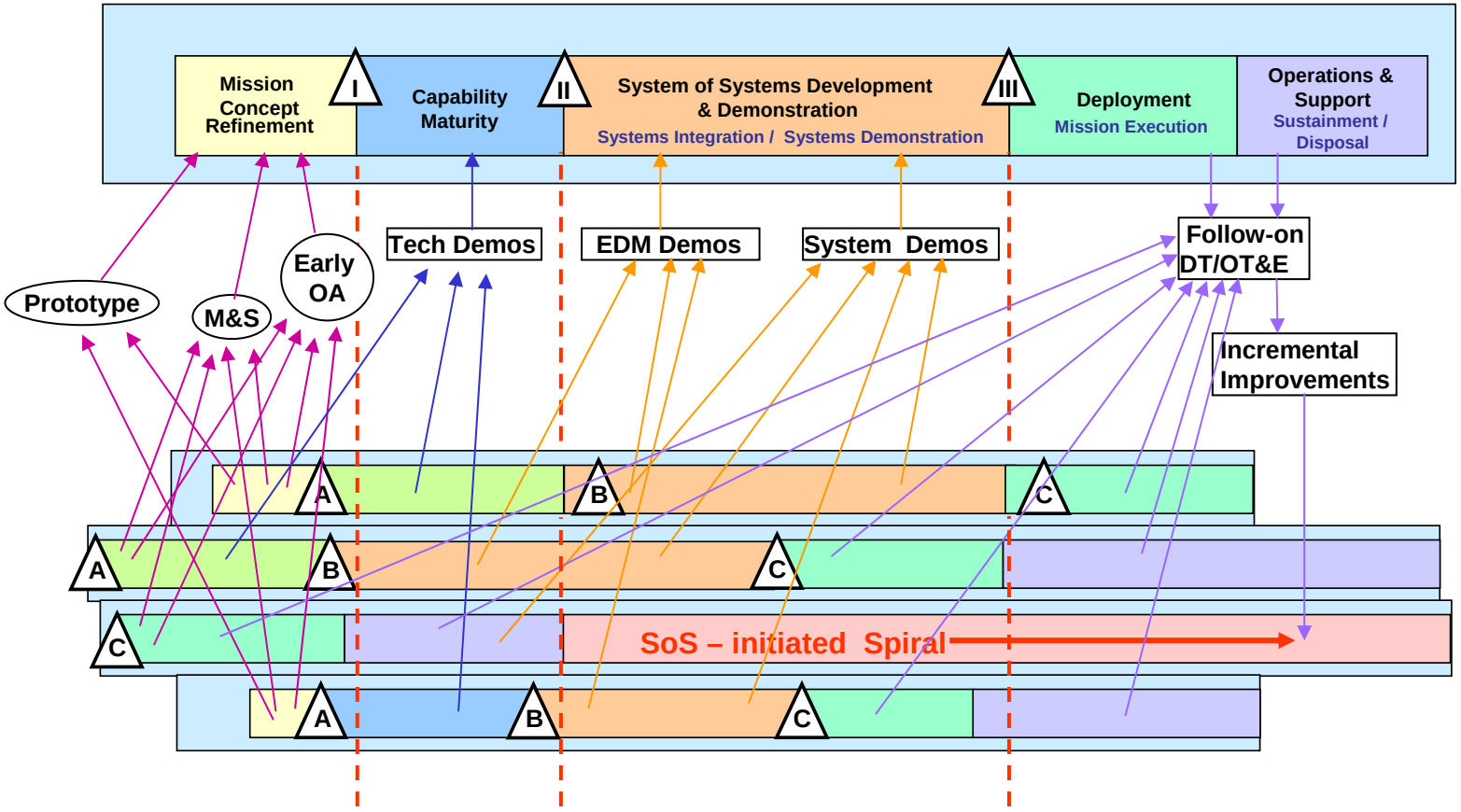
System DoD 5000



"Conceptual" SoS DoD 5000



Using the SoS Guidebook

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- ASW
  - Mission → Capability → SoS — RDA CHENG Engaged
- MIW
  - Mission → Capability → SoS — Starting to Engage
- SIAP
  - SoS → Capability → Mission — Engaging via SEP
- IAMD
  - SoS → Capability → Mission — Exploring

- *Leverage Army FCS SoS Plan*

System Engineering: System Level

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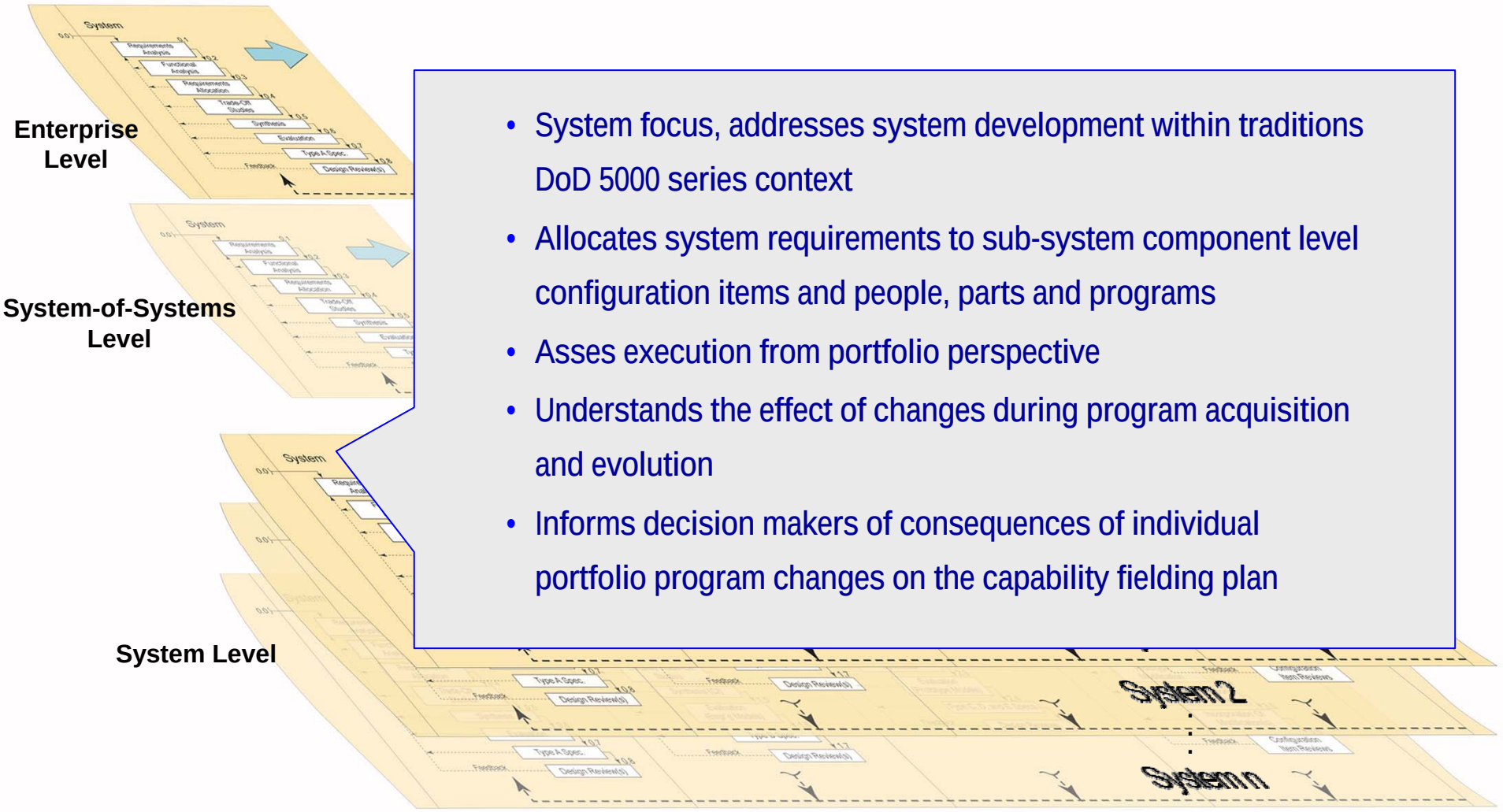

- System focus, addresses system development within traditions DoD 5000 series context
- Allocates system requirements to sub-system component level configuration items and people, parts and programs
- Asses execution from portfolio perspective
- Understands the effect of changes during program acquisition and evolution
- Informs decision makers of consequences of individual portfolio program changes on the capability fielding plan

Current Initiatives

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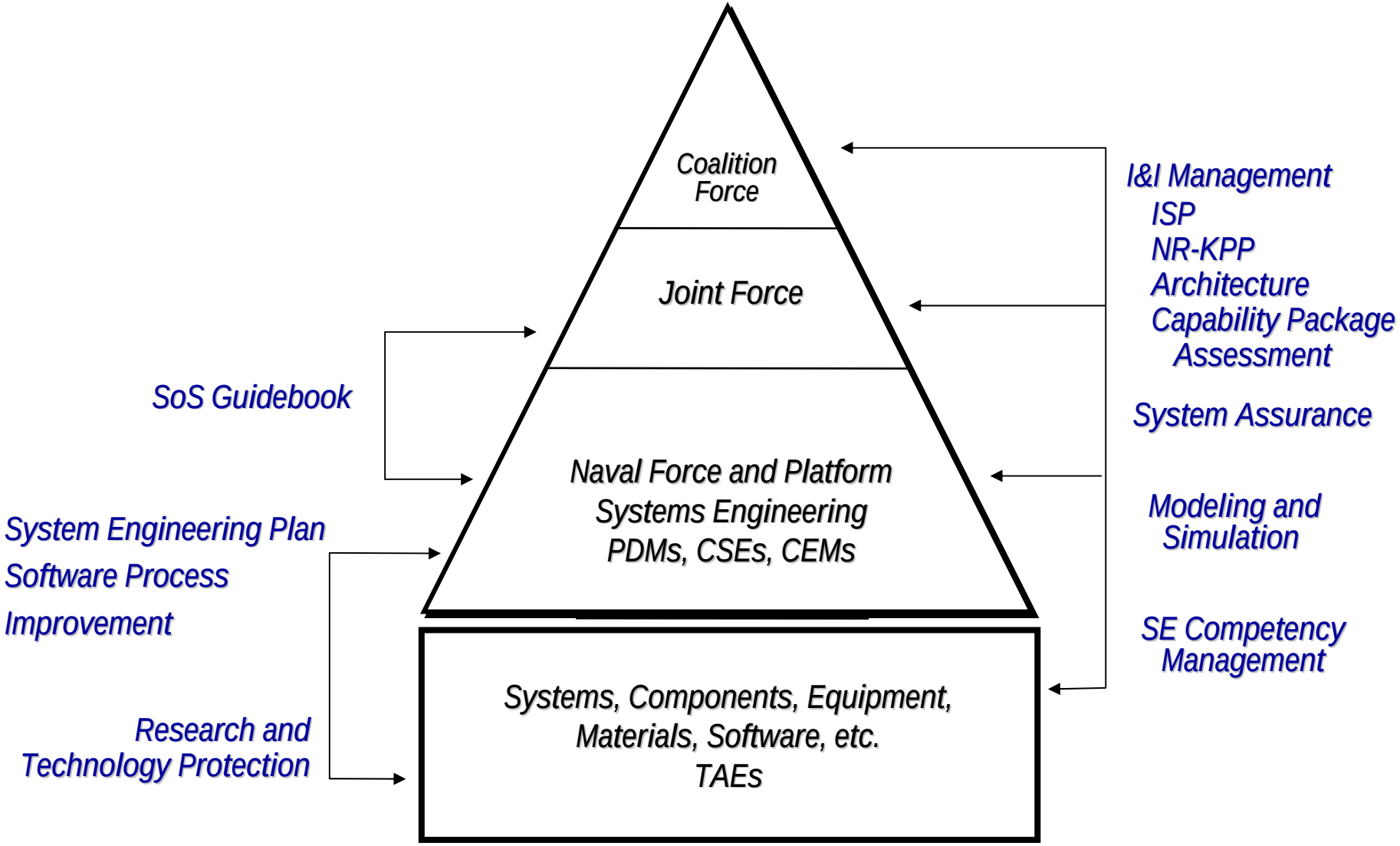

What is Needed?

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- A good construct for Architecture
  - Capture of the "As-is"
  - Basis for the "Vision"
- Engineering processes, methods and tools that support the Enterprise and SoS levels
- Collaborative management tools for decisions
- Experienced Systems Engineers

Government /Industry Commitment to make it Happen

Capability Roadmapping

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