



# NAVWAR

## Application of Technical Authority Across Industry

05 November 2024

Presented to:

**National Defense Industry  
Association Fall Forum**

Presented by:

**Mitch Seime**  
NAVWAR 52100 Mission Assurance

# What is Technical Authority?

---

- ▼ Technical Authority (TA) is the authority, responsibility, and accountability to establish, monitor, and approve technical standards, tools, and processes in conformance to higher authority policy, requirements, architectures and standards. (*SECNAVINST 5400.15D*)
- ▼ Foundational element in the Navy's approach to managing complex technical systems and processes, ensuring that they are safe, reliable, and meet the necessary standards and requirements

# Who exercises Technical Authority

▼ Naval & Maritime Industries/Organizations

- US Navy



▼ Aerospace

- US Air Force
- NASA
- FAA



▼ Law Enforcement

- FBI Firearms & Ammunition Technology Division

▼ International

- Int'l Atomic Energy Agency
- World Meteorological Organization
- Engineers Australia
- European Whole-Vehicle Type Approval System



▼ Construction Industry

▼ Information Technology Industry

▼ Cybersecurity Industry

▼ Automotive Industry

▼ Pharmaceutical Industry

▼ Health Care Industry

▼ Petroleum Industry

▼ Maryland Cannabis Administration



# How is Technical Authority used

- ▼ Independent view (or a new set of eyes) to aid in providing insight and direction for:
  - Engineering and Design
  - Technology Integration
  - Assessing conformance
  - Instill engineering rigor
  - Provide checks and balances
  - Safeguards and Verification
  - Creating standards and recommended practices
- ▼ Applies systems thinking through their experience, knowledge and insight to apply lessons gained from other programs/events (e.g., Crew Resource Management)
- ▼ Provides the program manager and corporate leadership an independent assessment of the maturity, and risks, issues, and opportunities



# Examples of Technical Authority in Action

- ▼ Engineering Technical Reviews
- ▼ City Planner Reviews (Residential and Commercial)
- ▼ Creating and evaluating new standards
- ▼ Product or Process certification
- ▼ Failure Review Boards/FMECA/FMEA
- ▼ Design Planning
- ▼ Requirements Analysis, Verification & Validation
- ▼ Providing expert testimony
- ▼ Systems Testing and Evaluation

**Technical Authority spans the life cycle**

# Technical Authority across the Life Cycle

**Business/Mission Needs Analysis (Domain TA)**

**Requirements Analysis (Reqmts TA)**

**System Architecture Design (Architecture TA)**

**System Design (SE, CM, T&E, Logistics, Interoperability TA)**

**System Development (System/Domain TA)**

**System Integration (System TAs)**

**System Verification and Validation (T&E TA)**

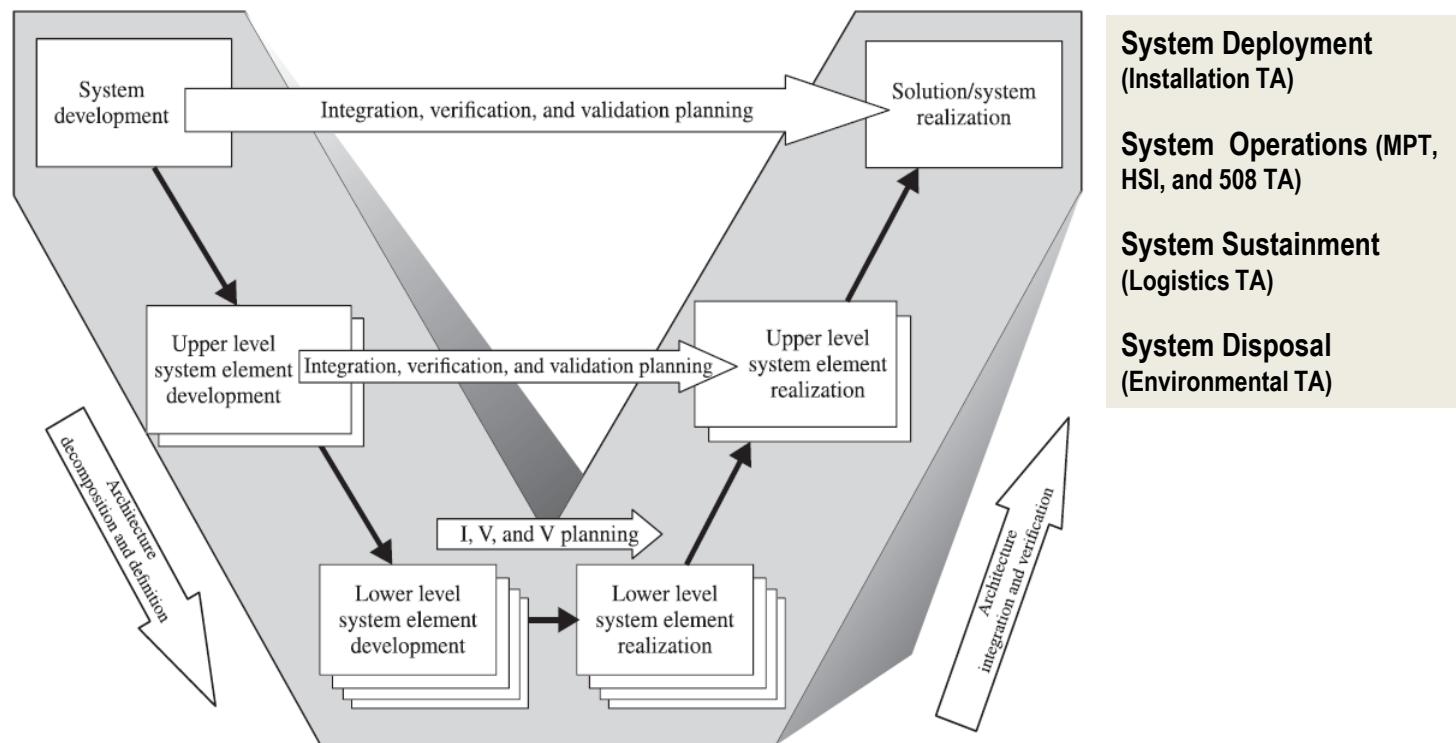


FIGURE 2.6 The SE Vee model. From Forsberg, et al. (2005) with permission from John Wiley & Sons. All other rights reserved.

# Challenges to Technical Authority

- ▼ The Program Manager has the final say (They control the \$\$\$)
- ▼ Pressures due to schedule and cost
- ▼ Cognitive Bias “We’ve always done it this way with no problems”
- ▼ No prior history of failures (not including “near misses”)
- ▼ Unclear governance and oversight
- ▼ Requirements compliance (can vary across states/countries)
- ▼ Changing technology
- ▼ Poor articulation of risk
- ▼ Business and Technical needs not aligned or not well understood



# Establishing Technical Authority in your Organization

▼ You may need TA, you may not. If you do, here are some thoughts:

- Define the roles and scope of authority, responsibilities, and decision processes
- Find the right personnel with extensive expertise or understanding of the technical areas
- Provide a reporting structure, preferably independent of the program manager
- Identify or develop the technical standards to use
- Create a plan for checks and balances (reviews, audits, validations)
- Use them to foster continuous improvement (training, knowledge sharing)
- Manage change effectively; avoid compromising the project
- Ensure clear communications and effective collaboration

# Using Technical Authority for Complex Projects

- ▼ A **complex system** has elements, the relationship between the states of which are weaved together so that they are not fully comprehended, leading to insufficient certainty between cause and effect.

*(Complexity Primer for Systems Engineers, 2021, INCOSE)*

- ▼ TA provides diversity in the expertise, experience, knowledge, skills and abilities

|  | Requirements Elicitation and Derivation   | Trade Studies  | Solution Architecture and Design  | Development Process   |
|--|---|--|---|---|
| <b>Complexity in the Environment General</b>   | <p>Use multiple methods for requirements elicitation.</p> <p>Elicit requirements from multiple perspectives and at multiple levels of aggregation.</p> <p>Emphasize capture of system objectives and desired outcomes rather than thousands of detailed requirements.</p> | Emphasize robustness over local efficiency and performance.  | Include both positive and negative feedback mechanisms to provide mechanisms to compensate for the effects of higher-than-linear positive feedback and runaway system behavior.   | Employ soft systems methodologies to surface the nature of the problem space, its internal structure and information flows, and produce simple representations, for example 'rich pictures' to communicate these. |
| <b>Intricate and Evolving/Self-Organizing Interactions with the Environment</b>  | Include requirements for the system to provide adaptive local control, rather than strong, deterministic control.   | Trade end-to-end system performance and behavior against problem space complexity. Think hierarchy rather than flat networks.                | Early implementation (or at least prototyping) of external interfaces.  | Early deployment of system functionality with feedback to developers.   |
| <b>Environment Susceptible to "Black Swan" Events (Unlikely, Unpredictable, High-Consequence Events) and/or Recursive Complexity</b> | <p>Use power laws rather than Gaussian distributions to characterize phenomena in requirements and sell-off criteria.</p> <p>Focus requirements elicitation on resiliency, robustness and adaptiveness vice optimizing to particular assumptions.</p>                     | Make resilience a key trade-space attribute and use trades to identify aspects of the problem space that will drive the system architecture. | Design for resilience to "beyond-design-envelope" events to provide robustness and timely recovery to a minimally functional state.   | Resilience analysis. Enterprise development: study how enterprises or societies survive catastrophes.   |
| <b>Complexity in the Problem/Mission</b>   | <p>Emphasize identification of constraints as well as requirements.</p> <p>Capture scenarios and mission threads in preference to large numbers of requirements.</p>  | Use scalability and agility as criteria in appropriate trade Studies.  | <p>Use solution elements which are adaptable and/or reconfigurable.</p> <p>Design to achieve scenarios rather than detailed requirements.</p> <p>Satisfy at the system level rather than satisfy detailed requirements.</p> | <p>Use Agile, evolutionary systems engineering processes instead of Waterfall systems engineering processes. Define multi-layer processes and their interface points.</p>   |
| <b>Complexity in Stakeholder Relationships</b>   | Use multiple scales (or a Balanced Scorecard approach) instead of a single utility function to determine "goodness" or fitness for use.   | Seek stakeholder buy-in to trade studies.  | Use modeling and simulation to enable stakeholders to experience (rather than just be briefed about) interactions of solution elements and the environment.   | Employing a multi-methodological approach, for example, soft systems methodologies plus systems engineering plus boundary critique, to identify stakeholders and achieve buy-in.                                  |

Table 3 A Complexity Primer for Systems Engineers, 2021, INCOSE

# Early Planning

- ▼ Use TA to perform Requirements Analysis and understand the challenge (or opportunity) as much as possible
- ▼ Bring in diversity of expertise (mission TA, platform TA, system(s) TA. Understand the planned life cycle and define the unknowns
- ▼ Collaborate with project manager to understand the parameters for cost, schedule and performance. Define the knowns
- ▼ Create use cases, scenarios, mission threads, and abstract models to gain understanding

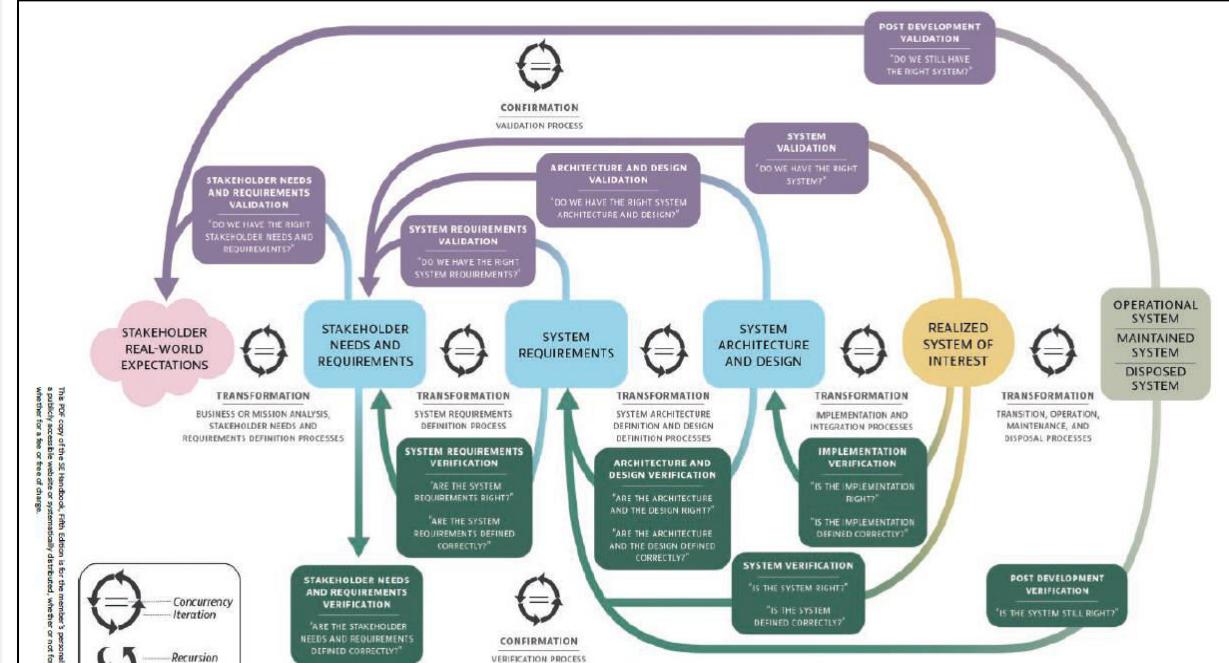
|                                   | Requirements Elicitation and Derivation  | Trade Studies  | Solution Architecture and Design  | Development Process  |
|-----------------------------------|--|--|---|--|
| Complexity in the Problem/Mission | <p>Emphasize identification of constraints as well as requirements.</p> <p>Capture scenarios and mission threads in preference to large numbers of requirements.</p> | <p>Use scalability and agility as criteria in appropriate trade Studies.</p> | <p>Use solution elements which are adaptable and/or reconfigurable.</p> <p>Design to achieve scenarios rather than detailed requirements.</p> <p>Satisfice at the system level rather than satisfy detailed requirements.</p> | <p>Use Agile, evolutionary systems engineering processes instead of Waterfall systems engineering processes. Define multi- layer processes and their interface points.</p> |

# Design and Development

▼ Use Systems, Interface, Interoperability, Cyber, CM, HSI, Training and other TA to:

- Employ modeling and experimentation to ensure relevant effects of trades are explored at different levels of aggregation
- Conduct development activities always within context of the whole
- Perform prototyping and holistic testing to explore and check for emergent behavior

▼ Use SoSE methodologies to synchronize constituent systems

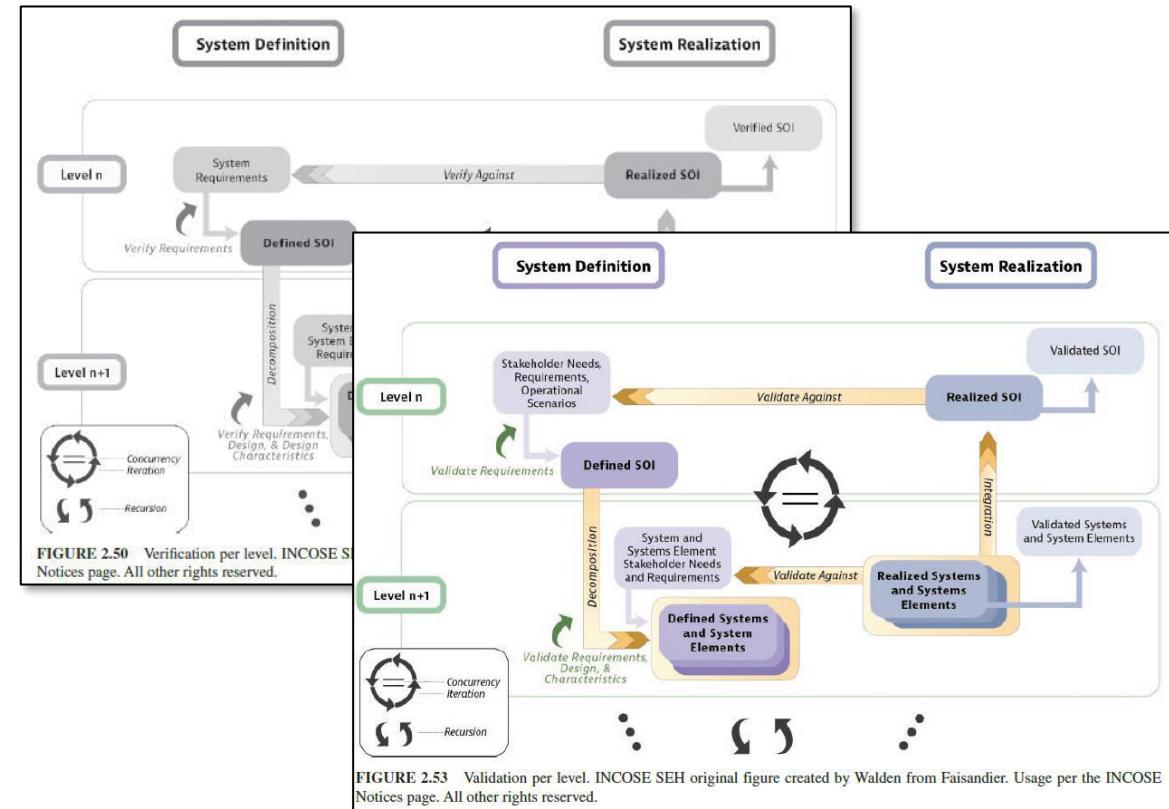


Systems Engineering Handbook V5, 2023, INCOSE)

# Integration, Verification and Validation

▼ Use Systems, Interface, Interoperability, Cyber, T&E and other TA to:

- Conduct IV&V activities always within context of the whole
- Use prior M&S work to find potential emergent behavior to test (eliminate surprises and risk)
- Focus on the interfaces, minimize change there
- Think about a build, test, build approach with smaller, faster cycles



▼ Use SoSE methodologies to synchronize constituent systems

(SEHB V5, 2023, INCOSE)

# Deployment and Sustainment

- ▼ Utilize TA familiar with the deployment, operations and sustainment phases
- ▼ Use this to evaluate the deployment plans and proposed execution. Does it fit the agreed upon life cycle model, does it meet the users/stakeholders needs, how will it be sustained (replacement, upgrades?)
- ▼ Spare parts, repair parts, training, manpower, personnel, modernization/upgrades, support (local / remote)

|   | Requirements Elicitation and Derivation   | Trade Studies   | Solution Architecture and Design   | Development Process   |
|---|---|---|--|---|
| Complexity in System Deployment & Operation | <p>Employ soft systems methodologies to surface the nature of the deployed solution, and its internal structure and information flows; produce simple representations, for example, 'rich pictures' to communicate these.</p> <p>Use problem definition methods from an evolutionary systems engineering or SoSE methodology.</p> | <p>Trade criteria need to value cost and ease of training and logistical support over acquisition cost. Model system evolution with genetic algorithms.</p> | <p>Use self-organizing and self-repairing elements when possible. Model the cost of change, the benefits, and the balance.</p> | <p>Employ soft systems methodologies to surface issues, engage stakeholders, identify approaches to improve the deployed system, and to achieve stakeholder buy-in to the solution.</p> <p>Use an evolutionary systems engineering or SoSE methodology.</p> <p>Identify utility and cost of using and modifying legacy systems.</p> |

# End of Life / Disposal

- ▼ Start with the end in mind (Covey). What should be done with the system which it has reached end of life
  - Repurpose / Reuse
  - Donate
  - Recycle
- ▼ Environmental TA can assist to ensure any compliance requirements are known, understood and planned for
  - Think about Zero Footprint, Zero Emissions, creating a Circular Economy





## Summary

*Effective Technical Authority supports Systems Engineering to build the right system(s) the right way*