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Pittsburgh, PA 15213-3890

# **System of Systems Navigator: Managing the Challenges of Systems of Systems**

Lisa Brownsword  
Dennis Smith

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## Drivers for Change

- No one stakeholder group or individual has complete, global SoS insight
- Distributed orchestration (rather than central control) is essential
- SoS capabilities and properties emerge from cumulative, indirect effects of local actions and near neighbor interactions
- Broader set of stakeholders, including users, are directly involved throughout the life of a SoS
- Local decisions and reward systems are tempered by understanding of SoS purpose and goals
- Uncertainty and change are proactively and continuously managed

SoS paradigm: “think globally when act locally”



## Why SoS Navigator?

Organizations need approaches

- To rapidly identify the barriers and enablers to achieving and maintaining interoperability across complex systems of systems
- To determine what corrective actions to take
- To successfully introduce new management and engineering paradigms and techniques for SoS
- That form sustainable environments – not short-term fixes
- That are repeatable



## What is SoS Navigator?

Collection and codification of essential practices for building large scale systems of systems

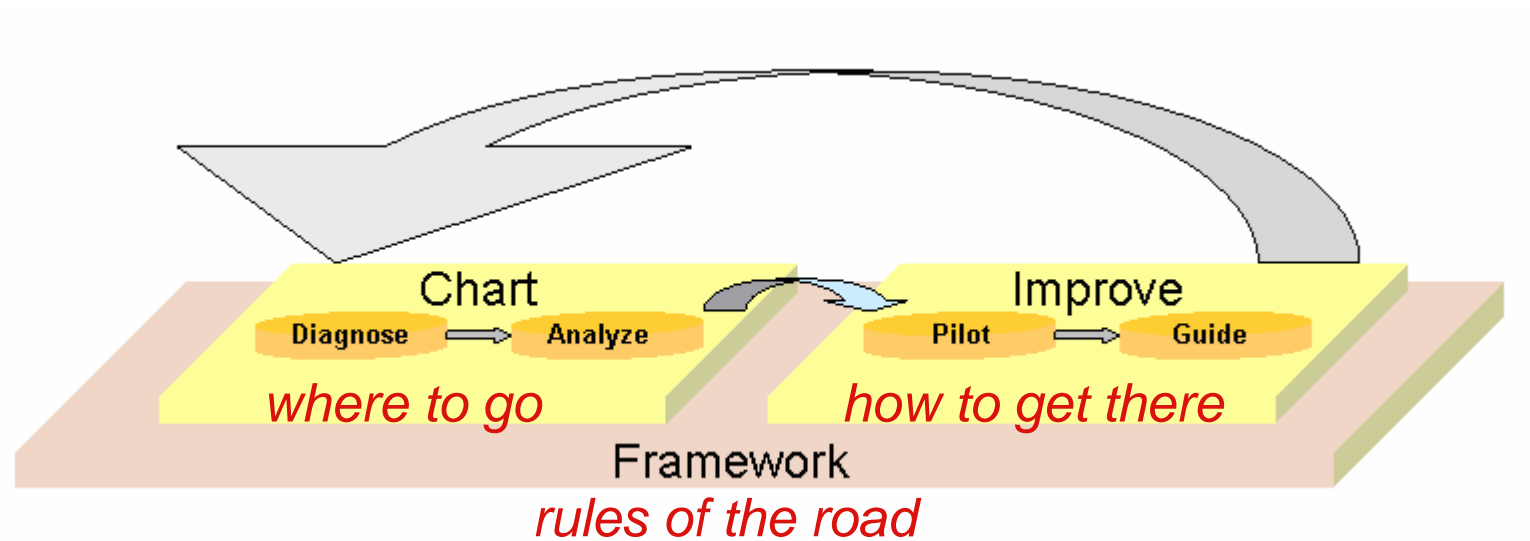
- Leverages work from many communities, including outside of system and software engineering
- Applies to a spectrum of systems of systems types
- Will continue to grow and be refined to incorporate new information

Tools and techniques to

- Characterize organizational, technical, and operational enablers and barriers to success
- Identify improvement strategies
- Pilot and institutionalize these strategies



# SoS Navigator



# Elements of SoS Navigator

## *Chart* (where to go)

- **SoS Diagnose** – identifies and characterizes enablers and barriers for a particular system of systems
- **SoS Analyze** – applies the SoS Framework to the information uncovered during SoS Diagnose to identify improvement strategies for the system-of-systems effort

## *Improve* (how to get there)

- **SoS Pilot** – demonstrates and prototypes selected system-of-systems practices in a particular system-of-systems context
- **SoS Guide** – provides mechanisms to institutionalize improvements of systems-of-systems practices across stakeholders of a system of systems

**SoS Framework** (rules of the road) – codifies core paradigms, principles, processes, and techniques associated with effective systems-of-systems



# SoS Framework

Categories of core paradigms and principles

- System-of-systems context
- System-of-systems perspectives
- System-of-systems organizational entities
- Unbounded nature

Processes, methods, and techniques

- Process drivers
- Interoperability maps
- Tactics to guide actions and interactions among constituents



# Chart

SoS Diagnose and SoS Analyze collectively provide approaches to understand the current state of a system of systems and determine necessary improvements

Objectives: provide stakeholders associated with a specific system of system with

- Profile of constituents and primary patterns of relationships
- Barriers and enablers to achieving desired system of system interoperation
- Recommended actions to enhance success

A Charting team performs SoS Diagnose followed by SoS Analyze



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# SoS Diagnose

Assists organizations in the identification and characterization of key enablers and barriers to achieving and maintaining required levels of interoperability

Gathers information about the constituents and the most important relationships

- Series of structured discussion sessions/workshops with stakeholders representing the multiple perspectives
- Quantifiable data and other documented information
- Interoperability maps

Composed of two phases

- Context Setting
- Data Gathering



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# SoS Analyze

Uses information gathered with SoS Diagnose, including the interoperability maps, to look for root causes and patterns

## Objectives

- Characterize enablers and barriers to interoperability and effective system of system operations
- Identify potential system of systems “practices gap”
- Form recommended actions
- Determine next steps to initiate the action planning activities of SoS Pilot (what could be done, who should be involved in actual action planning)

## Composed of two phases

- Data analysis and findings
- Recommendations and results



# Improve

## Motivation:

- Lists of recommendations are insufficient for many organizations to enact and effectively derive improvements
- Many recommendations from SoS Analyze demand significant cultural and process changes
- Experience shows that explicit planning and management of improvements produces more effective results

## Objectives:

- Plan, execute, and manage an implementation roadmap for the recommendations
- Prototype and validate new approaches within the system of systems environment
- Perform necessary adaptations for the specific environment
- Determine viable rollout strategies to broader use
- Manage and monitor effectiveness of new approaches in use

A given system of systems will iterate between SoS Pilot and SoS Guide to enact the recommendations from SoS Analyze



# SoS Pilot

Builds upon

- Information, findings, and recommendations from SoS Analyze
- Paradigms, practices, and techniques of SoS Framework

Objectives:

- Form a new or revise an existing improvement roadmap
- Demonstrate, prototype, and pilot the use of new practices in the specific system of systems context
- Adapt system of systems practices as necessary for the local environment
- Gain commitment to proceed further



## SoS Guide

Expand use of practices demonstrated in SoS Pilot to entire range of organizations of a system-of-systems

### Objectives:

- Characterize organizational readiness for cultural and organizational assumptions of SoS Framework
- Characterize adoption risks
- Create institutionalization plan to broader community
- Create or expand change infrastructure across the broader community
- Execute institutionalization plan
- Monitor effectiveness of adopted practices and recommend adjusts when necessary

SoS Guide leverages traditional improvement strategies but work is needed to expand these to work better in large multi-organization environments of systems of systems



## In Summary - SoS Navigator

Is an integrated set of practices to address the challenges of effective interoperability in a large system of systems context

- Core set of paradigms and principles, along with techniques and processes

Helps organizations

- Chart a technical, organizational, and operational path through this system of systems environment
- Prepare for the demanding environments of future, internet-scale systems of systems

Will continue to evolve!



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## For More Information

[www.sei.cmu.edu/isis](http://www.sei.cmu.edu/isis)

Lisa Brownsword  
[llb@sei.cmu.edu](mailto:llb@sei.cmu.edu)

Dennis Smith  
[dbs@sei.cmu.edu](mailto:dbs@sei.cmu.edu)