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System of Systems Navigator Foundations: The Dual Challenge

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Agenda

Systems of Systems and Their Issues

SoS Navigator Product Suite

SoS Navigator Foundations

Summary

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Systems of Systems and Their Issues

Systems of Systems—Health IT Systems Example

Dynamic orchestrations and compositions of autonomously managed, operated, and evolving entities (both technical and organizational)

-That together create sets of desired effects for multiple users.

The effects are themselves dynamic and
-may or may not be part of the designed repertoire of behaviors of the individual entities

Implications of Systems of Systems

Dynamism of the participating entities and the effects they are trying to achieve and the environment they are working in

- The participating organizations need agility along multiple dimensions

- The demand environment – where you're trying to have an effect – is at least as dynamic as the supplier environment

Autonomy of both the technical and organizational entities

- The organizations participating are not likely to be operating by the same rules—they have different, often incompatible, *governance frameworks*

Effects that cannot be generated from the designed repertoire of individual entities and are *only seen in the system of systems as a whole*

- Unanticipated behaviors could be positive or negative

- Impossible to trace the behavior back to a single entity

Common Issues in Dealing with SoS

No Global View

Unanticipated System Behaviors

Capabilities can't keep up with needs

Unknown Participants

Synchronization Challenges

Latent Incompatibilities

"Common" Terms are understood differently

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SoS Navigator Product Suite

SEI's SoS Navigator Product Suite
Dealing with Multiple Aspects of the SoS Challenges

SoS Navigator provides a context - sensitive approach to finding and introducing practices beneficial to working in a SoS context

SoS Navigator provides activities, tools and techniques to

- Understand how a stakeholder's context affects *and is affected by* their participation in a SoS

- Understand how the agility needed in a particular demand environment is constrained by the SoS approach being used

- Identify risks within a particular context to working in a SoS environment

- Prioritize multi-dimensional solutions to enhance chances of success

- Support the adoption of solutions recommended for a particular SoS environment

SoS Navigator Product Suite
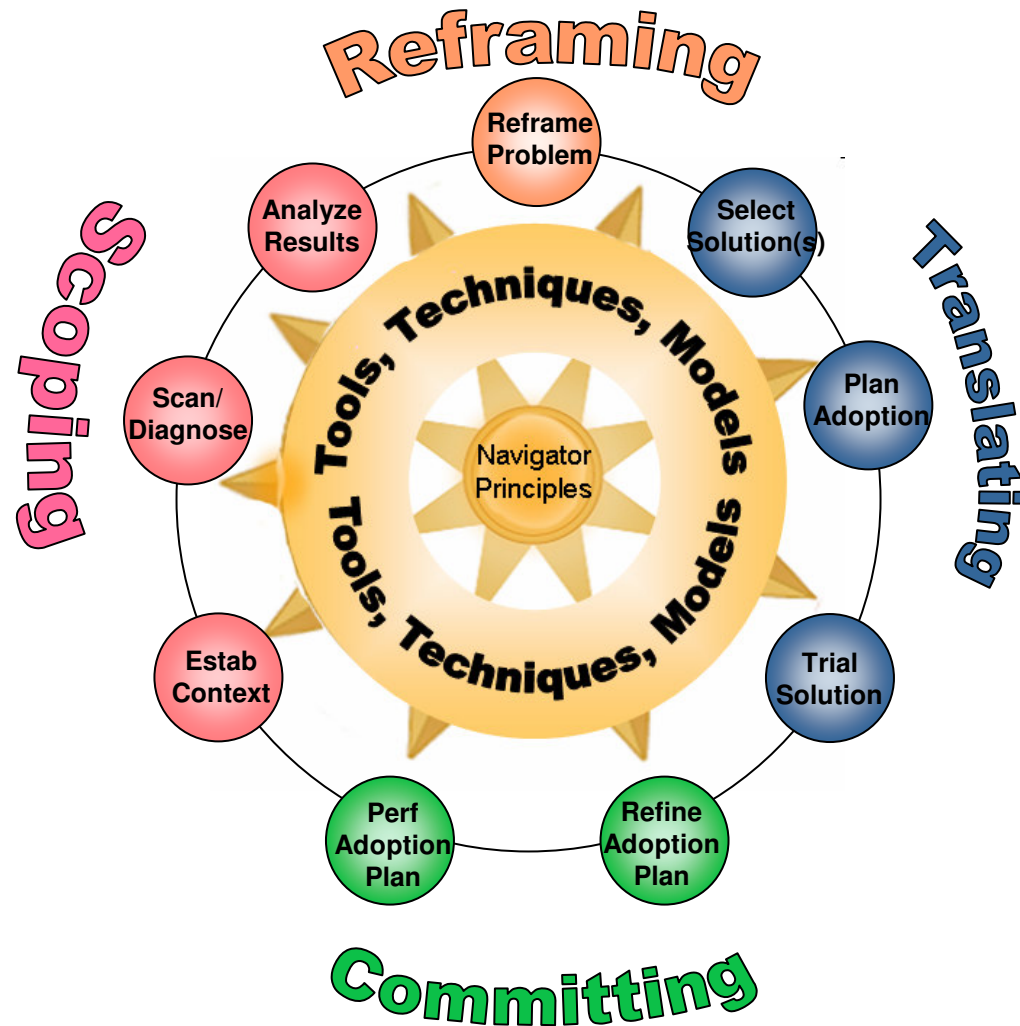
SoS Navigator is scoped to deal with complex, multiple enterprise SoS contexts

The Three Areas of SoS Navigator

SoS Navigator Improvement Cycle

- A set of activities to guide organizations through diagnosing and characterizing complex SoS challenges, selecting and prioritizing solutions to meet them, and supporting those solutions with robust adoption guidance
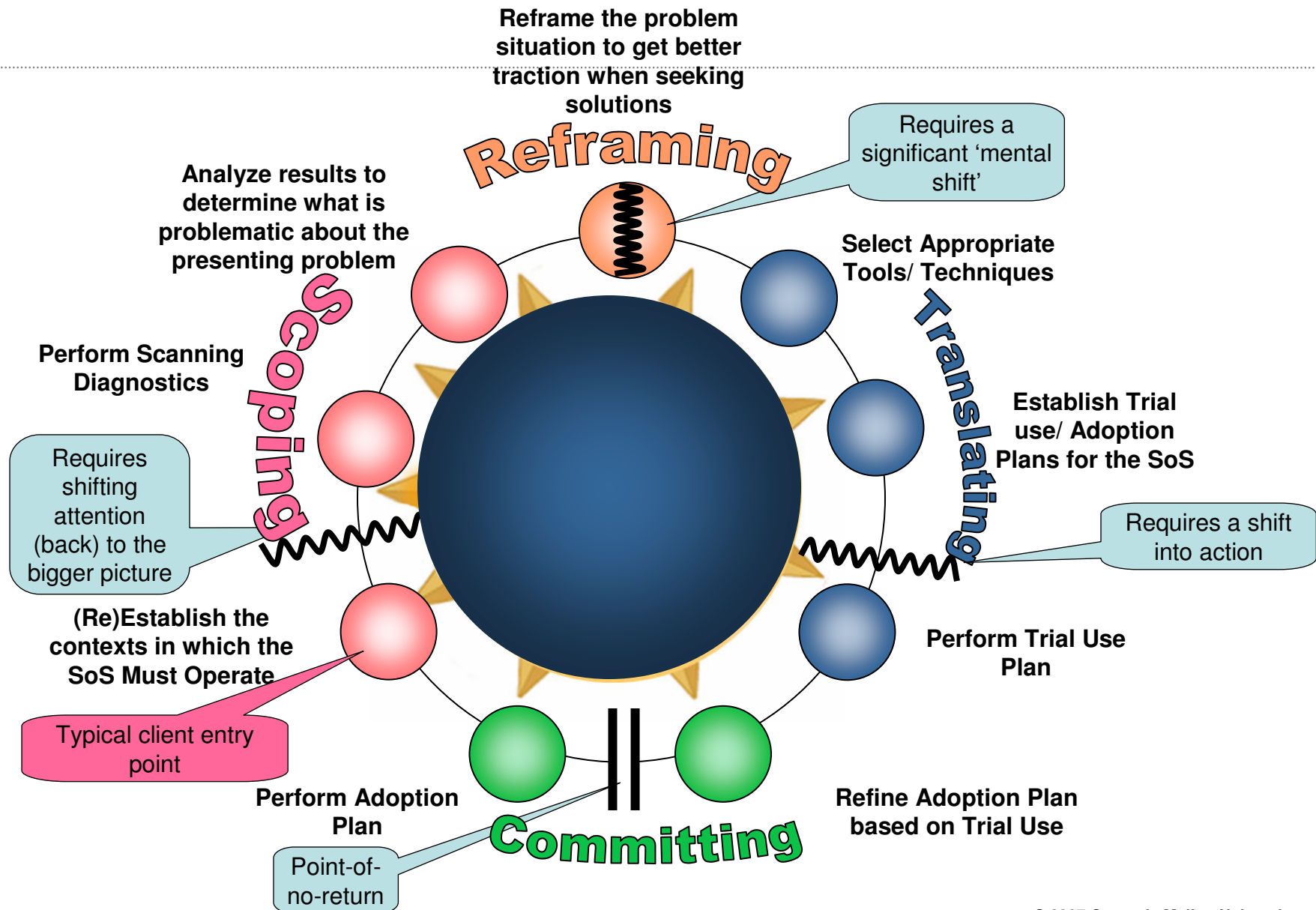
SoS Navigator Principles

- A set of SoS guiding principles used with SoS Navigator tools and techniques within the Navigator improvement cycle, that help organizations prioritize the changes they need to make to be more effective in their SoS context
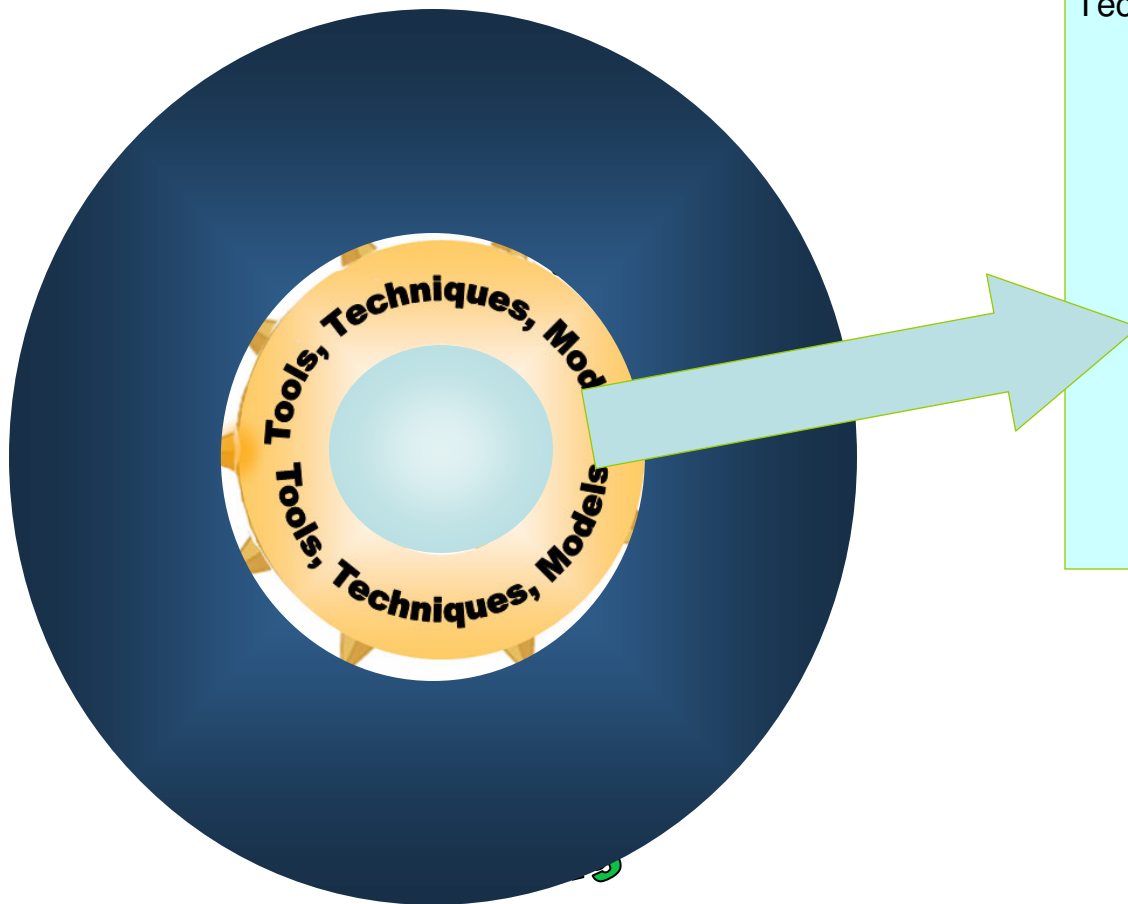
SoS Navigator Tools & Techniques

- A toolkit of tools and techniques that generally apply in multiple SoS contexts, particularly focused on scanning diagnostics and adoption support techniques tuned to systems of systems

Navigator Improvement Cycle

Reframe the problem situation to get better traction when seeking solutions

Reframing

Requires a significant 'mental shift'

Analyze results to determine what is problematic about the presenting problem

Select Appropriate Tools/ Techniques

Scoping

Translating

Perform Scanning Diagnostics

Establish Trial use/ Adoption Plans for the SoS

Requires shifting attention (back) to the bigger picture

Requires a shift into action

(Re)Establish the contexts in which the SoS Must Operate

Perform Trial Use Plan

Typical client entry point

Perform Adoption Plan

Committing

Refine Adoption Plan based on Trial Use

Point-of-no-return

Navigator Tools, Techniques, & Models

Navigator's Tools & Techniques

- Draw from multiple bodies of knowledge

- Support moving through a Navigator improvement cycle

- Can be used independently or in conjunction with other tools/techniques (e.g. CMMI)

- Are consistent with Navigator Principles

- Will eventually include a library of models that represent emerging patterns in SoS

Currently Envisioned Tools for SoS Navigator (likely to change as we evolve)

Diagnostic/Prioritization Tools:

- Organization Scanning Diagnostics (avail for piloting)

- Organizational Modeling Diagnostics (IM, PAN, available for piloting)

- Risk Analysis (avail for piloting)

Adoption Support Tools:

- Scenario Generation to Support Shared Understanding of Purpose (avail for piloting)

- Piloting and Adoption Support Planning (avail now)

- Readiness/Fit Analysis (avail now)

- Adoption Measurement (avail for piloting)

These tools are supplemented by other tools and techniques that support specific practices (e.g. engineering-focused, governance-focused, acquisition-focused)

Navigator Principles
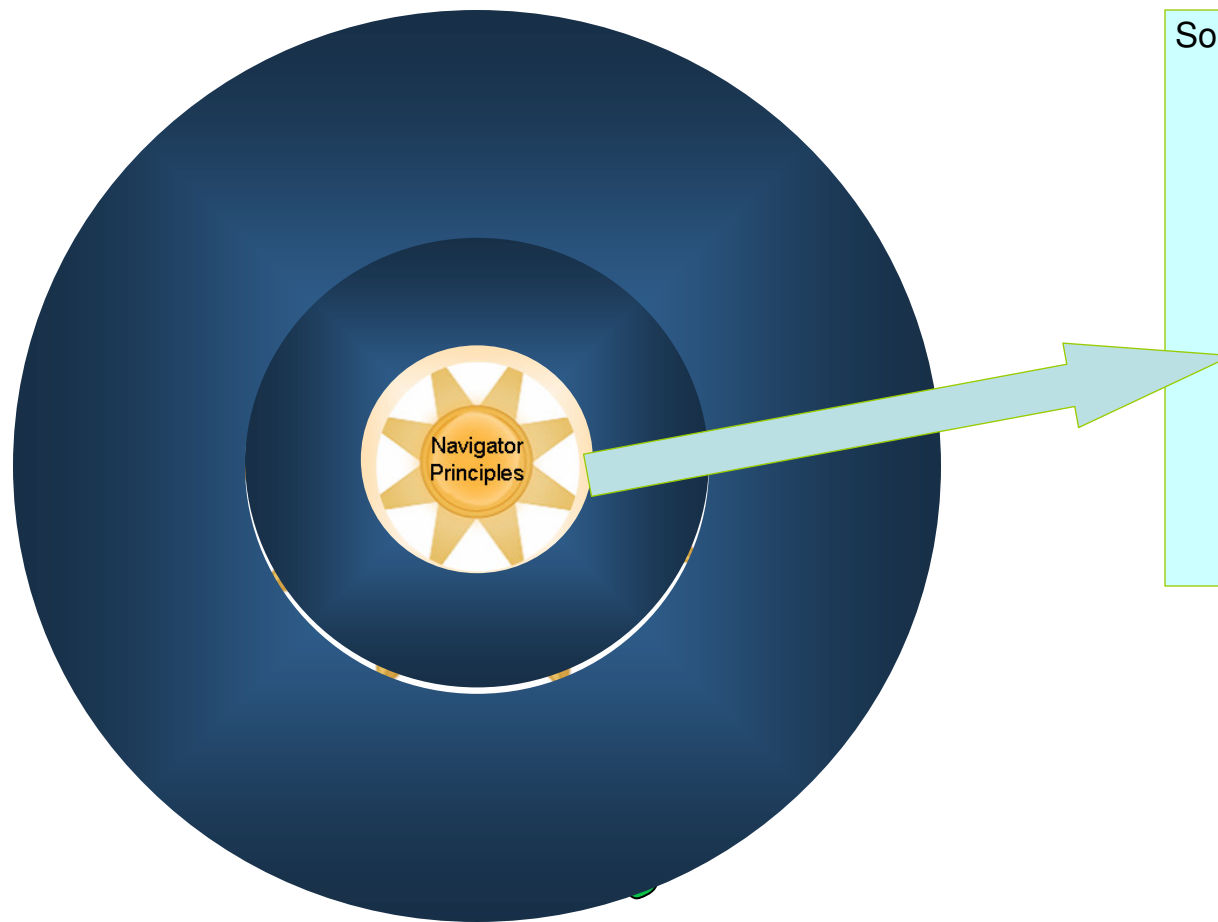
SoS Navigator's Principles

- Characterize different attributes of a SoS Context (i.e. "the double challenge")

- Support creating a profile of a SoS context

- Gaps between principles-in-use and Navigator principles are target areas for investigation

- Ultimately, Navigator principles layer could evolve into a catalog of recommended practices

Navigator Principles

Most of the rest of this presentation addresses foundational SoS principles that inform SoS Navigator

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SoS Navigator Foundations

Three Key Perspectives for Navigating Systems of Systems

Physical View
(product driven)

Situational View
(solution driven)

Effects-based View
(experience driven)

How do we get the platform with all the
relevant bits and personnel in the *right place*
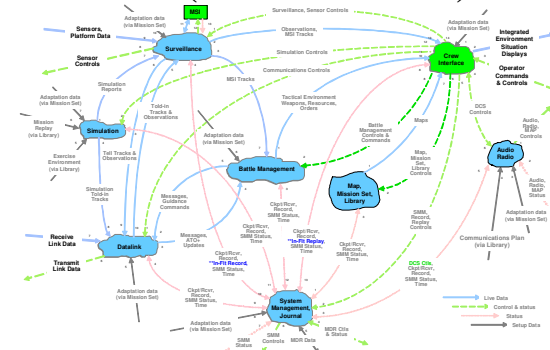at the *right time* and *keep it there*?

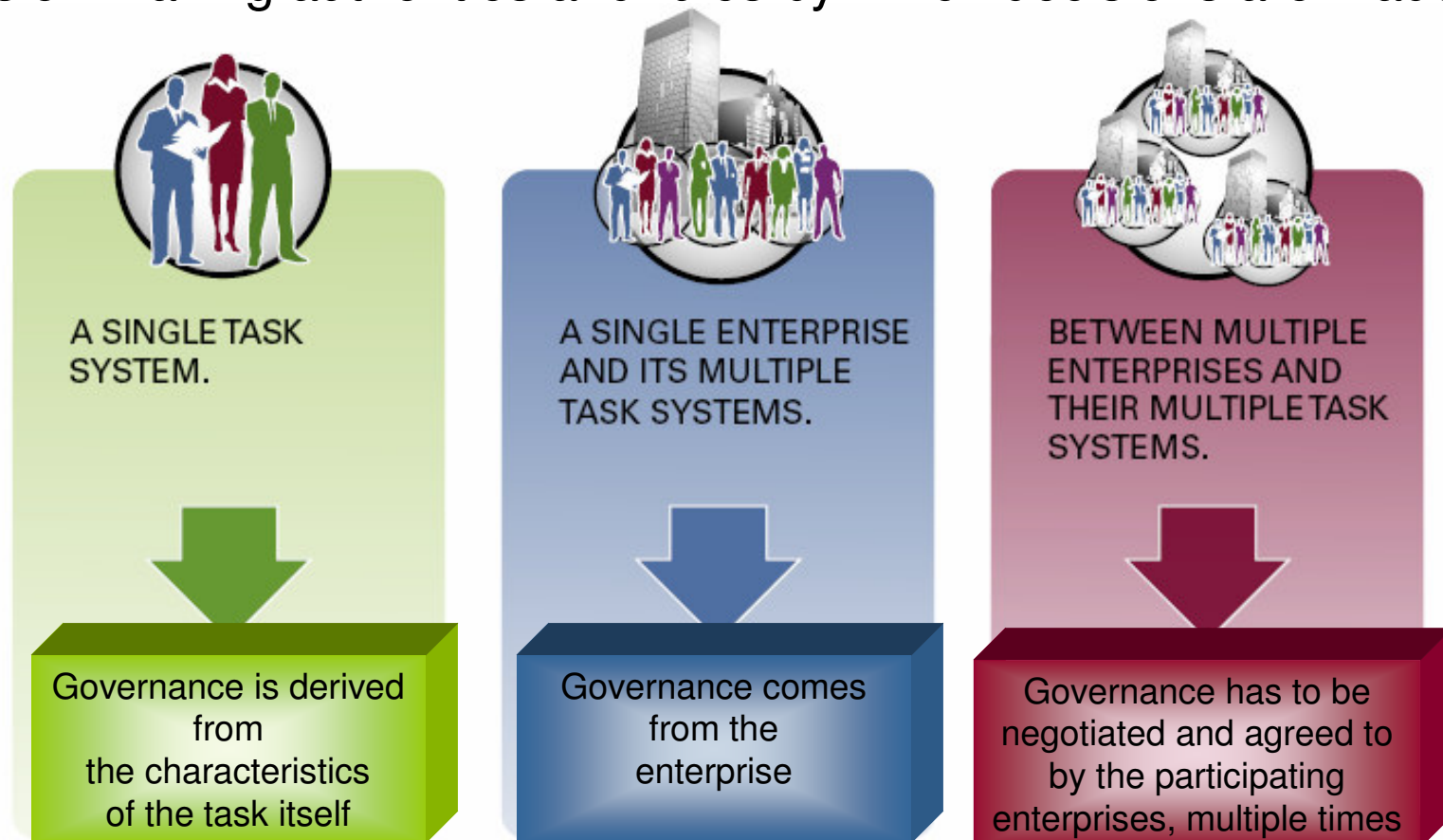How do we get all the systems working together
in such a way that the right pictures containing
the *right information* can be put in front of the
right decision-makers at the *right time*.

How do we draw upon the other two
perspectives in support of *generating desired
operational effects*.

We have traditionally addressed Physical and Situational Views, but consistently ignore Effects-Based Views

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Governance, Enterprises, and Conflict

Governance: the means by which an enterprise *secures the availability of capabilities* for its use when and where it needs them, including the decision making authorities and rules by which decisions are made

A SINGLE TASK SYSTEM.

A SINGLE ENTERPRISE AND ITS MULTIPLE TASK SYSTEMS.

BETWEEN MULTIPLE ENTERPRISES AND THEIR MULTIPLE TASK SYSTEMS.

Governance is derived from the characteristics of the task itself

Governance comes from the enterprise

Governance has to be negotiated and agreed to by the participating enterprises, multiple times
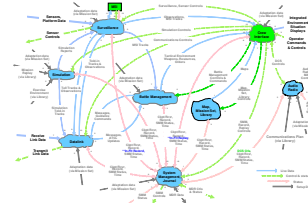
Where is Governance Needed?

To direct how the bits, bytes and systems get the right capabilities to the right places at the right time and keep them there

To direct how all the systems can work in concert to provide the right information to the right people at the right time
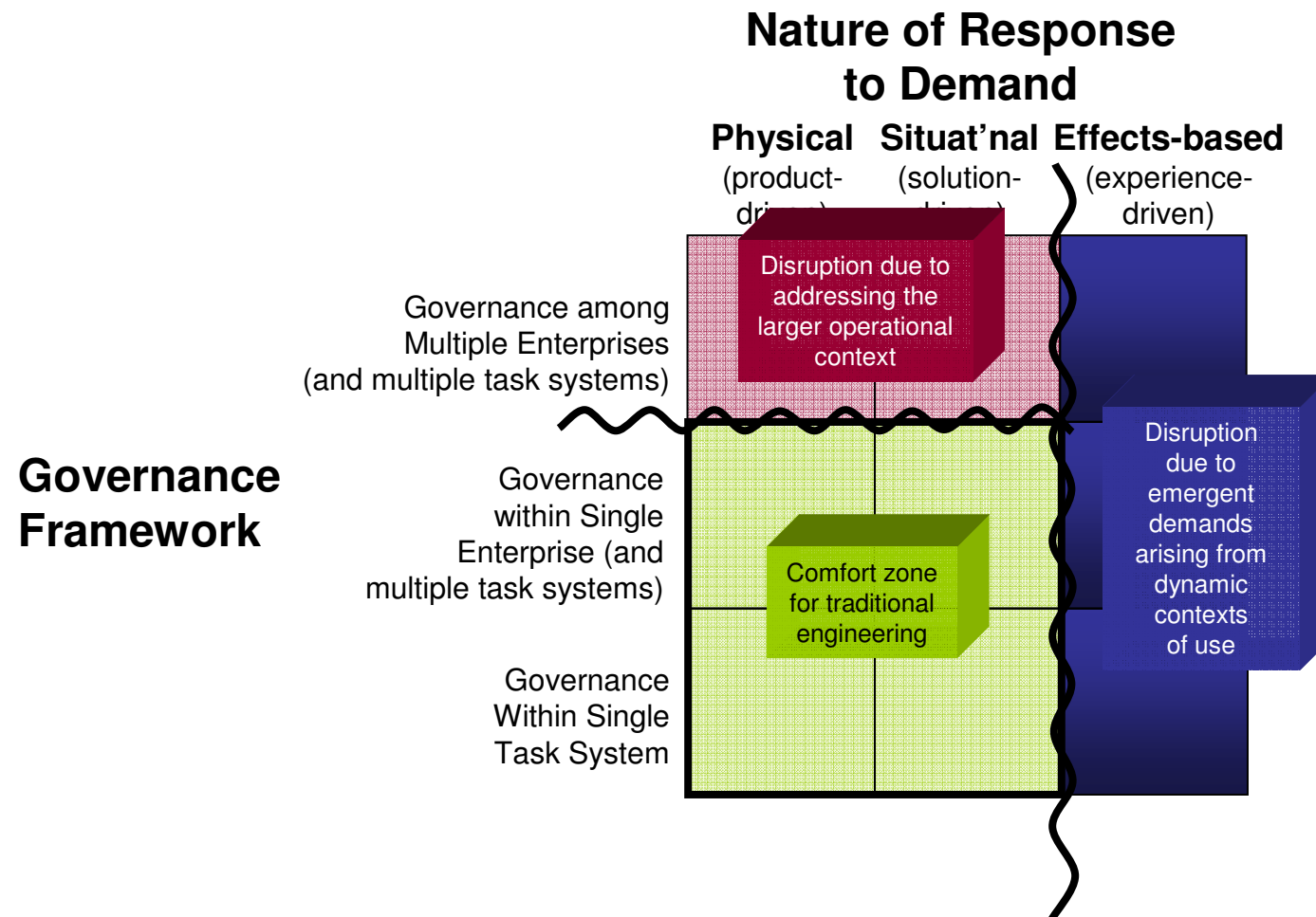
I - Physical View

II – Situational View

I – Effects-based View

To direct how physical and capabilities views can be drawn on to support an *effects-based view* of achieving desired operational effects

Complex SoS Take Us Beyond Our Traditional Comfort Zone…

Nature of Response to Demand

Physical (product-driven), Situat'nal (solution-driven), Effects-based (experience-driven)

Governance Framework

- Governance among Multiple Enterprises (and multiple task systems)
- Governance within Single Enterprise (and multiple task systems)
- Governance Within Single Task System

Disruption due to addressing the larger operational context

Comfort zone for traditional engineering

Disruption due to emergent demands arising from dynamic contexts of use

The 'double challenge'…

Nature of Response to Demand

Physical (product-driven)	Situat'nal (solution-driven)	Effects-based (experience-driven)

Governance Framework

Governance among Multiple Enterprises (and multiple task systems)

Governance within Single Enterprise (and multiple task systems)

Governance Within Single Task System

The first challenge: what form of governance framework is needed to include the relationship to the operational context?

The second challenge: how is the requisite level of agility to be made available in relation to the (asymmetric) demand environment?

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Summary

Intended Benefits of SoS Navigator

Tools and techniques based on SoS Navigator principles provide:

- Non-intuitive insights into ways your current strategy could be undermining your SoS efforts

- Tools and techniques to effectively communicate "the new reality" to your leadership and management staff

- Insights into how current practices and structures impact your ability to serve the dynamic environments you're interacting with

- Tools and techniques to help you successfully adopt new practices to support your system of systems efforts

- Ways of describing your evolving, dynamic environment and relating them to the SoS participants that you're working with

These can be used within an improvement cycle tuned to the unique challenges of complex systems of systems

How to Engage with SoS Navigator

The SoS Navigator team is looking for:

- Case study sites where effective SoS approaches are being used

  — To cull practice patterns and validate Navigator principles

- Pilot sites for Navigator's improvement cycle and tools and techniques

  — Long term engagements that allow us to exercise multiple elements of the improvement cycle and multiple tools/techniques are especially useful

- Affiliates willing to work closely with us (at least 50% Full Time Equivalent) to evolve SoS Navigator concepts, tools, techniques, and models

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Acronyms

SoS: System of Systems

IT: Information Technology

CMMI: Capability Maturity Model Integrated

IM: Influence Map

PAN: Projective ANalysis