

A Double Challenge in Software Requirements Management

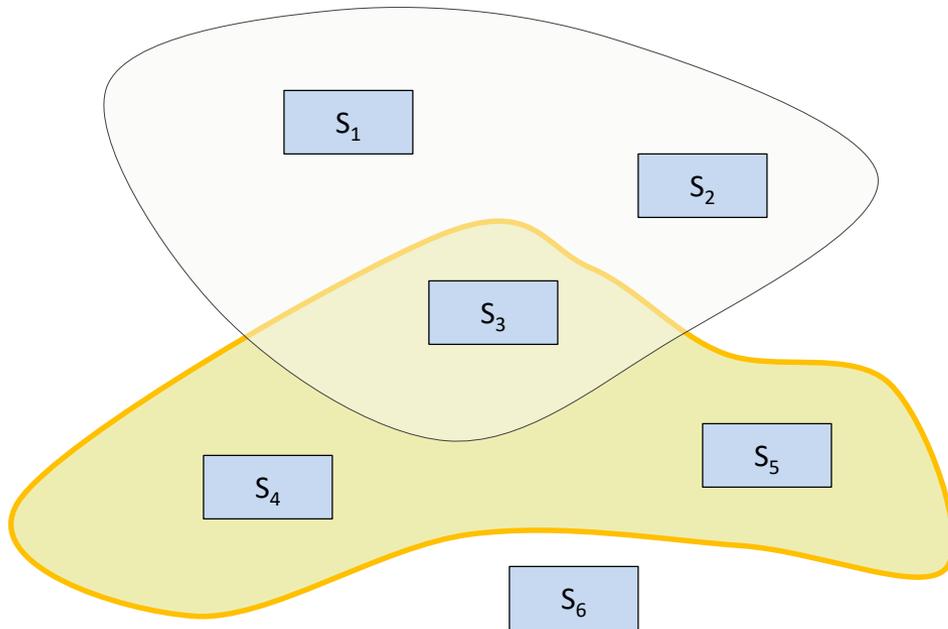
Presentation given
by Philip Boxer, Lisa Brownsword, and Dennis Smith
in
16 October 2007

Briefing Objective and Agenda

- Objective
 - Instigate an alternative way of viewing requirements in a system-of-systems context

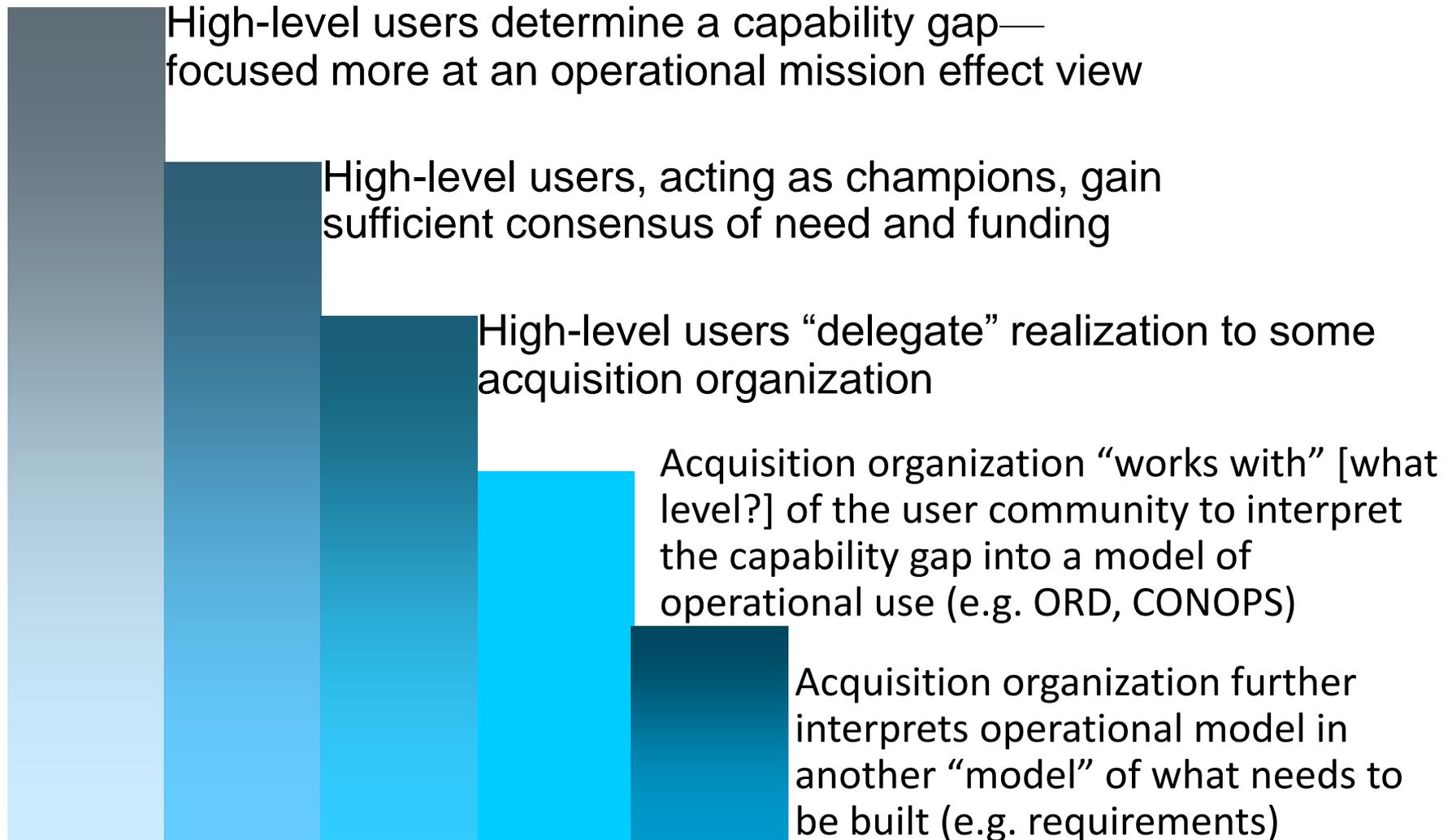
- Agenda
 - Explore implications of a changing world
 - Describe an alternative reasoning framework

Creating, Using, and Evolving Composites of Systems



- Which systems are likely candidates?
- Will they continue to be effective in the system of systems?
- Many of the systems are well into their acquisition life cycle
- Many systems were specified and built as “standalone” capability
- [trying to get a number of characterizations of a) how the world has changed and b) how people are viewing/working with systems, acquisition, requirements]

What We Typically Do Today - Formal Acquisition



What is Needed—Concept of “Operational” that Takes a Broader View

Multiple forms of (potentially non pre-determined) operational effects

Operational uses have to be addressed this level

Geometries of use

SoS orchestrations

Requirements

Solutions

Decomposition

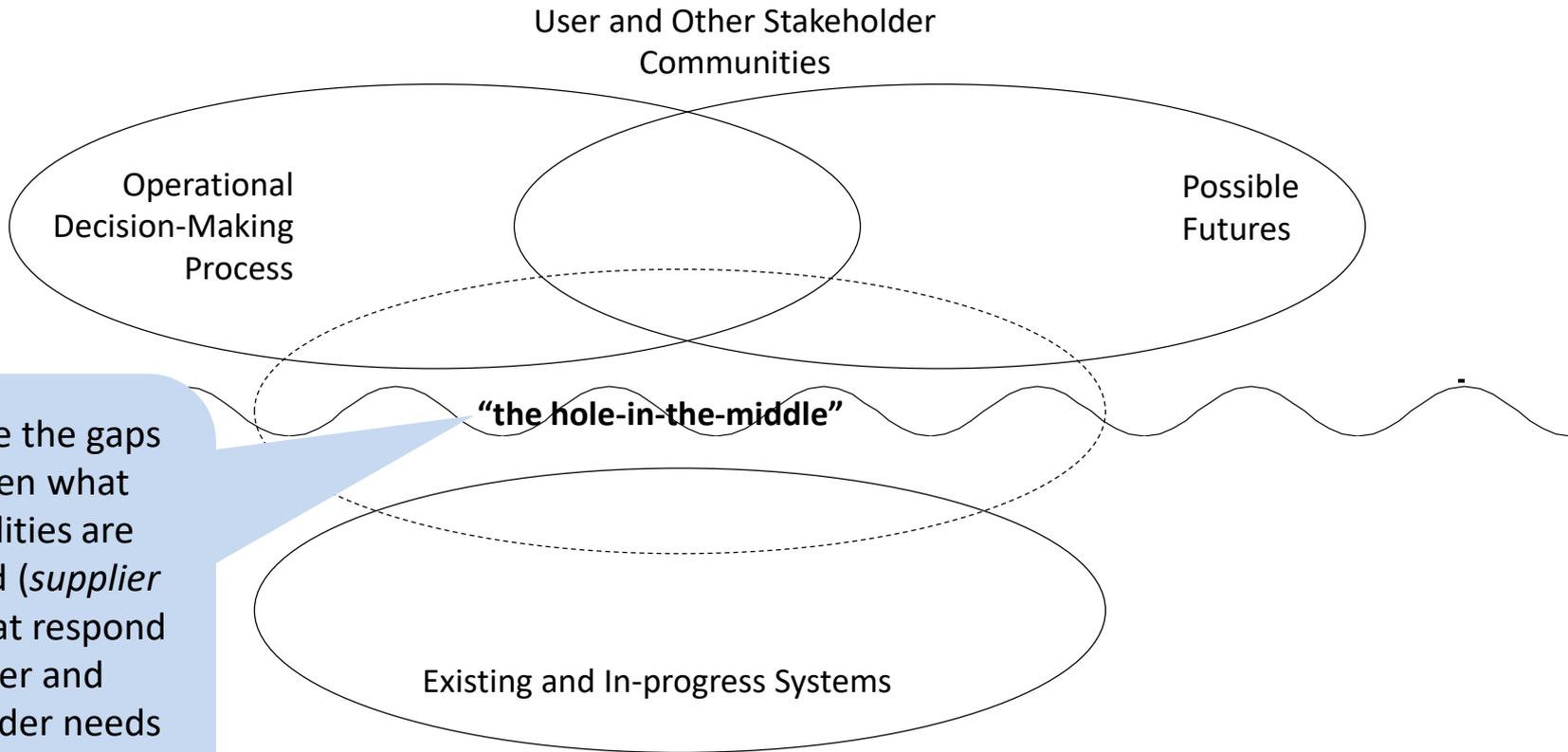
System integration

The programmatic and constructive deal with the bottom 'Vs'

System components

Source: <http://www.asymmetricdesign.com/2007/01/managing-the-sos-value-cycle/>

In Practice, There is an Increasing Lack of Alignment—a Hole-in-the-Middle



What are the gaps between what capabilities are provided (*supplier push*) that respond to user and stakeholder needs (*operational pull*)?

Key Challenge—How Entities Work Together and Resolve Conflicts

- Number, type, and roles of participants are increasingly diverse, reflecting differing vested interests.
- Scarce resources and the need for concurrent uses make a single decision authority increasingly unlikely.



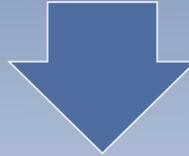
Single Task System



A single program directs composition
—little potential for conflict



Single Enterprise System



A real or virtual entity directs how multiple entities collaborate to compose multiple programs
—resolves potential conflicts by imposing constraints



Multi-Enterprise System



Multiple real or virtual directing entities making competing demands on SoS
—conflict resolution requires negotiating mutual constraints

Category names from “Architecting Principles for Systems of Systems”, by Mark W. Maier. <http://www.infoed.com/open/papers/systems.htm>

Key Challenge—Increasingly Turbulent Operational Contexts

- Customers and users want specialized solutions in ever shorter time frames continuously adapted to their changing and evolving situations.
- Suppliers and systems have to become more agile to respond.



Product-Based



Users want products or services that can be provided in a way that is unaffected by how they are used



Solution-Based



Users want integrated solutions that are customized to their context, but in a way that can be specified beforehand



Customer Experience-Based



Users want integrated solutions that are customized in ways that change and evolve throughout the life of the mission that they support

'Turbulence' as per "The Causal Texture of Organizational Environments", Emery F E and Trist E, Human Relations 1965, 18, pp 21-32.

Categories

A Double Challenge—Diversity of Participants with Turbulent Usage Contexts and Needs

1 - Collaborating effectively across boundaries



Disruption due to addressing the multi-enterprise governance context

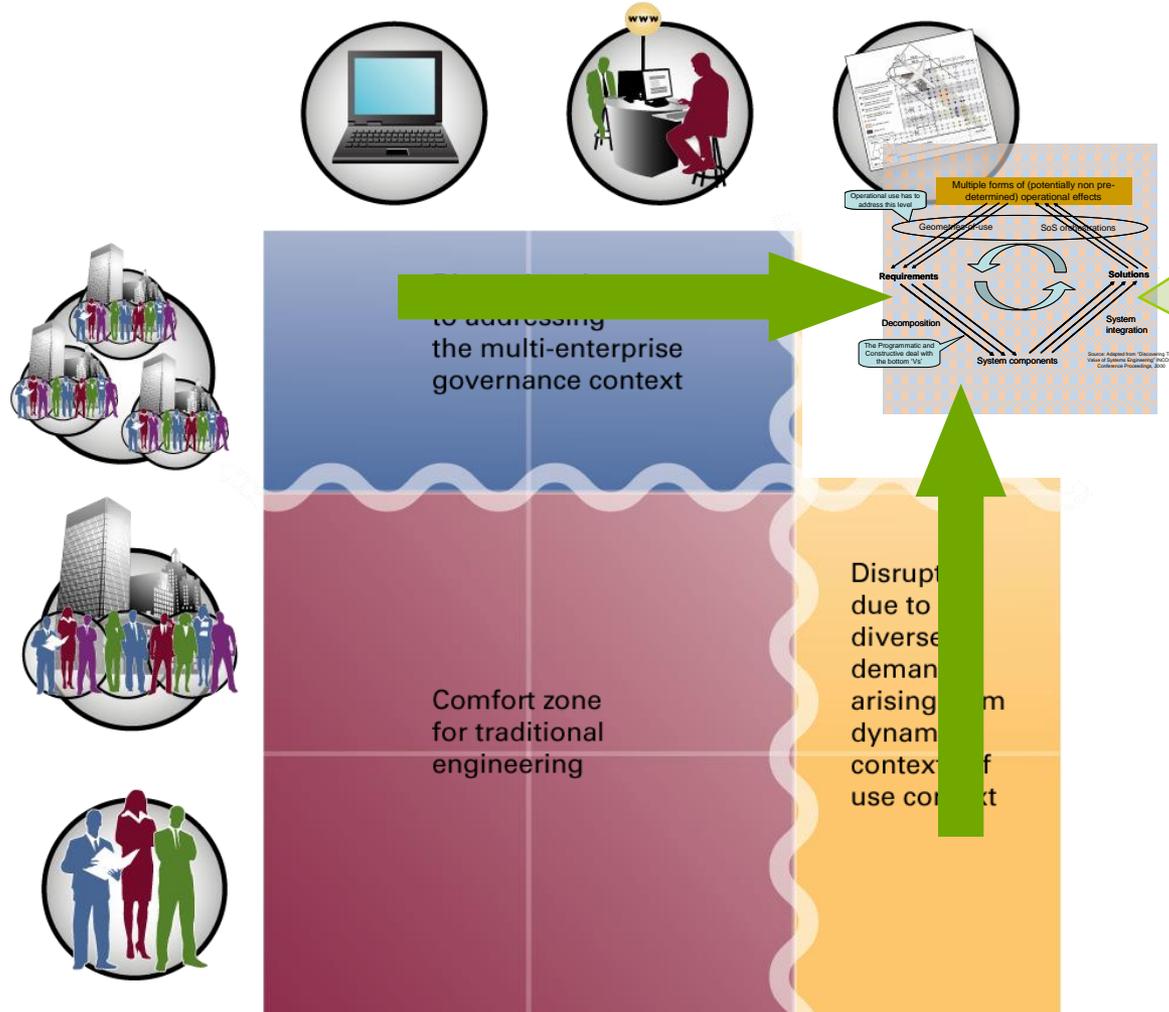
Comfort zone for traditional engineering

Disruption due to diverse demands arising from dynamic contexts of use context

2- Developing flexible responses to changing situations

Source: *The Double Challenge*, Philip Boxer, 2006;
<http://asymetricdesign.com>

What is Needed— Leveraging the Double Challenge



Collaborating across boundaries to provide flexible responses to changing situations

Agility

• What does it mean?

– Wikipedia

- “ability of a firm to sense and respond to business opportunities in order to stay innovative and competitive in a turbulent and quickly changing business environment”

– Microsoft (Future Foundation 2003)

- “the connected enterprise, and the talent to sense and respond to the outside world”

– Gartner

- “the ability of an organization to sense environmental change and respond efficiently and effectively to that change” (2006)
- “the ability to demonstrate flexible, efficient and swift responses to changing circumstances by maximising physical and human resources”

What is an agile organization?

- An **agile** organization (one that demonstrates *agility*) has the capabilities and processes to respond to environmental changes efficiently and effectively.
 - Environmental changes can be internal or external; technological, business, or mission; local or global.

Why is Agility Relevant?

- Traditionally, software-intensive system success characterized by managing
 - System development (primary): cost, risk, schedule
 - System functionality (secondary): functional and non-functional behavior
- In steady state environments (i.e., system functionality known and stable)
 - Agility in relation to the environment can be ignored
 - Can revert to the emphasis on system development rather than on system functionality
- In dynamic environments (i.e., system functionality driven from unanticipated and changing behaviors by the end user community)
 - Agility is **the** fundamental driver for implementation and fielding.
 - Primary emphasis is on functionality demanded.

Forms of Agility Required

Type II Agility:

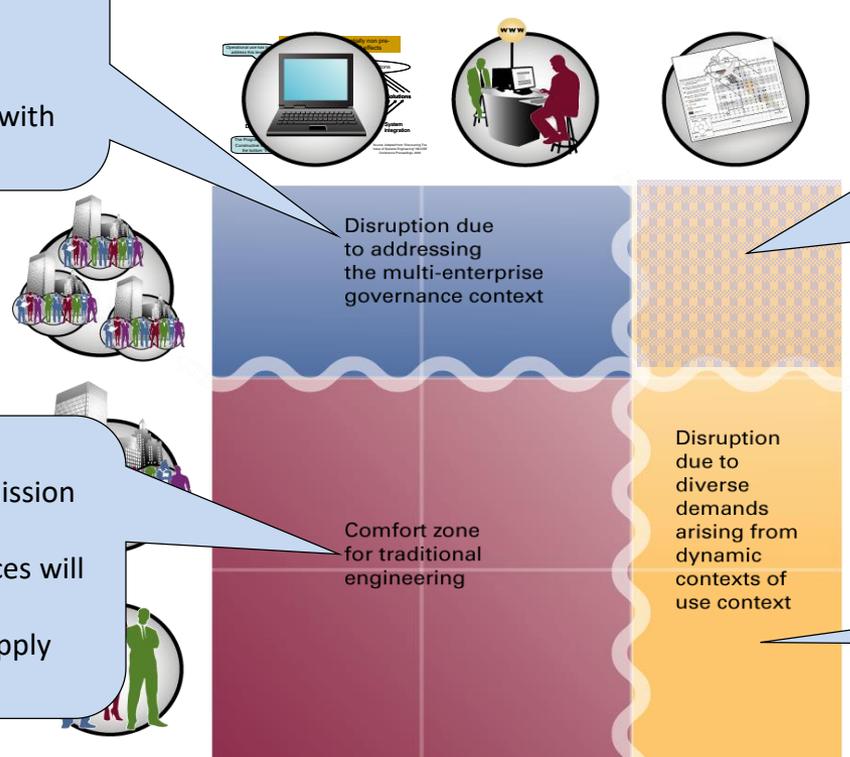
Anticipate the demands on the mission
 Anticipate how products or services will be used
 Multiple organizations each with its own form of command

Type III Agility:

Can't anticipate the demands on the mission
 Can't anticipate how products or services will be used
 Multiple organizations each with its own form of command

Type I Agility:

Anticipate the demands on the mission of defending against intrusion
 Anticipate how products or services will be used
 Ensure that managerial entities apply appropriate commands



Type I Agility + contingency planning

Mapping Agility Types to the Double Challenge



Multiple	Directed Collaboration (Type II Agility)	Distributed Collaboration (Type III Agility)	Multiple
Single	Directed Composition (Type I Agility)	Directed Composition (Type I Agility + contingency planning)	Single
	Single	Multiple	

**Operational
Models
Supported**

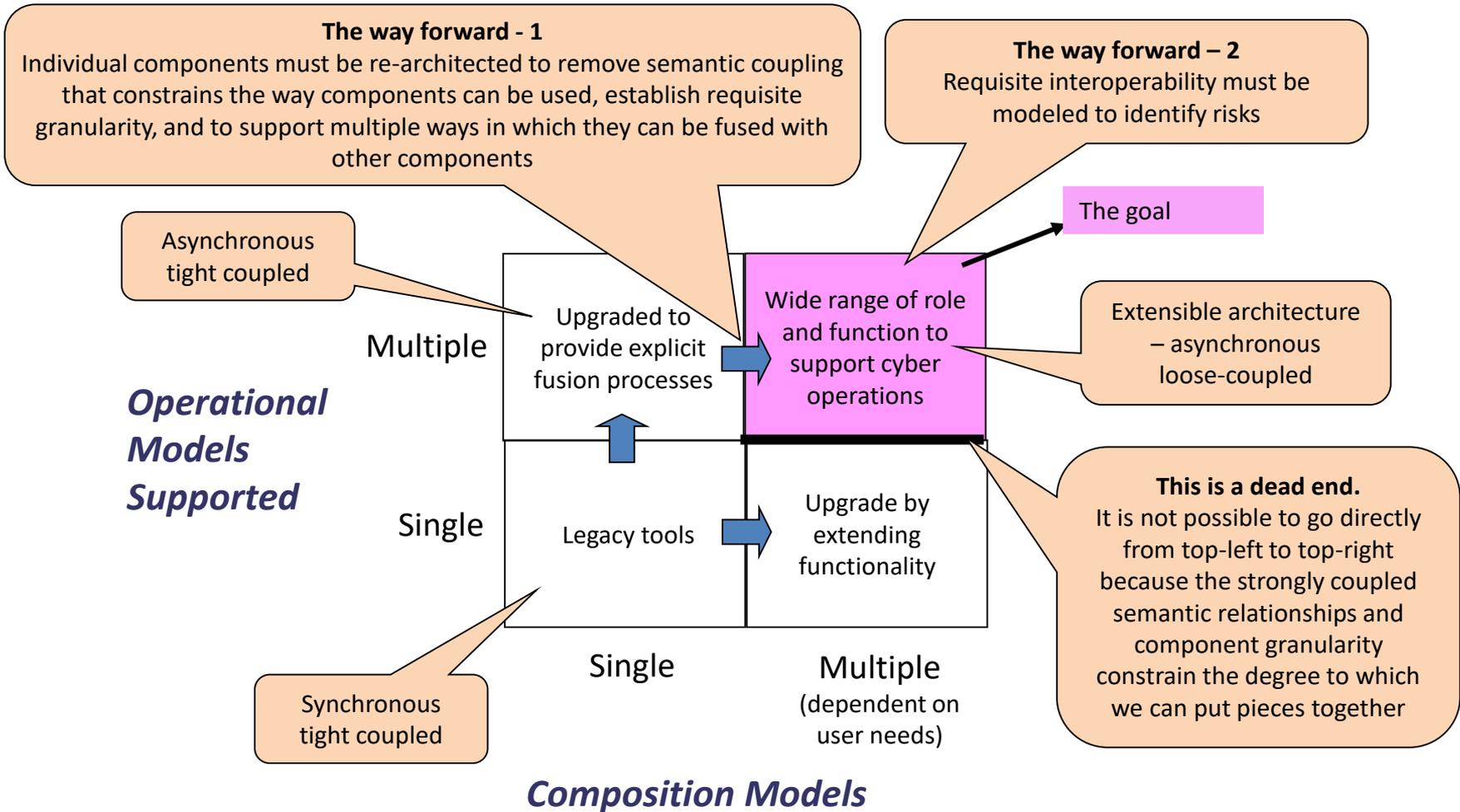
(dependent on user needs)

Composition Models

Forms of Collaboration from "Architecting Principles for Systems of Systems", by Mark W. Maier
<http://www.infoed.com/open/papers/systems.htm>

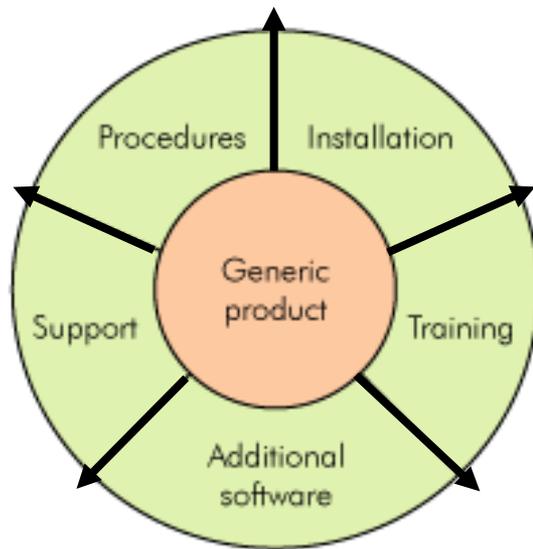


How Do We Get There?

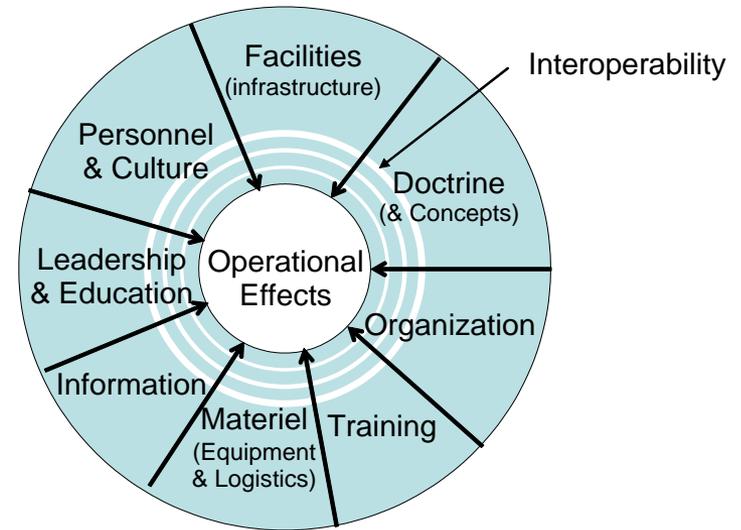


The Role of the Acquisition Organization

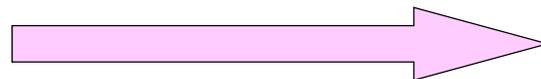
- Systems are developed one-by-one around particular problems and challenges, with varying degrees of adoption and take-up across client organizations.
 - The double challenge involves approaching this problem from the point-of-view of effects ‘pull’



Systems "Push"



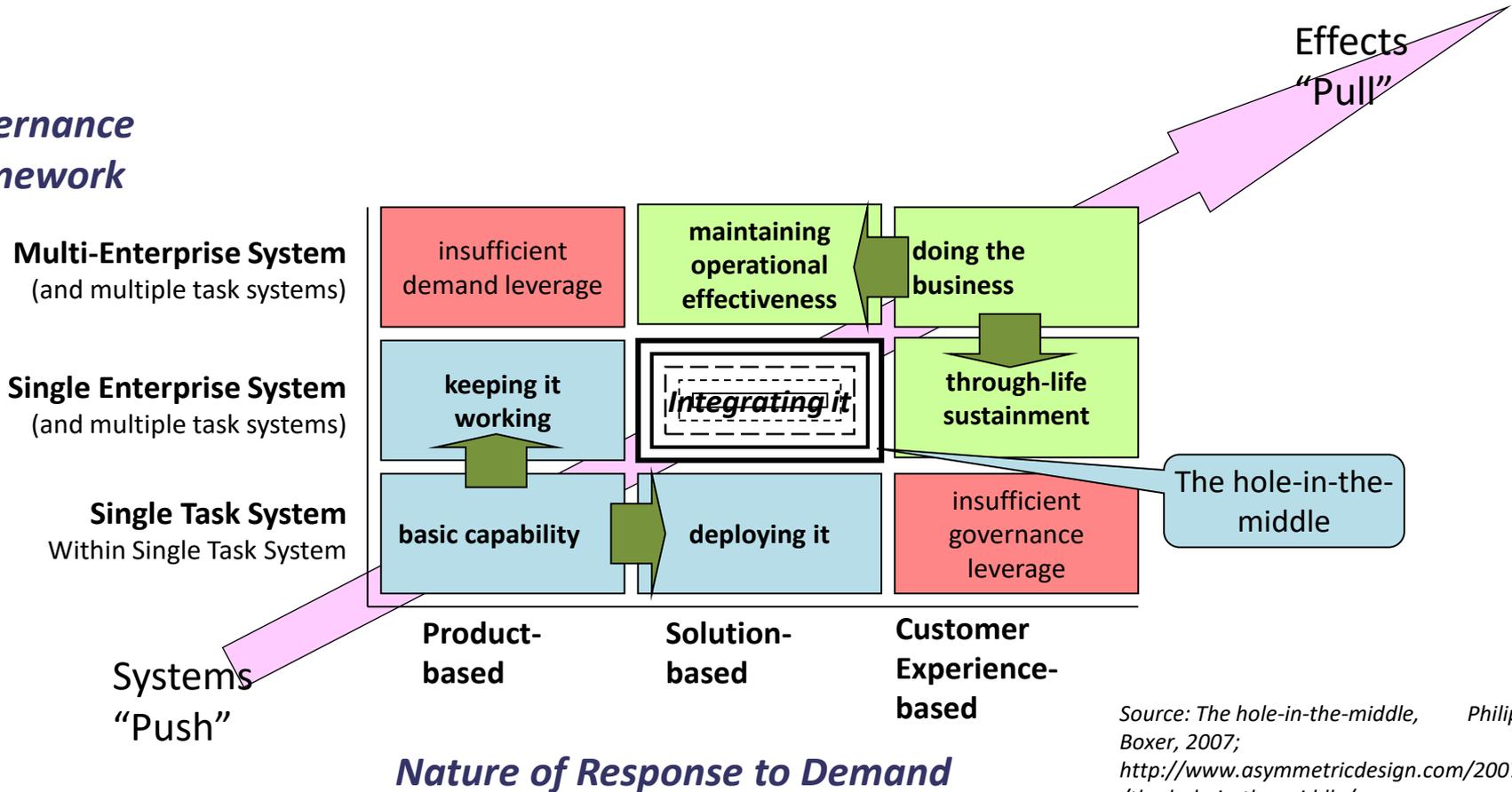
Effects "Pull"



The Hole-in-the-Middle

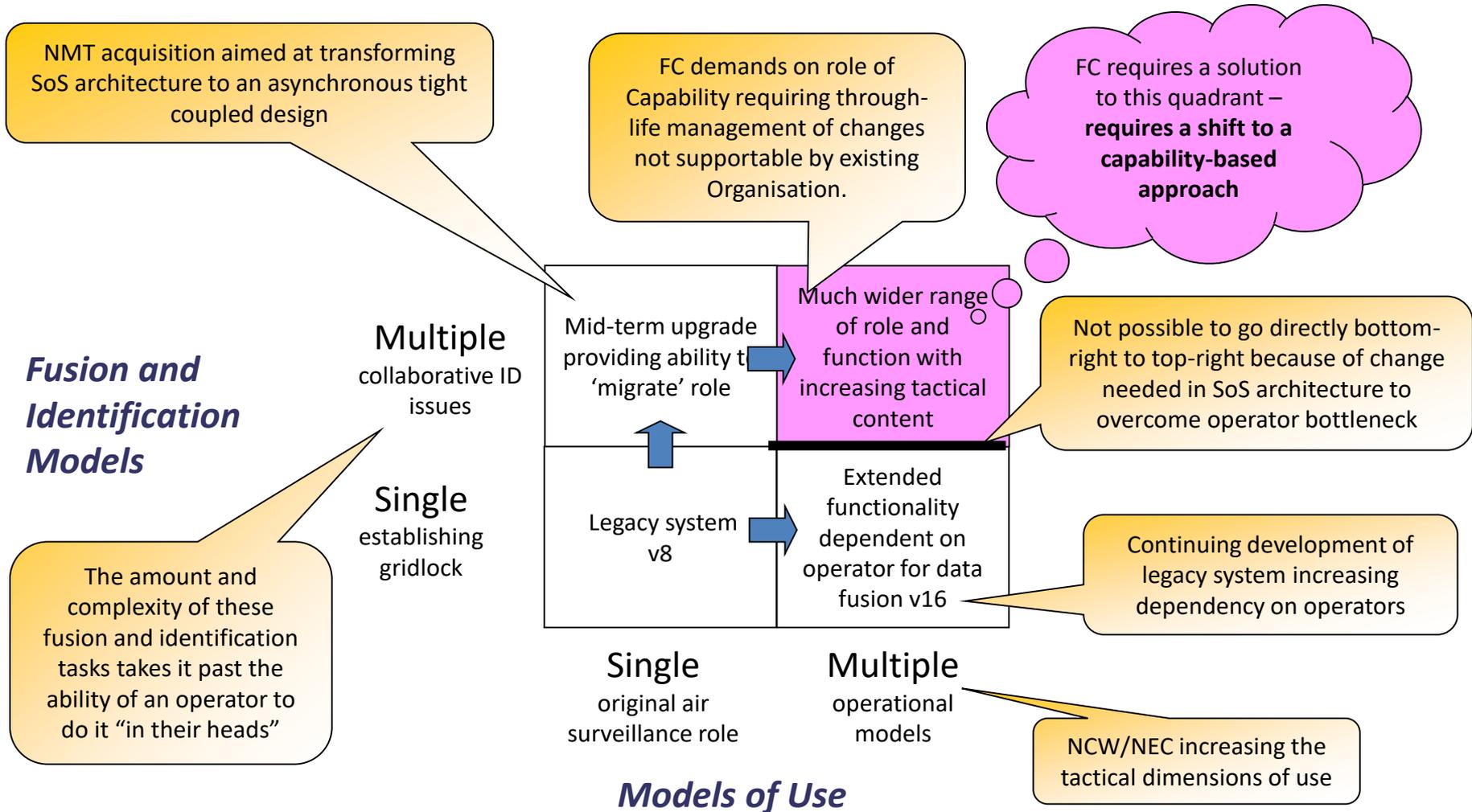
- The aim is to bridge the hole by developing risk mitigation strategies and a supporting model management system.

Governance Framework



Source: *The hole-in-the-middle*, Philip Boxer, 2007;
<http://www.asymmetricdesign.com/2007/01/the-hole-in-the-middle/>

The NATO Case - The Challenge Facing the NMT



Joint Fire Science Project

Fusion Models

