

Enterprise Architecture for Complex System-of-Systems Contexts

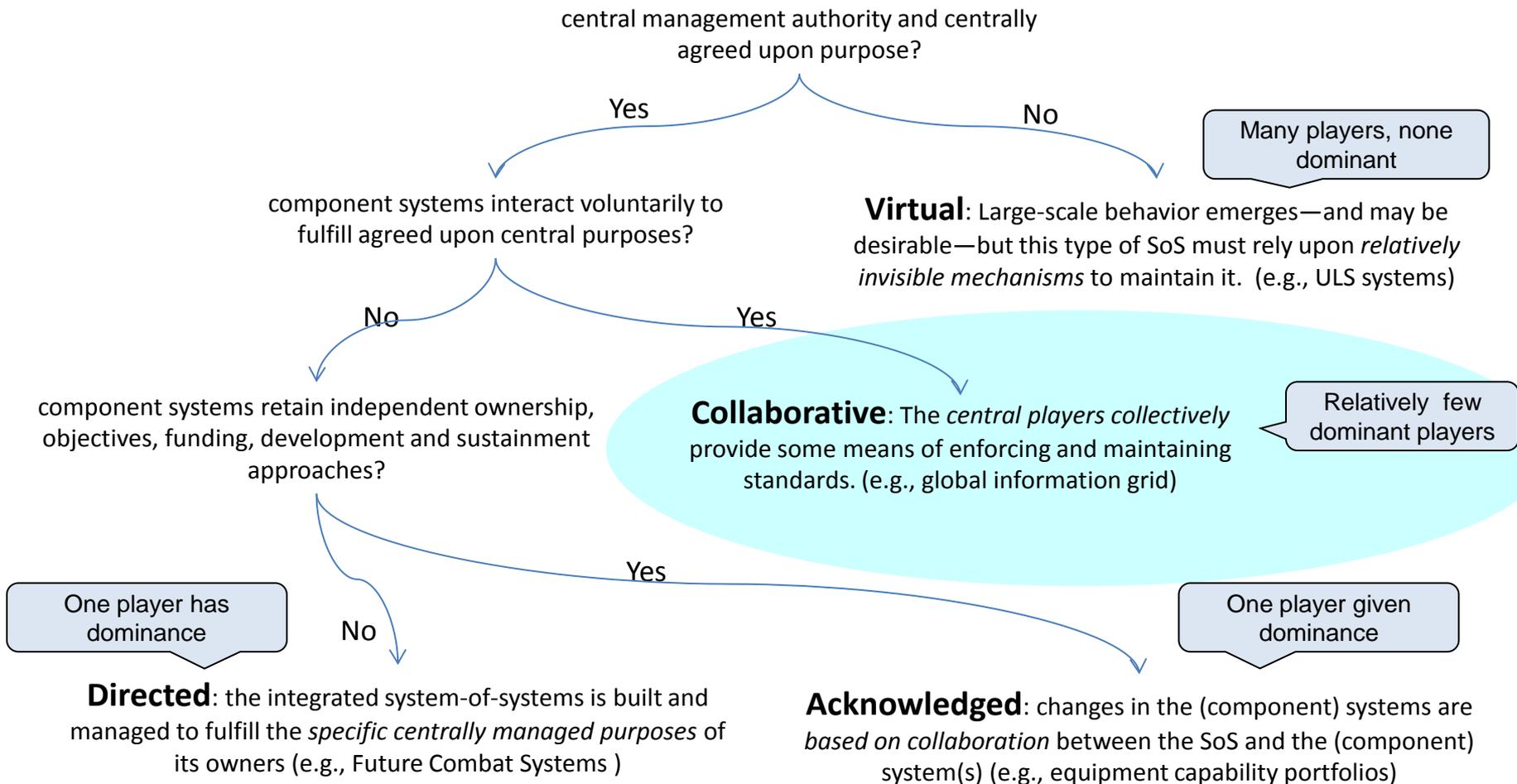
Philip Boxer and Suzanne Garcia

March 25th 2009

Agenda

- ➔ Double challenge facing collaborating players (4)
- Enterprise architecture and beyond (6)
- Modeling the relation to the 'beyond' (3)

Systems of Systems: *there are these 4 kinds*



Source of definitions: Systems Engineering Guide for Systems of Systems, OSD, Version 1.0 August 2008. Brackets added.

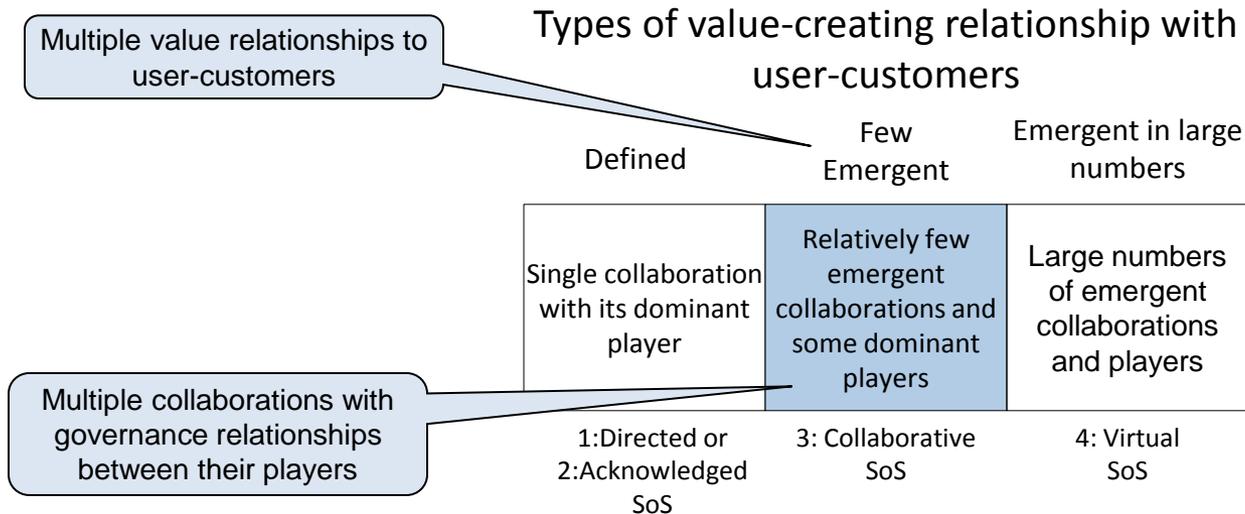
Collaborating Players: *face a Double Challenge*

Systems of Systems (SoS) are both social and technical in nature

- A Collaborative SoS has to support multiple *socio-technical* collaborations..

There is a Double Challenge to prevent disparity between:

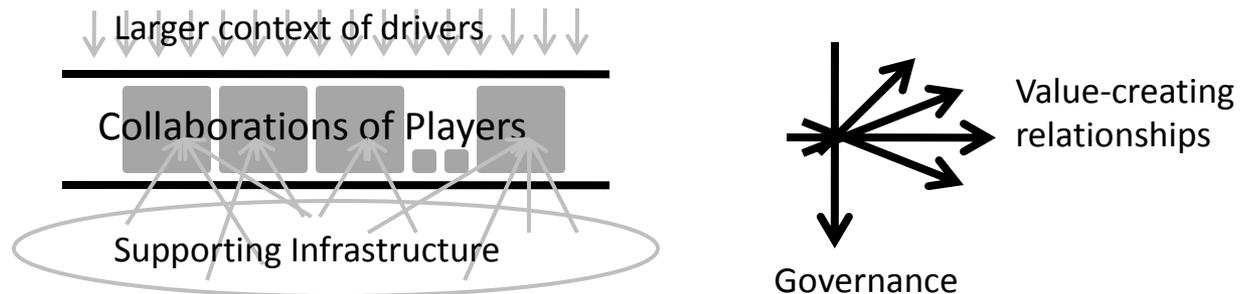
- The *governance* of the collaborating players' relationship to the SoS
- The *value relationship* through which the collaboration creates value for its customers



Governance in a Collaborative SoS:

involves separating the collaboration from its supporting infrastructure

The players in a collaboration can be spread across multiple enterprises and/or different parts of an enterprise:



It is the players participating in a particular collaboration who will define

- Their system-of-interest and its environment
- The stakeholders they judge to be relevant
- The way they want their collaboration supported by a system of systems

Preventing disparity between the infrastructure relationship and the value-creating relationships



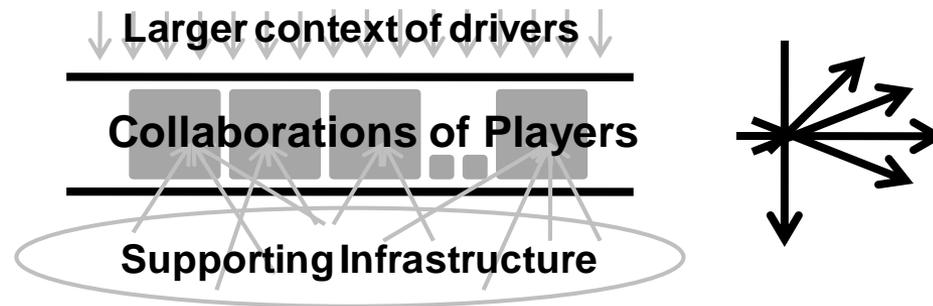
And so...

Collaborative SoS present a different order of complexity

This complexity arises because multiple collaborations exist concurrently, supported by a shared infrastructure

This means understanding *both*

- the relationships between the players in each collaboration, *and*
- the infrastructure supporting the collaborations



Agenda

Double challenge facing collaborating players (4)

➔ Enterprise architecture and beyond (6)

Modeling the relation to the 'beyond' (3)

Describing the way the enterprise creates value:

Zachman roots

| | DATA (WHAT) e.g. data | FUNCTION (HOW) e.g. function | NETWORK (WHERE) e.g. network | PEOPLE (WHO) e.g. organisation | TIME (WHEN) e.g. schedule | MOTIVATION (WHY) e.g. strategy |
|--|---|--|--|--|---|---|
| SCOPE (Competitive context) Planning | List of Things Important to the Business Entity = Class of | List of Processes the Business Performs Process = Class of | List of Locations in Which the Business Operates Node = Major Business | List of Organizations Important to the Business People = Major | List of Events/Cycles Significant to the Business Time = Major Business | Lists of Business Goals/Strategies Ends/Means = Major Business Goal/Strategy |
| BUSINESS MODEL (Conceptual) Owning | e.g., Semantic Model Entity = Business Entity Relationship = Business Relationship | e.g., Business Process Model Process = Business Process I/O = Business Resources | e.g., Business Logistics System Node = Business Location Link = Business Linkage | e.g., Work Flow Model People = Organization Unit Work = Work Product | e.g., Master Schedule Time = Business Event Cycle = Business Cycle | e.g., Business Plan End = Business Objective Means = Business Strategy |
| SYSTEM MODEL (Logical) Designing | e.g., Logical Data Model Entity = Data Entity Relationship = Data Relationship | e.g., Application Architecture Process = Application Function I/O = User Views | e.g., Distributed System Architecture Node = I/S Function (Processor, Storage, etc.) Link = Line Characteristics | e.g., Human Interface Architecture People = Role Work = Deliverable | e.g., Processing Structure Time = System Event Cycle = Processing Cycle | e.g., Business Rule Model End = Structural Assertion Means = Action Assertion |
| TECHNOLOGY MODEL (Physical) Building | e.g., Physical Data Model Entity = Segment/Table/etc. Relationship = Pointer/Key/etc. | e.g., System Design Process = Computer Function I/O = Data Elements/Sets | e.g., Technology Architecture Node = Hdw/System Software Link = Line Specifications | e.g., Presentation Architecture People = User Work = Screen Formats | e.g., Control Structure Time = Execute Cycle = Component Cycle | e.g., Rule Design End = Condition Means = Action |
| DETAILED REPRESENTATIONS (out-of-modelling-context) Subcontracting | e.g., Data Definition Entity = Field Relationship = Address | e.g., Program Process = Language Statement I/O = Control Block | e.g., Network Architecture Node = Address Link = Protocol | e.g., Security Architecture People = Identity Work = Job | e.g., Timing Definition Time = Interrupt Cycle = Machine Cycle | e.g., Rule Specification End = Sub-condition Means = Step |

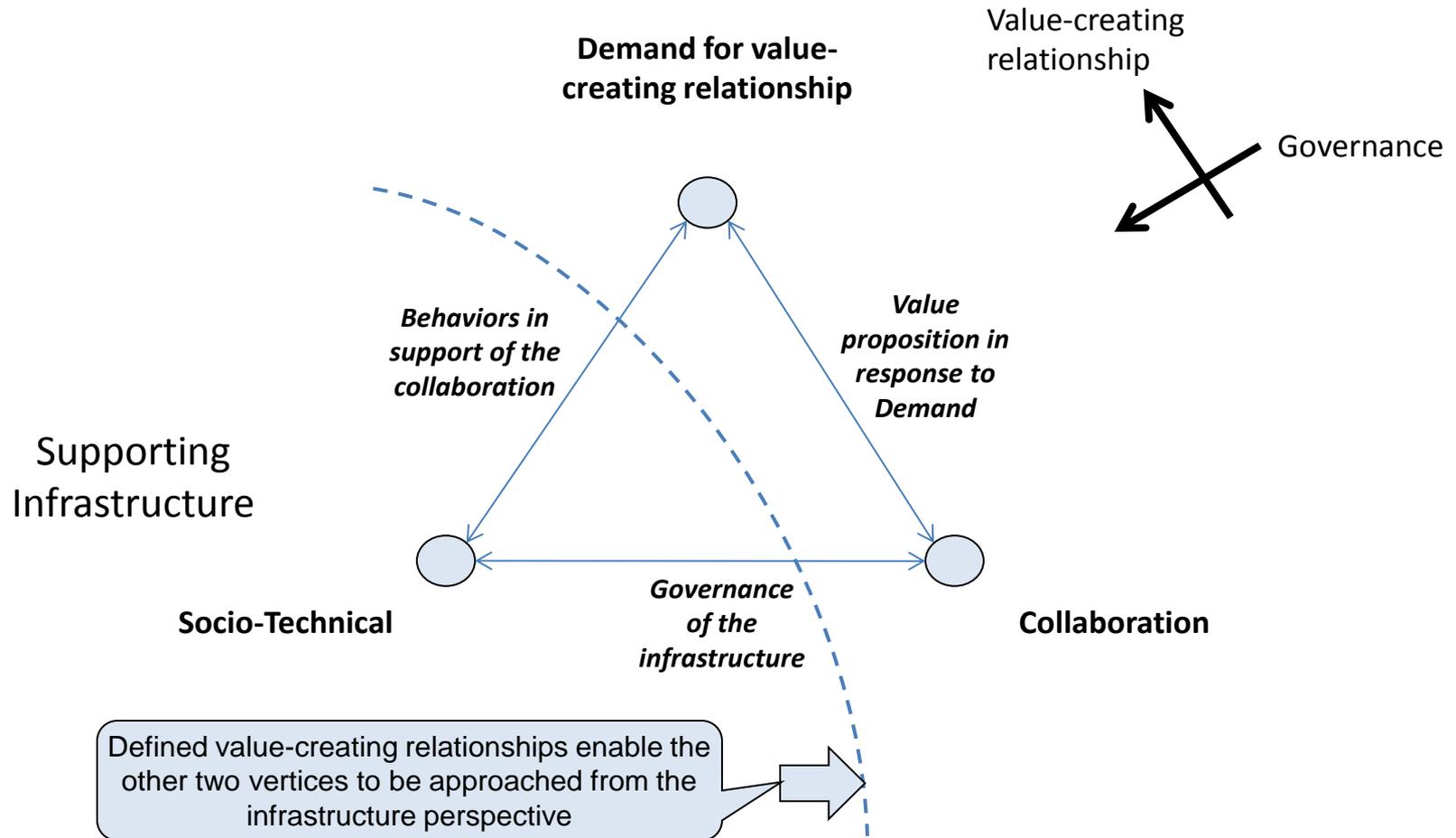
Focus on the defined value-creating relationships

The context defining that focus is the directing enterprise

Source of coloured squares: Zachman Framework, www.zifa.com

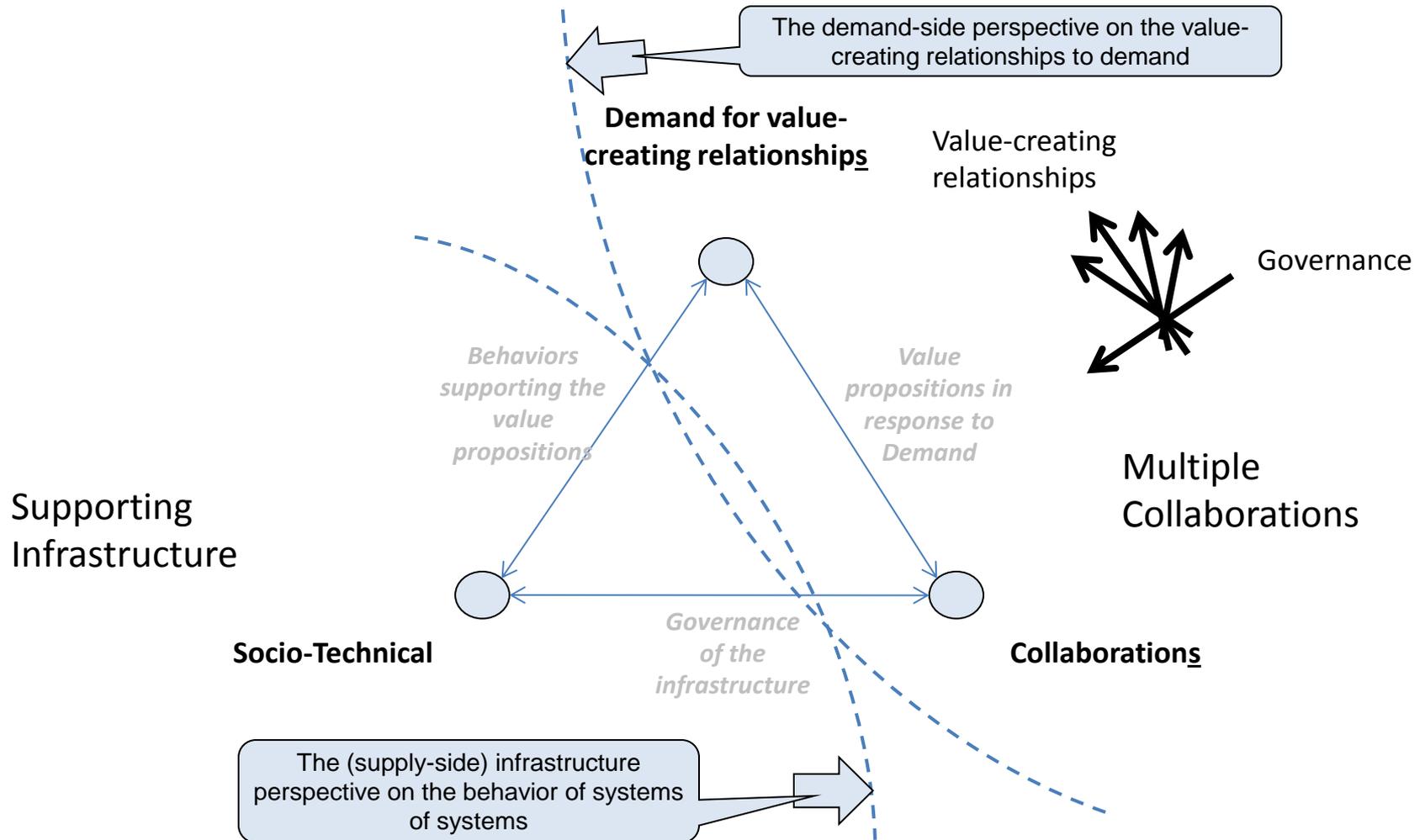
The Infrastructure perspective on the enterprise:

the focus is on the supporting socio-technical SoS



Multiple collaborations:

it becomes necessary to make the demand-side perspective explicit



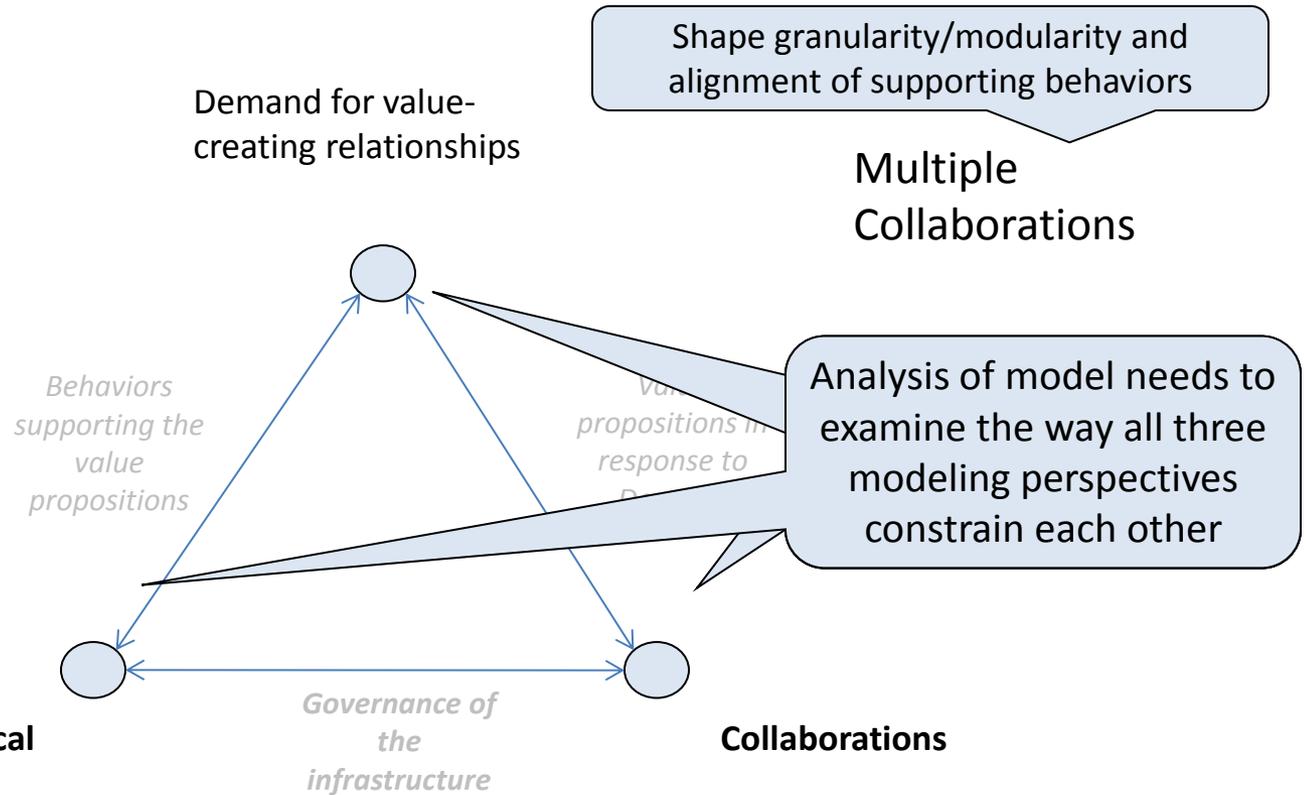
The demand-side perspective: *creates gaps in Zachman*

| | EVENT (WHAT) <i>e.g. things done</i> | DATA (WHAT) <i>e.g. data</i> | FUNCTION (HOW) <i>e.g. function</i> | NETWORK (WHERE) <i>e.g. network</i> | PEOPLE (WHO) <i>e.g. organisation</i> | TIME (WHEN) <i>e.g. schedule</i> | USE CONTEXT (WHO for WHOM) e.g. particular client | MOTIVATION (WHY) <i>e.g. strategy</i> |
|---|---|--|---|---|---|--|--|--|
| SCOPE (Competitive context) Planning | | List of Things Important to the Business Entity = Class of Business Thing | List of Processes the Business Performs Process = Class of Business Process | List of Locations in Which the Business Operates Node = Major Business Location | List of Organizations Important to the Business People = Major Organizational Unit | List of Events/Cycles Significant to the Business Time = Major Business Event/Cycle | | Lists of Business Goals/Strategies Ends/Means = Major Business Goal/Strategy |
| COLLABORATIVE MODEL (Collaboration) Governance | | | | | | | | |
| | Different collaborations imply different physical realities | | Multiple Players in multiple collaborations | | | Different collaborations imply different types of value-creating relation to demand | | |
| BUSINESS MODEL (Conceptual) Owing | | <i>e.g., Semantic Model</i> Entity = Business Entity Relationship = Business Relationship | <i>e.g., Business Process Model</i> Process = Business Process I/O = Business Resources | <i>e.g., Business Logistics System</i> Node = Business Location Link = Business Linkage | <i>e.g., Work Flow Model</i> People = Organization Unit Work = Work Product | <i>e.g., Master Schedule</i> Time = Business Event Cycle = Business Cycle | | <i>e.g., Business Plan</i> End = Business Objective Means = Business Strategy |
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Source of gaps: Philip Boxer, Modeling structure-determining processes, <http://www.asymmetricdesign.com/archives/59>, December 2006

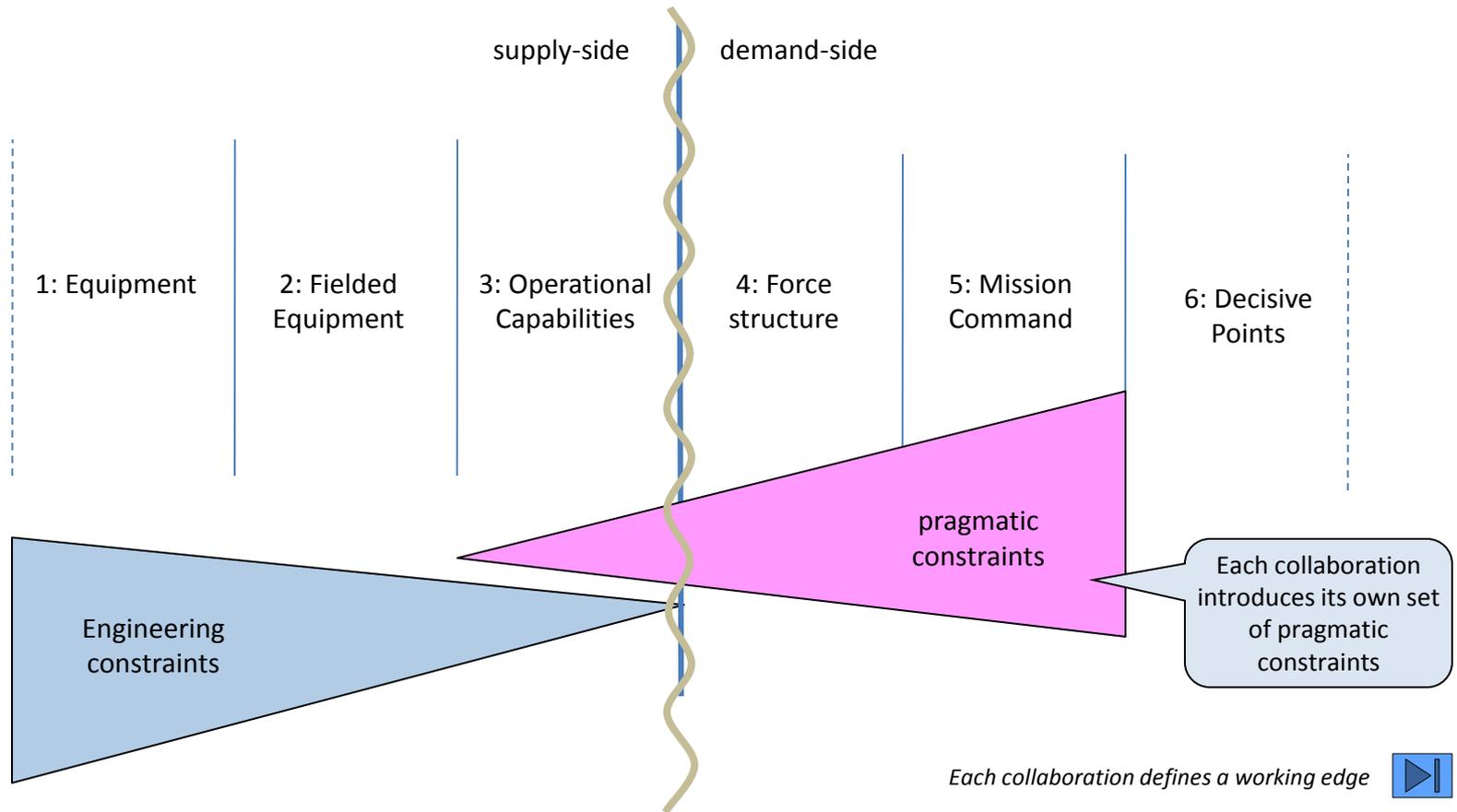
Modeling the 'beyond' of the Enterprise

Architecture: *three modeling perspectives*



And So...

Stratification describes how services are aligned to demand in order to meet these constraints



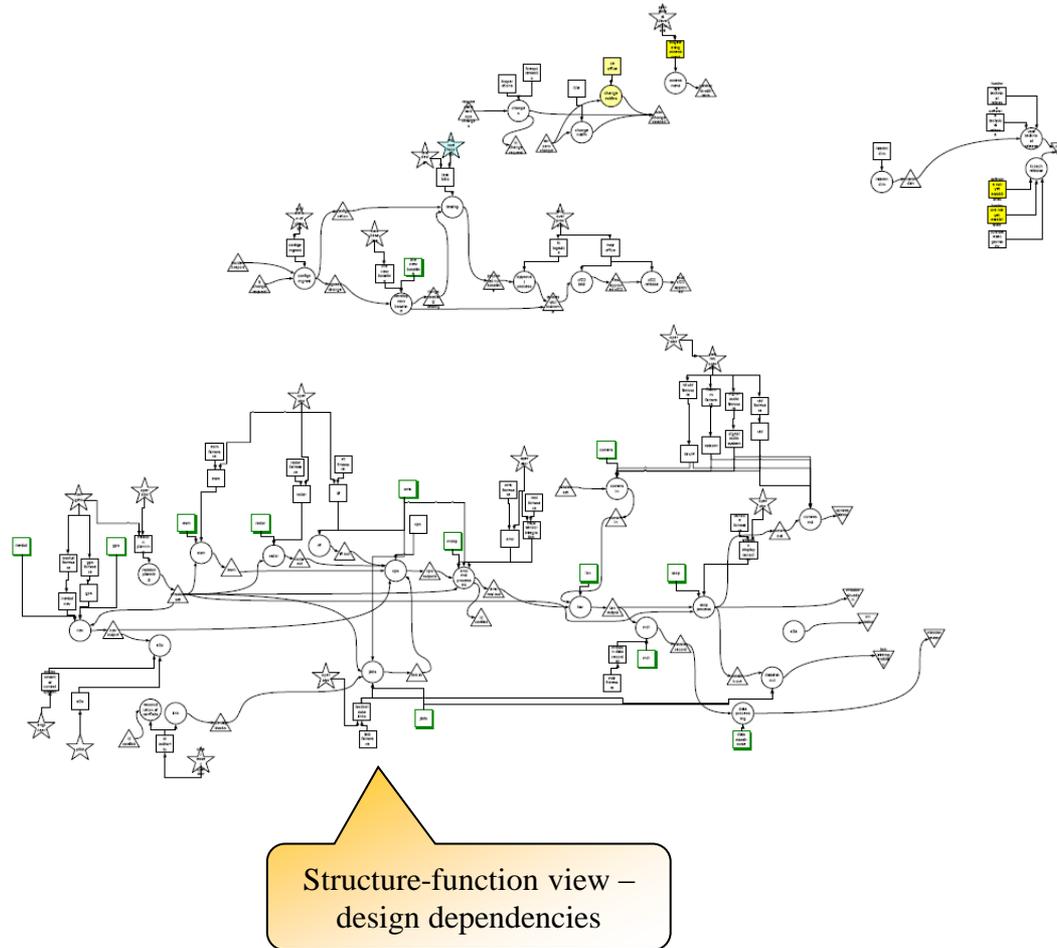
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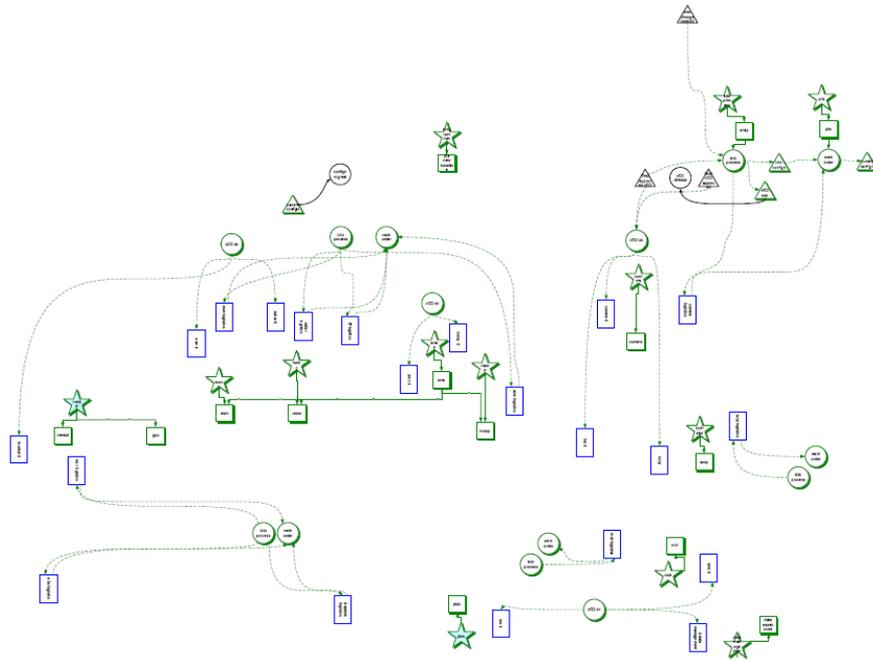
Enterprise architecture and beyond (6)

➔ Modeling the relation to the 'beyond' (3)

Complex systems of systems: *socio-technical*

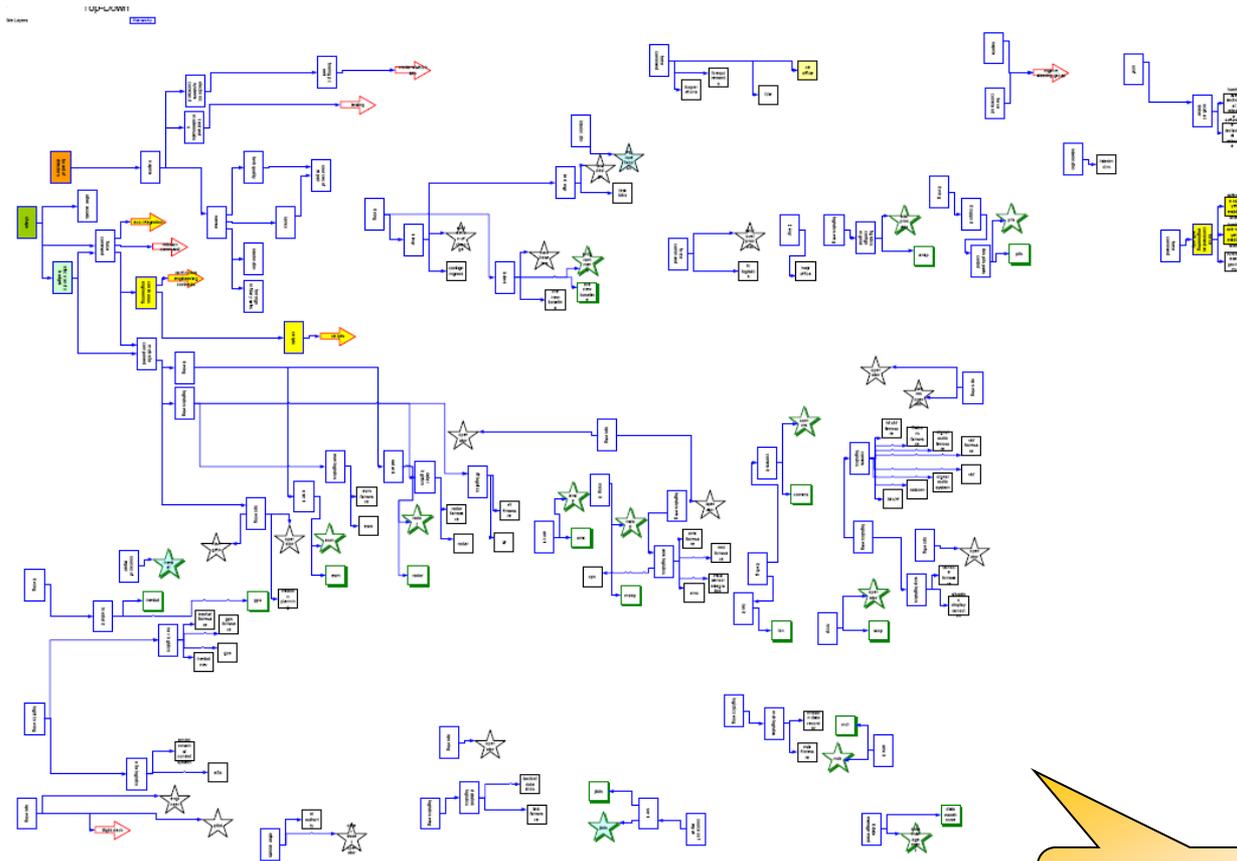


Complex systems of systems: *socio-technical*



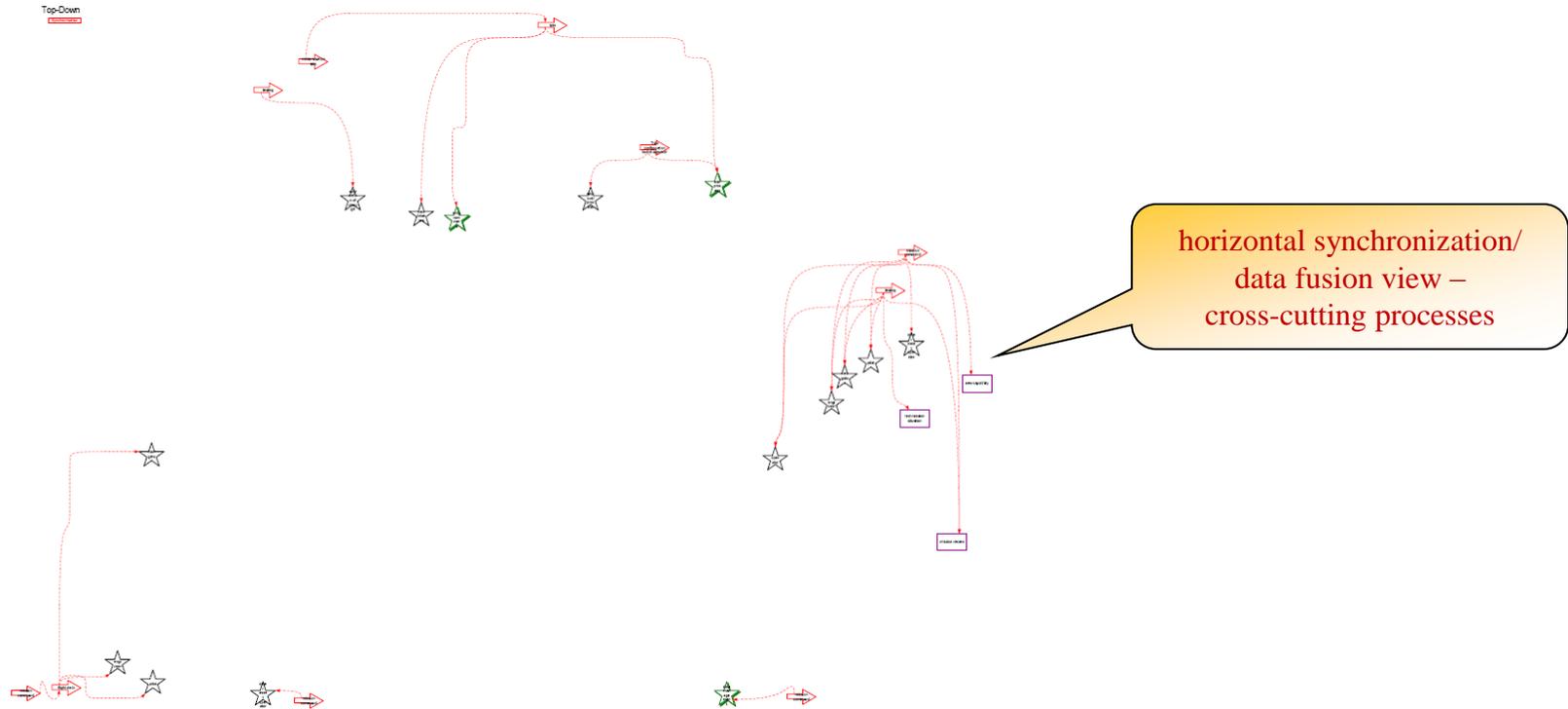
State/trace view – state variables and controls

Complex systems of systems: *collaborations*

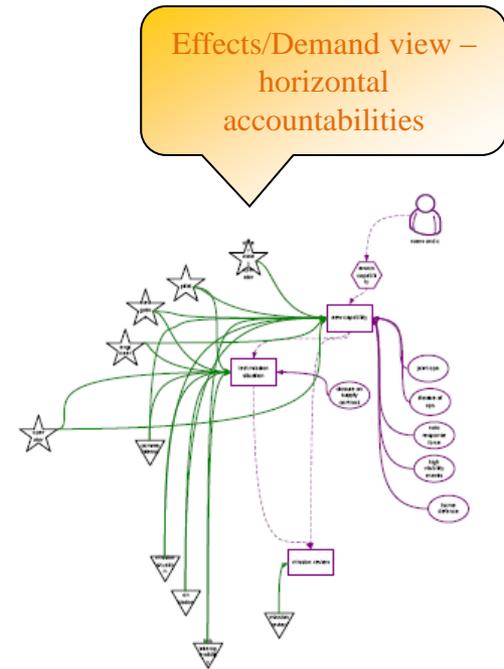


Hierarchy view –
vertical accountabilities

Complex systems of systems: *collaborations*



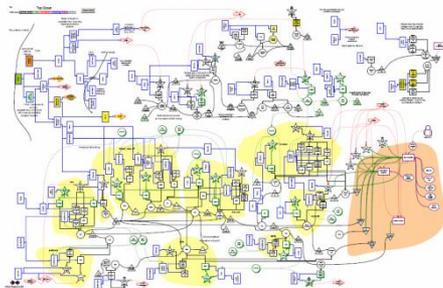
Complex systems of systems: *demands*



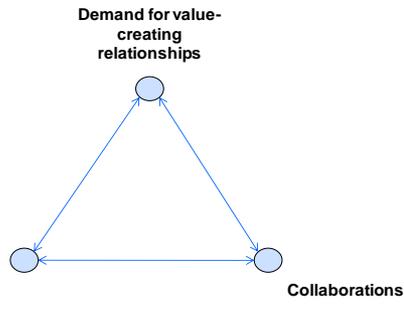
Identifying interoperability risks:

leads to a different kind of analysis

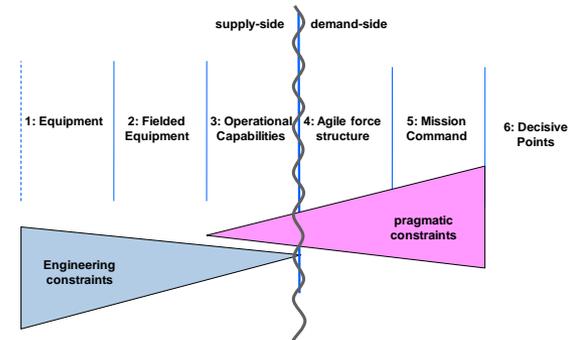
Collaborations across socio-technical SoS in relation to Demand



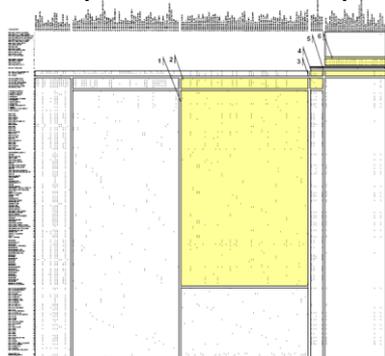
Defining the relationships between the three different modeling perspectives



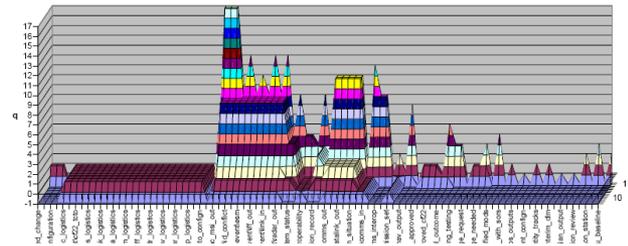
Analyzing the alignment to demand by collaborations of the SoS infrastructure



Analysis of Granularity



Identifying Gaps in the different strata

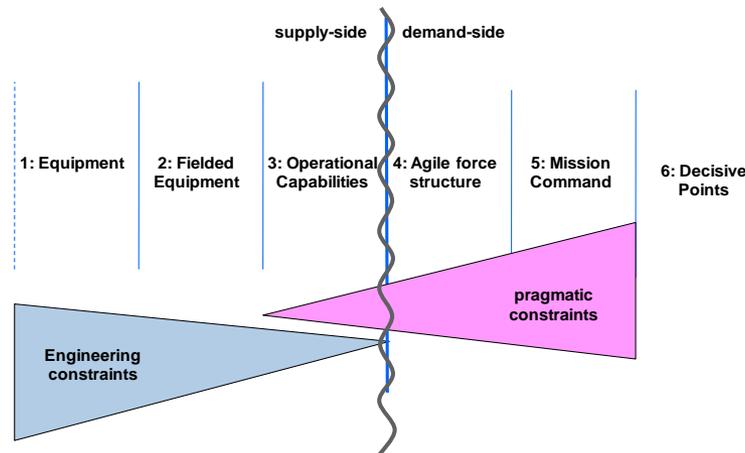


Source: Anderson, Boxer & Browword (2006) *An Examination of a Structural Modeling Risk Probe Technique*, Special Report, Software Engineering Institute, Carnegie Mellon University, CMU/SEI-2006-SR-017, October 2006. <http://www.sei.cmu.edu/publications/documents/06.reports/06sr017.html>
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Conclusion

Collaborative Systems of Systems involve multiple concurrent collaborations supported by SoS Infrastructure

- Both supply-side and demand-side perspectives have to be modeled in order to understand
 - How infrastructure supports varieties of demand
 - How collaborations differ
 - What forms of alignment and granularity of services are needed.
- This has involved
 - Extending modeling to include demand-side perspectives
 - Adding new forms of analysis of alignment between supply- and demand-side perspectives



END

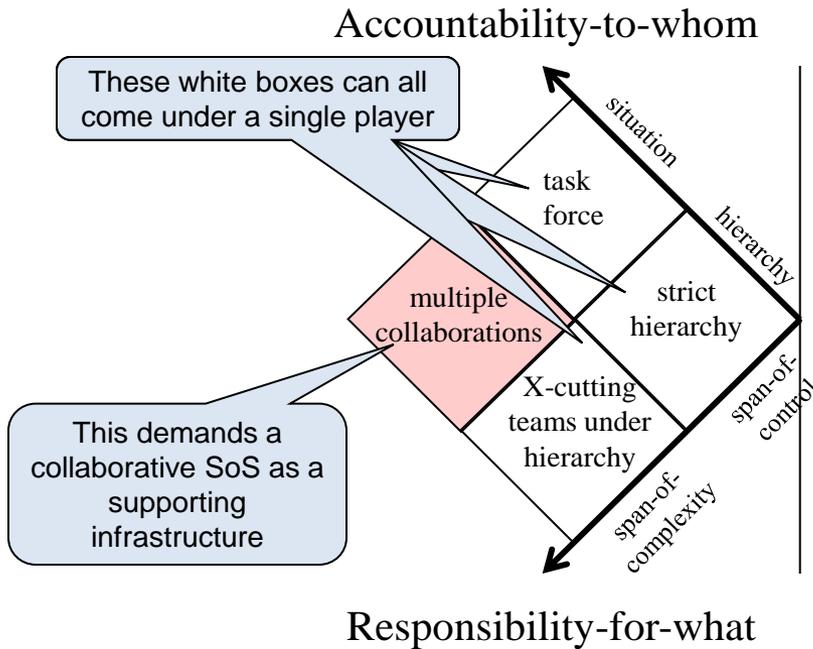
Preventing disparity:



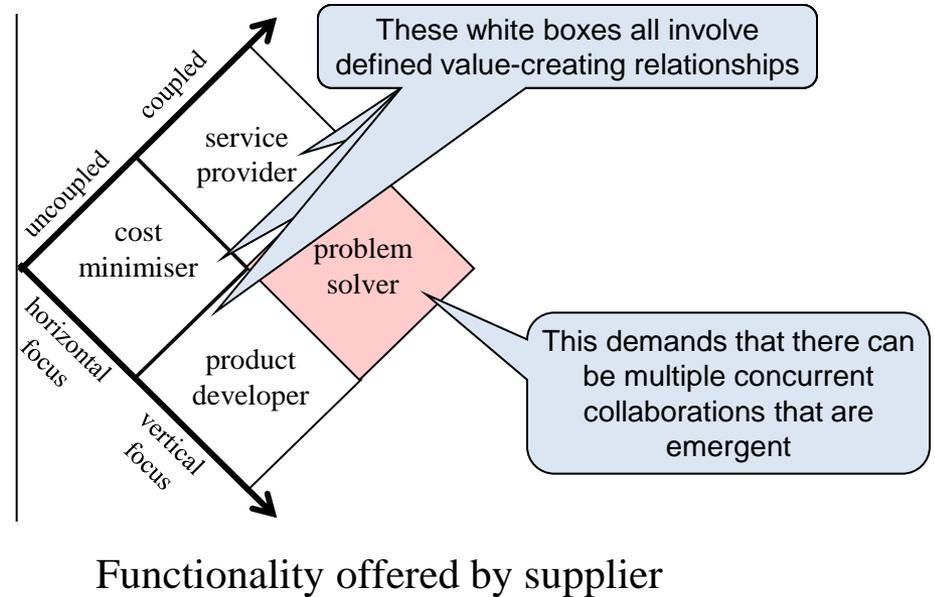
between the infrastructure relationship and the value-creating relationships

The type of governance relationship to the infrastructure

The type of value-creating relationship to the customer's demand



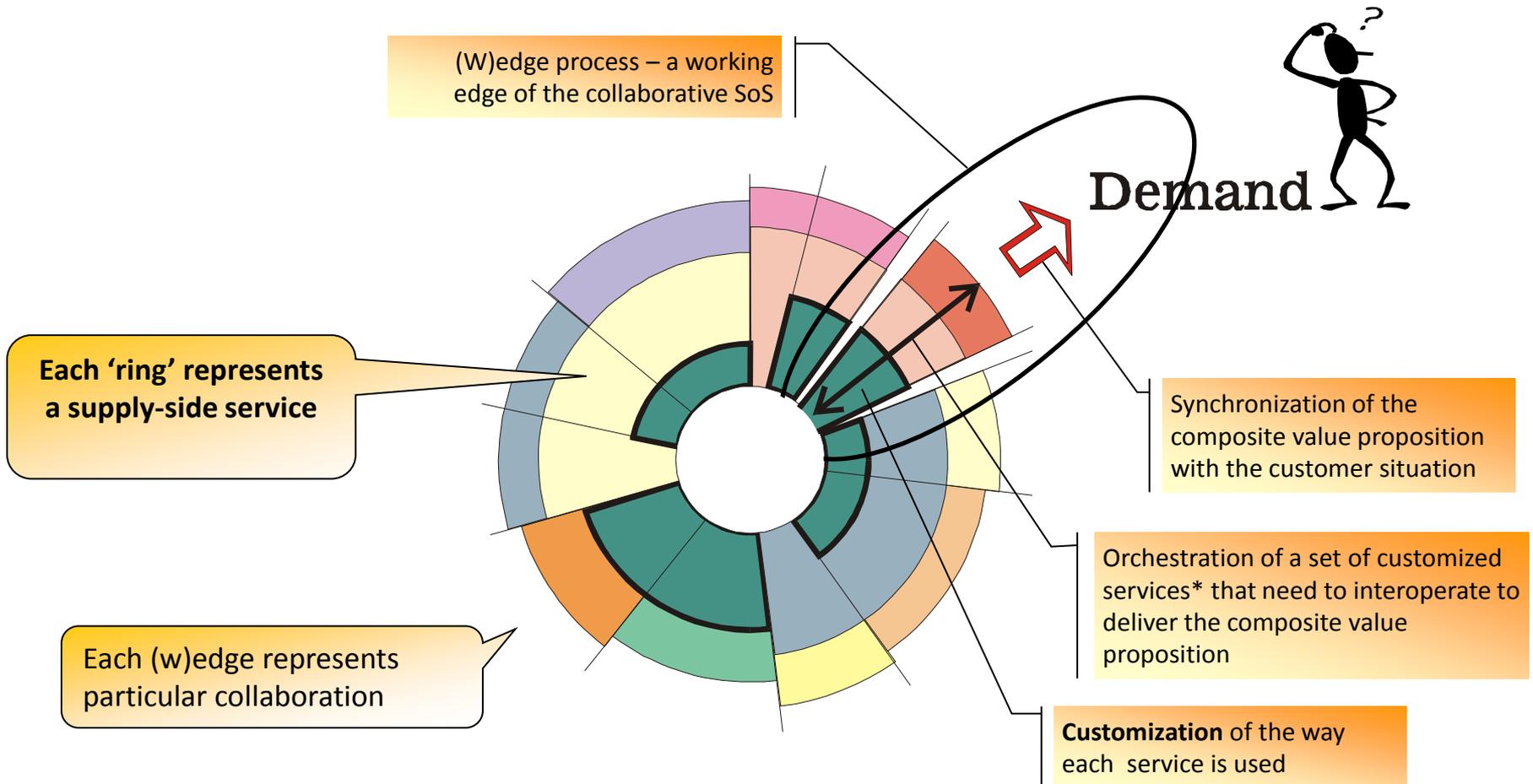
Relationship to Customer's Timing & Logistics



Source: Philip Boxer, *The Double Challenge*, <http://www.asymmetricdesign.com/archives/26>, March 2006



Each collaboration defines a working edge



* This set of services has an SoS architecture

Source: Philip Boxer, Finding the edge, <http://www.asymmetricdesign.com/archives/56>, December 2006