

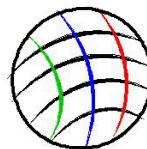
# Acquisition System Development: A Complex System Governance (CSG) Perspective

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**July 18, 2017**

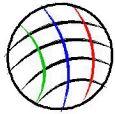


**EMSE**  
Engineering Management and Systems Engineering



**NCSOSE**  
*National Centers for System of Systems Engineering*

# Old Dominion University



**NCSOSE**  
National Centers for System of Systems Engineering

Located in  
Norfolk,  
Virginia,  
USA



- Established 1930, 26,000+ students from 106 countries, 795 Full-time faculty
- Degree Programs: 70 undergraduate, 54 Masters, 42 doctoral
- Graduates: 124,000+ from 77 different countries
- Home to the National Centers for System of Systems Engineering (NCSOSE)
  - *focused on system science based engineering of technologies to improve complex system performance*

# ***Topics***



01

**Introduction: Complex System  
Problem Domain Facing Acquisition**



02

**Complex System Governance:  
Foundations and Glimpse**



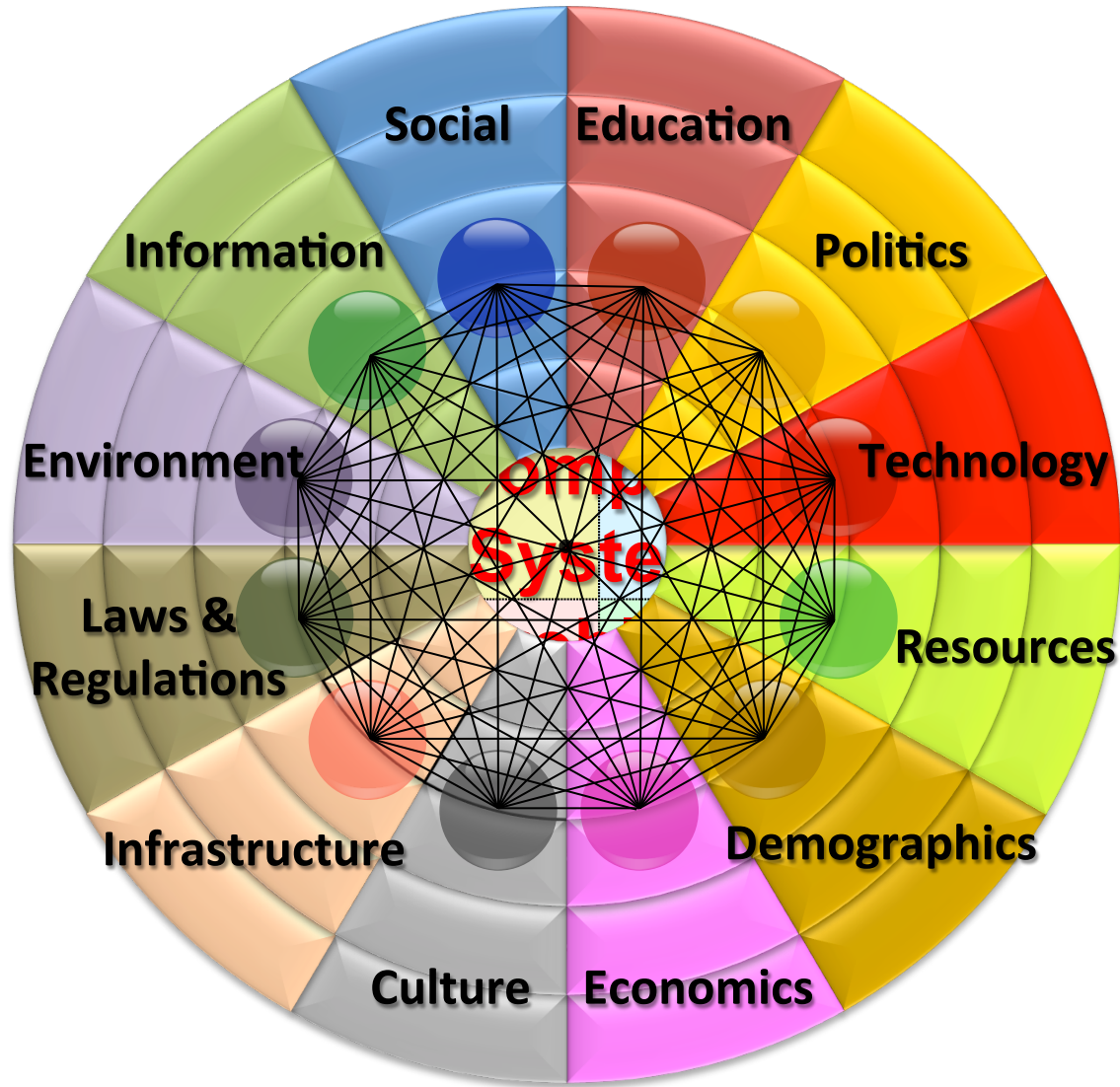
03

**CSG contributions and a Path  
Forward**

# Complex System Problem Domain

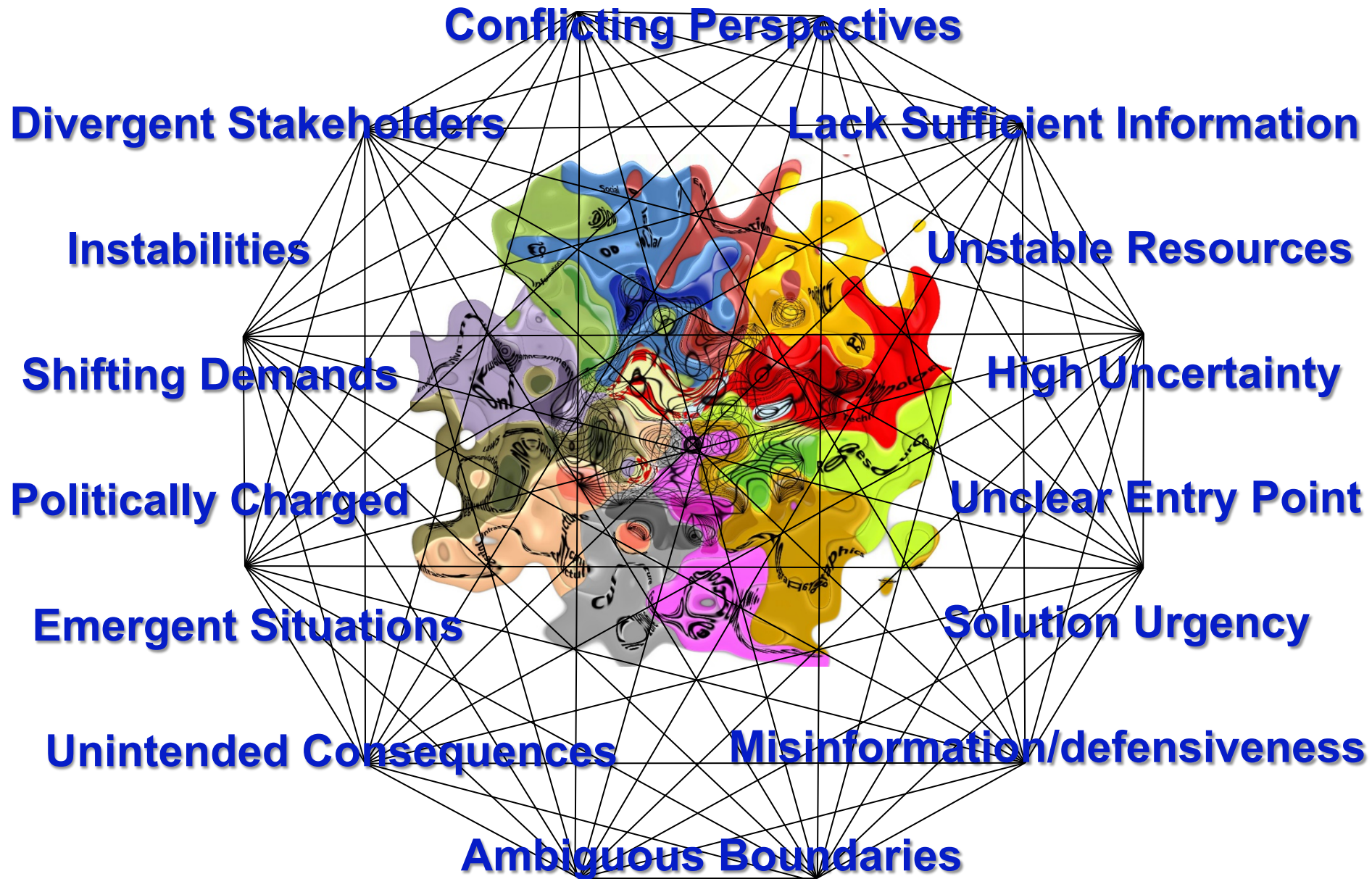
**Landscape of the modern systems  
practitioner**







**Ouch!! That's going to make a mark!**



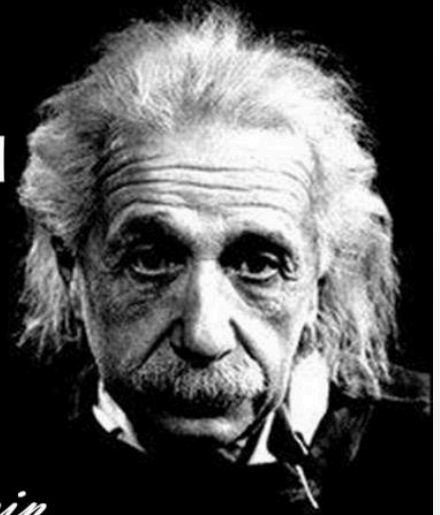


# An Ugly Dilemma – Are We ‘Flatlanders’?

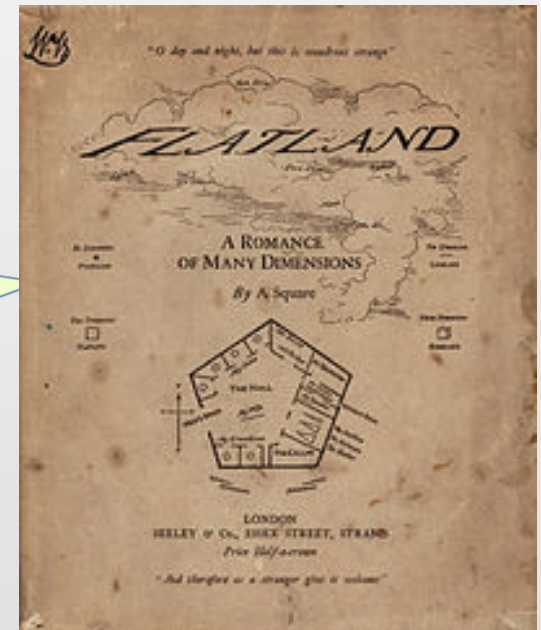


WE CANNOT SOLVE  
OUR PROBLEMS WITH  
THE SAME THINKING  
WE USED WHEN  
WE CREATED THEM

*~ Albert Einstein*

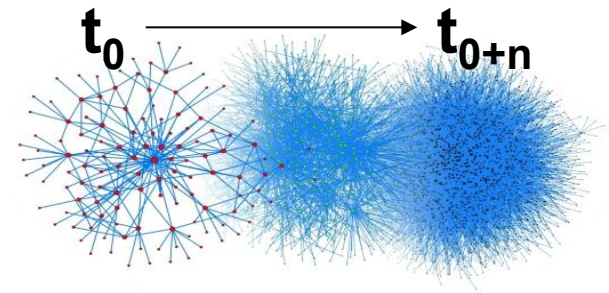


Abbott, Edwin A. (1884). *Flatland: A Romance in Many Dimensions*. New York: Dover Thrift Edition

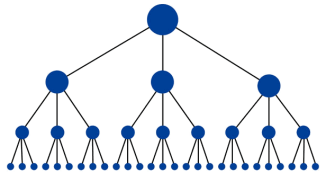


Why do we seem to be frustrated in responding to this domain – a Systems View?

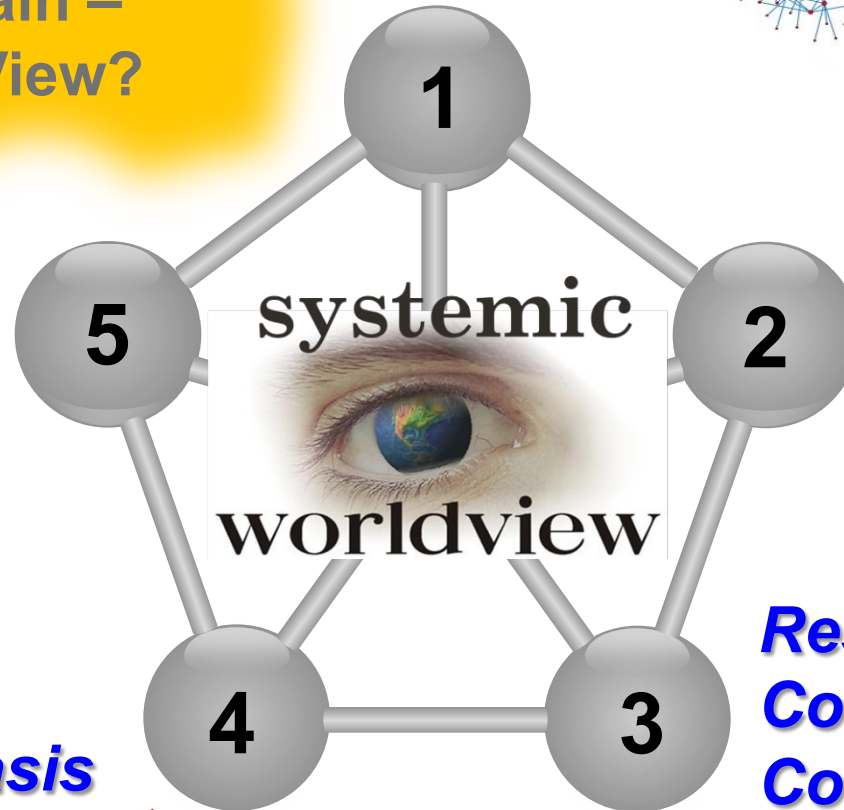
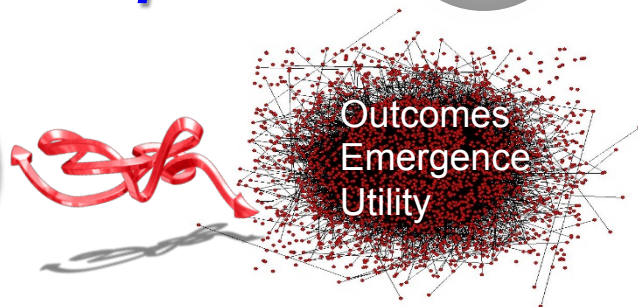
**Sprawling Complexity**



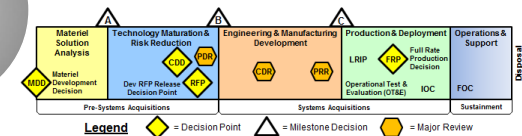
**Preference for Global Control**



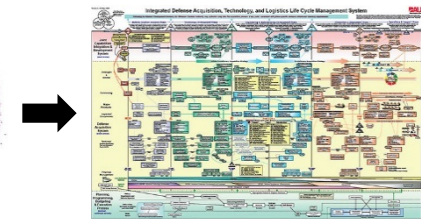
**Paradigm Embedded in Output Emphasis**



**Process & Event Centric**



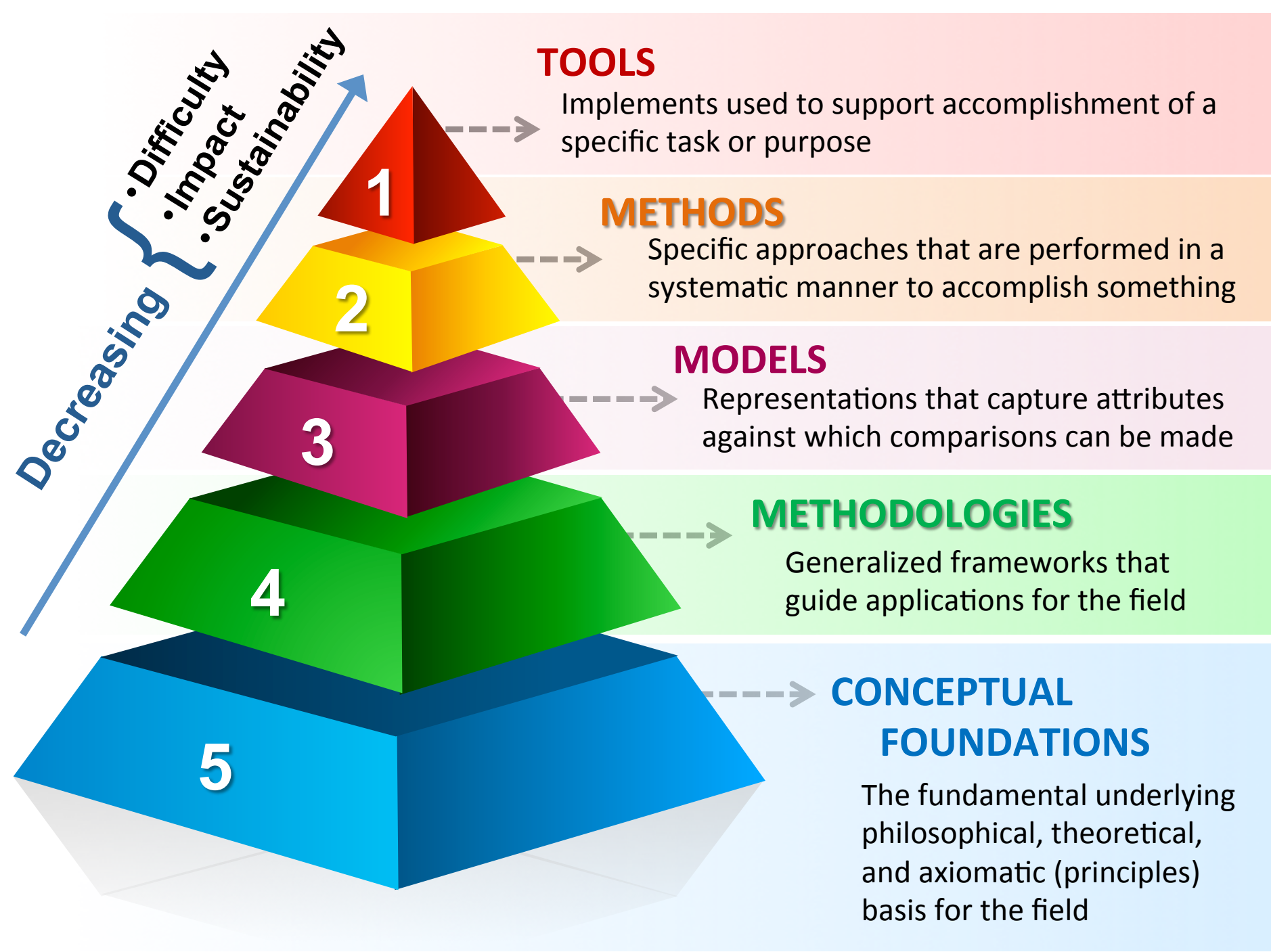
**Respond to Complexity with Complication**



# Complex System Governance: A Glimpse

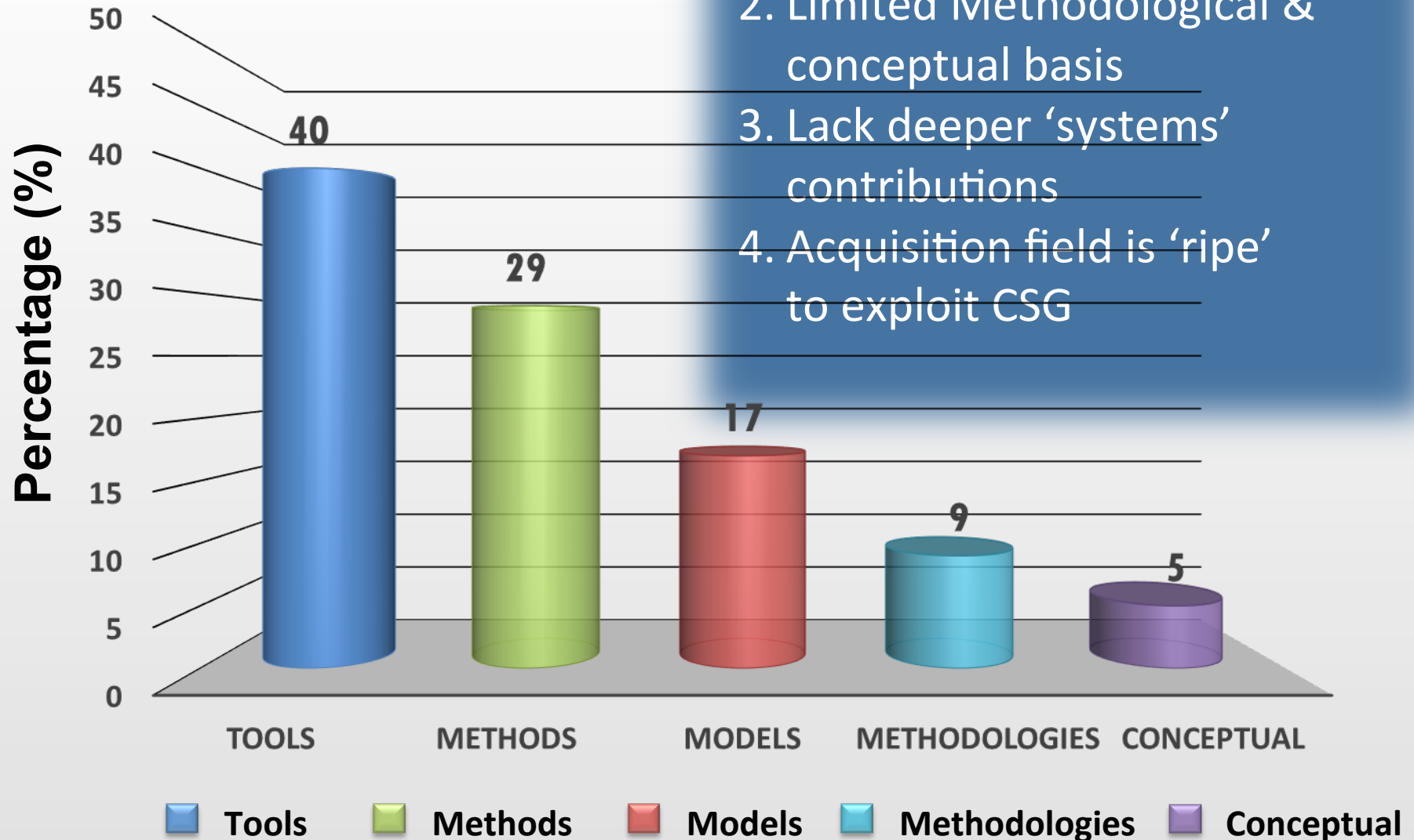
**Charting a 'Different' Vantage Point  
for Acquisition**





# ***A Glimpse of the Acquisition Literature***

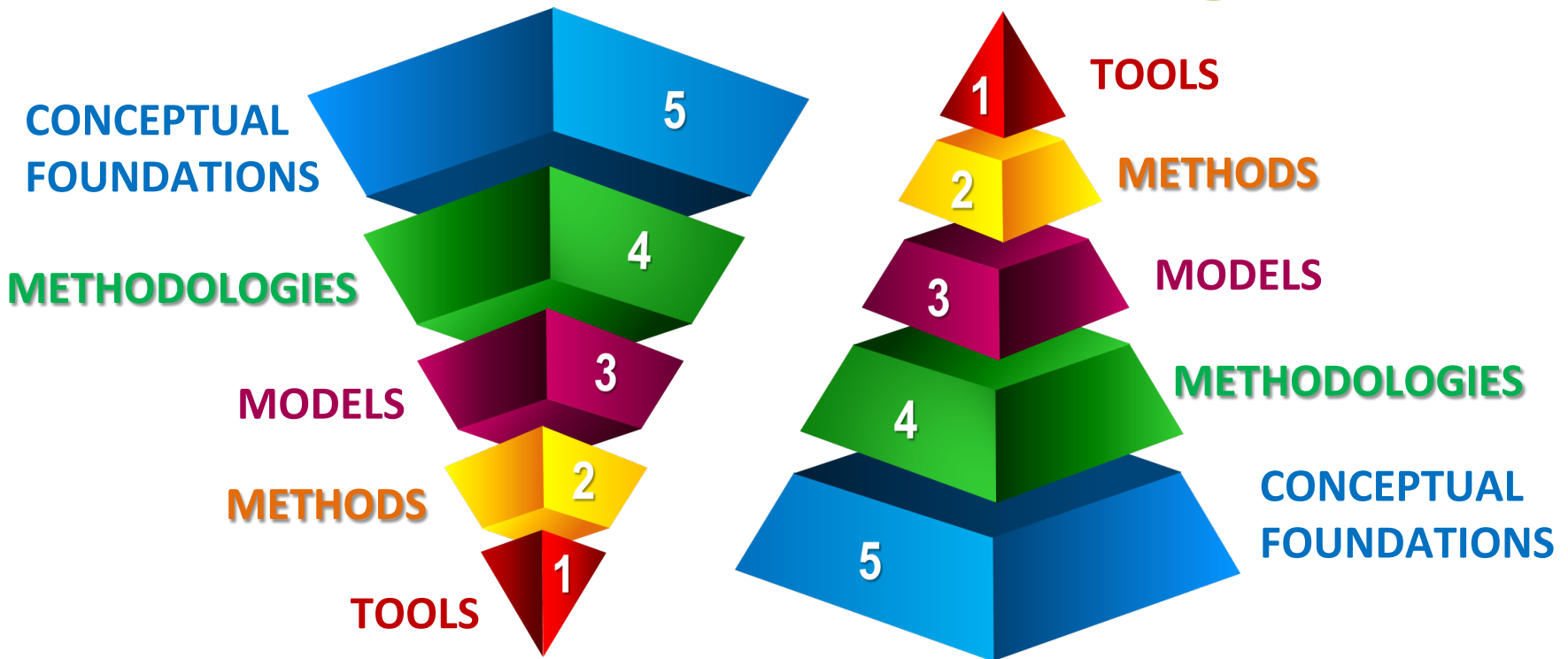
**Defense Acquisition Premier Journal  
Coverage Distribution % (2006 -2016)**



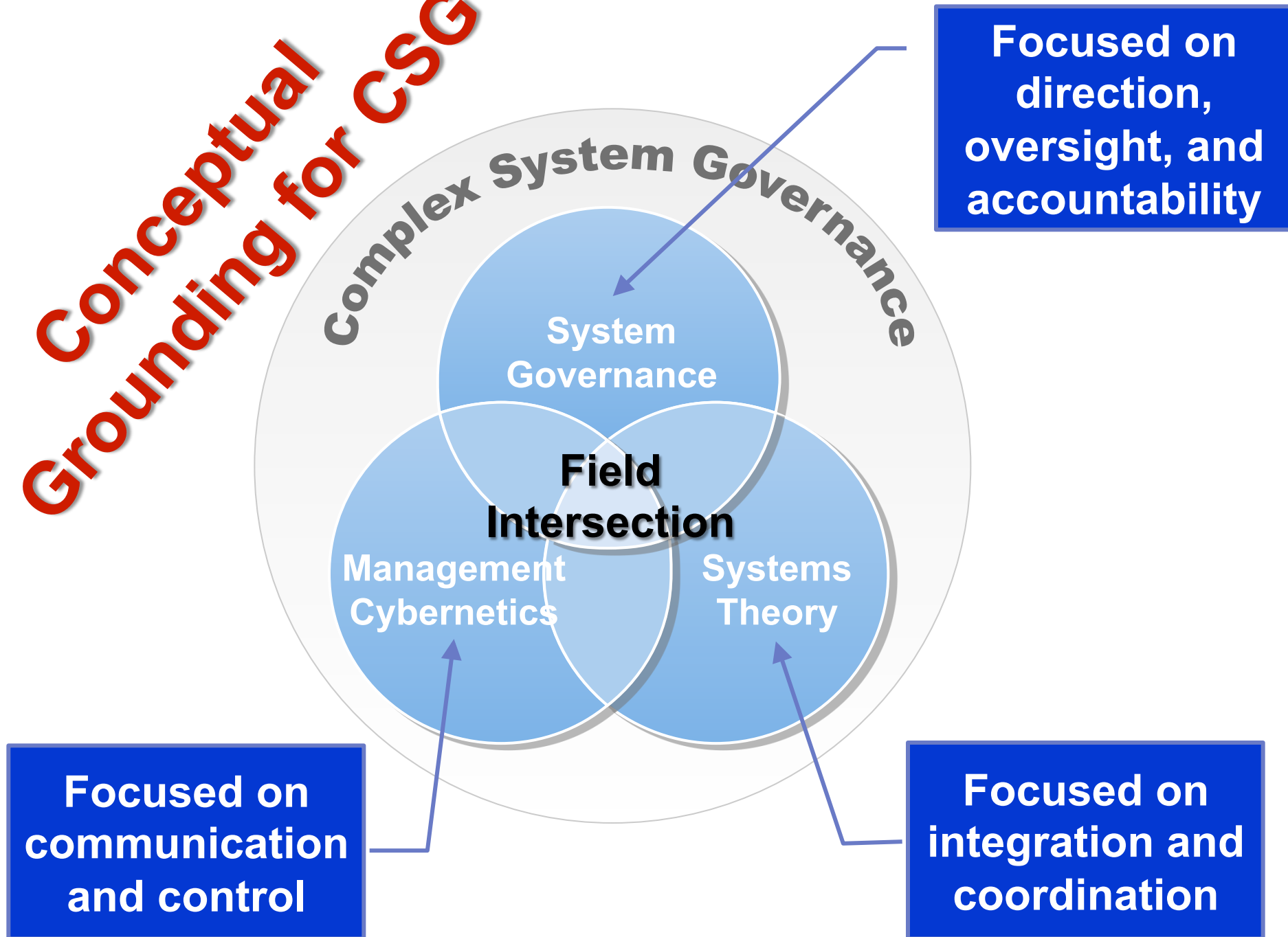
# ***So What? What's the big Deal? Who cares?***

Fields (as pyramids) derive their Strength, Stability, and Sustainability from the base.

**As is      Breakthrough??**

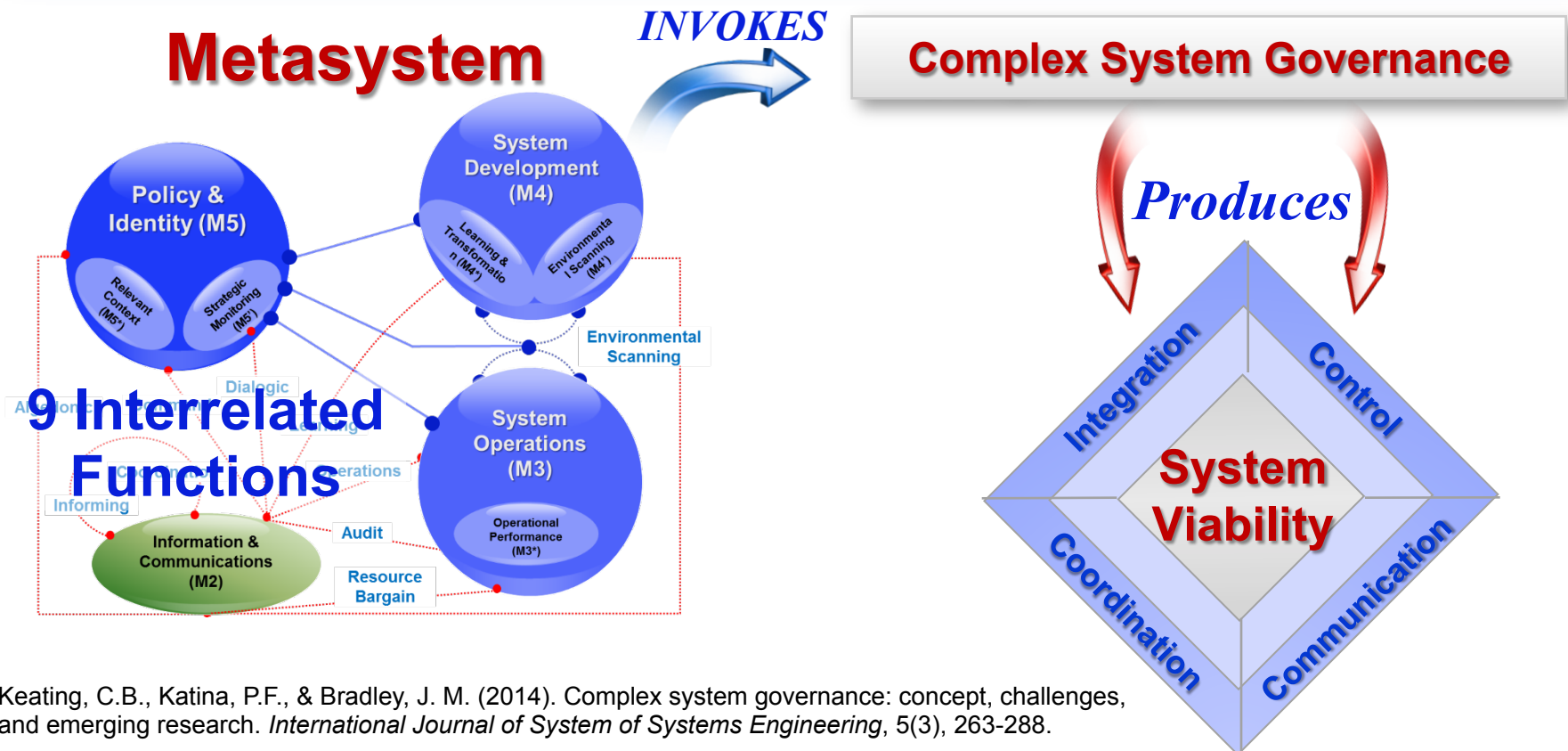


# Conceptual Grounding for CSG



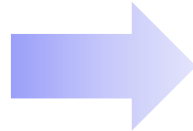
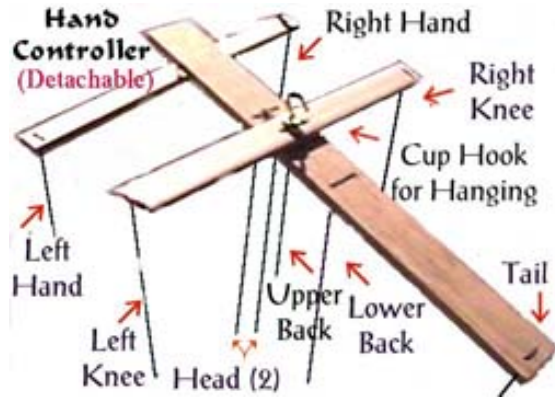
# Complex System Governance

CSG is the design, execution, and evolution of the [nine] metasystem functions necessary to provide control, communication, coordination, and integration of a complex system  
(Keating, et al. 2014)

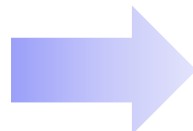
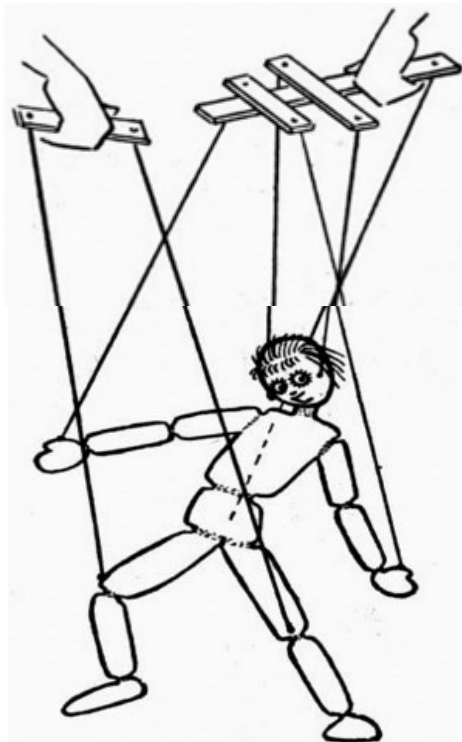
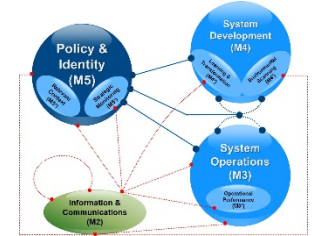


Keating, C.B., Katina, P.F., & Bradley, J. M. (2014). Complex system governance: concept, challenges, and emerging research. *International Journal of System of Systems Engineering*, 5(3), 263-288.

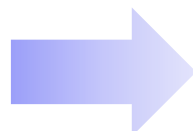
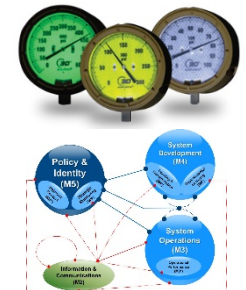
# CSG: An Analogy – THE MARIONETTE



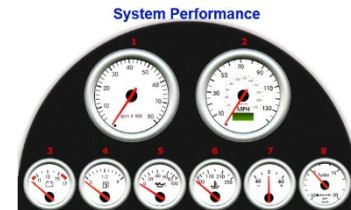
## CSG Design



## CSG Execution



## System Performance





# Complex System Governance – in a nutshell of 5 fundamentals points



All systems are subject to the laws of systems



All systems perform essential governance functions that determine system performance.



Governance functions can experience pathologies in their performance.



Pathologies linked to ‘violation’ of one or more system principles



System performance can be enhanced through purposeful development of governance functions & addressing pathologies

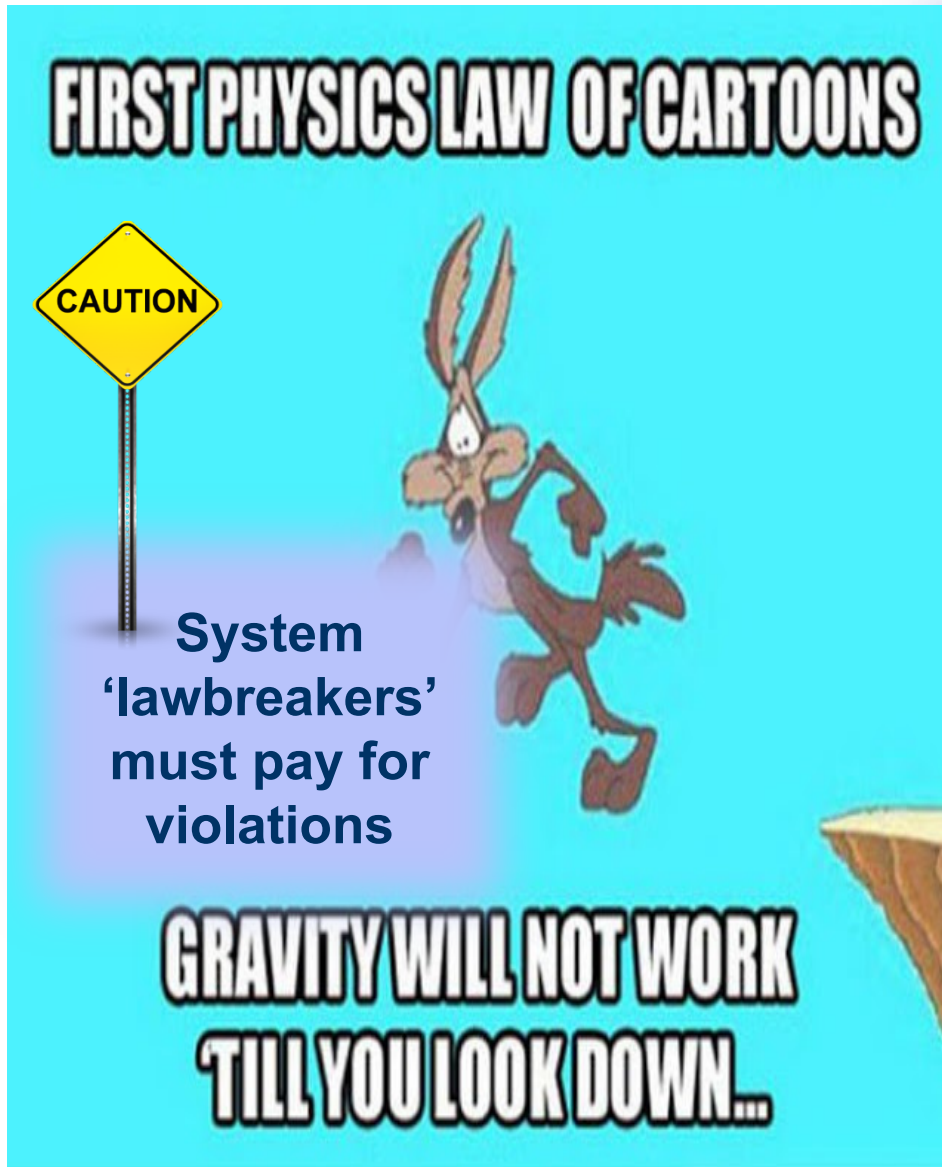
## PATHOLOGY

“circumstance, condition, factor, or pattern that acts to limit system performance, or lessen system viability, such that the likelihood of a system achieving performance expectation is reduced” (Keating and Katina, 2012, p. 253)

## EXAMPLE

**M2.11. Introduction of uncoordinated system changes resulting in excessive oscillation.**

# Physics Laws in the Cartoon World



# Systems (principles) Laws in the Real World

Unlike cartoons, real world Systems conform to principles that:

1. Don't sleep, are always there & on
2. Apply equally without bias or value judgments
3. Make no allowances for ignorance
4. Have real consequences for violations

Cost Overrun

Schedule Overrun

**OBSERVED FAILURE(s)**

Missed Performance Target

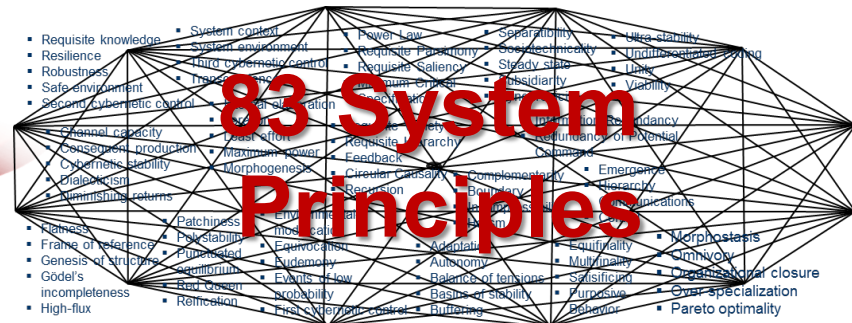
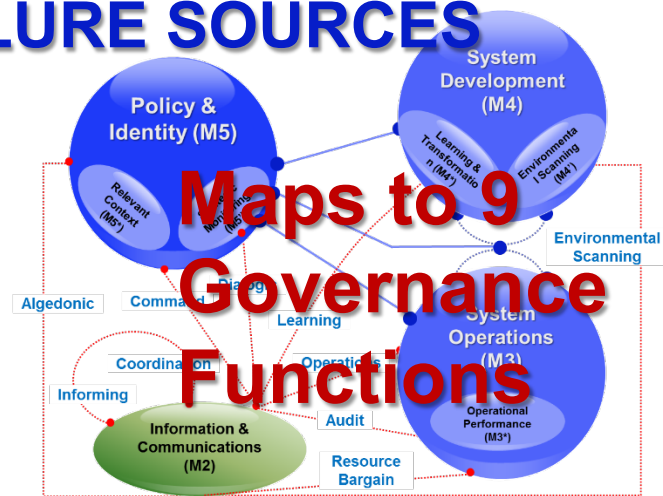
High Employee Turnover

**UNOBSERVED FAILURE SOURCES**

Same underlying system pathology appears as 'different' surface issues

56	M3*1. Limited accessibility to data necessary to monitor performance.	3*1 We have access to sufficient information to monitor system performance.
57	M3*2. [SYSTEM OF INTEREST]-level operational performance indicators are absent.	3*2 We have an effective set of operational performance indicators.
58	M4.5. Strategic planning/thinking focuses on operations - limited time devoted to strategic analysis.	4.4.2. The crises we encounter are for the most part manageable.
59	M4*1. Limited learning achieved related to operational level planning and improvement.	4*1 We effectively respond to shifts in the environment.
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**53 Complex System Pathologies**





# ***What CSG is NOT***

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**Magic**

2

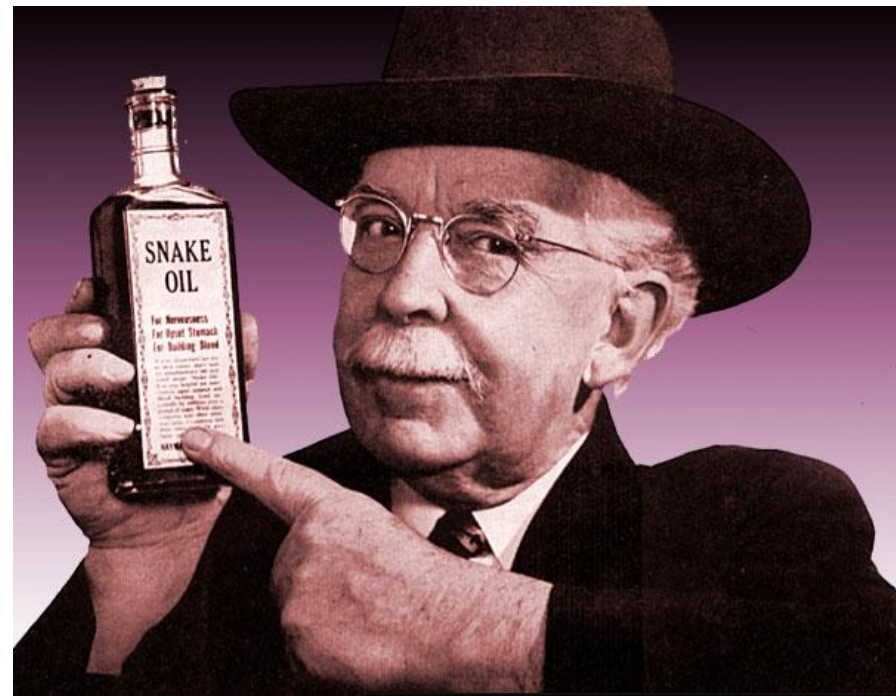


**Easy**

3



**Prescriptive**



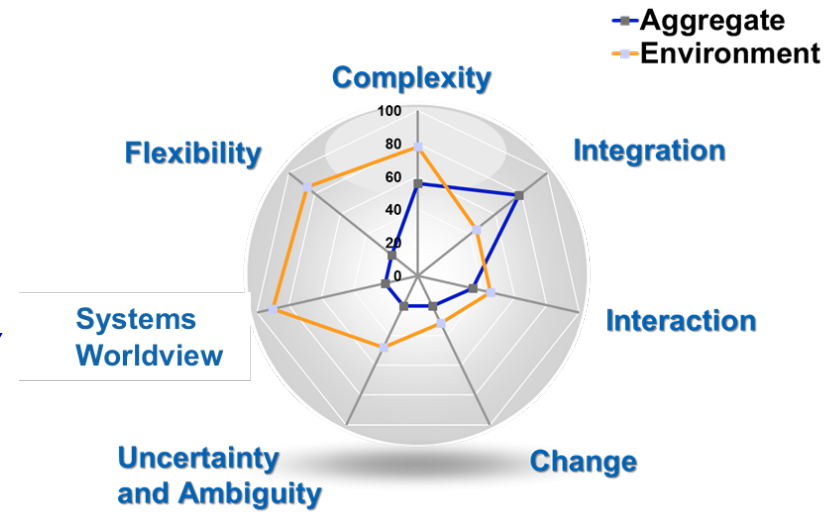
# Complex System Governance: Contributions & Directions

**A path out of 'Flatland'**

# Results: What we have been able to do

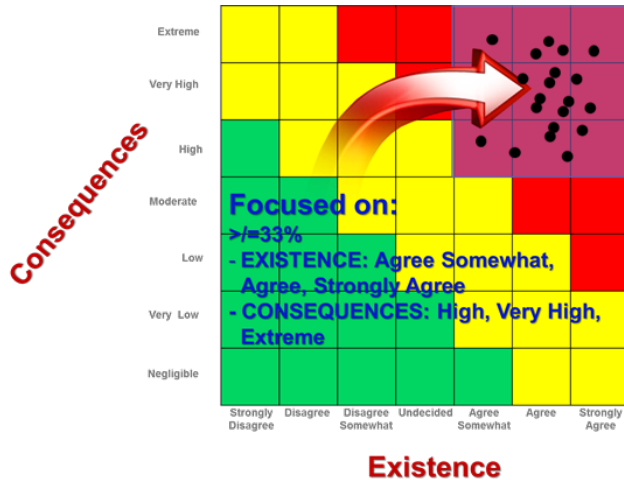
1

Identification of gaps between workforce systems thinking capacity and complexity demanded by the environment

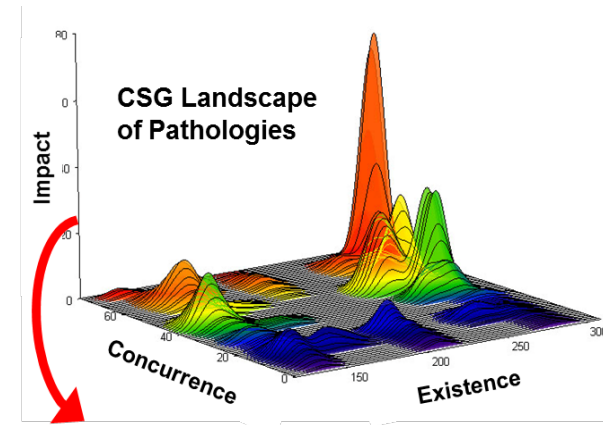
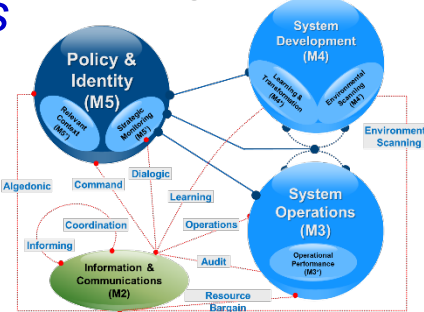


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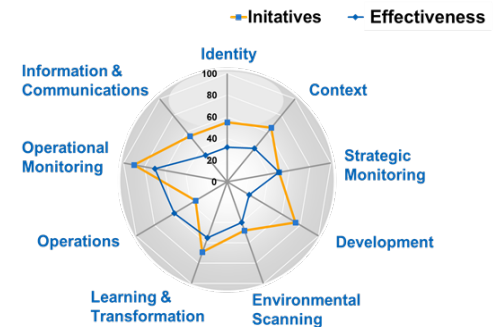
Identification, mapping, and prioritization of pathologies for CSG landscape



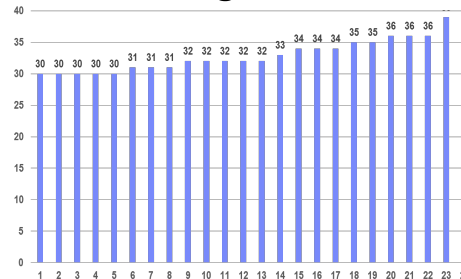
## Pathologies Mapped



## Governance Check Aggregate Profile



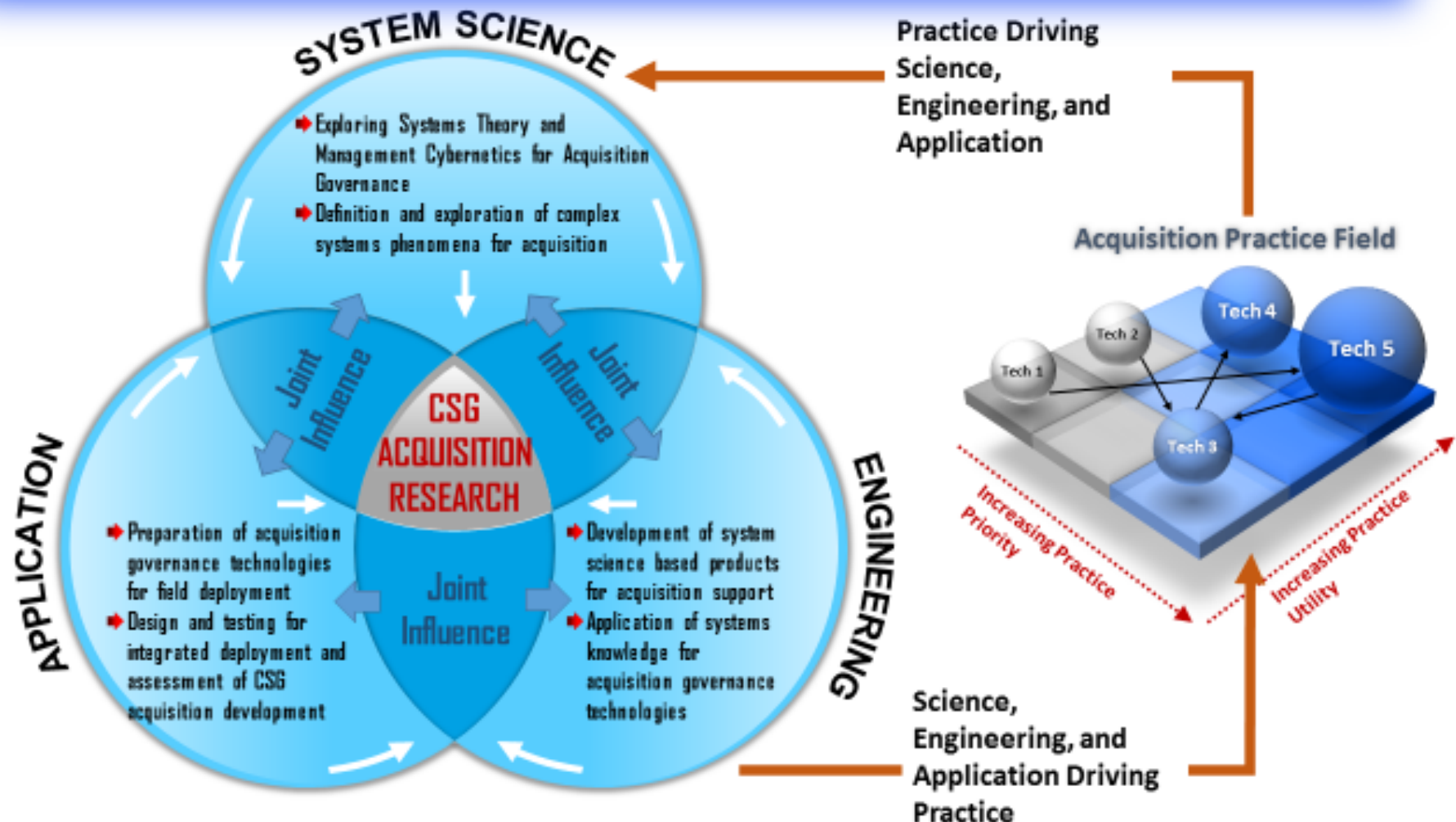
## Pathologies Ranked





# Research directions: Where we are going

‘The system-science based engineering of technologies to support application development that advances practices related to design, execution, and development of complex systems’.





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***Engineering Management & Systems Engineering***

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# ***The CSG Functions***

