SoSECIE Webinar

Welcome to the 2020 System of Systems Engineering Collaborators Information Exchange (SoSECIE)



We will start at 11AM Eastern Time Skype Meeting +1 (703) 983-2020, 46013573# You can download today's presentation from the SoSECIE Website: <u>https://mitre.tahoe.appsembler.com/blog</u> To add/remove yourself from the email list or suggest a future topic or speaker, send an email to sosecie@mitre.org

NDIA System of Systems SE Committee

Mission

- To provide a forum where government, industry, and academia can share lessons learned, promote best practices, address issues, and advocate systems engineering for Systems of Systems (SoS)
- To identify successful strategies for applying systems engineering principles to systems engineering of SoS

Operating Practices

 Face to face and virtual SoS Committee meetings are held in conjunction with NDIA SE Division meetings that occur in February, April, June, and August

NDIA SE Division SoS Committee Industry Chairs:

Mr. Rick Poel, Boeing

Ms. Jennie Horne, Raytheon

OSD Liaison:

Dr. Judith Dahmann, MITRE

Simple Rules of Engagement

- I have muted all participant lines for this introduction and the briefing.
- If you need to contact me during the briefing, send me an e-mail at sosecie@mitre.org.
- Download the presentation so you can follow along on your own
- We will hold all questions until the end:
 - I will start with questions submitted online via the CHAT window in Skype.
 - I will then take questions via telephone; State your name, organization, and question clearly.
- If a question requires more discussion, the speaker(s) contact info is in the brief.

Disclaimer

- MITRE and the NDIA makes no claims, promises or guarantees about the accuracy, completeness or adequacy of the contents of this presentation and expressly disclaims liability for errors and omissions in its contents.
- No warranty of any kind, implied, expressed or statutory, including but not limited to the warranties of non-infringement of third party rights, title, merchantability, fitness for a particular purpose and freedom from computer virus, is given with respect to the contents of this presentation or its hyperlinks to other Internet resources.
- Reference in any presentation to any specific commercial products, processes, or services, or the use of any trade, firm or corporation name is for the information and convenience of the participants and subscribers, and does not constitute endorsement, recommendation, or favoring of any individual company, agency, or organizational entity.

2020-2021 System of Systems Engineering Collaborators Information Exchange Webinars Sponsored by MITRE and NDIA SE Division

February 11, 2020 Mission Focused Engineering Mr. Dean Ridgely

February 25, 2020 Cybernetics, Complexity, and the Challenges to the Realization of the Internet-of-Things Dr. Tod Schuck

> March 10, 2020 Analysis of Interoperability to Support Mission-Oriented SoS Dr. Ronald Giachetti

> > March 24, 2020

Extending the DoD Digital Engineering Strategy to Missions, Systems of Systems, and Portfolios Philomena Zimmerman

April 21, 2020

Mission Engineering, Systems Engineering and Systems of Systems Engineering Dr. Andreas Tolk

Complex Systems Governance: Concept, Utility and Challenges for SoSE

Chuck Keating, Ph.D.

January 14, 2020











National Centers for System of Systems Engineering



© 2020 Old Dominion University

Topics



World of the SoS Engineer Wicked Problems and Messes





Products of the Domain





The CSG View

Connecting the dots differently – Escaping Flatland

- Flatland: A Romance of Many Dimensions
 by Edwin Abbott (1884)
 People
 - *trapped in two dimensions*



The Flatland Dilemma

Flatland View



Beyond Flatland View



Result of addressing complex systems in flatland

Solving the wrong problems precisely in the most efficient way possible – Mitroff's Type III Error

Escaping Flatland Creating a Decisive Difference



CSG: "One" Approach to Escape from Flatland

Complex System Governance

Mastering Complexity by Design



Complex System Governance – in a nutshell of 5 fundamentals points



<u>All systems</u> are subject to the laws of systems



All systems <u>perform essential</u> <u>governance functions</u> that determine system performance.



Governance <u>functions can</u> <u>experience pathologies</u> in their performance.



Pathologies linked to <u>'violation'</u> of one or more <u>system laws</u>



System <u>performance</u> can be <u>enhanced</u> through <u>purposeful</u> <u>development</u> of <u>governance</u> <u>functions</u> & <u>addressing pathologies</u>

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.

Keating, C. B., & Katina, P. F. (2012). Prevalence of pathologies in systems of systems. *International Journal of System of Systems Engineering*, 3(3-4), 243-267.

Complex System Governance

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)







The Utility of CSG

Some Promising Results, and Current/Future Directions

Results: What we have been able to do



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



Results: What we have been able to do



Results: What we have been able to do



Definition of the CSG landscape of pathologies and state of CSG

..... in contrast to system development initiatives

CSG Landscape Map to identify highest impact development areas. **CSG** Landscape 0 of Pathologies Impact 20 300 F_{easibility} 250 Existence 150 Complex System Governance Profile Initatives Effectiveness Identity Information & 100 Communications Context 80 60 40 Operational Strategic Monitoring Monitoring Operations

> Learning & Environmental Transformation Scanning

Development



Some of Our Challenges

4 Challenges to Move the Needle



Perceived risk and threat to status quo



Limited patience for the long view and immersive study







Overcoming the "In Addition To" Syndrome



Chuck Keating, Ph.D., <u>ckeating@odu.edu</u>

Old Dominion University Engineering Management & Systems Engineering National Centers for System of Systems Engineering