25th anniversary annual INCOSE international workshop
Los Angeles, CA
January 24 - 27, 2015

Model Based Systems Engineering for Systems of Systems

Sunday, January 25, 1:00-5:00

INCOSE
International Council on Systems Engineering

Objective

- Present results from two recent EU projects on SoS modeling
  - COMPASS: Comprehensive Modelling for Advanced Systems of Systems – Claire Ingram and Jeremy Bryans
  - DANSE: Designing for Adaptability and evolutioN in Systems of systems Engineering (DANSE) - an Effective, Model-Based Approach – Eric Honour
- Provide information on current and emerging practices related to MBSE as applied to SoS
- Facilitate exchange on challenges and opportunities
- Prioritize next steps for the SoSWG on SoS and MBSE

Agenda

1:00 **Introduction on "Why MBSE for SoS?"**

1:15 **COMPASS presentation and demo**
- Claire Ingram and Jeremy Bryans

3:15 **DANSE presentation and demo**
- Eric Honour

4:15 **Panel and group discussion "Challenges and Opportunities"**
- Presenters
- Stephen Cook, research perspective
- Fatma Dandashi, Standards perspective

Why MBSE for SoS?

A Practitioner's Approach using MBSE in Systems of Systems

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INTRODUCTION

In a world of uncertainty for today's Department of Defense (DoD) there exists an inevitability that the services will require more of the systems brought to the battlefield than originally intended. Our expectations will be to deliver decisive victory against a dynamic and ever increasing complex threat, all the while living within tightening budget constraints. To be successful those systems will be employed in such a way to allow the warfighter to 'overcome and adapt' in order to engage and counter whatever the conditions on the ground or sea or air maybe. Increasingly, the employment of a battlefield system will not only operate effectively, but to optimize the success of a mission environment defined in terms of systems-of-systems (SoS). As stated in the DoD SoS Systems Engineering guide [OUSD AT&L, 2008].

"With the adoption of net-centric approach to information management, developers recognize that systems operate in a broader context today than in the past. Most importantly, changing threat situations increase the need for flexibility and adaptability in the way the war fighters configure and apply suites of systems to respond to changing situations. The notion of "systems of systems" is becoming a critical perspective in thinking about systems."

In 2012 the RAND Corporation published a report, "Lessons Learned from the Army's Future Combat Systems," at the request of the Army's Acquisition Executive to provide an after-action analysis of the FCS program [Perina, et al., 2012]. FCS program officials interviewed for the report stated, "The trend toward networked capabilities will increasingly demand movement away from acquisitions of platforms in isolation and toward a more sophisticated consideration of how the Army should integrate systems into existing and future formations." Further, they agreed that more preparatory system engineering is needed for such a large, ambitious program and that SoS engineering should have been much stronger early in the program. And in case the reader believes that programs like FCS are the exception, the Defense Acquisition Guidebook (DAG) states that whether or not a system is formally acknowledged as an SoS, nearly all of our DoD systems function as part of an SoS to deliver capability to the warfighter. Unfortunately, the acquisitions of these systems aren't often structured and don't always yield optimized systems-of-systems. There are multiple contributors leading to sub-optimal conditions that include, but are not limited to organizational structure/culture, governance, budgets, and conflicting schedules. While understanding the impact that these contributors have on program and mission success is significant, it is the aim of this paper to focus discussion on how the use of a model based, i.e. Model Based Systems Engineering (MBSE), approach may provide a remedy for some of the technical aspects of this condition.

A Practitioner's Approach using MBSE for SoS

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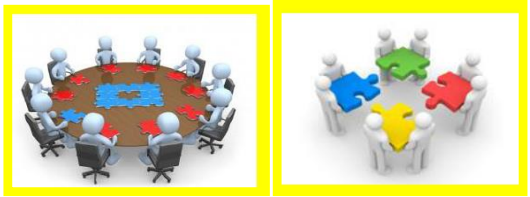
I/ITSEC 2014

Pain Points

SoS Authority
What are effective collaboration patterns in SoS?

Leadership
What are the roles and characteristics of effective SoS leaders?

Capabilities & Requirements
How can SE address SoS capabilities and requirements?



Constituent Systems
What are effective approaches to integrating constituent systems?

Testing, Validation & Learning
How can SE approach SoS validation, testing, and continuous learning in SoS?

Autonomy, Interdependencies & Emergence
How can SE address the complexities of interdependencies and emergent behaviors?

SoS Principles
What are the key SoS thinking principles?

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