Systems Engineering Advancement Research Initiative

Massachusetts Institute of Technology

A Framework for System of Systems Tradespace Exploration

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Biography

Debarati Chattopadhyay is a graduate student at MIT pursuing a Masters degree in Aeronautics and Astronautics. Debarati has B.S. degrees in Computer Engineering (2005) and Astrophysics(2004) from Lehigh University. She has worked in mission operations for the Chandra X-ray Observatory at the Harvard-Smithsonian Center for Astrophysics.

Related Publications

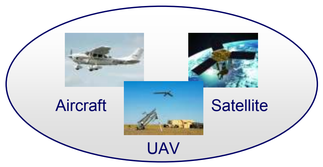
Chattopadhyay, D., Ross, A.M., and Rhodes, D.H., "A Framework for Tradespace Exploration of Systems of Systems", 6th Conference on Systems Engineering Research, Los Angeles, CA, April 2008.

What is a SoS?

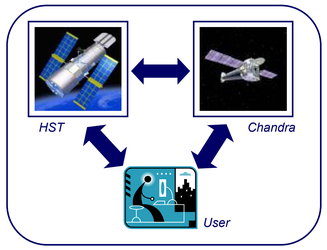
A system-of-systems (SoS) is a *set of collaboratively integrated systems* that possess two additional properties: *operational independence* of the components and *managerial independence* of the components. (Maier 98)

SoS is defined as a set or arrangement of systems that results when *independent and useful systems are integrated* into a larger systems that delivers unique capabilities. (DoD 2004)

Multi-Concept Responsive Disaster Surveillance



Coordinating Observatories



Motivation

• System of Systems design requires *sophisticated decision making under high uncertainty* to ensure selection of designs that maintain value over the operational lifetime

• A *quantitative method* is necessary to compare SoS design alternatives and understand the tradeoffs between diverse stakeholder preferences.

Design of future SoS will require quantitative concept exploration methods to improve SoS selection decisions

Anticipated Contributions

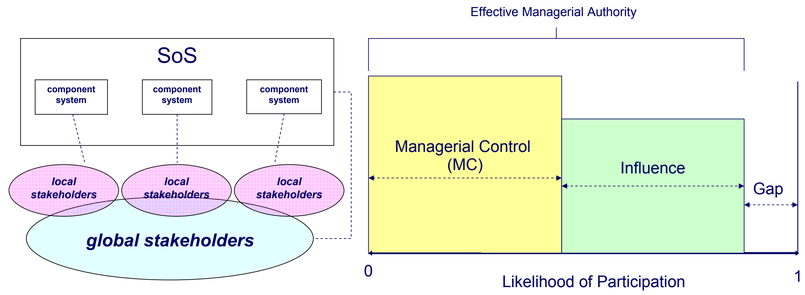
• Validate Dynamic Multi-Attribute Tradespace Exploration (MATE) as a basis for a framework for SoS tradespace exploration

• Provide a framework for testing SoS design heuristics suggested in literature

Research Questions

1. What are the characteristics that distinguish SoS design from traditional system design?
2. What is a practical framework for SoS tradespace exploration?
3. How can the developed tradespace exploration framework be used to select SoS designs that are value robust through the SoS lifetime?

SoS Specific Considerations



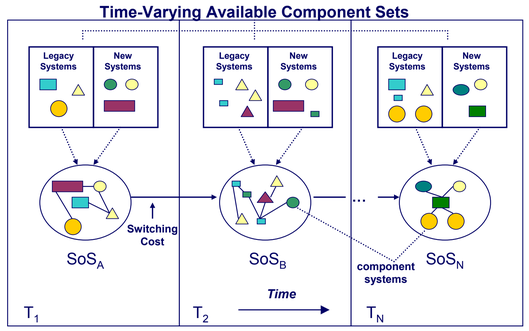
Local and Global Stakeholder Sets

Legacy and New Systems

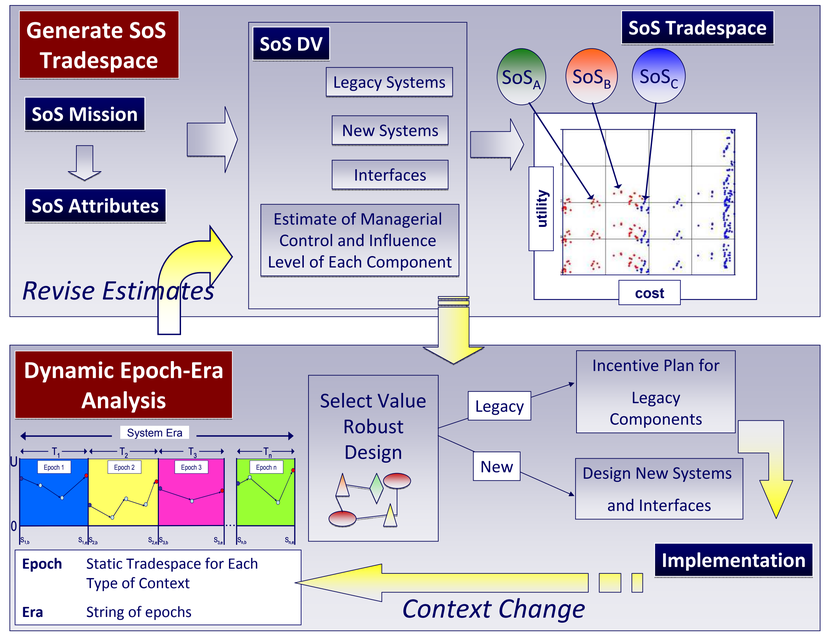
Dynamic Composition

Consider managerial authority during SoS design

Study SoS value delivery over time, accounting for dynamic composition



Proposed Framework for SoS Tradespace Exploration



References

Maier, M.W., "Architecting Principles for Systems-of-Systems", *Systems Engineering*, Vol. 1, No. 4, pp. 267-84, 1998.

DoD, "4.2.6. System of Systems Engineering," In Defense Acquisition Guidebook, Department of Defense, 2004.

Ross, A.M., and Rhodes, D.H., "Architecting Systems for Value Robustness: Research Motivations and Progress," Annual IEEE Systems Conference, Montreal, Canada, April 2008.

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http://seari.mit.edu