The Systems of Systems (SoS) Primer: A Guide to SoS for all Expertise Levels

October 2017

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NDIA 20th Annual Systems Engineering Conference
http://www.ndia.org/events/2017/10/23/20th-systems-engineering-conference

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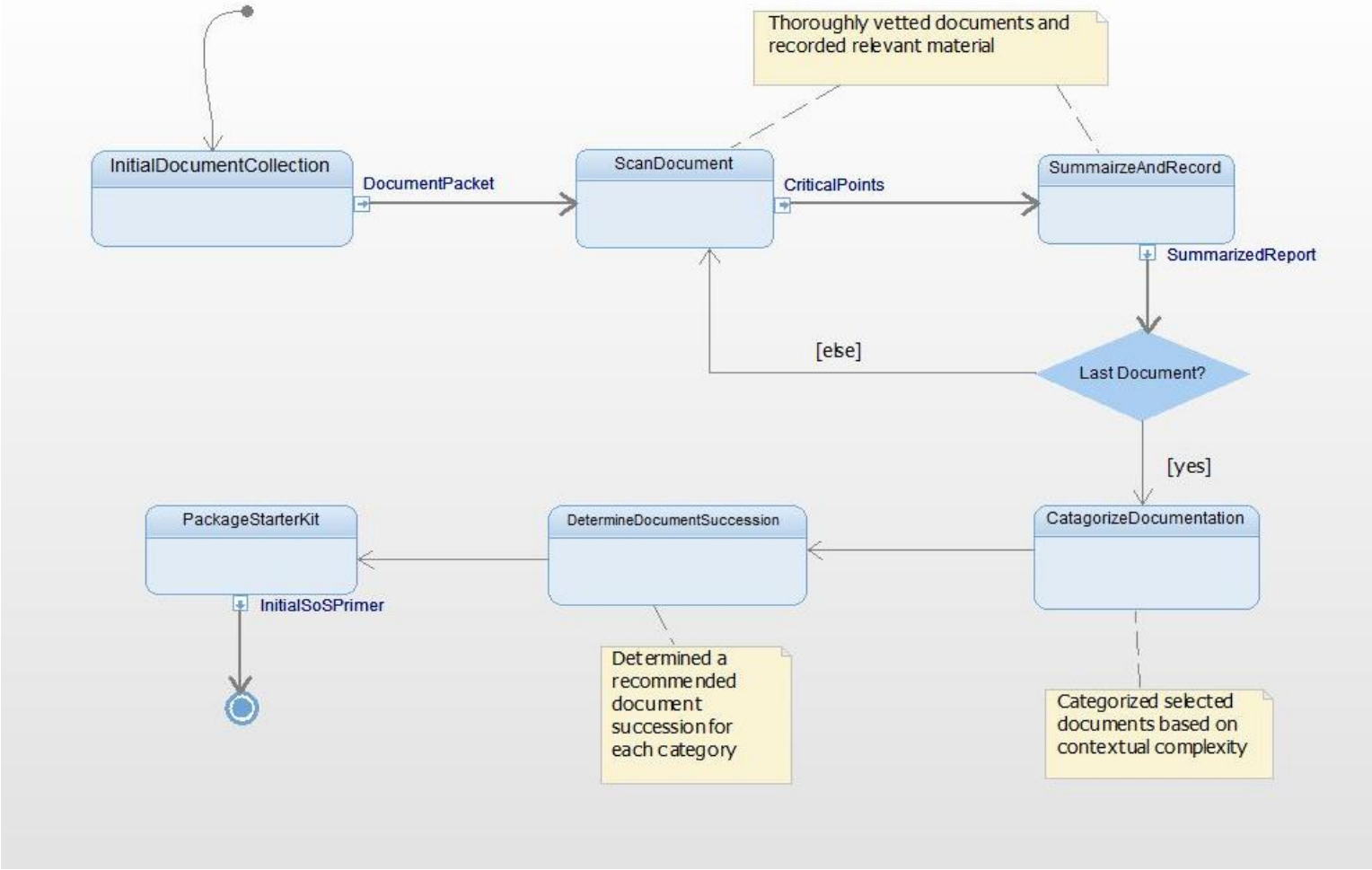
Overview

- **Objective:**
  - Develop a “SoS Primer” to serve as a guide for SoS concepts and practices with content that accommodates users of all expertise levels
- **Intended to be a living document that is updated**
  - Following user feedback
  - To reflect the most recent advances in the state of the practice

SoS Primer: Developmental Workflow



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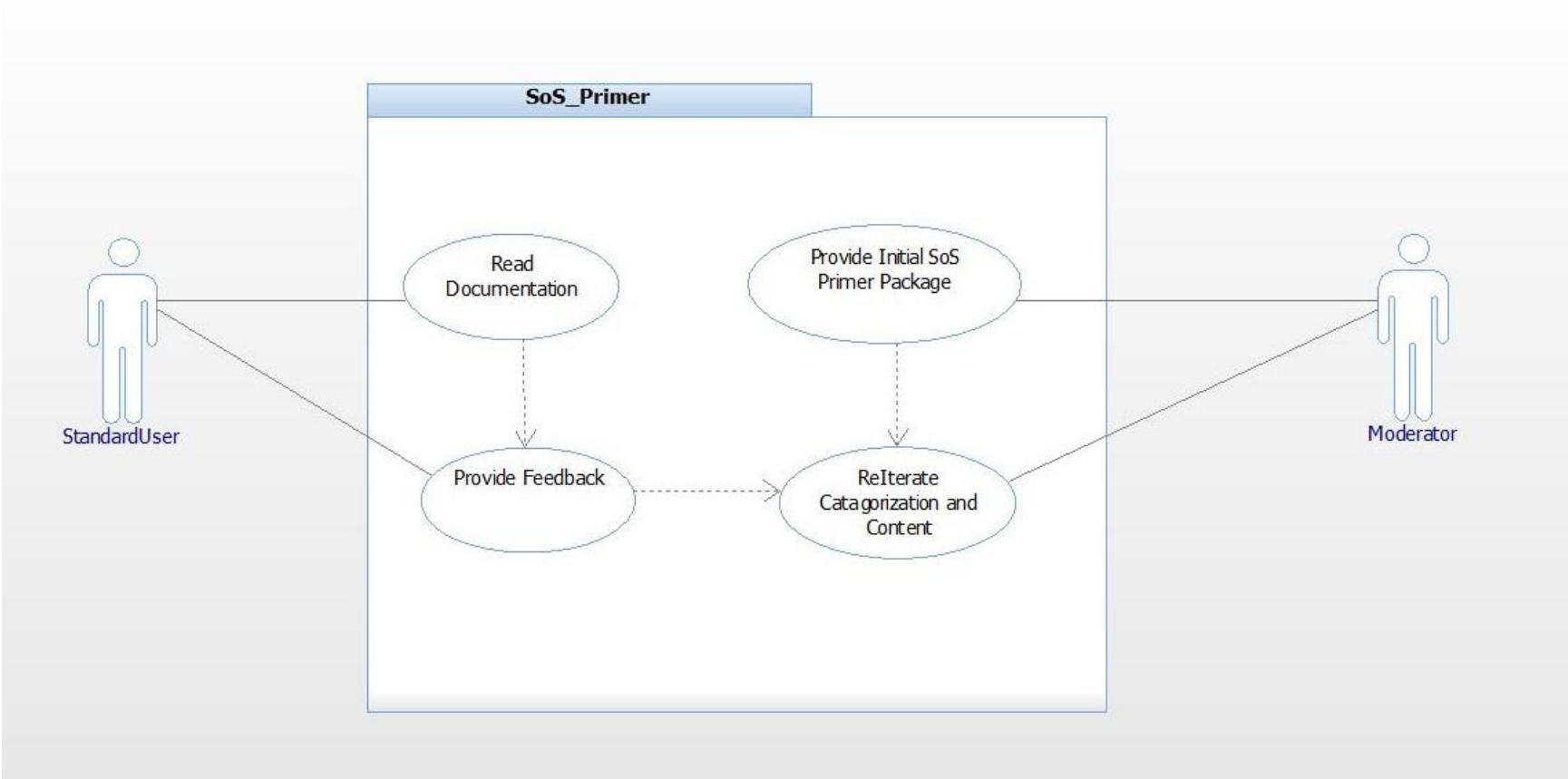
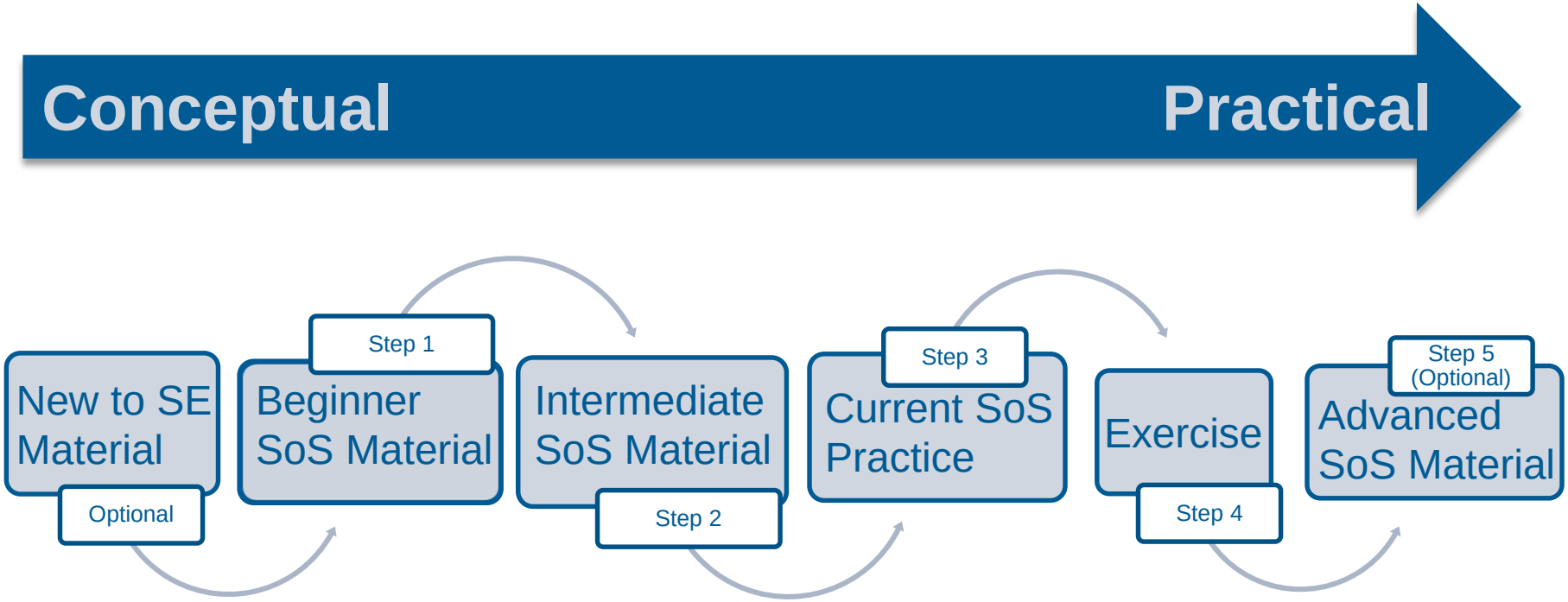
SoS Primer: User Roles



Document Categorization



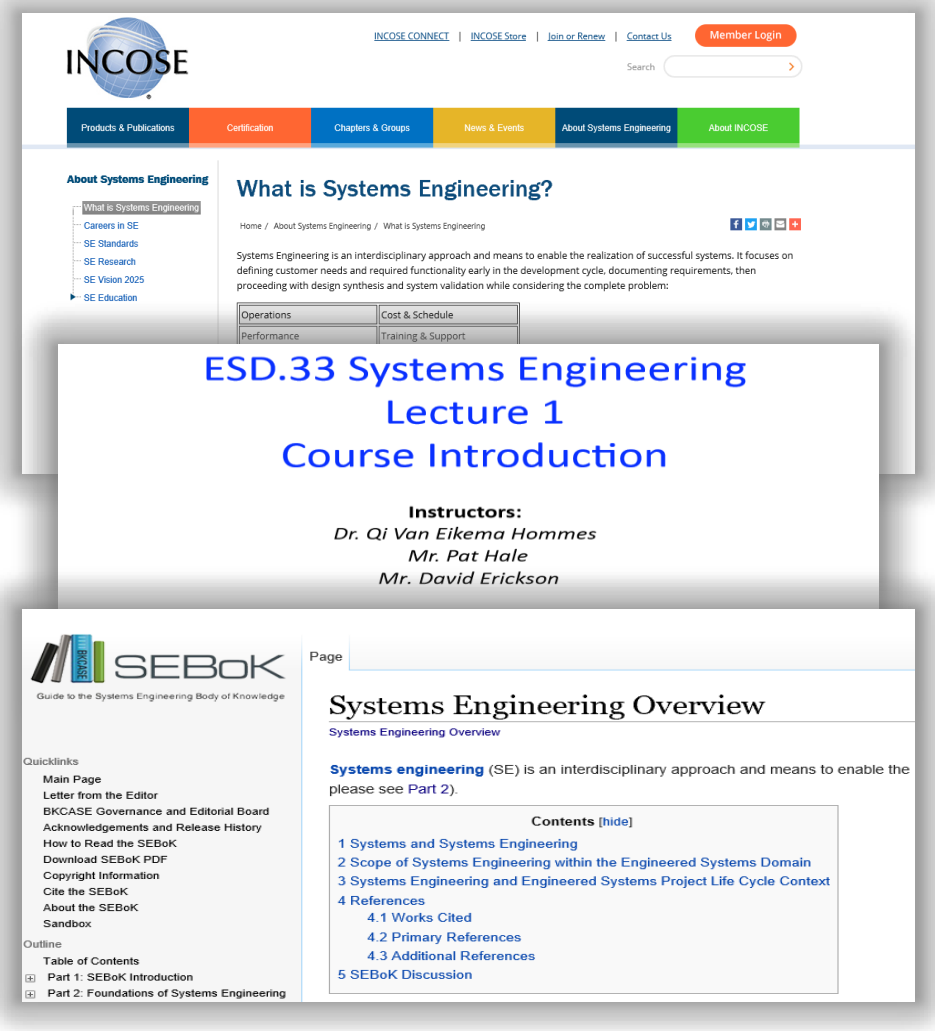
Recommended Document Succession

Proposed Order

New to SE Material	Beginner SoS Material	Intermediate SoS Material	Current SoS Practice	Advanced SoS Material
INCOSE: What is SE?	MITRE: Overview of SoS (Summarized PPT)	MITRE: Understanding SOP	INCOSE INSIGHT SoSE	INCOSE Systems Engineering Journal
MIT: Systems Introduction	MITRE: Am I dealing with a SoS?	MITRE: Implementer View SoSE (Summarized PPT)		IEEE Xplore
SEBoK: Systems Engineering Overview		INCOSE: SoS Pain Points Study (Summarized PPT)		INCOSE Journal of Enterprise Transformation
				International Journal of Systems of Systems Engineering

New To SE Material*

1. **INCOSE: What is SE?**
   - Definition of Systems and SE
   - The SIMILAR Process
2. **MIT: Systems Introduction**
   - Characteristics and Applications
   - Process Models
3. **SEBoK: Systems Engineering Overview**
   - SE Scope and Project Lifecycle



*Optional for individuals new to systems and systems engineering concepts

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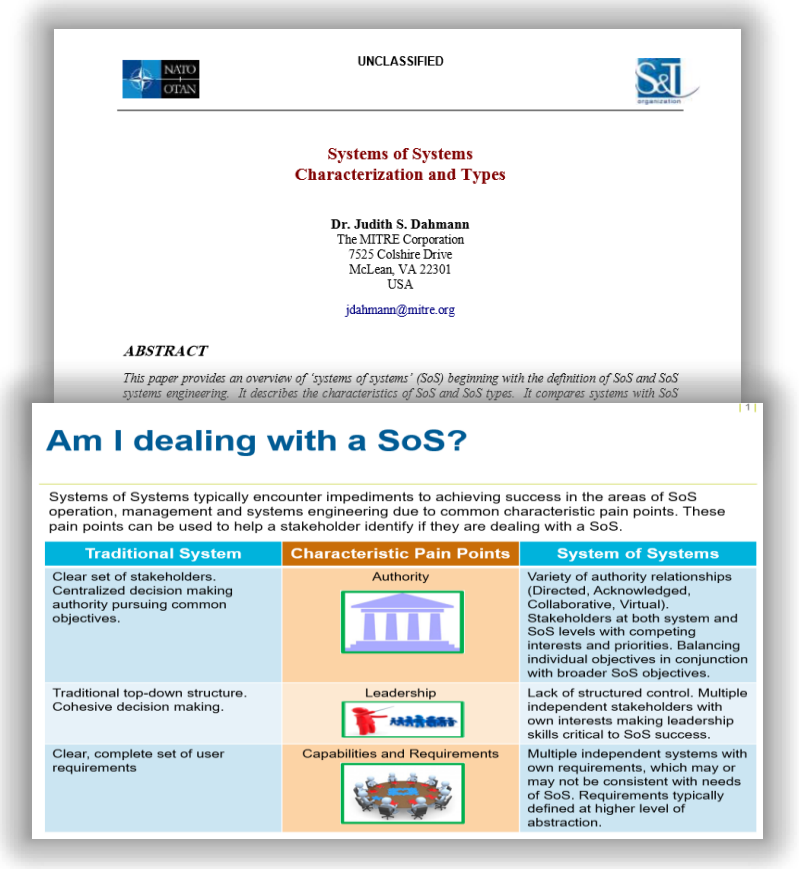
Beginner SoS Material

1. **MITRE: Overview of SoS**
   - SoS Definitions
   - Characteristics and Attributes
   - Scope and Domains
   - Types and Aspects of SoS SE
   - Challenges
2. **MITRE: Am I dealing with a SoS?**
   - Pain Points



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Systems of Systems
Characterization and Types

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ABSTRACT

This paper provides an overview of 'systems of systems' (SoS) beginning with the definition of SoS and SoS systems engineering. It describes the characteristics of SoS and SoS types. It compares systems with SoS

Am I dealing with a SoS?

Systems of Systems typically encounter impediments to achieving success in the areas of SoS operation, management and systems engineering due to common characteristic pain points. These pain points can be used to help a stakeholder identify if they are dealing with a SoS.

Traditional System	Characteristic Pain Points	System of Systems
Clear set of stakeholders. Centralized decision making authority pursuing common objectives.	Authority	Variety of authority relationships (Directed, Acknowledged, Collaborative, Virtual). Stakeholders at both system and SoS levels with competing interests and priorities. Balancing individual objectives in conjunction with broader SoS objectives.
Traditional top-down structure. Cohesive decision making.	Leadership	Lack of structured control. Multiple independent stakeholders with own interests making leadership skills critical to SoS success.
Clear, complete set of user requirements	Capabilities and Requirements	Multiple independent systems with own requirements, which may or may not be consistent with needs of SoS. Requirements typically defined at higher level of abstraction.

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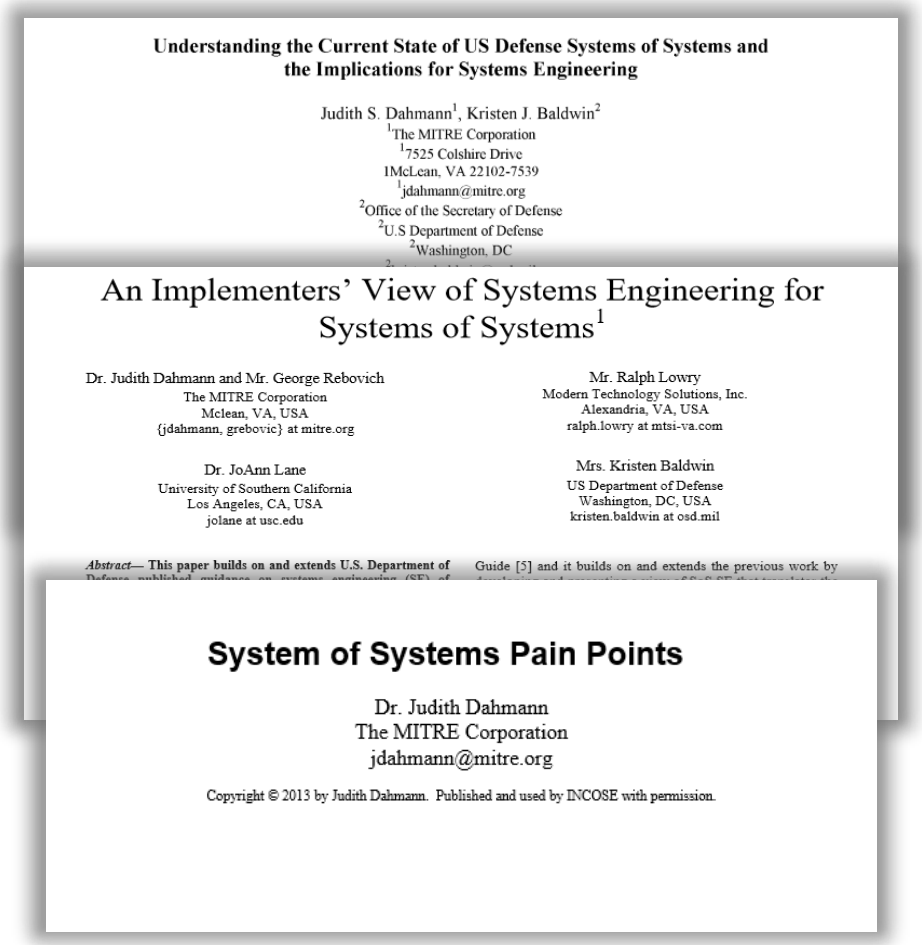
Intermediate SoS Material

1. **MITRE: Understanding SOP**
   - Acknowledged SoS in the DoD
   - SE Challenges for Acknowledged SoS
2. **MITRE: Implementer View SoSE**
   - Wave Model
3. **INCOSE: SoS Pain Points Study**
   - Origins of Pain Points



Understanding the Current State of US Defense Systems of Systems and the Implications for Systems Engineering

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An Implementers' View of Systems Engineering for Systems of Systems[1]

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Abstract— **This paper builds on and extends U.S. Department of**

Guide [5] and it builds on and extends the previous work by

System of Systems Pain Points

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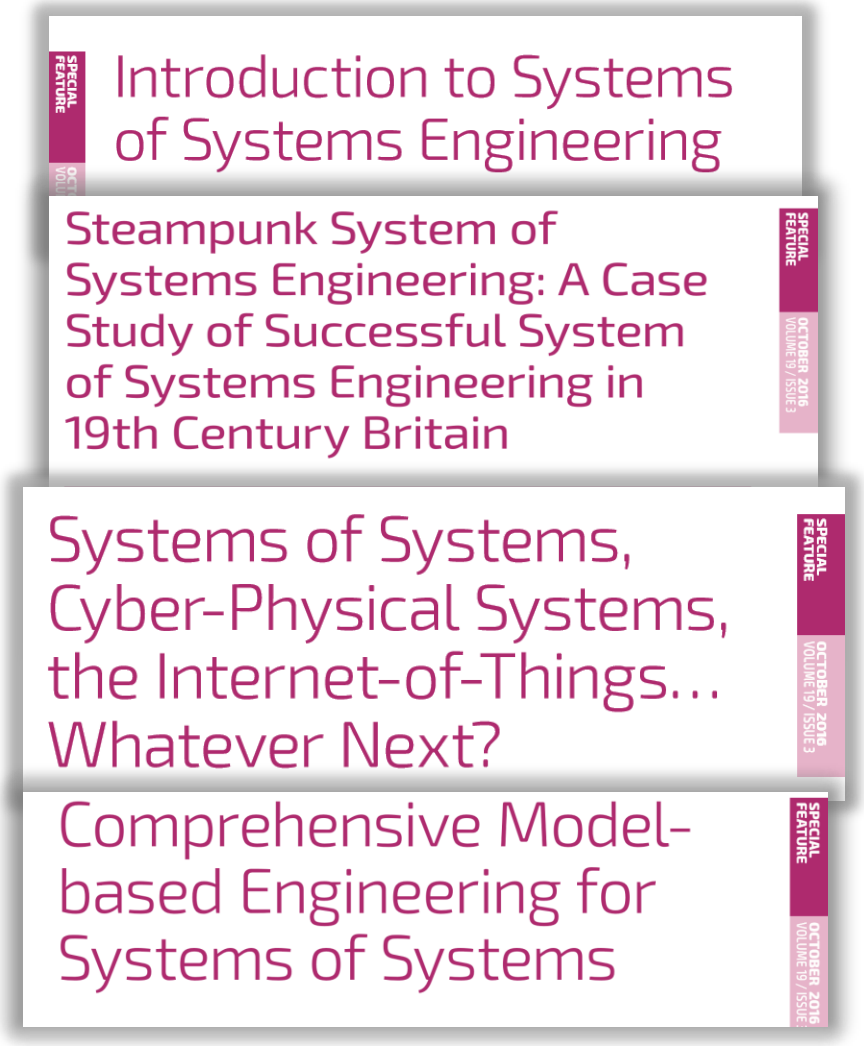
Current SoS Practice

1. **INCOSE: INSIGHT**
   - SoS Background
   - SoS/SoSE Case Studies
   - Emerging Ideas in SoS/SoSE
   - SoSE Tools, Techniques, and Approaches



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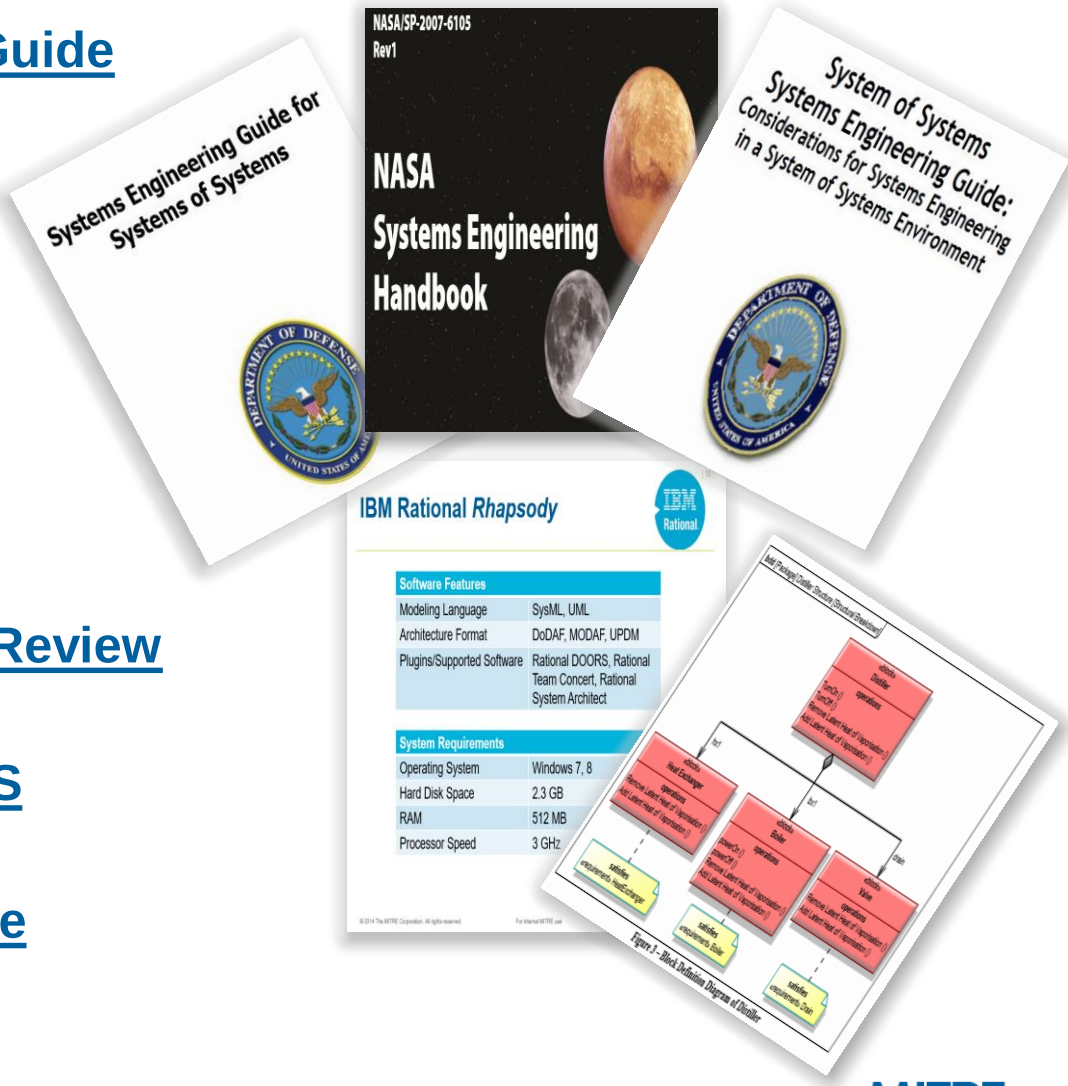
Advanced SoS Material

- **INCOSE Systems Engineering Journal**
  - International Council on Systems Engineering's (INCOSE) quarterly journal publications
- **IEEE Xplore**
  - Online database of articles published on systems through the Institute of Electrical and Electronics Engineers (IEEE)
- **INCOSE Journal of Enterprise Transformation**
  - INCOSE quarterly publication that focuses on enterprise transformation in academic fields including systems engineering
- **International Journal of Systems of Systems Engineering**
  - Inderscience quarterly publication whose articles are centered around ground-breaking changes and areas of interest within the field of SoS engineering

Optional SoS Material

- DAU: Systems Engineering Guide For Systems of Systems
- NASA: Systems Engineering Handbook
- DSIAC: System of Systems Systems Engineering Guide: Considerations for Systems Engineering in a System of Systems Environment
- MITRE: Analytic Workbench Review
- MITRE: Software Tools for Modeling and Analysis of SoS Architecture
- MITRE: SoS Modeling Mhause
  - SysML Resource



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Acronyms

- **COTS** – Commercial Off-the-Shelf
- **INCOSE** – International Council on Systems Engineering
- **SE** – System Engineering
- **SoS** – System of System
- **DoDAF** – Department of Defense Architecture Framework
- **MoDAF** – Ministry of Defense Architecture Framework
- **SEBoK** – System Engineering Body of Knowledge
- **IOC** – Initial Operational Capability
- **SoSE** – System of Systems Engineering
- **DoD** – Department of Defense
- **TTCP** – The Technical Cooperation Program
- **CONOPS** – Concept of Operations
- **IMS** – Integrated Master Schedule
- **SOP –** Standard Operating Procedure
- **DAG –** U.S. Defense Acquisition Guidebook
- **EC –** European Commission
- **COMPASS –** Comprehensive Modeling for Advanced Systems of Systems
- **DANSE –** Designing for Adaptability and evolutioN in System of systems Engineering
- **IT –** Information Technology
- **T-AREA-SoS –** Trans-Atlantic Research and Education Agenda in Systems of Systems
- **E2E –** End to End
- **SoSWG –** System of Systems Working Group
- **COI –** Communities of Interest
- **AOC –** Air Operations Center
- **SEP –** Systems Engineering Plan
- **V&V –** Verification and Validation

SoS Primer: User Workflow

- **Piloting with New Hire or Employee New to SoS**