

DoD Software Engineering and System Assurance

System of Systems



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Acquisition, Technology and Logistics

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Topics

- Action items from last SISAIG (October 2007)
- SoS SE Guide and Best Practices
 - Update on SoS SE Guide
 - SoS SE Follow up Plans
- Options for follow-on SISAIG SoS Activity



SoS Action Items

Action Item 5:

- AUS will pilot the US SoS SE guide on the Australian Joint Fires effort
 - We are looking forward to feedback on the Joint Fire results from an SoS perspective

Action Item 6:

- The US will provide the SoS SE guide to the UK for review and comment, and consideration of a pilot
 - SoS SEG went out for review in Dec 2007
 - Included international partners (UK, AUS)
 - Comments received in late February from AUS (Dr. Dombkins)
 - Focus on management complexity
 - Included tech paper on 'wave' approach

Action Item 13:

- US will draft a POAM for SoS
 - We are open (interested) in AUS or UK cooperative pilot
 - Discussion of possible areas for cooperation include later in this presentation



SoS SE Guide (SEG) Revision

- Draft SoS SEG version .9 released December 2006
- March - September 2007 - 'Pilot Phase'
 - Structured review of V.9 with SoS SE practitioners and researchers
 - Results offer 'boots on the ground' basis for guide revision
- Draft SoS SEG V1 released for comment December 10, 2007
 - Available at
 - <http://www.acq.osd.mil/sse/ssa/guidance.html>
- Formal comment acceptance closed on February 14, 2008
- Majority of comments were adjudicated by April 1
- Final release of version 1.0 expected by June 2008



Now for the numbers...

- 1161 comments in total
 - 128 critical
 - 518 substantive
 - 596 administrative
- 20 organizations submitting comments
 - 2 Industry (AIA, LMCO)
 - 3 FFRDC/University - SEI, MITRE, USC
 - 16 Government
 - All Services

Distribution of Critical and Substantive Comments by Section

Comment Category	Number of Comments	Number of pages	Comment density (#/page)
General	49		
Chapter 1	76	7	10.9
Chapter 2	78	5	15.6
Chapter 3	87	8	10.9
Section 4.0	1	0.5	2.0
Section 4.1	173	36	4.8
Section 4.2	87	17	5.1
Section 5	11	2.5	4.4
References	2	2	1.0
Annex A	8	15	0.5
Annex B	6		
Future work	58		

Total 636

Tremendous Interest in the topic
Most comments provided positive contributions to the guide




SoS SEG Highlights Definitions

System: *A functionally, physically, and/or behaviorally related group of regularly interacting or interdependent elements; that group of elements forming a unified whole. (JP 1-02 & JP 3-0)*

SoS: *A set or arrangement of systems that results when independent and useful systems are integrated into a larger system that delivers unique capabilities [DoD, 2004(1)].*

Taxonomy of SoS

- Directed
 - SoS objectives, management, funding and authority; systems are subordinated to SoS
-  - Acknowledged
 - SoS objectives, management, funding and authority; however systems retain their own management, funding and authority in parallel with the SoS
- Collaborative
 - No objectives, management, authority, responsibility, or funding at the SoS level; Systems voluntarily work together to address shared or common interest
- Virtual
 - Like collaborative, but systems don't know about each other



SoS SEG Highlights

Focus on Acknowledged SoS

- Increased US DoD emphasis on war fighter capabilities
 - Typically require multiple systems to meet end-to-end capability needs
 - Approach has been to leverage current systems to meet new capability needs
- However, current systems are still needed for original use
 - And since most systems are developed and managed by the Military Services, responsibility for systems often differs from responsibility for capabilities or SoS
 - Consequently, there are increasing instances of acknowledged SoS in the US DoD
- Characterized by dual management, funding and technical authorities
 - Source of management issues which impact SE
- V1 of the guide provides an initial resource for SE teams working in this environment

Acknowledged SoS growing in the US DoD
They have received little attention to date

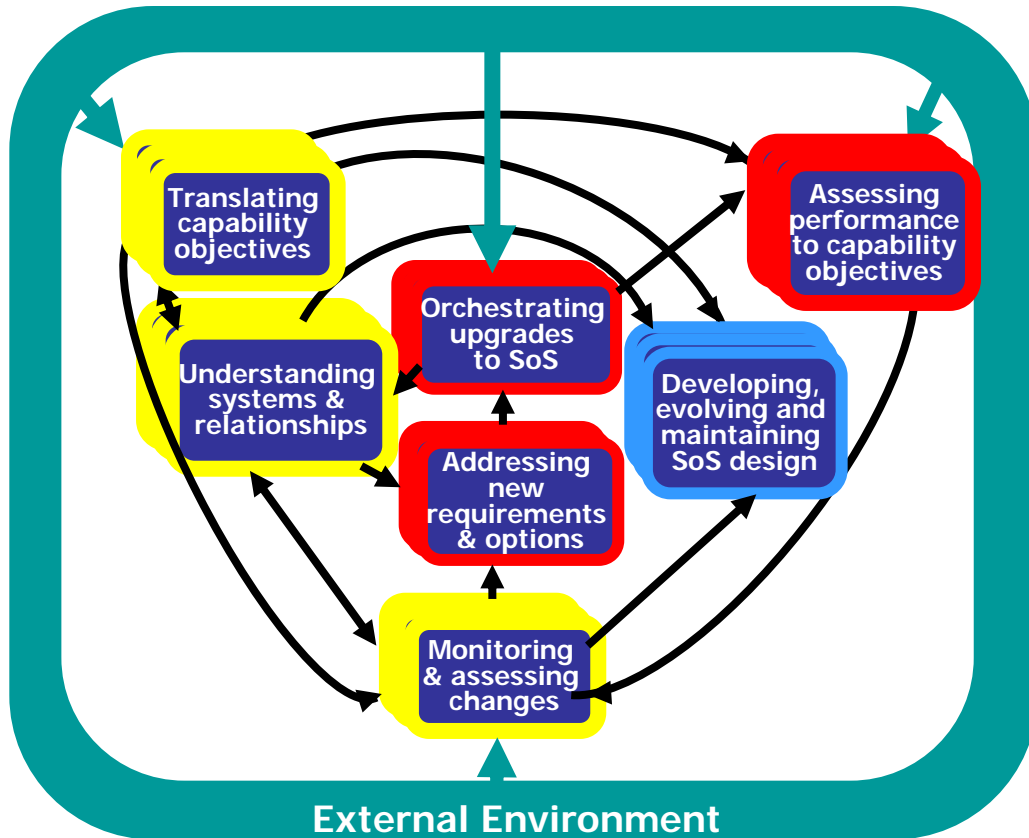


Comparing Systems and SoS

	System	System of Systems
Management & Oversight		
Stakeholder Involvement	Clearer set of stakeholders	Two levels of stakeholders with mixed possibly competing interests
Governance	Aligned PM and funding	Added levels of complexity due to management and funding for both SoS and systems; No SoS does over all systems
Operational Environment		
Operational Focus	Designed and developed to meet operational objectives	Called upon to meet operational objectives using systems whose objectives may or may not align with the SoS system's objectives
Implementation		
Acquisition	Aligned to established acquisition processes	Cross multiple system lifecycles across acquisition programs, involving legacy systems, developmental systems, and technology insertion; Capability objectives but may not have formal requirements
Test & Evaluation	Test and evaluation the system is possible	Testing more challenging due systems' asynchronous life cycles and given the complexity of all the moving parts
Engineering & Design Considerations		
Boundaries & Interfaces	Focuses on boundaries and interfaces	Focus on identifying systems contributing to SoS objectives and enabling the flow of data, control and functionality across the SoS while balancing needs of the systems
Performance & Behavior	Performance of the system to meet performance objectives	Performance across the SoS that satisfies SoS user capability needs while balancing needs of the systems



Relationships Among Core Elements of SoS SE



- Translating SoS capability objectives into high level requirements over time
- Understanding the systems in the SoS and their relationships
- Assessing extent to which the SoS meets capability objectives over time
- Developing, evolving and maintaining a design for the SoS
- Anticipating and assessing impacts of potential changes on SoS performance
- Evaluating new and evolving requirements on SoS and options for addressing these
- Orchestrating upgrades to SoS

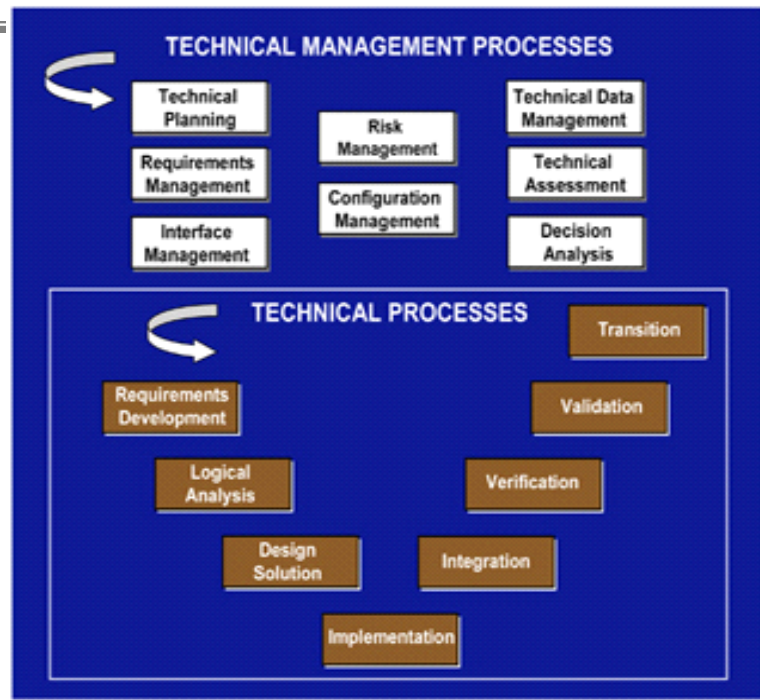
SoS SE creates and continually applies approaches to accomplish these elements





SE Processes Support Core Elements

- DoD Defense Acquisition Guide presents 16 basic SE processes
- In an SoS, SE team adapts these processes to execute core SE elements
- Focus for SoS SE is on technical management since implementation is in systems



SoS SE Core Elements

Technical Processes

Technical Management Processes

	Rqts Devel	Logical Analysis	Design Solution	Implement	Integrate	Verify	Validate	Transition	Decision Analysis	Tech Planning	Tech Assess	Rqts Mgt	Risk Mgt	Config Mgt	Data Mgt	Interface Mgt
Translating Capability Objectives	X											X		X	X	
Understanding Systems & Relationships		X							X				X		X	X
Assessing Performance to Capability Objectives		X					X		X		X		X		X	
Developing & Evolving an SoS Architecture	X	X	X						X	X		X	X	X	X	X
Monitoring and Assessing Changes									X				X		X	X
Address Requirements & Solution Options	X		X						X	X		X	X	X	X	X
Orchestrating Upgrades				X	X	X	X	X	X	X	X	X	X	X	X	X



SoS SE Guide Next Steps

- Complete the guide and publish, including an online version
- Develop outreach/educational materials
- Followup on key issues current planned or underway in the US
 - SoS and T&E
 - SoS Risk
 - SOA and SoS
 - SoS management and implications for SE



Potential Areas for SISAIG SoS

- General applicability of SoS SE elements and model
 - Does the SoS SE model fit across the US, AUS and the UK? What are areas where the fit is good and others where changes are needed?
- SoS management
 - Can we address the difficulties in SoS SE for acknowledged SoS by addressing SoS management?
 - Can we address the issues by moving from 'acknowledged' to 'directed' SoS? Under what conditions does this work? Not?
 - Are there other approaches to SoS management and government which should be considered? (e.g. Australia Complex Systems Management)
- SE for collaborative or virtual SoS
 - What characterizes these types of SoS in each Nation? How is SE approached in these environments? What are the issues and implications?
- Others?
 - Work collaboratively on topics we are addressing in the US? (previous slide)

Conduct comparative use cases drawn from each nation?
Produce White Paper?



Mission

Organization

Functions

ABOUT SOFTWARE ENGINEERING & SYSTEM ASSURANCE

Font Size:

SSA Mission

- Establish a DoD community of excellence, in concert with government, industry, academia and international partners, for software engineering and system assurance. Provide engineering support to, DoD acquisition programs, policy, guidance, education, and training for software, system assurance, system of systems, process improvement, and mature and propagate software best practices
- Provide system assurance policy, guidance and training to evolve assuring DoD systems
- Advance the state of the art for system engineering of DoD system of systems

<http://www.acq.osd.mil/sse/ssa/>