

The Body of Knowledge and Curriculum to Advance Systems Engineering

*IEEE System of Systems Conference
Albuquerque, NM
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Panelists

Prof. David Olwell, Naval Postgraduate School

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Moderator

Dr. Ricardo Valerdi, MIT (moderator)



Report Documentation Page

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- 1. BKCASE Intro (Valerdi) – 5 min**
- 2. Overview of SEBoK and Description of Parts 1 & 2 (Olwell) – 10 min**
- 3. Description of Parts 3, 5, 6 and 7 (Roedler) – 10 min**
- 4. Description of Part 4 - Applications of SE - SoS, Product SE, Enterprise SE, and Service SE (Henshaw) – 10 min**
- 5. Q&A – 20 min**

What is a Body of Knowledge?

1. A complete set of concepts, terms and activities that make up a professional domain
2. The accepted ontology for a specific domain
 - Civil Engineering Body of Knowledge (CEBoK)
 - Software Engineering Body of Knowledge (SWEBOK)
 - Project Management Body of Knowledge (PMBOK)
 - Enterprise Architecture Body of Knowledge (EABOK)
 - Etc.



Prof. David Olwell

- *Professor of Systems Engineering, Naval Postgraduate School*
- *Co-Principal Investigator for BKCASE*



Garry Roedler

- *Fellow & Engineering Outreach Program Manager, Lockheed Martin*
- *Editor of ISO/IEC/IEEE 15288, 29148 and 15939; INCOSE CAB Co-chair, ESEP and Founder Recipient*



Prof. Michael Henshaw

- *Professor of Systems Engineering, Loughborough University*
- *BAE Systems (17 years)*

- Wikitize
- BKCASE
- SEBoK
- GRCSE
- Collective intelligence

- BKCASE
- GRCSE
- Need
- Precedent
- Process
- Authors
- Bkcasewiki.org



- Part 1: SEBoK 0.5 Introduction
- Part 2: Systems (What type of systems exist)
- Part 3: Systems Engineering and Management (How)
- Part 4: Applications of Systems Engineering (Product, Enterprise, Service, SoS)
- Part 5: Enabling Systems Engineering (When, Who)
- Part 6: Related Disciplines
- Part 7: Systems Engineering Implementation Examples

KA and Topic Structure

- Content within Knowledge Areas/Topics for consistency
 - Items to be included in each Knowledge Areas (aka chapters)
 - Introduction
 - Fundamentals (if applicable)
 - SE Topics (Links to separate Topic articles)
 - Practical Considerations (if applicable)
 - Primary References
 - Additional References
 - Glossary
 - Items to be included in each SE topic
 - Introduction
 - Topic Overview and Discussion
 - Ontology (if included, then figures and/or tables)
 - Linkages to other topics
 - Practical Considerations (Pitfalls, Good Practice, etc.) – Transition to table format – see next chart
 - Primary References
 - Additional References
 - Glossary

- Context and Purpose of the SEBoK
- Scope of the SEBoK
- SE and Other Engineering Disciplines
- A Short History of SE: Challenge and Response
 - Overview of Systems Engineering Challenges
- Key SE Principles and Practices
- Origins of the SEBoK
- SEBoK Users and Uses
- Another Scope Dimension: Domain-Independent Knowledge
- Intertwined Disciplines and the SEBoK
- Scope and Guidance for the Construction of the SEBoK
- Structure of SEBoK version 0.5
- Next Steps

- Knowledge Area: Systems Overview
 - Topics: What is a System?; System Context; Overview of System Science; System Perspectives

- Knowledge Area: System Concepts
 - Topics: Concepts Related to Systems; Concepts Related to System Relationships; Complexity and Emergence

- Knowledge Area: Types of Systems
 - Topics : Classifications of Systems; Groupings of Systems; System Domains; The Product View of Engineered Systems; The Service View of Engineered Systems; The Enterprise View of Engineered Systems
- Knowledge Area: Representing Systems with Models
 - Topics: What is a Model?; Why Model?; Types of Models; System Modeling Concepts; Modeling Standards
- Knowledge Area: Systems Approach
 - Topics: Overview of the Systems Approach; Exploring a Problem or Opportunity; Systems Analysis Approach; Synthesis of a System; Proving a System; Owning and Making Use of a System; Applying the Systems Approach

Knowledge Area: Systems Challenges

- Topics: Systems Engineering Success Factors; Complex System Challenges; Dynamically Changing Systems; Interoperability and Centric Architectures; Evolutionary Systems

1. Overview of Contents
2. Fundamental Concepts and Terms
3. Focus of Parts 3, 5, 6, and 7

At end:

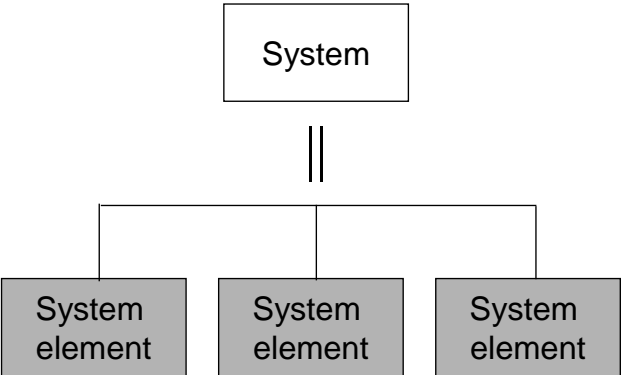
1. Path Forward
2. How You Can Help



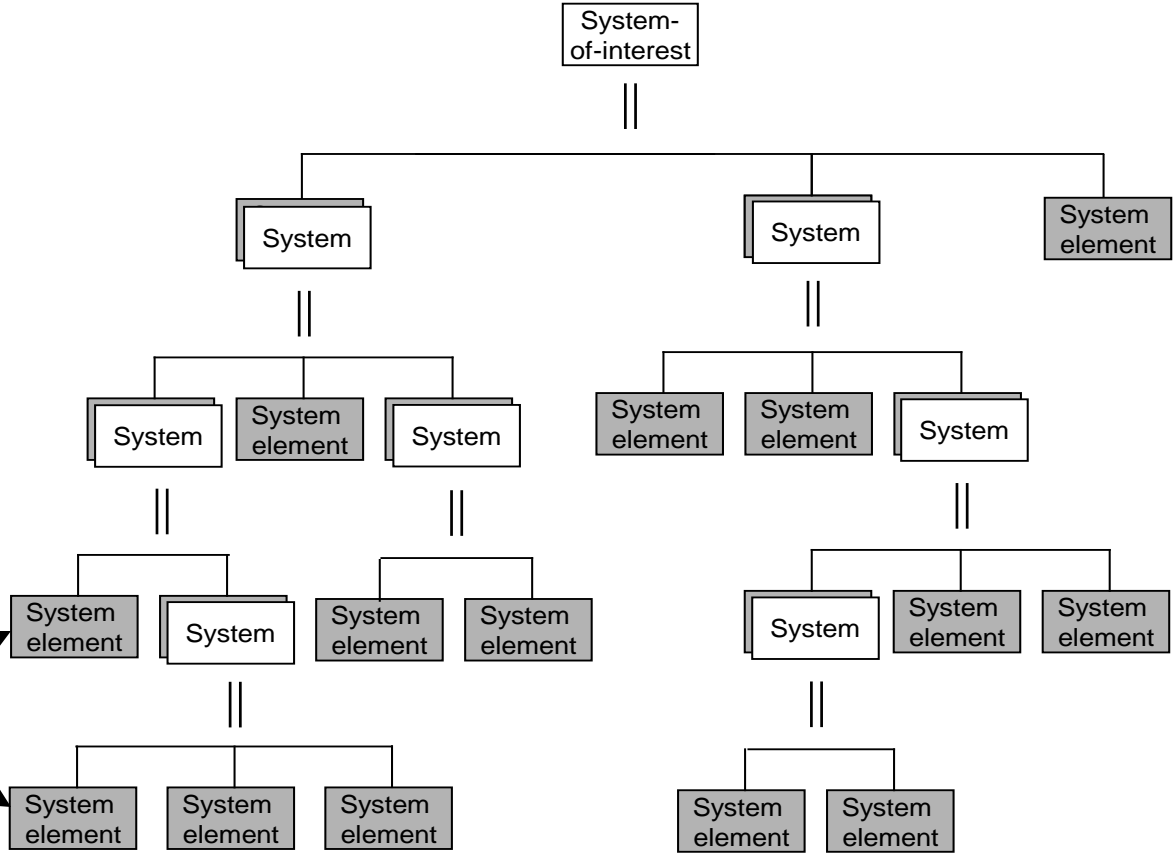
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- Concepts
 - System Structure – System-of-Interest and System Elements
 - Iteration, Recursion, and concurrency of stages and processes
 - Modularity of processes (can be invoked by other processes)
 - May have a blend of process models or types of process models at the same time.
 - Complex Systems and System of Systems need to be addressed consistently throughout
- Terms
 - Defer to SEVOCAB when possible
 - It reflects ISO, IEC, IEEE, and PMI terminology for SE and SWE
 - Enterprise vs organization
 - Program vs Project
 - System Hierarchy Terms
 - System / System-of-interest
 - System Element vs. subsystem, component, assembly, unit, ...
 - Note: system element may be HW, SW, people, products, services, ...
 - Roles: Stakeholder, user, customer, end user, operator, administrator, acquirer, supplier, developer, provider, maintainer, ...
 - Still need to resolve

System-of-Interest Structure

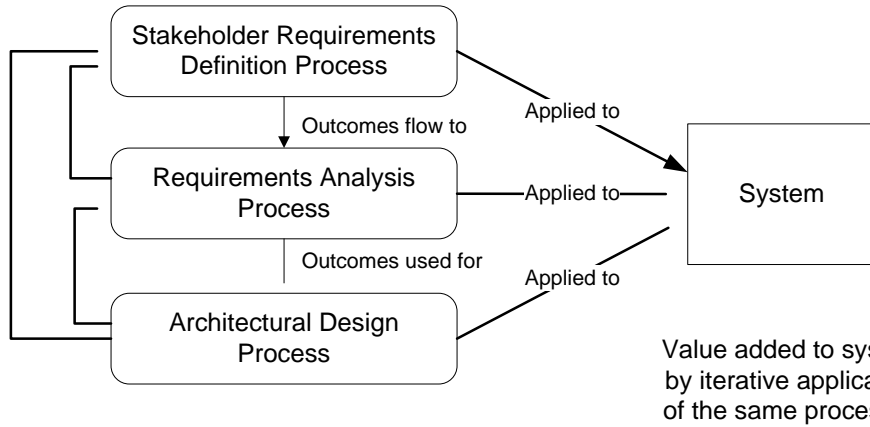


- ← A system
- ← is completely composed of
- ← a set of interacting
- ← system elements



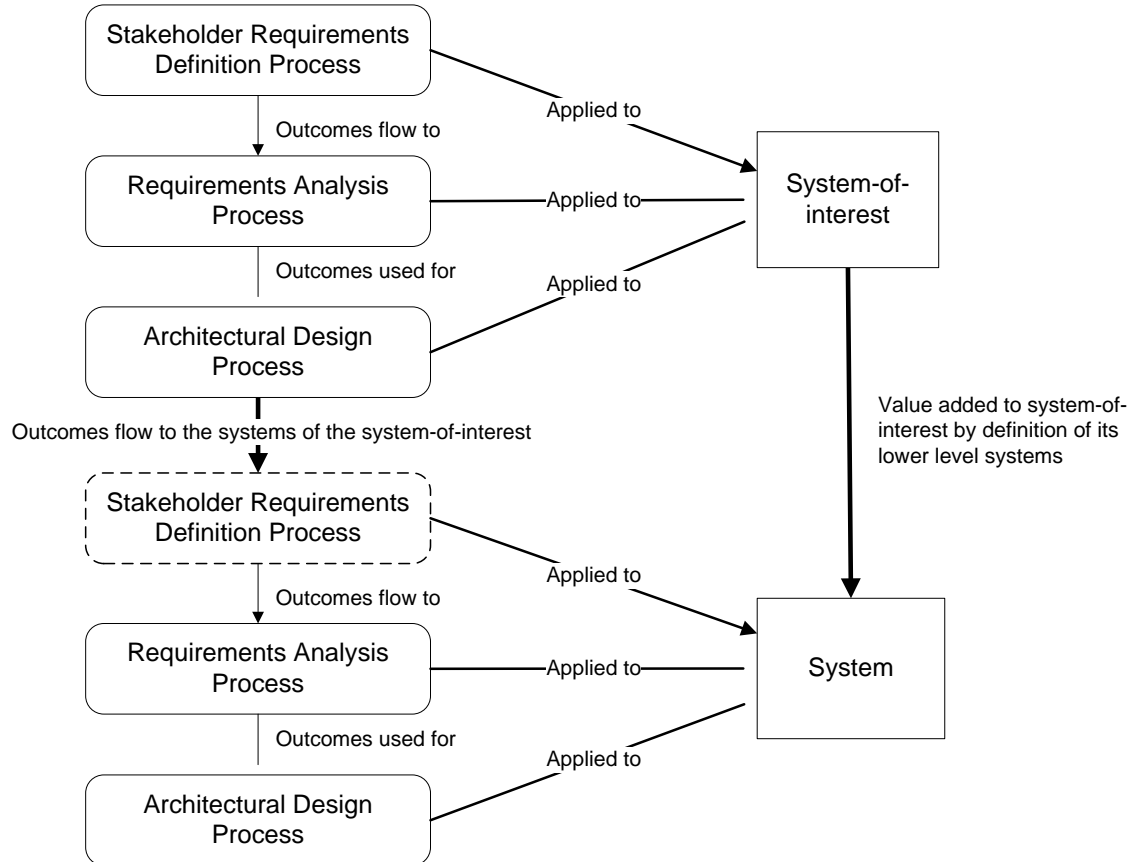
Make, Buy, or Reuse

Iteration and Recursion



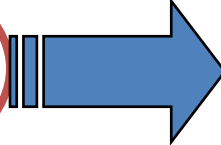
Iteration

Recursion



Part 3 - Systems Engineering and Management (How)

- Part 1: SEBoK 0.5 Introduction
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- **Part 3: Systems Engineering and Management (How)**
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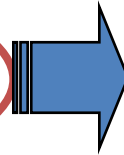
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- Life Cycle Models
 - System Definition
 - System Realization
 - Deployment and Use
 - SE Management
 - Product and Service Life Management
 - SE Standards

Focuses on *How* SE is Conducted; Core Technical and Management Processes, Life Cycle Models and SE-Related Standards

Part 5 - Enabling the Organization to Perform Systems Engineering (When, Who)

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- **Part 5: Enabling Systems Engineering (When, Who)**



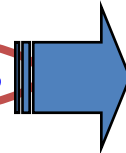
- Part 6: Related Disciplines
- Part 7: Systems Engineering Implementation Examples

- Strategy to organize to perform SE
- Organizing Individuals to Perform SE
- Organizing Teams, Projects and Programs to Perform SE
- Organizing Businesses and Enterprises to Perform SE

Strategies for organizing for SE; considerations for individuals, groups, and the business/enterprise

Part 6 - Software Engineering, Project Management and Specialty Engineering

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- **Part 6: Related Disciplines**
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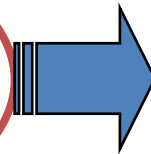


- SE & Software Engineering
 - SE & Project Management
 - Specialty Disciplines
 - Reliability, Availability, Maintainability
 - System Human Integration
 - Safety
 - Security
 - System Assurance
 - EMI/EMC
 - Manufacturability
- V0.5
- V1.0

Focused on the relationship of SE to other disciplines

Part 7 - Systems Engineering Implementation Examples

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- **Part 7: Systems Engineering Implementation Examples**



- Case Studies
- Vignettes

Case studies and vignettes provide real-world examples of SE activities; includes links of concepts to activities in the SEBoK

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- Addresses: How to apply systems engineering to creation and LC management of different types of systems
 - Products systems engineering
 - Consistent with ISO/IEC/IEEE 15288
 - Traditional SE
 - Services systems provisioning
 - Dynamic binding of products and services
 - Multiple providers
 - Enterprise Systems Engineering
 - Systems of processes (business and LC processes)

- Definitions and characteristics
 - Types of SoS: Virtual, collaborative, acknowledged, directed
- Architecture and Architecting approaches
 - Interoperability
 - Standards
 - Networks and Network analysis
 - Service view of SoSE
 - Open systems approaches
- Socio-technical aspects (real SoS)
 - Governance
 - Enterprise nature
 - The SoS mindset
 - Difference between SoSE and SE
- Capability Engineering (relationship to..)

- Michael Henshaw
- Judith Dahmann
- Mo Jamshidi
- Charles Dickerson
- +2

- Milestones

- ✓ May 6 – All comment incorporation determined – “prototype” of comment incorporation; determine any residual resource issues
- ✓ May 20 – Rough draft ready for incorporation into Wiki (“wikitize” it)
- ✓ May 20-June 6 – Review and refine rough draft in wiki
- ✓ June 6-10 – Core team review of wiki
- July 1 – Identify potential breaks and key threads
- July 15 – Lockdown of SEBoK structure
- July 31 – Deadline to provide all figures, diagrams, and images for IP approval
- August 15 – Completion of all writing
- September 15 – Ready for SE community review

Good progress being made – on track for September 15 review

- Provide key information and references
- Provide case studies or vignettes
- Serve as a reviewer after V0.5 is released for review in September
- Try Bkcasewiki.org and let us know if it meets your needs