

# 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

Garry Roedler, Lockheed Martin

Prof. Michael Henshaw, Loughborough University

## Moderator

Dr. Ricardo Valerdi, MIT (moderator)



- 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?

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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](http://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:

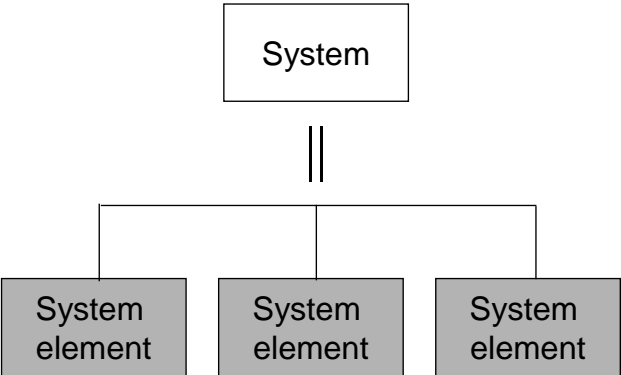
1. Path Forward
2. How You Can Help



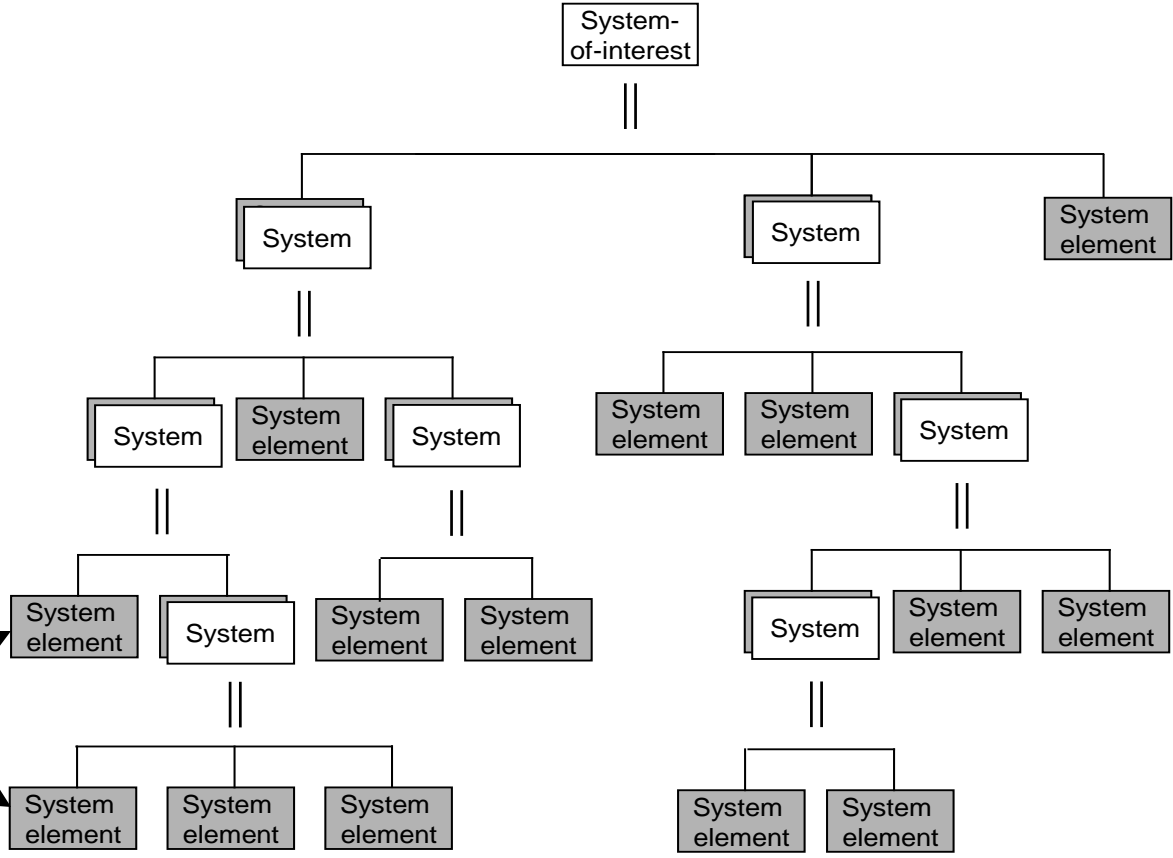
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- Concepts
  - System Structure – System-of-Interest and System Elements
  - Iteration, Recursion, and concurrency of stages and processes
  - Modularity of processes (can be invoked by other processes)
  - May have a blend of process models or types 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

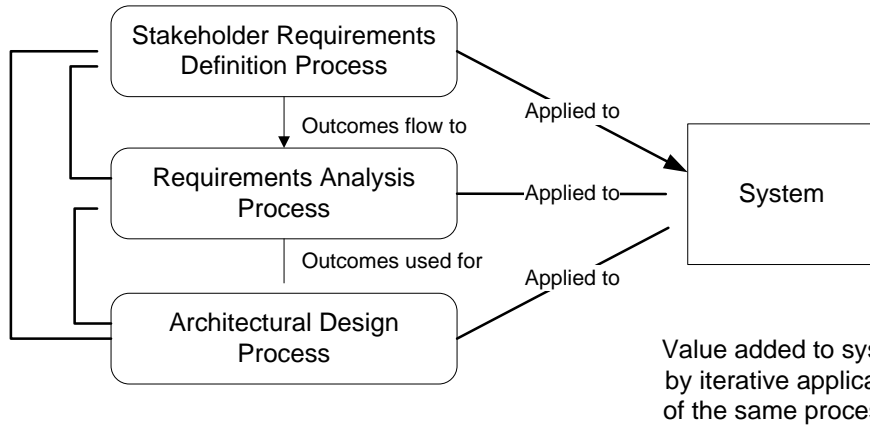


- ← A system
- ← is completely composed of
- ← a set of interacting
- ← system elements



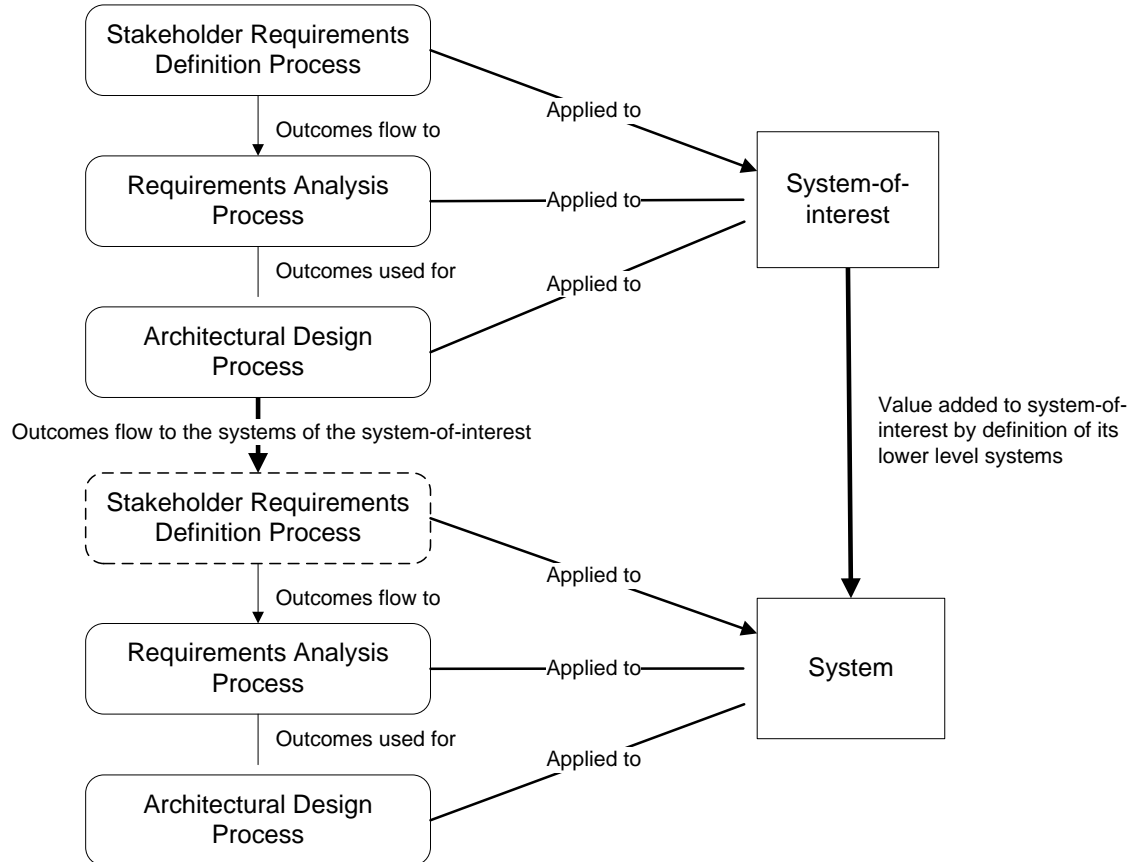
Make, Buy, or Reuse

# Iteration and Recursion



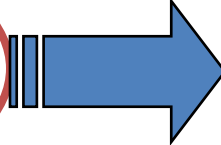
## Iteration

## Recursion



# Part 3 - Systems Engineering and Management (How)

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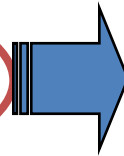
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- Life Cycle Models
  - System Definition
  - System Realization
  - Deployment and Use
  - SE Management
  - Product and Service Life Management
  - SE Standards

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)**



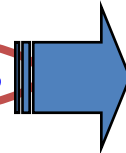
- Part 6: Related Disciplines
- Part 7: Systems Engineering Implementation Examples

- 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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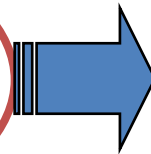


- SE & Software Engineering
  - SE & Project Management
  - Specialty Disciplines
    - Reliability, Availability, Maintainability
    - System Human Integration
    - Safety
    - Security
    - System Assurance
    - EMI/EMC
    - Manufacturability
- V0.5
- V1.0

Focused on the relationship of SE to other disciplines

# Part 7 - Systems Engineering Implementation Examples

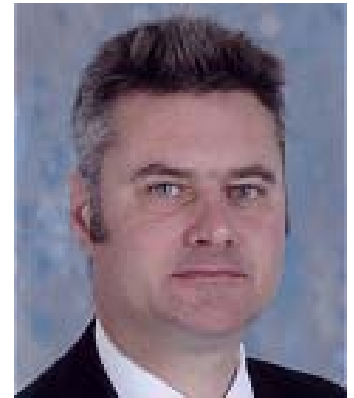
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- Case Studies
- Vignettes

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](http://Bkcasewiki.org) and let us know if it meets your needs