Faculty and Researchers   Faculty and Researchers' Publications

2011-06

The Body of Knowledge and Curriculum to Advance Systems Engineering

Squires, A.; Pyster, A.; Sauser, B.; Olwell, D.; Enck, S.; Gelosh, D.; Anthony, J.

Squires A., Pyster A., Sauser B., Olwell D., Enck, S. Gelosh D, Anthony J. 2010.
Applying Systems Thinking via Systemigrams for Defining the Body of Knowledge
and Curriculum to Advance Systems Engineering (BKCASE) Project. Proceedings
from the 20th Annual INCOSE International Symposium, Chicago, IL, July 12-15, 2010.
http://hdl.handle.net/10945/58177

The Body of Knowledge and Curriculum to Advance Systems Engineering

IEEE System of Systems Conference
Albuquerque, NM
June 28, 2011

Panelists
Prof. David Olwell, Naval Postgraduate School
Garry Roedler, Lockheed Martin
Prof. Michael Henshaw, Loughborough University

Moderator
Dr. Ricardo Valerdi, MIT (moderator)

Agenda

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

- 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

Part 1: SEBoK 0.5 Introduction

- 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

Discussion Topics

1. Overview of Contents

2. Fundamental Concepts and Terms

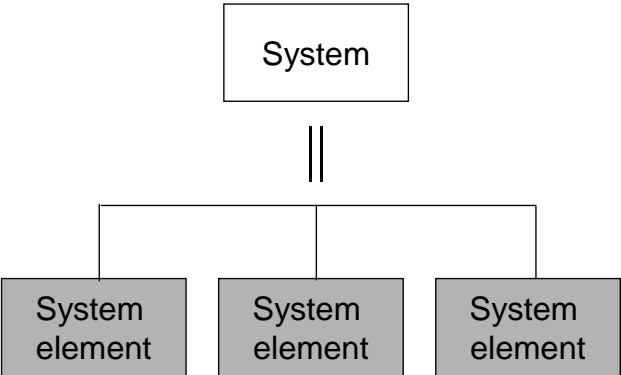3. Focus of Parts 3, 5, 6, and 7
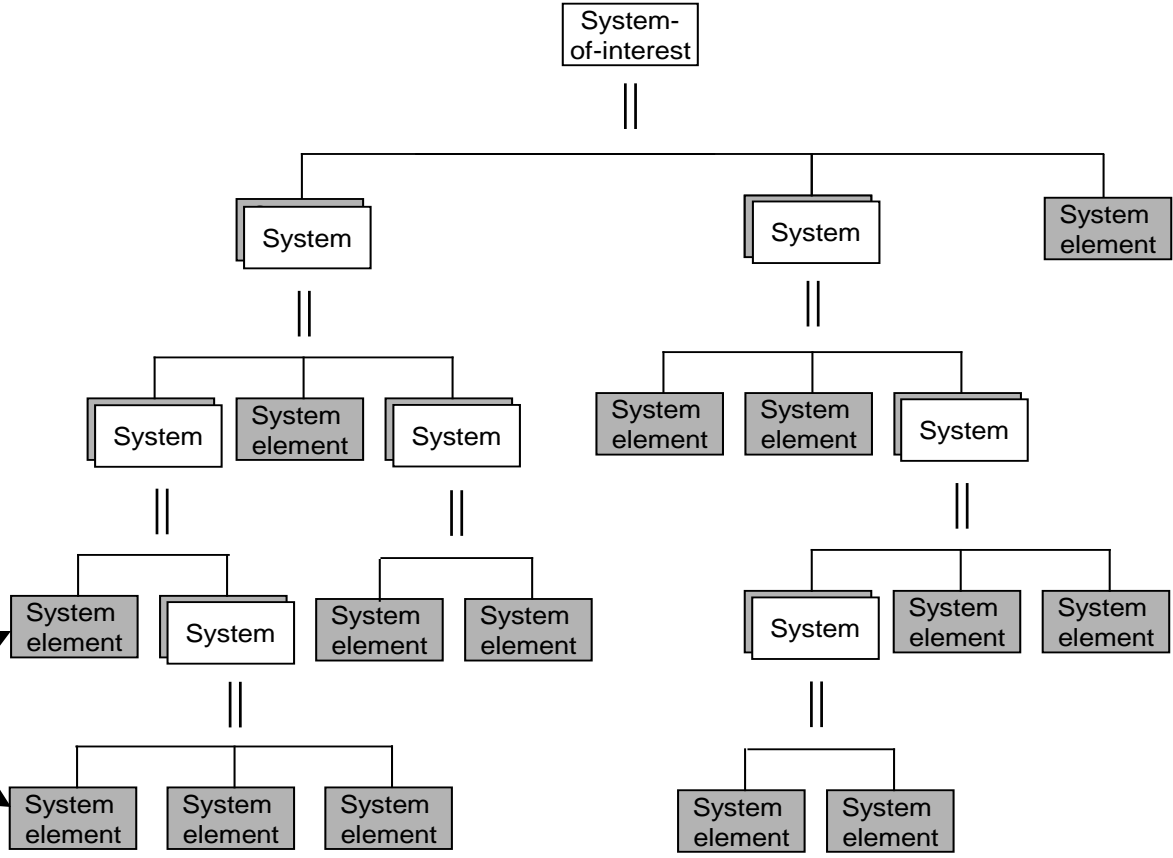
At end:

1. Path Forward

2. How You Can Help

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Fundamental Concepts and Terms

- 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, …
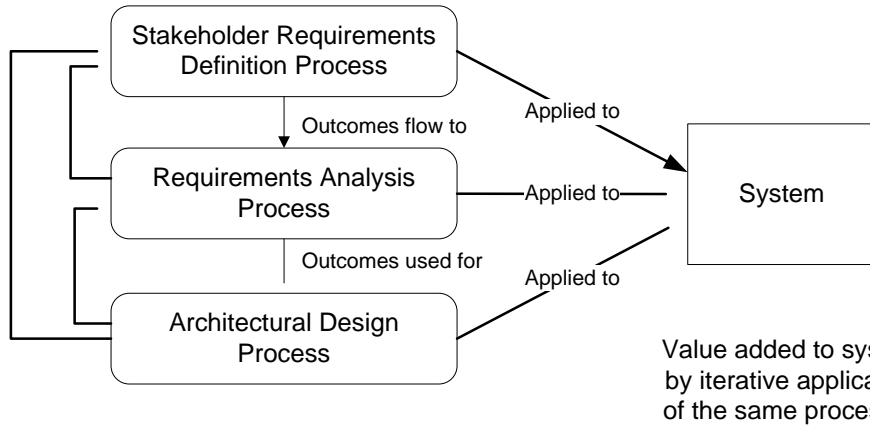   - Still need to resolve

System-of-Interest Structure

Make, Buy, or Reuse

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Iteration and Recursion
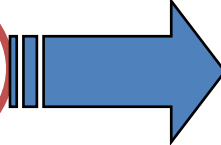
Iteration

Recursion
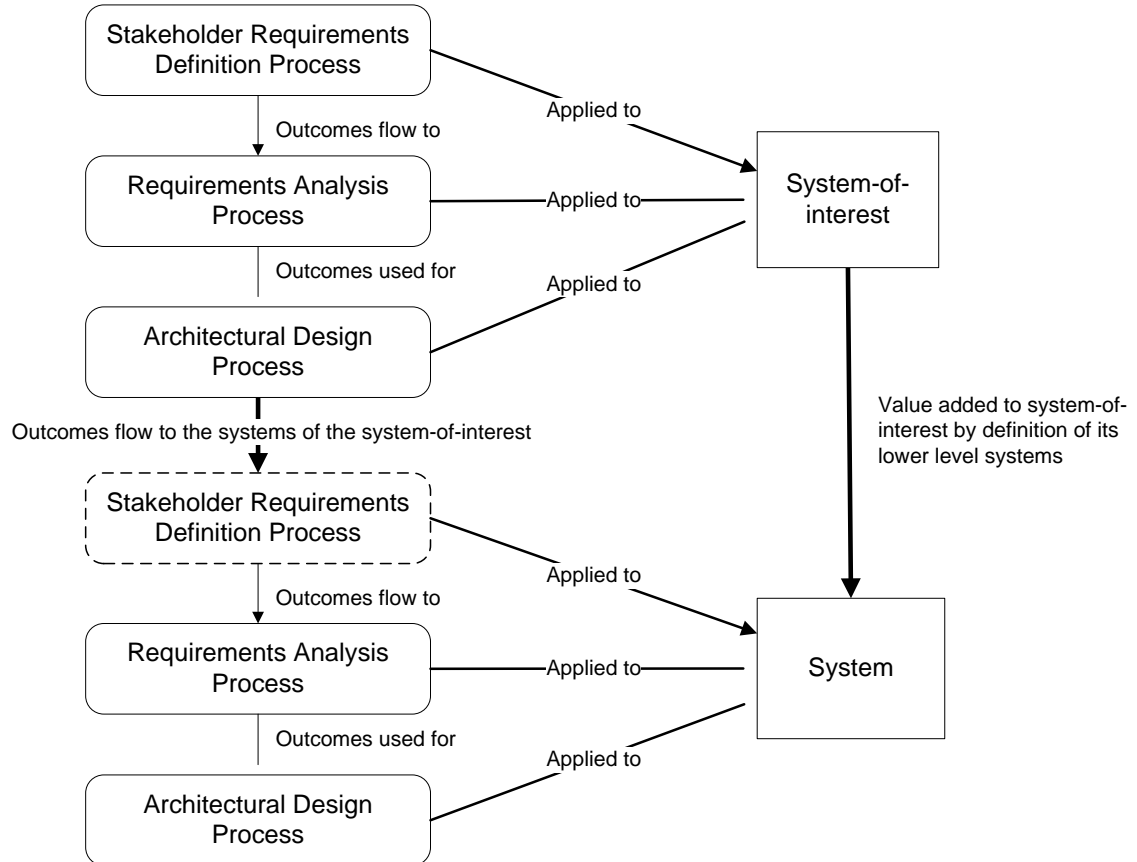
Value added to system by iterative application of the same processes

Value added to system-of-interest by definition of its lower level systems

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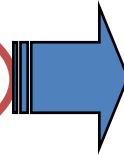- Part 7: Systems Engineering Implementation Examples

- 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

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- 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

- Part 1: SEBoK 0.5 Introduction
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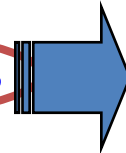- Part 5: Enabling Systems Engineering (When, Who)
- Part 6: Related Disciplines
- Part 7: Systems Engineering Implementation Examples

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

Focused on the relationship of SE to other disciplines

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

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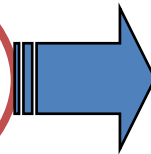
- Case Studies

- Vignettes

Case studies and vignettes provide real-world examples of SE activities; includes links of concepts to activities in the SEBoK
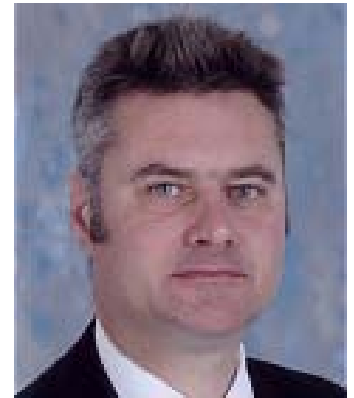
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- Addresses: How to apply systems engineering to creation and LC management of different types of systems
  - Products systems engineering
    - Consistent with ISO/IEC/IEEE 15288
    - Traditional SE
  - Services systems provisioning
    - Dynamic 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..)

BKCASE™

- 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