BKCASE
Body of Knowledge and Curriculum to Advance Systems Engineering

UK INCOSE Chapter
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Art Pyster
art.pyster@stevens.edu
Overview

• Stevens and the Naval Postgraduate School have begun a 3-year project to create a robust body of knowledge and a reference curriculum to advance systems engineering.

• DoD recognizes that their own SE success depends on having a well-accepted robust SE BoK on which standard practice, certification, and workforce competency and education can be based. They are providing substantial funding for effort.

• BKCASE will likely follow similar approach as did SWEBOK and GSwE2009, two analogous projects for software engineering and leverage other efforts such as NPS Modeling and Simulation Acquisition Curriculum

• INCOSE and IEEE Systems Council have agreed to participate

• IEEE Computer Society and ACM invited to participate
Babel

- There are many Systems Engineering (SE) workforce development initiatives that rely on a clear understanding of the knowledge that is included in SE and on how that information is organized – but there is no authoritative body of knowledge on which to rely
  - INCOSE SE Handbook
  - FAA SE competency model
  - DoD SE competency model
  - UK INCOSE SE framework
  - INCOSE SE reference curriculum framework
  - NASA SE Handbook
  - etc

Everyone is forced to invent their own or rely on references to other non-authoritative sources
Vision

“Systems Engineering competency models, certification programs, textbooks, graduate programs, and related workforce development initiatives around the world align with BKCASE.”

Objectives

1. Create a SE BoK that is globally recognized by the SE community as the authoritative BoK for the SE discipline.

2. Create a graduate reference curriculum for SE (GRCSE – pronounced “Gracie”) that is globally recognized by the SE community as the authoritative guidance for graduate programs in SE.

3. Facilitate the global alignment of related workforce development initiatives with SE BoK and GRCSE.

4. Transfer stewardship of SE BoK and GRCSE to INCOSE and other suitable professional societies after BKCASE releases version 1.0 of those products.
BKCASE Systems Diagram

Body of Knowledge and Curriculum to Advance Systems Engineering (BKCASE)

INCOSE
IEEE
ACM
Professional Societies

SE Community
Academia
Industry

SE Masters Program Selection
consistent proficiency in SE graduates

SE Certification Programs
- ASEP
- CSEP
- CSEP-Acq

SE Competency Models

SE Workforce Development Initiatives

SE Body of Knowledge (SEBoK)

Graduate Reference Curriculum in SE (GRCSE)

Graduate Programs in SE
- Curriculum Architecture
- Curriculum Content
- Defined Student Outcomes
- Entrance Expectations

SE Textbooks

SE textbooks

that shapes and endorses
is supported by SE experts in
used to certify
to define
to develop
to guide

drives

to develop
to guide

that facilitates searching of
metadata

builds consensus on

leverages to build

organizes/defines

that together create
that will maintain

for use by
for use by

that simplifies
that enables

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by
by
by
by

that guides
that guides
that facilitates
that guides

informs
drives
informs

28Oct09

Alice Squires 10/23/2009
Body of Knowledge and Curriculum to Advance Systems Engineering (BKCASE)

BKCASE Project

SE Certification Programs
- ASEP
- CSEP
- ESEP
- CSEP-Acq

SE Competency Models

SE Workforce Development Initiatives

SE Body of Knowledge (SEBoK)

BKCASE Products

Graduate Reference Curriculum in SE (GRCSE)

Academia
- INCOSE
- IEEE
- ACM

Industry

Government

SE Community

Professional Societies

SE Masters Program Selection

Consistent Proficiency in SE graduates

Evaluation of Job Candidates

resulting in

Entrance Expectations

Graduate Programs in SE

Curriculum Architecture

Curriculum Content

Defined Student Outcomes

SE Textbooks

that shapes and endorses

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Strategy

- Publish incrementally/iteratively with SE curriculum reference trailing SE BoK
- Involve professional societies from the beginning
- Build early consensus and maintain throughout
- Rely on and include academia, industry, and government
- Leverage volunteer labor for both authoring and editorial review
- Rely on existing source material wherever possible and involve principals from efforts that created source material wherever possible
- Use GSwERC and NPS M&S process as foundations
- Keep completely open and collaborative at a global level
- Use workshops every 3 months to sync up teams and build team relationships – rely on virtual and electronic communication at other times
- Keep team focused on value proposition when conflicts arise
Exemplars

- SWEBOK
- GSwE2009
- Modeling and Simulation for Acquisition project
SWEBOK Example

BREAKDOWN OF TOPICS FOR SOFTWARE

Software Requirements

- Software Requirements Fundamentals
  - Definition of a Software Requirement
  - Product and Process Requirements
  - Functional and Non-functional Requirements
  - Emergent Properties
  - Quantifiable Requirements
  - System Requirements and Software Requirements

- Requirements Process
  - Process Models
  - Process Actors
  - Process Support and Management
  - Process Quality and Improvement

- Requirements Elicitation
  - Requirements Sources
  - Elicitation Techniques

- Requirements Analysis
  - Requirements Classification
  - Conceptual Modeling
  - Architectural Design and Requirements Allocation
  - Requirements Negotiation

- Requirements Specification
  - System Definition Document
  - Systems Requirements Specification
  - Software Requirements Specification

- Requirements Validation
  - Requirements Reviews
  - Prototyping
  - Model Validation
  - Acceptance Tests

- Practical Considerations
  - Iterative Nature of Requirements Process
  - Change Management
  - Requirements Attributes
  - Requirements Tracing
  - Measuring Requirements
1. Software Requirements Fundamentals

1.1. Definition of a Software Requirement

At its most basic, a software requirement is a property which must be exhibited in order to solve some problem in the real world. The Guide refers to requirements on "software" because it is concerned with problems to be addressed by software. Hence, a software requirement is a property which must be exhibited by software developed or adapted to solve a particular problem. The problem may be to automate part of a task of someone who will use the software, to support the business processes of the organization that has commissioned the software, to correct shortcomings of existing software, to control a device, and many more. The functioning of users, business processes, and devices is typically complex. By extension, therefore, the requirements on particular software are typically a complex combination of requirements from different people at different levels of an organization and from the environment in which the software will operate.

An essential property of all software requirements is that they be verifiable. It may be difficult or costly to verify certain software requirements. For example, verification of the throughput requirement on the call center may necessitate the development of simulation software. Both the software requirements and software quality personnel must ensure that the requirements can be verified within the available resource constraints.

Requirements have other attributes in addition to the behavioral properties that they express. Common examples include a priority rating to enable trade-offs in the face of finite resources and a status value to enable project progress to be monitored. Typically, software requirements are uniquely identified so that they can be used throughout the entire software life cycle. [Ket00; Pfi01; Som05; Tha97]

1.2. Product and Process Requirements

A distinction can be drawn between product parameters and process parameters. Product parameters are requirements on software to be developed (for example, "The software shall verify that a student meets all prerequisites before he or she registers for a course.").

A process parameter is essentially a constraint on the development of the software (for example, "The software shall be written in Ada."). These are sometimes known as process requirements.

Some software requirements generate implicit process requirements. The choice of verification technique is one example. Another might be the use of particularly rigorous analysis techniques (such as formal specification methods) to reduce faults which can lead to inadequate reliability. Process requirements may also be imposed directly by the development organization, their customer, or a third party such as a safety regulator [Ket00; Som07].
Graduate Software Engineering 2009 (GSwE2009)

Curriculum Guidelines for
Graduate Degree Programs in Software Engineering

Version 1.0

September 30, 2009
# GSwE2009 Table of Contents

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The following authors contributed to the creation of GSweE2009:

1. Rick Adcock, Cranfield University and INCOSE representative, UK
2. Edward Aief, General Motors, USA
3. Bruce Amato, Department of Defense, USA
4. Mark Ardis, Stevens Institute of Technology, USA
5. Larry Bernstein, Stevens Institute of Technology, USA
6. Barry Boehm, University of Southern California, USA
7. Pierre Bourque, École de Technologie Supérieure and SWEBOK volunteer, Canada
8. John Brackett, Boston University, USA
9. Murray Cantor, IBM, USA
10. Lillian Cazzel, Villanova and ACM representative, USA
11. Robert Edson, Analytic Services Inc., USA
12. Richard Fairley, Colorado Technical University, USA
13. Dennis Frailey, Raytheon and Southern Methodist University, USA
14. Gary Hafon, Lockheed Martin and NDIA, USA
15. Thomas Hilburn, Embry-Riddle Aeronautical University, USA
16. Greg Hislop, Drexel University and IEEE Computer Society representative, USA
17. David Klappholz, Stevens Institute of Technology, USA
18. Philippe Kruchten, University of British Columbia, Canada
19. Phil Laplante, Pennsylvania State University, Great Valley, USA
20. Qiaoyun (Liz) Li, Wuhan University, China
21. Scott Lucero, Department of Defense, USA
22. John McDermid, University of York, UK
23. James McDonald, Monmouth University, USA
24. Ernest McDuffie, National Coordination Office for NITRD, USA
25. R. Michael, Naval Postgraduate School, USA
26. William Milam, Ford, USA
27. Ken Nidiffer, Software Engineering Institute, USA
28. Art Pyster, Stevens Institute of Technology, USA
29. Paul Robitaille, Lockheed Martin & INCOSE representative, USA
30. Mary Shaw, Carnegie Mellon University, USA
31. Sarah Sheard, Third Millennium Systems, USA
32. Robert Suritis, IBM, USA
33. Massood Towhidnejad, Embry-Riddle Aeronautical University, USA
34. Richard Thayer, California State University at Sacramento, USA
35. J. Barrie Thompson, University of Sunderland, UK
36. Guilherme Travassos, Brazilian Computer Society, Brazil
37. Richard Turner, Stevens Institute of Technology, USA
38. Joseph Urban, Texas Tech University, USA
39. Ricardo Valerdi, MIT & INCOSE representative, USA
40. Osmo Vikman, Nokia, Finland
41. David Weiss, Avaya, USA
42. Mary Jane Willshire, Colorado Technical University, USA
GSwE2009 includes the following:

- A set of outcomes to be fulfilled by a student who successfully completes a graduate program based on the curriculum (see summary below)
- A set of student skills, knowledge, and experience assumed by the curriculum, not intended as entrance requirements for a specific program, but as the starting point for the curriculum’s outcomes (see summary below)
- An architectural framework to support implementation of the curriculum
- A description of the fundamental or core skills, knowledge, and experience to be taught in the curriculum to achieve the outcomes. This is termed a Core Body of Knowledge (CBOK) and includes topic areas and the depth of understanding a student should achieve.

Additional materials included in this document:

- The fundamental philosophy for GSwE2009 development as described in a set of guiding principles (see summary below)
- A discussion of how GSwE2009 will evolve to remain effective
- A mapping of expected outcomes to the CBOK and to the total GSwE2009 program recommendations
- A description of Knowledge Areas (KAs) discussed in GSwE2009 that are not yet fully integrated into the current version of the Software Engineering Body of Knowledge (SWEBOK)
- Glossary, references, and other supporting material.
Modeling and Simulation
Educating the DoD Communities and Services

UCF
Old Dominion University
UCSD
George Mason University
UAHuntsville
NPS
Johns Hopkins University

Acquisition; Test and Evaluation
NPS Engineering Case Studies

- Supplemental program material for courses.
- Case studies developed primarily for acquisition professionals who do not possess engineering degrees.
- Case study content focuses on describing underlying engineering concepts.

8 Case Studies Available Online at www.nps.edu/msacq
Coming to a University Near You January 2009

FULL ACADEMIC COURSES
SHORT ACADEMIC COURSES
WEB-BASED MODULES

16 NEW COURSES
M&S in the Acquisition Life Cycle, Parts 1 and 2
M&S Strategy and Support Plans
M&S Requirements and Evaluating M&S Proposals
Contracting for M&S
Best Practices in M&S
M&S in Decision Risk Analysis and Mitigation
M&S Environments
M&S Data Strategies
M&S for Test and Evaluation, Introduction and Advanced
Introduction to Engineering M&S Applications
Physics-based M&S
Basic Engineering Concepts in M&S, Parts 1 and 2
Topics in the Application of Engineering M&S
BKCASE Authors So Far…

1. John Baras from University of Maryland and IEEE Systems Council
2. Barry Boehm from University of Southern California and fellow of INCOSE, ACM, IEEE. Member of National Academy.
3. Tim Ferris from Defence and Systems Institute at University of South Australia and Director of Technical Operations for INCOSE
4. Kevin Forsberg is co-inventor of ‘Vee’ model and fellow of INCOSE. Runs CSM training company.
5. Sandy Friedenthal is one of the inventors of SYSML, INCOSE fellow, with Lockheed Martin
6. Bud Lawson runs his own consulting company, credited with the ‘Pointer’ concept in programming languages and an INCOSE fellow.
7. Alex Lee is Deputy Director of the DSTA College in Singapore and one of the leaders of the INCOSE Singapore Chapter
8. David Olwell, professor with the Naval Postgraduate School Systems Engineering Department
9. Art Pyster, professor with Stevens Institute of Technology
10. Garry Roedler is a senior SE employee at Lockheed Martin and written extensively on systems measurement
11. Bill Rouse is from GA Tech, INCOSE and IEEE fellow, member of National Academy
12. Hillary Sillitto (tentative) is from Thales, INCOSE fellow, and named as INCOSE representative to BKCASE
13. Alice Squires is faculty and researcher with Stevens Institute of Technology
14. Massood Towhidnejad is an author of GSwE2009 from Embry-Riddle Aeronautical University

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