Bodies of Knowledge and Competency Models for Software and Systems Engineering

presented by
Richard E. (Dick) Fairley, PhD, CSDP
Chair, IEEE-CS SSE Committee
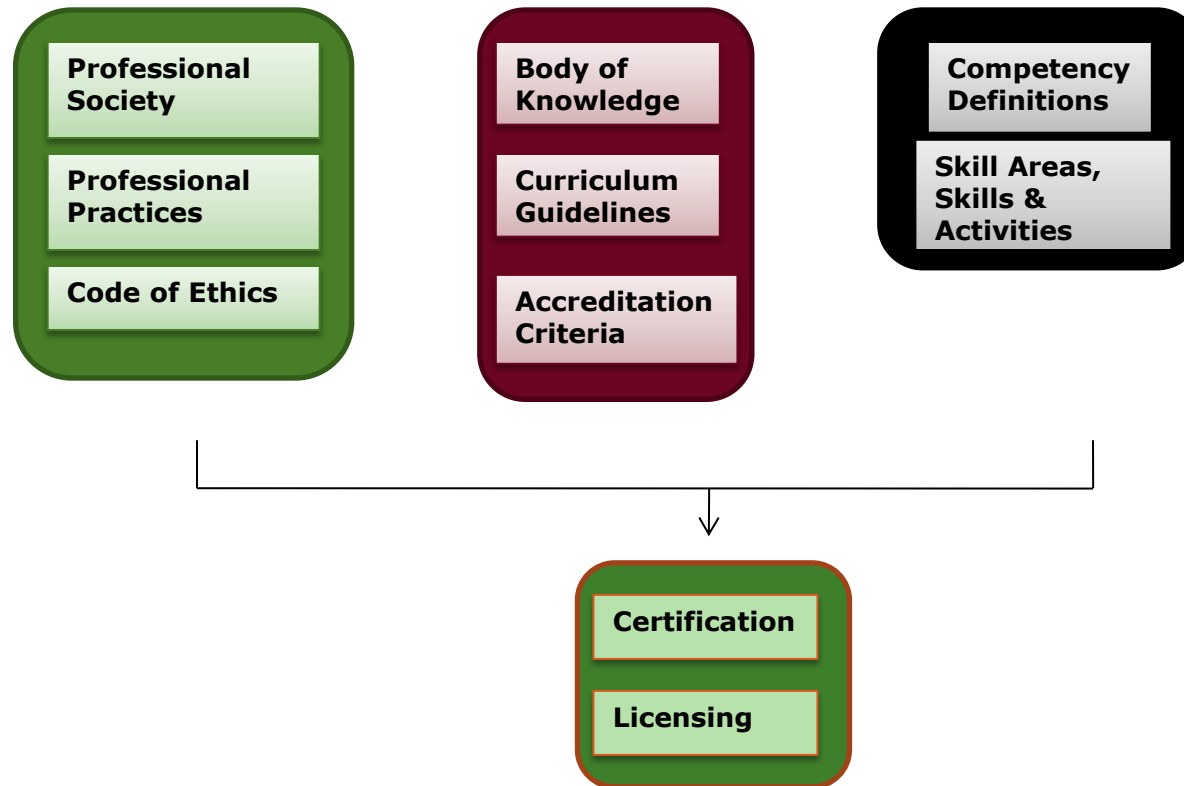Principal Associate, S2EA
Adjunct Professor, Colorado Technical University

IEEE
Advancing Technology
for Humanity

Outline

- Elements of a profession
- BOKs and COMPs
- Intended Audiences
- SEBOK
- SWEBOK
- SSECM

Elements of a Mature Computing Profession

Professional Society

Professional Practices

Code of Ethics

Body of Knowledge

Curriculum Guidelines

Accreditation Criteria

Competency Definitions

Skill Areas, Skills & Activities

Certification

Licensing

Intended Audiences for BOKS and COMPs

- Computing practitioners
- Managers of computing practitioners
- Work force planners
- Curriculum developers
- Training providers

IEEE
Advancing Technology
for Humanity

Intended Audiences (2)

- *IEEE Computer Society:* to provide a basis for training programs and authoritative credentials, and credibility for the computing professions

- *Regulatory agencies:* to provide guidance for establishing regulations that impact the health, safety, and welfare of the general population

- *Legislative and legal bodies:* to provide guidance for licensing criteria

IEEE
Advancing Technology
for Humanity

Intended Audiences (3)

- *Other professional societies:* to determine common interests, overlaps, and boundaries
  - e.g., INCOSE and PMI
- *Society at large:* to increase the number of competent computing professionals

BOKS and COMPS

- A *body of knowledge* is the set of concepts, terminology, and subject matter that characterizes a profession
  - o curricula, textbooks, journals, standards
- *Competency* is the ability of an individual to perform an activity efficiently and effectively
  - o activities can be performed at different skill levels
- Knowledge is what one knows
- Skill is what one can do

BOK Guides and COMP Models

- A documented BOK is a *Guide* to a body of knowledge
  - o it is not the entire body of knowledge
- A competency *model* is a characterization of commonly accepted competencies within a profession
  - o it is not the entire set of competencies for every conceivable situation

Two BOKS

- The Systems Engineering Body of Knowledge (SEBOK V1.1)

  www.sebokwiki.org

- The Software Engineering Body of Knowledge (SWEBOK 2004 & V3)
  - 2004: www.swebok.org
  - V3: computer.centraldesktop.com/swebokv3review/

  both BOKs are accessible at no cost

SEBOK

- Wiki based
- Seven parts
    - each part has knowledge areas (38 total)
        - each knowledge area has topics
            - with Primary and Additional references
            - primary references are annotated
- An extensive glossary of terms

The Computer Society, INCOSE, and Stevens Institute are the stewards of BKCASE and GRCSE

SEBOK Parts

- Part 1 Introduction
- Part 2 Systems
- Part 3 Systems Engineering and Management
- Part 4 Applications of Systems Engineering
- Part 5 Enabling Systems Engineering
- Part 6 Related Disciplines
- Part 7 Systems Engineering Implementation Examples

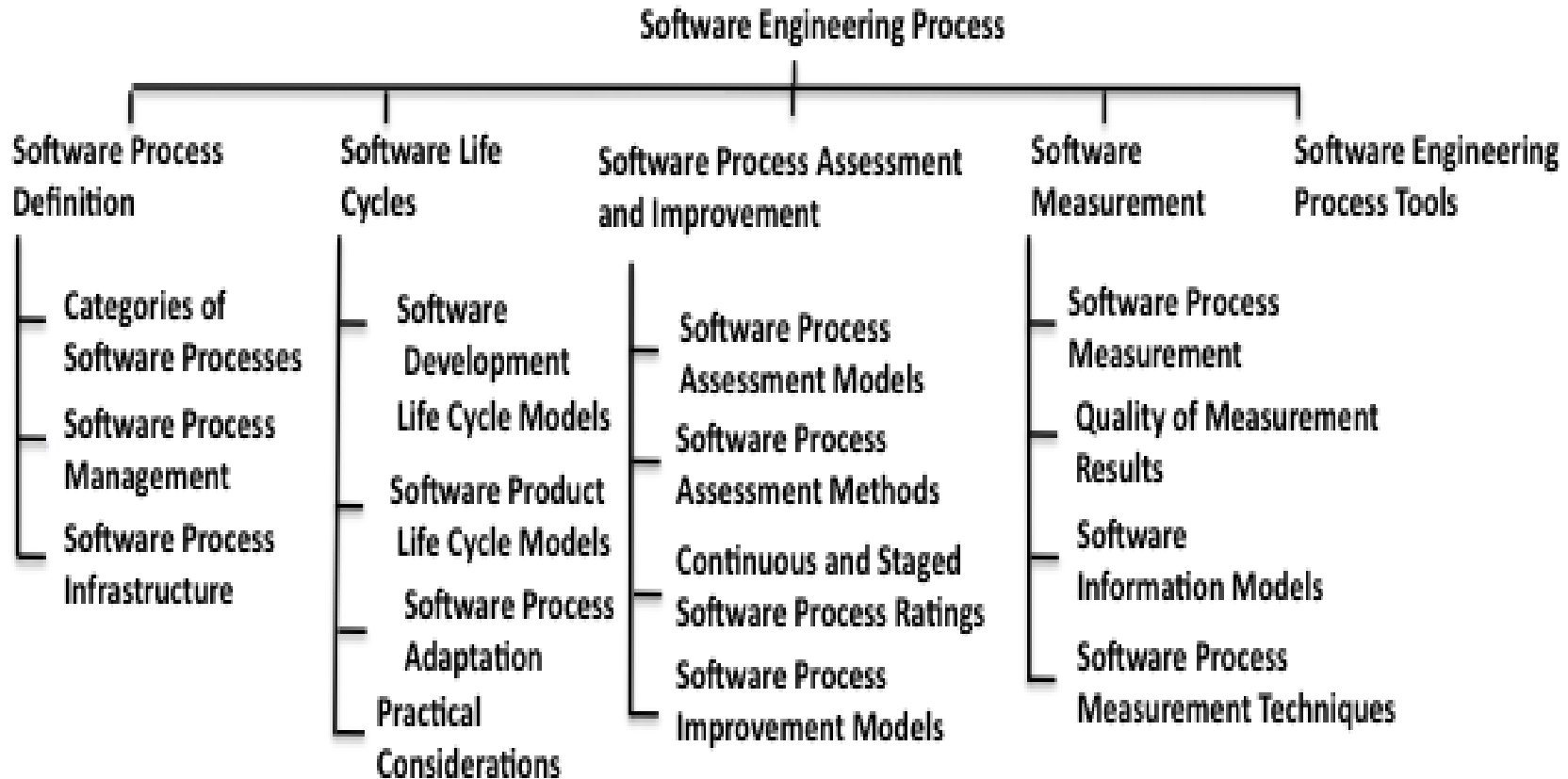IEEE
Advancing Technology
for Humanity

SWEBOK V3 Knowledge Areas (1)

1. Software engineering process
2. Software requirements
3. Software design
4. Software construction
5. Software testing
6. Software engineering management
7. Software configuration management
8. Software quality
9. Software maintenance
10. Software engineering models and methods

IEEE
Advancing Technology for Humanity

SWEBOK V3 Knowledge Areas (2)

11. Computing foundations
12. Mathematical foundations
13. Engineering foundations
14. Software engineering economics
15. Software engineering professional practice

SWEBOK V3 Software Engineering Process KA – Breakdown of Topics

Software Engineering Process

Software Process Definition
- Categories of Software Processes
- Software Process Management
- Software Process Infrastructure

Software Life Cycles
- Software Development Life Cycle Models
- Software Product Life Cycle Models
- Software Process Adaptation
- Practical Considerations

Software Process Assessment and Improvement
- Software Process Assessment Models
- Software Process Assessment Methods
- Continuous and Staged Software Process Ratings
- Software Process Improvement Models

Software Measurement
- Software Process Measurement
- Quality of Measurement Results
- Software Information Models
- Software Process Measurement Techniques

Software Engineering Process Tools

Two COMPs

- ITCOMP: a competency model for information technology
- SSECM: a competency model for software systems engineering

IEEE
Advancing Technology for Humanity

CS-PAB Guidelines for Competency Models

- A PAB competency model should:
  - be based on demonstrated need
  - be grounded in reference materials
  - specify skills at various levels of competency
  - describe activities, not job roles
  - include technical skills and affective skills
  - include leadership skills but not management skills

* CS-PAB is the Professional Activities Board of the IEEE Computer Society
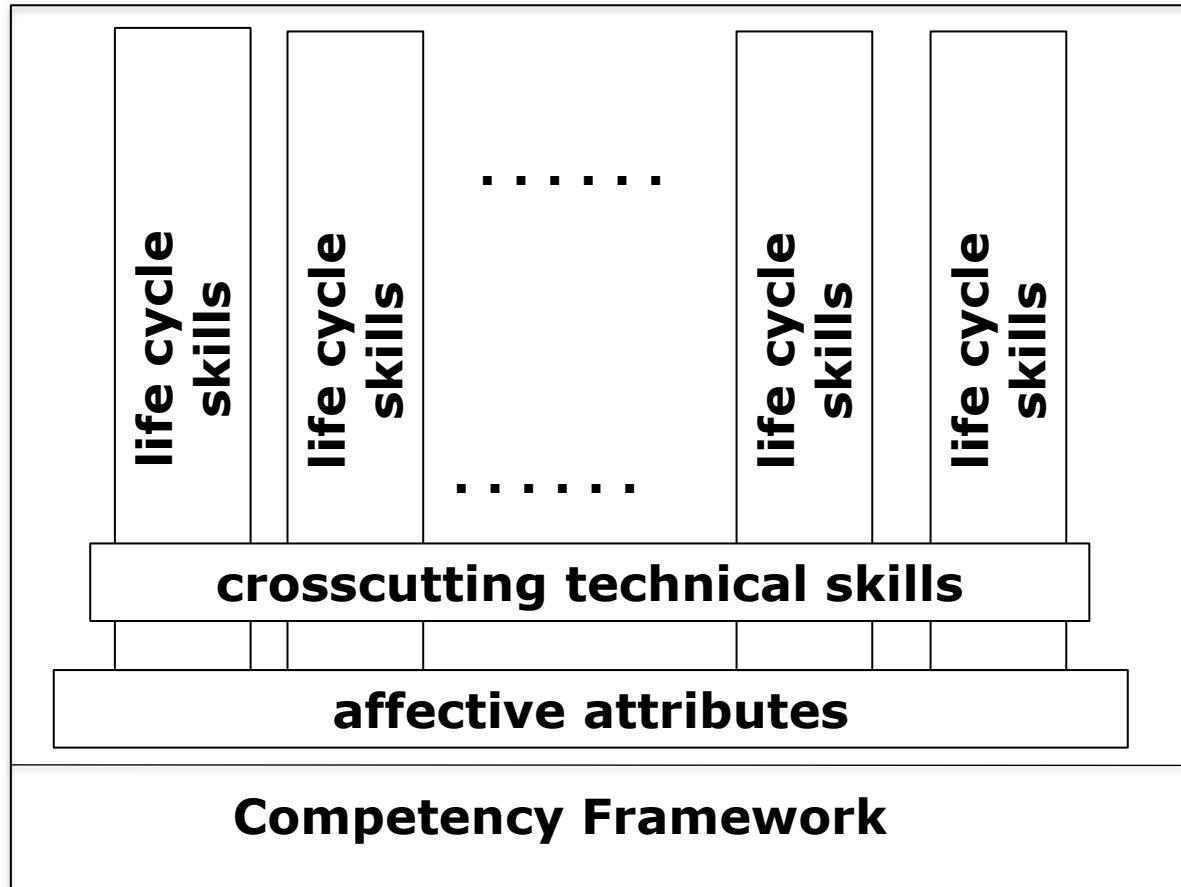
CS-PAB Structure for Competency Models

- CS-PAB competency models are structured as:
  - skill areas
    - skill levels
      - skills
        - activities

Different individuals have different skill levels in different skill areas

IEEE
Advancing Technology
for Humanity

PAB Competency Framework

Affective Attributes

- Aptitude
- Initiative
- Enthusiasm
- Work ethic
- Willingness
- Trustworthiness
- Communication skills
- Team participation skills
- Technical leadership skills

IEEE
Advancing Technology for Humanity

Software Engineering Crosscutting Skill Areas

- Engineering Models and Methods
- Process Models & Life Cycle Models
- Security Engineering
- Configuration Management
- Quality Assurance and Quality Control
- Measurement and Improvement
  - process and product
- Software Domain Engineering
  - database, algorithms, web, communications, interaction design

Software Systems Engineering Life Cycle Skill Areas

- SSECM Systems Engineering
- Software Requirement Engineering
- Software Design
- Software Construction
- Software Verification and Validation
- Software Sustainability

The SSECM System Engineering Skill Area

- System Life Cycle Models
- System Engineering Processes
- System Requirements Engineering
- System Design
- Allocation and Flowdown
- Component Engineering
- System Verification and Validation
- System Sustainability
- System Safety Engineering?

Example: Requirements Engineering SA Skills

- Requirements Process
- Requirements Elicitation
- Requirements Analysis
- Requirements Specification
- Requirements Verification and Validation
- Requirements Management

Skill Area: Requirements Engineering					
Skill levels **Skill**	**L1 Technician**	**L2 Entry Level**	**L3 Practitioner**	**L4 Technical Leader**	**L5 Industry Leader**
Requirements process	1. Follows and applies defined processes for requirements engineering with guidance (F)	1. Assists requirements management through the use of appropriate tools (A) 2. Assists with traceability analysis (A)	1. Implements requirement engineering plans for projects (P) 2. Applies elements of the selected requirements process (P) 3. Supports impact analysis to determine effect of changes on schedule, budget, staffing, and technology (A) 4. Supervises traceability work activities (P/L)	1. Prepares requirement engineering plans for projects (L) 2. Selects elements of the requirements process from existing organizational assets (P/L) 3. Conducts impact analysis to determine effect of changes on schedule, budget, staffing, and technology (P/L) 4. Specifies traceability items, tools, and techniques (L)	1. Creates new guidelines, templates, tools, and techniques for requirement engineering (M) 2. Sets strategy and direction for the requirements process across projects and functional units of an organization (M) 3. Creates new ways to engage stakeholders, management team and developers in requirements work activities (M) 4. Analyzes traceability effectiveness and develops new methods and tools (M)

Some Key Words

- Technician: follows defined processes
- Entry Level: assists
- Practitioner: assist, practice, lead
- Technical Leader: practice, lead
- Industry Leader: mastery

An individual who is competent at a given competency level for an activity will be competent to perform at all lower levels for that activity

IEEE
Advancing Technology
for Humanity

Questions?