The Software Engineering Competency Model (SWECOM)

presented by

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Presentation Agenda

- The SWECOM development process
- Attributes of a Profession
- Elements of SWECOM
- SWECOM Technical Skill Areas
- SWECOM Competency Levels
- SWECOM Use Cases
- Next Steps
- SWECOM Gap Analysis
- Discussion Questions
- Call for Public Reviewers
The SWECOM Development Process

• A team of six members developed SWECOM
  o sponsored by the IEEE Computer Society
  o originally called SECOM
• 22 subject matter reviewers submitted comments
• Team adjudicated the comments
  o provided feedback to the reviewers
  o revised SWECOM for public review comments
  o public review period is now open
The SWECOM Team

- Mark Ardis, Stevens Institute
- Dick Fairley, S2EA, Team Leader
- Kate Guillemette, IEEE Computer Society
- Thomas Hilburn, Embry Riddle University
- Ken Nidiffer, Software Engineering Institute
- Massood Towhidnejad, Embry Riddle University
- Mary Jane Willshire, S2EA
Model of a Profession

- Professional Discipline
- Professional Society
  - Code of Ethics
  - Activities
  - Standards of Practice
  - Job Roles
  - Career Paths
  - Competency Definition

Body of Knowledge
  - Curriculum
  - Accreditation Criteria
  - Preparatory Education
  - The ability to perform activities requires a combination of knowledge and skills (ie competency)

Certification
  - Licensing
  - Certification certifies that individuals have defined competencies. Licensing extends certification to include active oversight of the profession including disciplinary action.

Skills
  - Professional Development
  - Skills to apply the knowledge to accomplish tasks are acquired through professional development including on-the-job experience and training.
Knowledge, Skill, and Competency

• Knowledge is what one knows; skill is what one can do
  o SWECOM is based on software engineering knowledge sources
• A competent person has the knowledge and ability to perform work activities at a given competency level
• SWECOM includes five competency levels for each of 13 software engineering skill areas
Scope of SWECOM

- **SWECOM includes**
  - cognitive attributes
  - behavioral attributes and skills
  - technical skills
  - extensive references

- **SWECOM does not include**
  - project management skills related to scheduling, budgeting, and resource management
  - industry-sector technical skills
    - i.e., embedded systems, IT, or applications
  - domain-specific skills
    - i.e., health sciences, communication, automotive domains
### SWECOM TOC

| 2. SWECOM and the US IT Competency Model | 17. Software Systems Engineering Skill Area |
| 3. The Elements of SWECOM | 18. Software Quality Skill Area |
| 5. SWECOM Competency Levels | 20. Software Safety Skill Area |
| 7. SWECOM Validation | 22. Software Measurement Skill Area |
| 8. Acknowledgements | 23. Human-Computer Interaction Skill Area |
| 11. Software Requirements Skill Area | 26. Appendix C: SWECOM Use Cases |
| 13. Software Construction Skill Area | |
| 14. Software Testing Skill Area | |
| 15. Software Sustainment Skill Area | |
Elements of SWECOM

Cognitive Skills

Technical Skills

Requisite Knowledge

Related Disciplines

Behavioral Attributes and Skills

Only the Technical Skills are rated by competency level
SWECOM Knowledge Sources

• Primary knowledge sources include:
  o SWEBOK
  o IEEE/ISO Standards
  o Textbooks
  o Curricula

• SWECOM includes 49 references
  o compiled from the 13 skill areas
Related Disciplines

Related disciplines include, but are not limited to:

• Computer Engineering,
• Computer Science,
• General Management
• Mathematics
• Project Management,
• Quality Management, and
• Systems Engineering.

These are the related disciplines in SWEBOK
SWECOM Cognitive Skills

• Cognitive skills apply across all skill areas, skills, and activities of SWECOM; they include but are not limited to:
  o reasoning skills
  o analytical skills
  o problem-solving skills
  o innovation skills
SWECOM Behavioral Attributes and Skills

- Include but are not limited to:
  - aptitude
  - enthusiasm
  - initiative
  - work ethic
  - willingness
  - trustworthiness
  - cultural sensitivity
  - communication skills
  - team participation skills
  - technical leadership skills
Skill Areas, Skills, and Activities

• A skill area is a way of naming and grouping related skills
  o e.g., requirements engineering

• A skill is a way of naming and grouping related activities within a skill area
  o e.g., requirements elicitation, analysis, or specification

• Activities are units of work that constitute a skill
  o e.g., elicitation: interviews, prototyping, observation
SWECOM Technical Skill Areas

SWECOM technical skill areas are categorized as:

• 5 life cycle skill areas
  ○ include skills and activities for project phases

• 8 cross-cutting skill areas
  ○ each applies to one or more (perhaps all) life cycle skill areas
Two Caveats

• The order of listing skill areas, skills, and activities does not imply a life cycle sequencing of phases

• Activities are not job roles
  - but can be grouped into job roles
  - for specific organizations
  - and specific projects
Life Cycle Skill Areas

- Software Requirements
- Software Design
- Software Construction
- Software Testing
- Software Sustainment
Cross-Cutting Skill Areas

- Software Process and Life Cycle Models
- Software Systems Engineering
- Software Quality
- Software Security
- Software Safety
- Software Configuration Management
- Software Measurement
- Human-Computer Interaction
Some Examples of Skills and Activities

Skill Area: Software Requirements

• Skills: elicitation, analysis, specification, verification, management

• Elicitation activities:
  o Identifies stakeholders for elicitation of requirements
  o Engages stakeholders in elicitation of requirements
  o Uses appropriate methods to capture requirements
  o Negotiates conflicts among stakeholders during elicitation activities
Some Examples of Skills and Activities (2)

Skill Area: Software Process and Life Cycle Models

• Skills:
  o implementation of software life cycle models
  o process definition and tailoring
  o process implementation and management
  o process assessment and improvement
Some Examples of Skills and Activities (3)

Skill Area: Software Process and Life Cycle Models

- Skill: implementation of software life cycle models
  
  - Activities:
    
    - ✓ determine one or more organization-wide life cycle models for a project (e.g., waterfall, spiral, V-model, incremental, agile)
    - ✓ select a team software process (e.g., functional, integrated)
    - ✓ carry out process activities specified in a life-cycle process model script
    - ✓ lead a small team in executing some portion of a life-cycle process model (e.g., software design)
SWECOM Competency Levels

• SWECOM includes five competency levels for software engineering technical activities:
  o technician
  o entry level practitioner
  o practitioner
  o technical leader
  o senior software engineer

• Some activities do not have corresponding competency levels
Characterization of Competency Levels

- **Technician**: an individual who is competent to follow instructions while performing an activity
- **Entry Level Practitioner**: an individual who is competent to assist in performing an activity or to perform activities with some supervision
- **Practitioner**: an individual who is competent to perform an activity with little or no supervision
- **Technical Leader**: an individual who is competent to lead and direct participants in the performance of the activities in one or more skills or skill areas
- **Senior software engineer**: an individual who is competent to create new, and modify existing processes, procedures, methods, and tools for performing activities, groups of activities within one or more skills, and skills within skill areas
Characterization of Competency Levels (2)

• An individual may have different competency levels for different activities

• To be competent in a skill, at a given competency level, requires competency in all activities in that skill at the given competency level

• To be competent in a skill area, at a given competency level, requires competency in all skills in that skill area at the given competency level
SWECOM Use Cases

- Appendix C of SWECOM includes use cases to illustrate how the following individuals might use SWECOM:
  - HR and managers to screen job applicants
  - HR and managers to develop strategies and plans
  - To counsel new job-hires
  - Individuals to assess competencies and prepare self-improvement plans
  - Managers to evaluate and counsel individuals on improvement planning
  - Curriculum designers to develop a competency-based training program or academic curriculum
# A Manager’s Gap Analysis Worksheet

**Date:** [xxx]

**Organizational Unit:** [xxx]

**Completed by:** [names and titles of those completing the worksheet]

**Note:** Have, Need, and Gap are indicated by number of individuals and competency level (e.g., 3@Entry Level, 2@Practitioner Level)

Competencies (from Tables A & B of the SECOM Skill Areas)

<table>
<thead>
<tr>
<th>Skills</th>
<th>Have</th>
<th>Need</th>
<th>Gap</th>
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<tbody>
<tr>
<td><strong>Software Requirements Skills</strong></td>
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<tr>
<td>Software Requirements Elicitation</td>
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<td>Software Requirements Analysis</td>
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<td>Software Requirements Specification</td>
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<td>Software Requirements Verification</td>
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<td>Software Requirement Management</td>
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<td><strong>Software Design Skills</strong></td>
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<td>Software Design Fundamentals</td>
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<td>Software Design Strategies and Methods</td>
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<td>Software Architectural Design</td>
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<tr>
<td>Software Design Quality Analysis and Evaluation</td>
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Some Discussion Questions

• Have you used or been exposed to competency models in the past?
  o which ones?
  o how were they used?

• In what ways might you or your organization use SWECOM?

• What is missing from SWECOM?

• Other issues, comments, concerns?
Public Review Cycle is Open!

• SWECOM is currently available for public review
  https://computer.centraldesktop.com/swecomreview/
• Team will adjudicate public review comments
  and revise SWECOM accordingly
• Closing date for reviews is April 20, 2014
• Publication date is planned for June 2014

Please consider participating in the SWECOM public review