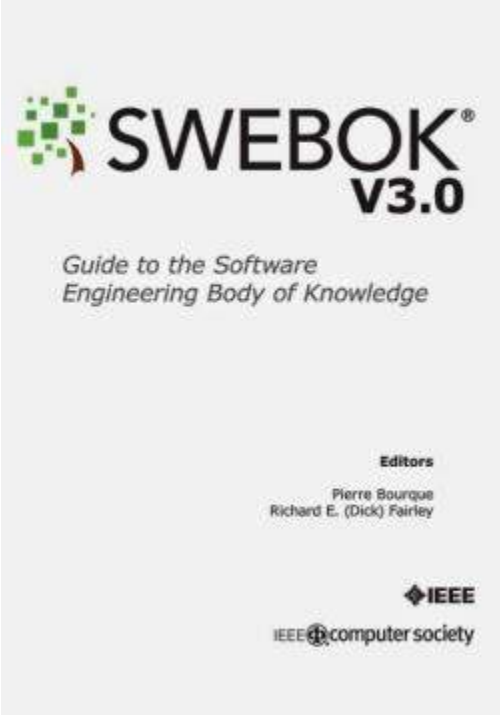
Ecosystem of the SWEBOK Guide V3.0



2015
CEE-SEC(R)
Software Engineering Conference in Russia

Sergey Avdoshin

Head of Software Engineering School
Computer Science Faculty

Key Dates of SWEBOK History

1958 – John Turkey – the term *Software*
1968 – NATO conference (L.F. Bauer) – the term *Software Engineering*
1972 – IEEE Computer Society – *Transactions on Software Engineering*
1976 – IEEE-CS – *Committee for Developing Software Engineering Standards*
1987 – ISO/IEC JTC 1 / SC 7 – *Software and Systems Engineering*
1993 – ACM/IEEE-CS – *Software Engineering Coordinating Committee (SWECC)*
1995 – *ISO/IEC 12207:1995 Standard for Software Life Cycle Processes*
1999 – ACM/IEEE-CS – *SE Code of Ethics and Professional Practice*
2001 – SWECC – *Trial Version of the SWEEBOK (start in 1998)*
2001 – Industrial Advisory Board – *Computing Curricula 2001 Initiative*
2004 – ACM/IEEE-CS – *Software Engineering 2004 & SWEBOK 2004*
2005 – *ISO/IEC 19759:2005 SWEBOK*
2008 – *ISO/IEC 12207:2008 Standard for Software Life Cycle Processes*
2009 – ACM/IEEE-CS – *Graduate Software Engineering*
2009 – Ivar Jacobson, Bertrand Meyer, Richard Soley – *SEMAT*
2012 – IEEE-CS – *Professional & Educational Activities Board*
Software and Systems Engineering Committee (PEB-SSE)
2014 – IEEE-CS & PEB-SSE – *SWEBOK V3.0*
2014 – IEEE-CS – *Software Engineering Competency Model (SWECOM)*
2015 – IEEE-CS & PEB-SSE – *Replacement CSDA&CSDP on full suite of certifications*

Transformation of Software Engineering Definition

Software engineering - the systematic application of scientific and technological knowledge, methods, and experience to the design, implementation, testing, and documentation of software *(ISO/IEC 2382-1:1993 Information technology--Vocabulary--Part 1: Fundamental terms)*

Software engineering - the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software; that is, the application of engineering to software *(ISO/IEC 24765:20010 Systems and software engineering vocabulary)*

System engineering - interdisciplinary approach governing the total technical and managerial effort required to transform a set of customer needs, expectations, and constraints into a solution and to support that solution throughout its life *(ISO/IEC 24765:2010 Systems and software engineering vocabulary) Note:* includes the definition of technical performance measures; the integration of engineering specialties toward the establishment of an architecture; and the definition of supporting lifecycle processes that balance cost, performance, and schedule objectives

Important Related Documents

- *GSwE2009: Curriculum Guidelines for Graduate Degree Programs in Software Engineering*
- *ISO/IEC 12207:2008 Standard for Systems and Software Engineering – Software Life Cycle Process*
- *J.W. Moore, The Road Map to Software Engineering: A Standards-Base Guide, Wiley-IEEE CS Press, 2006*
- *SE2004: Curriculum Guidelines for Undergraduate Degree Program in Software Engineering*
- *ISO/IEC/IEEE 24765:2010 Systems and Software Engineering - Vocabulary*
- *Certification and Training for Software Professionals, IEEE-CS, 2013*

Growing Influence of Systems Engineering in Software Engineering Education Programs (Graduate Software Engineers 2009)

	System Engineering
1	***Systems Engineering Concepts***
	System context
	People and systems
	System hierarchical relationships
	The role of system engineers
2	***System Engineering Life Cycle Management***
	Lifecycle Management
	Systems engineering and software engineering processes
3	***Requirements***
	Stakeholder requirements
	Requirements analysis
4	***System Design***
	Architectural design
	Implementation
	Trade studies
5	***Integration and Verification***
6	***Transition and Validation***
7	***Operation, Maintenance and Support***

GSwE 2009

www.GSwE2009.org

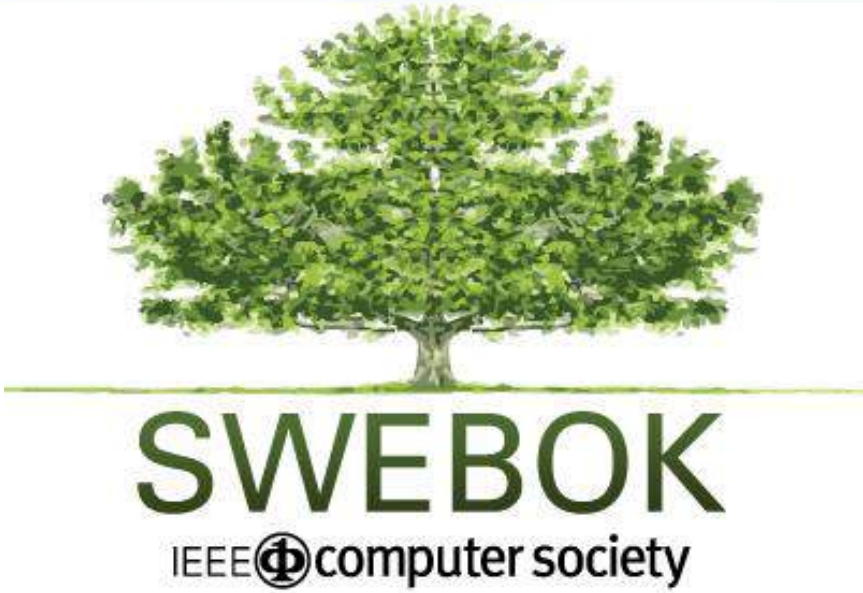
SWEBOK V3.0 Knowledge Areas

Software Requirements
Software Design
Software Construction
Software Testing
Software Maintenance
Software Configuration Management
Software Engineering Management
Software Engineering Process
Software Engineering Models and Methods
Software Quality

Software Engineering Professional Practices

Software Engineering Economics
Computing Foundations
Mathematical Foundations
Engineering Foundations

Foundation Knowledge Areas



Related Disciplines

- Computer Engineering
- Computer Science
- General Management
- Mathematics
- Project Management
- Quality Management
- Systems Engineering

Software Engineering Tools and Methods
has been revised as
Software Engineering Models and Methods

- Modeling
- Types of Models
- Analysis of Models
- Software Engineering Methods

New Knowledge Areas SWEBOK V3.0

- Software Engineering Professional Practice
- Software Engineering Economics
- Computing Foundations
- Mathematical Foundations
- Engineering Foundations

New Knowledge Areas SWEBOK V3.0
Software Engineering Professional Practice

- Professionalism
- Group Dynamics / Psychology
- Communications Skills

New Knowledge Areas SWEBOK V3.0 Software Engineering Economics

- Software Engineering Economics Fundamentals
- Life Cycle Economics
- Risk and Uncertainty
- Economic Analysis Methods
- Practical Considerations

New Knowledge Areas SWEBOK V3.0 Computing Foundations (Part I)

- Problem Solving Techniques
- Abstraction
- Programming Fundamentals
- Programming Language Basics
- Debugging Tools and Techniques
- Data Structure and Representation
- Algorithms and Complexity
- Basic Concept of a System
- Computer Organization

New Knowledge Areas SWEBOK V3.0 Computing Foundations (Part II)

- Compiler Basics
- Operating System Basics
- Database Basics and Data Management
- Network Communication Basics
- Parallel and Distributed Computing
- Basic User Human Factors
- Basic Developer Human Factors
- Secure Software Development and Maintenance

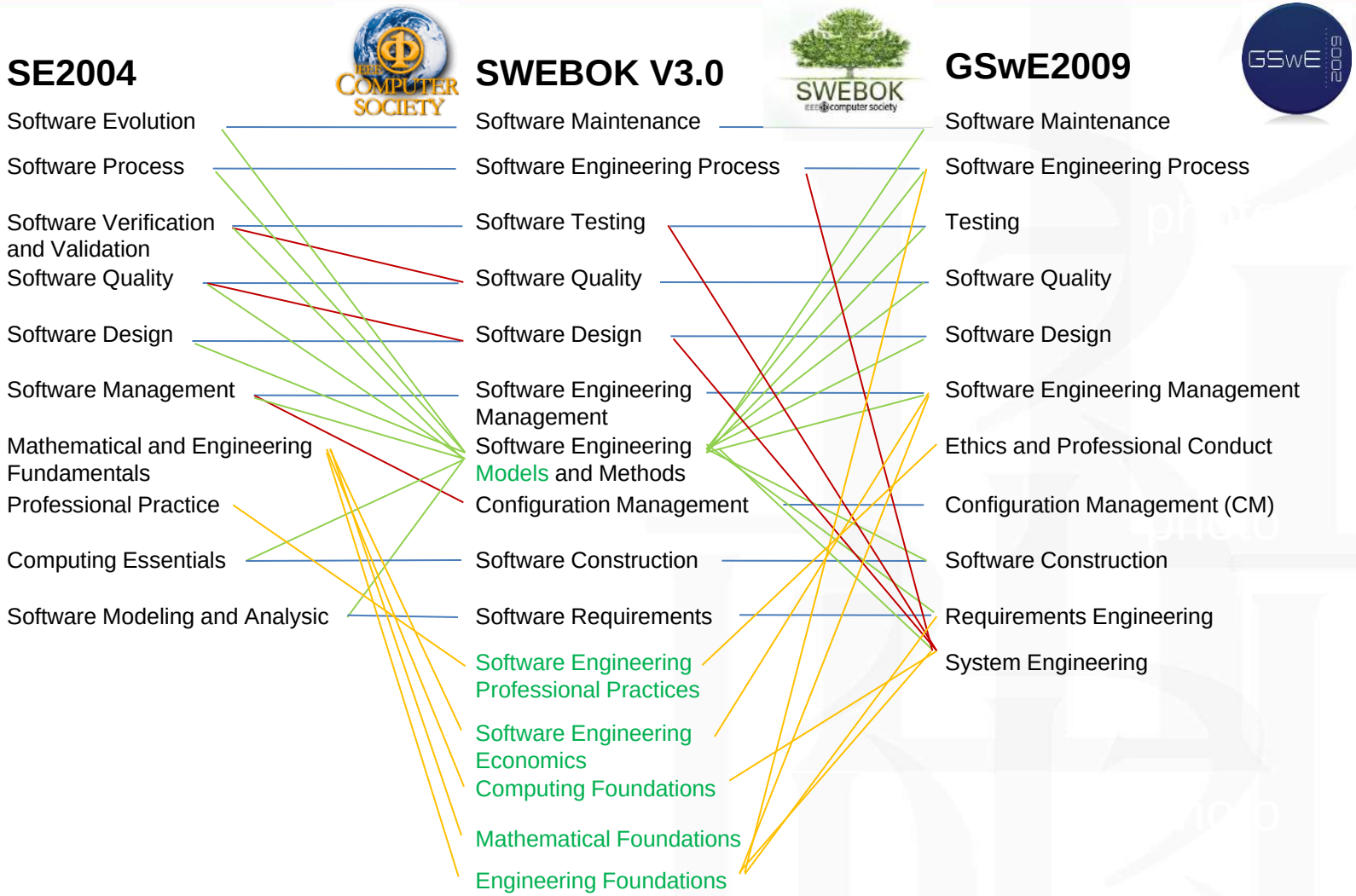
New Knowledge Areas SWEBOK V3.0 Mathematical Foundations

- Sets, Relations, Functions
- Basic Logic
- Proof Techniques
- Basic Counting
- Graphs and Trees
- Discrete Probability
- Finite State Machines
- Grammars
- Numerical Precision, Accuracy, and Errors
- Number Theory
- Algebraic Structures

New Knowledge Areas SWEBOK V3.0 Engineering Foundations

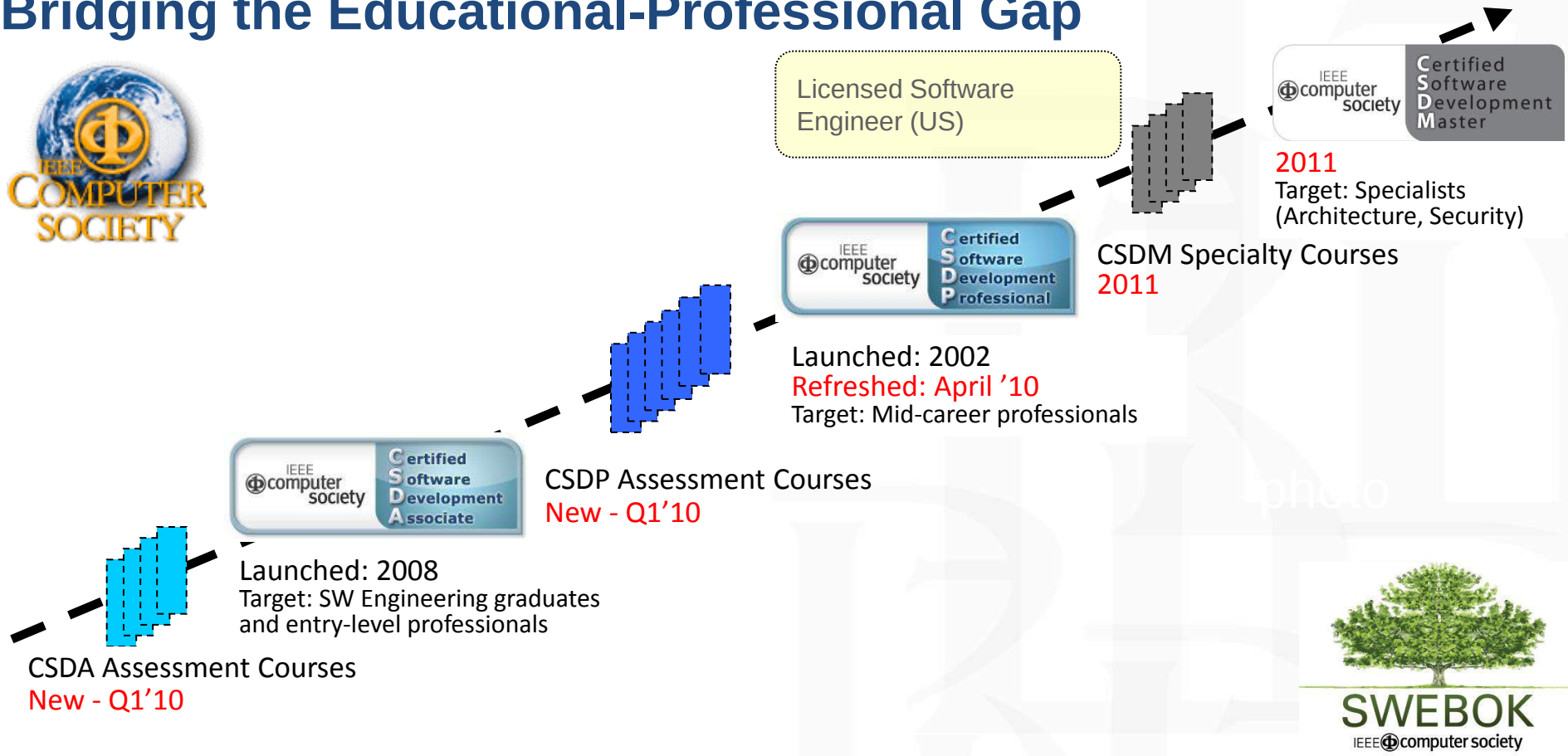
- Empirical Methods and Experimental Techniques
- Statistical Analysis
- Measurement
- Engineering Design
- Modeling, Simulation, and Prototyping
- Standards
- Root Cause Analysis

International Software Engineering Educational and Professional Standards



IEEE CS Old Certification and Training Roadmap

Bridging the Educational-Professional Gap

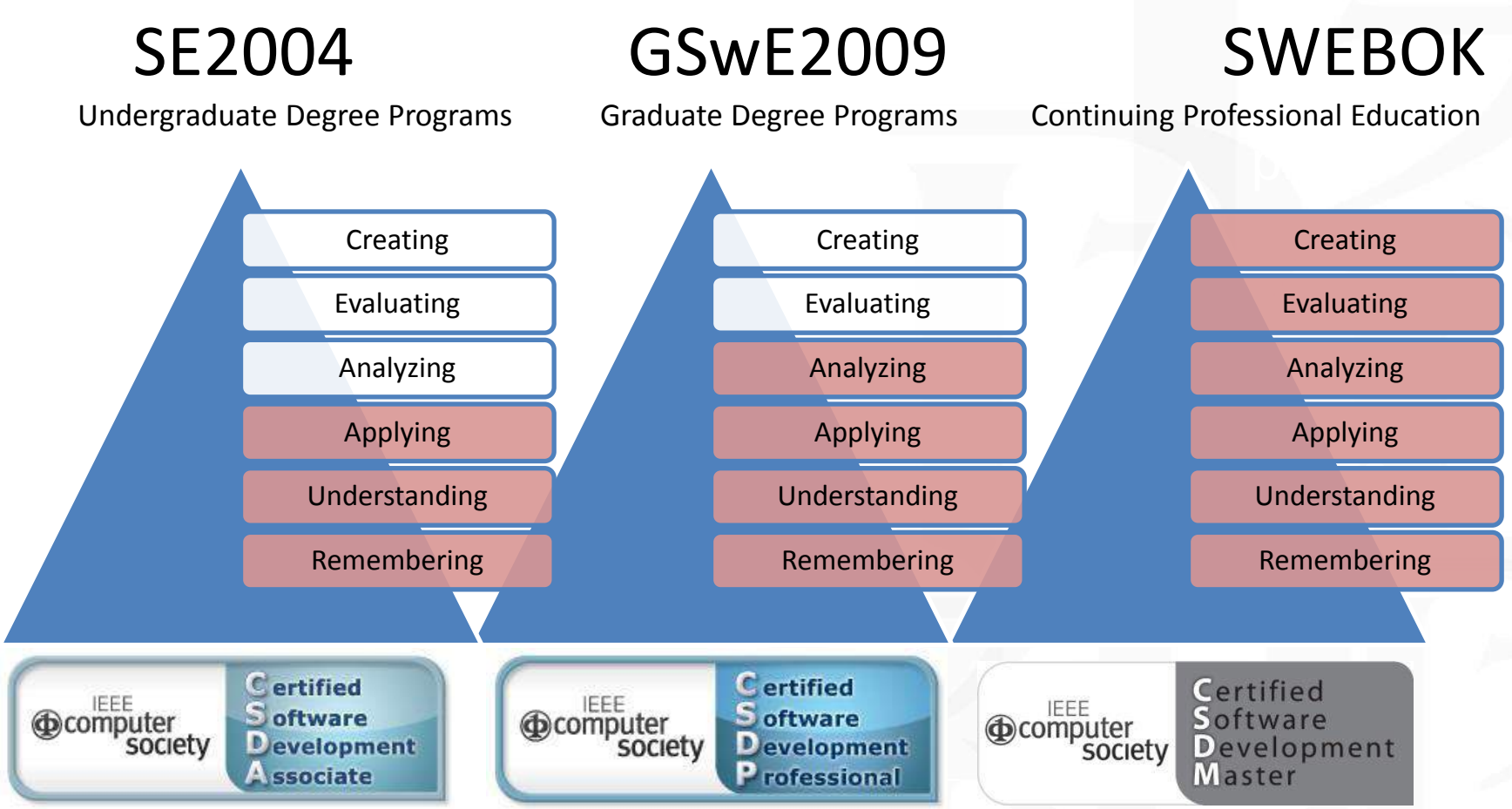


Foundation: 2004-2010 SWEBOK Guide (ISO/IEC TR 19759:2005, 24773)

Content Weights (%) Domains/Areas CSDA

Software Requirements	**7**
Software Design	**8**
Software Construction	**10**
Software Testing	**7**
Software Maintenance	**7**
Software Configuration Management	**3**
Software Engineering Management	**3**
Software Engineering Process	**4**
Software Engineering Tools and Methods	**5**
Software Quality	**6**
Software Engineering Professional Practice	**7**
Software Engineering Economics	**3**
Computing Foundations	**10**
Mathematic Foundations	**10**
Engineering Foundations	**10**

Bloom's Taxonomy Competence Levels Cognitive Domain: Mental Skills



Foundation: 2004-2010 SWEBOK Guide (ISO/IEC TR 19759:2005, 24773)

Employers That Have CSDA/Ps

Accenture
Agilent Technologies
Air Force Research Laboratory
Alcatel USA
Anheuser Busch
Antares Management Solutions
AOL
Avaya
BAE Systems
Barclays Capital
Barclays Global Investors Inc.
Baxter Health Care Corporation
BEA Systems India
Bearingpoint
Bechtel
Beyondsoft
BMC Software
Boeing
Booz Allen Hamilton
Borland Software
Bosch
Cadence Design Systems
Capgemini
Capital One Financial
Cisco Systems
Citicorp
Computer Science Corporation
Compuware Corp
Concurrent Technologies
Construx Software
Convergys Corporation
Daewoo Electronics
Daimler Chrysler
Dassault Falcon Jet
Deloitte & Touche Tax Technologies
Delphi Delco Electronics Systems
Exxon Mobil
Federal Express
Flextronics Electronics
Fidelity Information Services
GE
Goldman Sachs
Hewlett Packard
Hitachi
Honeywell India Software
Honeywell International
HP Corporation
IBM Corporation
IBM Global Services
Infosys Technologies
Intel Corporation
Interactive Data Corporation
Intuit Corporation
ITT Industries
JP Morgan Chase & Co
L-3 Communications
Lawrence Livermore National Laboratory
Linux Networx
Litton Advanced Systems Division
Lockheed Martin Co
Los Alamos National Laboratory
Lucent Technologies
Medtronic, Inc
Microsoft Corporation
Missile Defense Agency
Mitre Corporation
Motorola Electronics
NASA Langley Research Center
NASA Marshall Space Flight Center
NEC
Newbridge Networks
Nokia Networks
Oracle Palm
Philips Electronics
Printrak
Quark
Qwest
Rational Software Corp
Raytheon
Rockwell Collins
Sage
SAIC
Samsung
Sandia National Laboratories
SBC Communications
Schlumberger
Sharp
Shell Corporation
Siemens
Space And Naval Warefare Systems Center
Sprint Corporation
Sun Microsystems
Tata Consultancy Services
The Aerospace Corporation
Trane Company
TRW Automotive
Tyco Electronics
Unisys Corporation
United Space Alliance
United States Navy
US Air Force
US Army
US Marine Corp
US Navy
Visteon Coroporation
Wells Fargo Bank
Westinghouse
Wipro Infotech
Xerox Corporation

HSE – the Unique IEEE CS REP in Russia

IEEE computer society

hereby has designated

University-Higher School of Economics, Russia

as a

Registered Education Provider

Effective Date: February 2010

10010

Certificate Number

IEEE COMPUTER SOCIETY 1946

President, IEEE Computer Society

IEEE

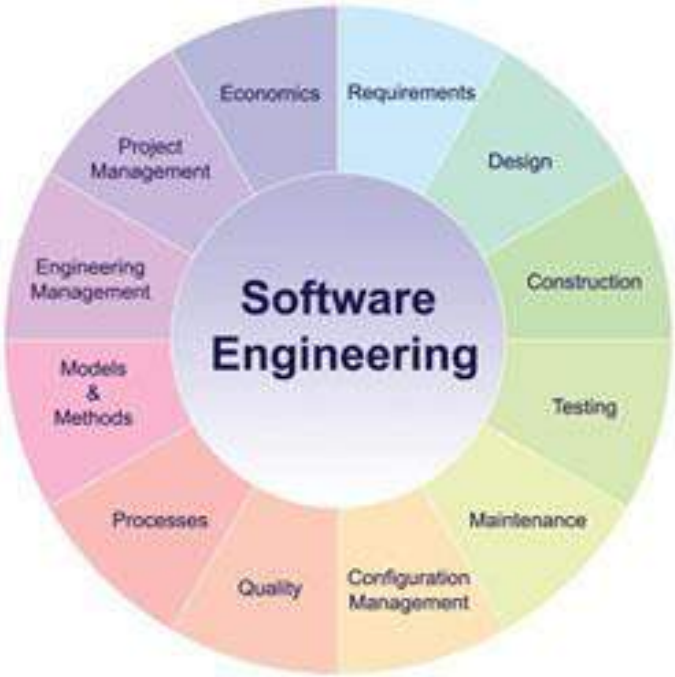
Overview of IEEE Computer Society Certification and Credential Program

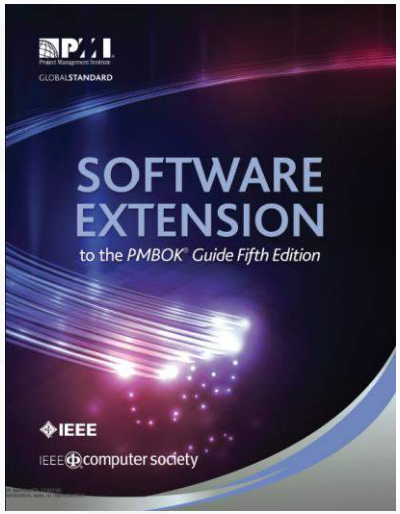
- Knowledge Area Certificates
- Software Engineering Associate Certifications
  - Software Development Associate Engineering
  - Software Quality & Maintenance Associate Engineering
  - Software Management Associate Engineering
- Professional Competency Certifications
  - Professional Software Development
  - Professional Software Engineering Process Master
  - Professional Software Engineering Master
  - Advanced Scrum Professional
- Certificates of Achievement (Continuing Education)
  - Cloud Computing Certificate of Achievement
  - Secure Software Certificate of Achievement
  - Embedded Systems Certificate of Achievement
  - Multi-Core Certificate of Achievement

Knowledge Area Certificates

KAs: 12, Duration: 90 Minutes, Questions: 70, Locations : Online

- Software Requirements
- Software Design
- Software Construction
- Software Testing
- Software Maintenance
- Software Configuration Management
- Software Engineering Management
- Software Engineering Process
- Software Engineering Models and Methods
- Software Quality
- Software Engineering Economics
- Software Project Management



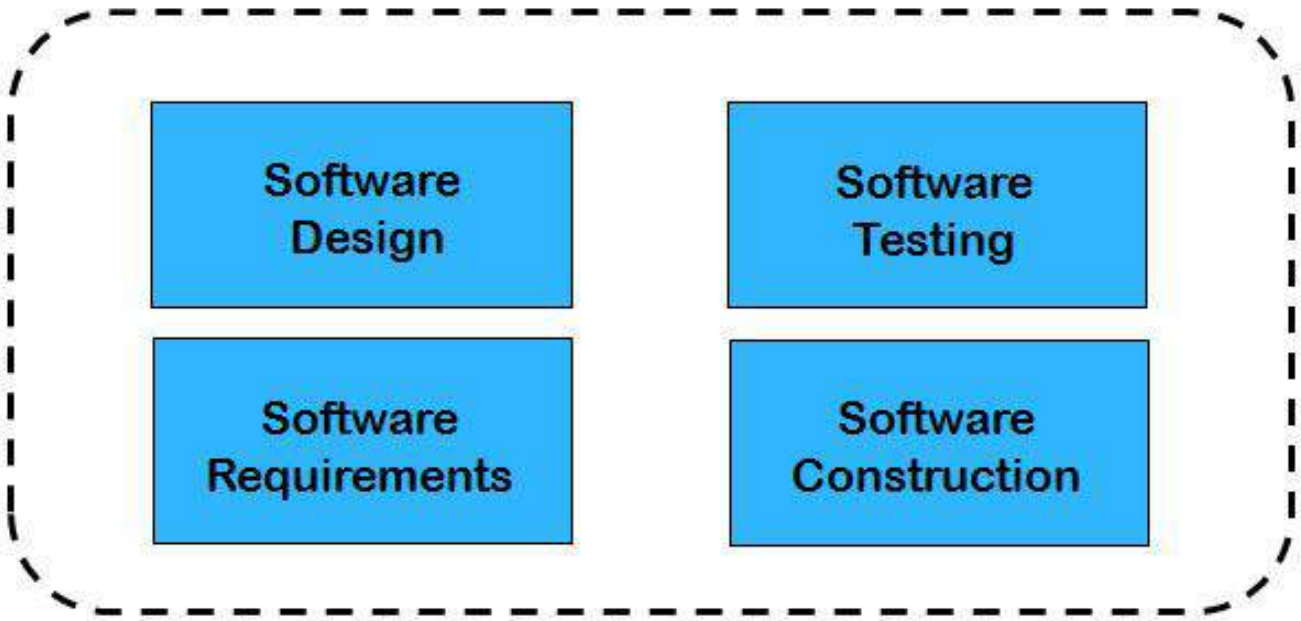


SWEBOK
IEEE computer society

Foundation: SWEBOK Guide V3.0 & SWEBOK/PMI Software Extension (SWX)

Software Development Associate Engineer Certification

Duration: 180 Minutes, Questions: 160, Locations : Online



SWEBOK
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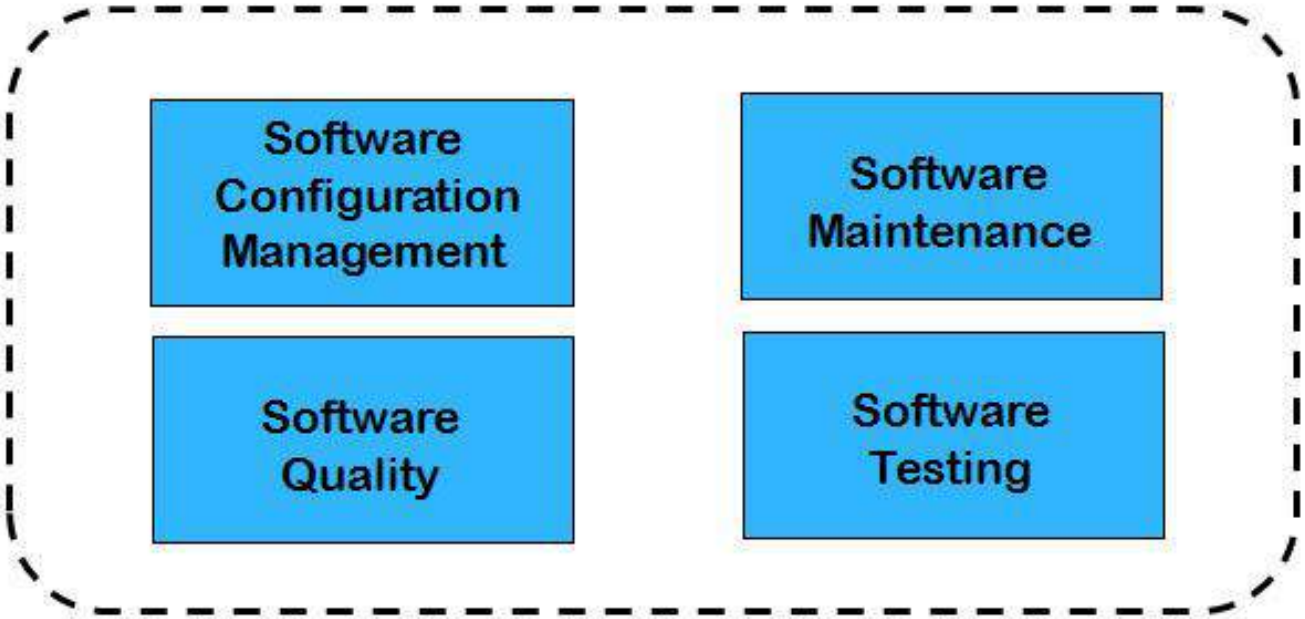
Foundation: SWEBOK Guide V3.0 (ISO/IEC TR 19759:2014)

Software Quality and Maintenance Associate Engineer Certification

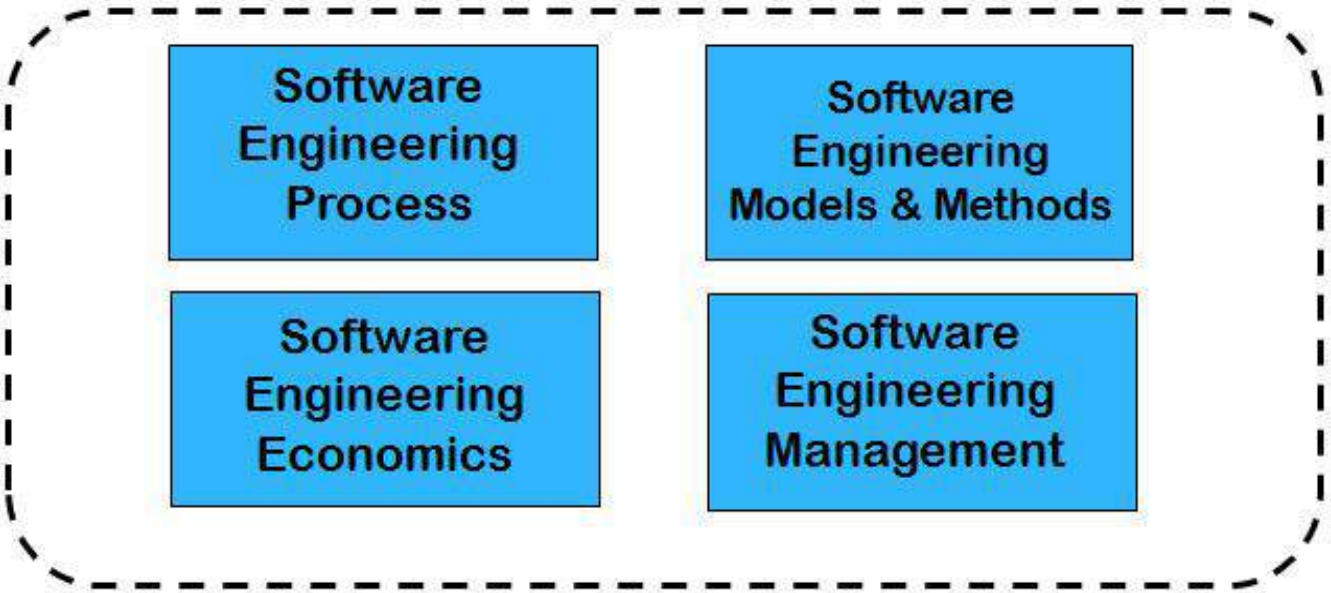
Duration: 180 Minutes, Questions: 160, Locations : Online



Foundation: SWEBOK Guide V3.0 (ISO/IEC TR 19759:2014)

Software Engineering Management Associate Engineer Certification

Duration: 180 Minutes, Questions: 160, Locations : Online



SWEBOK
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Foundation: SWEBOK Guide V3.0 (ISO/IEC TR 19759:2014)

Professional Software Developer Certification

Part I : PSD Exam.
KAs: 4, Duration: 3 hours,
Questions: 160, Locations : Online

Part II :
Applied Module I. Duration: 3 hours.
Applied Module II. Duration: 3 hours

Part I

One PSD exam containing the four knowledge areas:

- Software Design
- Software Requirements
- Software Construction
- Software Testing

\+

Part II

PROXOR

Applied Exam Modules (I and II)

=

Professional Software Developer Certification

An overall competency rating from 0 to 4 is then assigned.

- A score of 1 identifies a Beginner level.
- A score of 2 identifies an Intermediate Skill level.
- A score of 3 or higher identifies an Advance Skill level.

SWEBOK
IEEE computer society

Foundation: SWEBOK Guide V3.0 (ISO/IEC TR 19759:2014)

Professional Software Engineering Process Master Certification

Part I : PSEPM Exam.
KAs: 6, Duration: 3 hours,
Questions: 160, Locations : Online

Part II : PSEPM Exam.
KAs: 6, Duration: 3 hours,
Questions: 160, Locations : Online

Part I

PSEPM exam containing the 6 knowledge areas:

- Software Requirements
- Software Design
- Software Construction
- Software Testing
- Software Maintenance
- Software Configuration Management

+

Part II

PSEPM exam containing the 6 knowledge areas:

- Software Engineering Management
- Software Engineering Process
- Software Engineering Models and Methods
- Software Quality
- Software Engineering Economics
- Software Project Management

=

Professional Software Engineering Process Master Certification

SWEBOK
IEEE computer society

Foundation: SWEBOK Guide V3.0 (ISO/IEC TR 19759:2014)

Professional Software Engineering Master Certification

Part I : PSEM Exam.
KAs: 6, Duration: 3 hours,
Questions: 160, Locations : Online

Part II : PSEM Exam.
KAs: 6, Duration: 3 hours,
Questions: 160, Locations : Online

Part III : Applied Module III (3 hours) and Applied Module IV (3 hours)

Part I
PSEM exam containing the 6 knowledge areas:
- Software Requirements
- Software Design
- Software Construction
- Software Testing
- Software Maintenance
- Software Configuration Management

+

Part II
PSEM exam containing the 6 knowledge areas:
- Software Engineering Management
- Software Engineering Process
- Software Engineering Models and Methods
- Software Quality
- Software Engineering Economics
- Software Project Management

+

Part III
PROXOR
Applied Exam Modules (III and IV)

=

Professional Software Engineering Master Certification

An overall competency rating from 0 to 4 is then assigned.

- A score of 1 identifies a Beginner level.
- A score of 2 identifies an Intermediate Skill level.
- A score of 3 or higher identifies an Advance Skill level.

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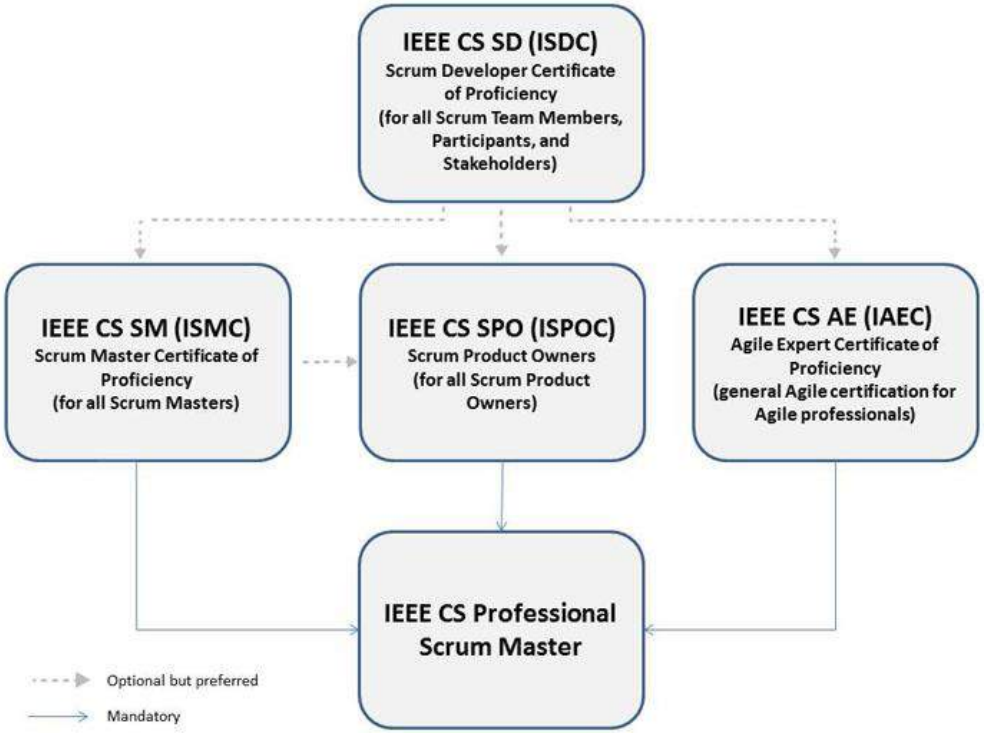
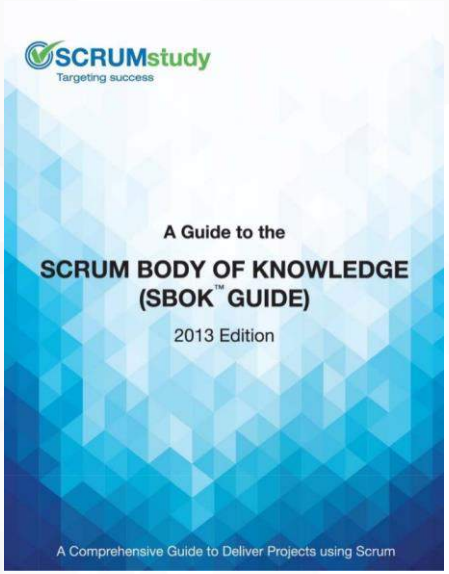
Foundation: SWEBOK Guide V3.0 (ISO/IEC TR 19759:2014)

Advanced Scrum Professional

Scrum Certificates of Proficiency





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Foundation: SWEBOK Guide V3.0 & SBOK Guide

IEEE CS Certificates of Achievement

Security Certificate of Achievement

- Foundations of Software Security
- Secure Software Design
- Managing Secure Software Development
- Secure Software Coding

Cloud Computing Certificate of Achievement

- Cloud in the Business Environment
- Cloud in Governance and Security
- Cloud in Economics, Metrics & Migration

High Performance Computing Certificate of Achievement

- Embedded System

Multi Core Video Lecture Series Certificate of Achievement

- Multi-core Video Series

Foundation: SWEBOK Guide V3.0

The Elements of SWECOM

Software Engineering Competency Model

IEEE

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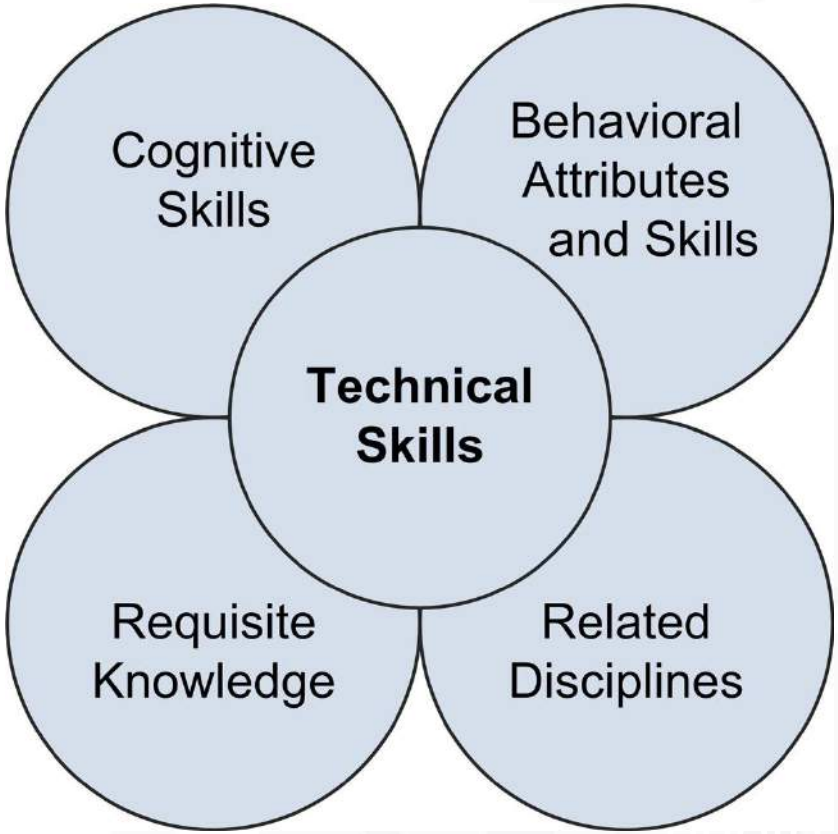

Foundation: SWEBOK Guide V3.0

Related Disciplines

Software Engineering Competency Model

IEEE

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- Computer Engineering
- Computer Science
- General Management
- Mathematics
- Project Management
- Quality Management
- Systems Engineering
- …

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Cognitive Skills

Software Engineering Competency Model

IEEE computer society

- **Reasoning** provides the basis for making decisions in a logical and effective manner.
- **Analytical skills** are related to techniques that involve data collection, organization and aggregation of data, and analysis and evaluation in order to draw conclusions or make decisions.
- **Problem solving** is concerned with various methods that employ reasoning, analytic techniques, and prioritizing information to solve problems.
- **Innovation** involves skills used to create models and abstractions that support analysis and problem solving.

Foundation: SWEBOK Guide V3.0

Behavioral Attributes and Skills

Software Engineering Competency Model

IEEE computer society

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

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Technical Skills

Software Engineering Competency Model

IEEE computer society

- **Software Engineering Life Cycle Skill Areas and Skills**
  - ***Software Requirements Skills***
  - ***Software Design Skills***
  - ***Software Construction Skills***
  - ***Software Testing Skills***
  - ***Software Sustainment Skills***
- **Software Engineering Crosscutting Skill Area**
  - ***Software Process and Life Cycle Skills***
  - ***Software Systems Engineering Skills***
  - ***Software Quality Skills***
  - ***Software Security Skills***
  - ***Software Safety Skills***
  - ***Software Configuration Management Skills***
  - ***Software Measurement Skills***
  - ***Human-Computer Interaction Skills***

Foundation: SWEBOK Guide V3.0

Requisite Knowledge

Software Engineering Competency Model

IEEE

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Academic Competencies –
Requisite Knowledge
for SWECOM Technical Skills

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SWECOM Competency Levels

Software Engineering Competency Model

IEEE

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- Technician
- Entry Level Practitioner
- Practitioner
- Technical Leader
- Senior Software Engineer

- Follows (F)
- Assists (A)
- Participates (P)
- Leads (L)
- Creates (C)

Foundation: SWEBOK Guide V3.0

SWECOM Use Cases

Software Engineering Competency Model

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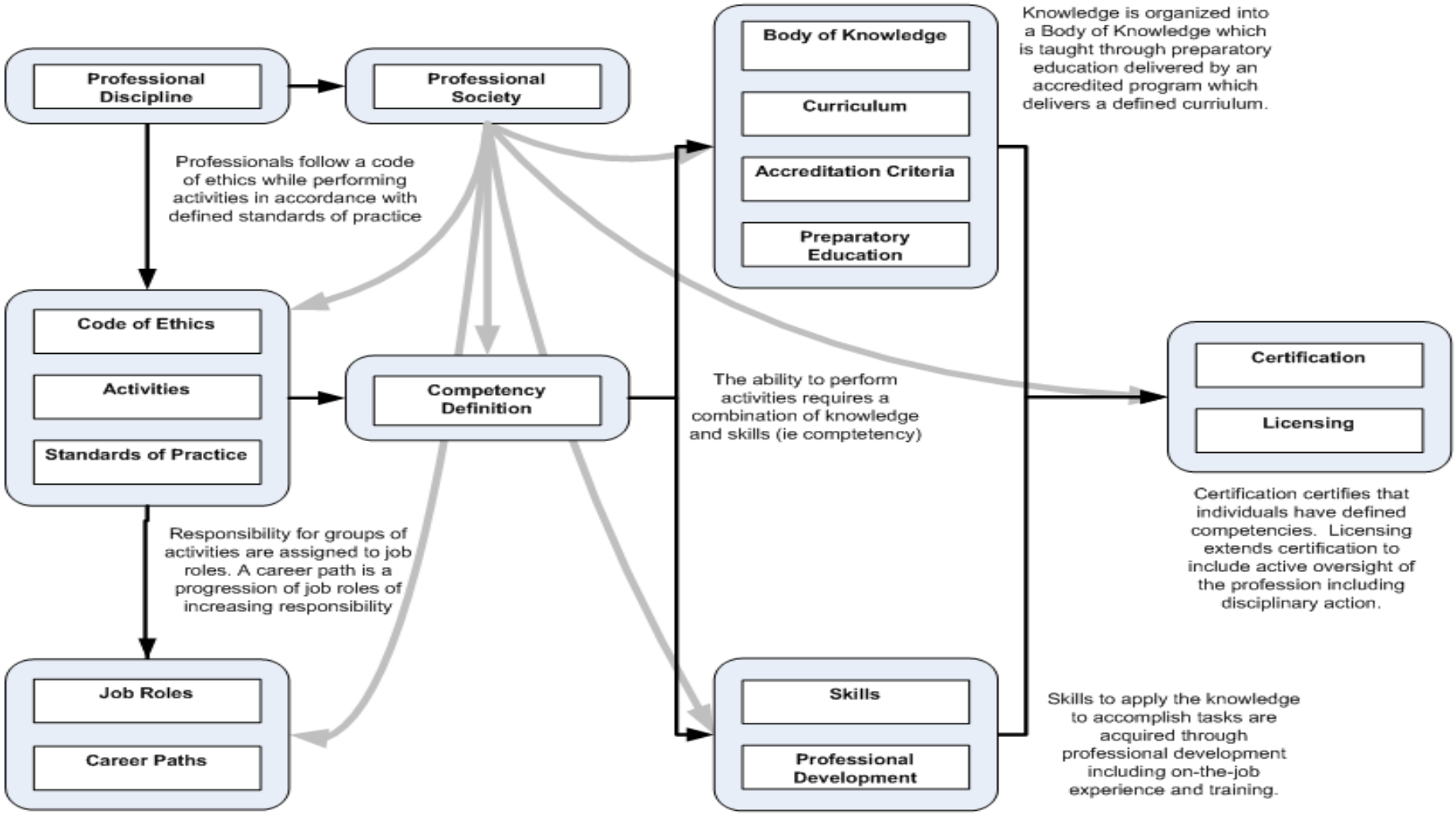
1. Organization Using SWECOM to Create a New Hire Job Description and Screen Job Candidates
2. Employee Using SWECOM for Self-Improvement
3. Manager Using SWECOM for Evaluation and Improvement Planning for Team Member
4. Curriculum Designer Using SWECOM to Prepare a Competency-Based Curriculum

Foundation: SWEBOK Guide V3.0

Model of a Profession



Future Versions of SWEBOK Guide

- Guide to the Systems Engineering Body of Knowledge (SEBoK) v1.3.2 (April 14, 2015)
- Graduate Reference Curriculum for Systems Engineering (GRCSE)
- EITBOK - Enterprise Information Technology Body of Knowledge
- Software Security Specialized Knowledge Area (Draft SWEBOK v3.0)
- SWECOM (Software Sustainment; Software Process and Life Cycle, Software Systems Engineering; Software Security; Software Safety; Software Measurement; Human-Computer Interaction)
- SWEBOK/PMI Software Extension to the PMBOK Guide Fifth Edition (SWX)
- A Guide to the SCRUM Body of Knowledge (SBOK Guide)
- People Capability Maturity Model (P-CMM)
- The Personal Software Process (PSP) Body of Knowledge (BOK)
- Team Software Process (TSP) Body of Knowledge (BOK)
- Enterprise Information Technology Body of Knowledge (EITBOK)
- SEMAT

NATIONAL RESEARCH UNIVERSITY

Thank you for your attention!

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http://www.hse.ru/en/staff/avdoshin