The Emerging Consensus on the Software Engineering Body of Knowledge & Software Quality

A. Abran,

P. Bourque, R. Dupuis, J. W. Moore, L. Tripp

American Society for Quality

Ottawa, Oct 29, 2002

Presentation Plan

- **Project background**
- Project objectives, audiences and plan
- Content of the Guide
- Current Uses
- Next step

A Key Issue: Quality

- Quality of the software is now a key issue for software:
  - Users
  - Purchasers
  - Producers
  - National competitiveness
  - Global economics progress

Software Quality

- How to address the issue at the:
  - Individual level?
  - Organisational level?
  - National level?
  - International level?

- What infrastructure must be set up to tackle all levels across the board?

Context

Increased interest in the establishment of the **software engineering** profession but up until the early 2000's…

- Groups and individuals:
  - Different views of software engineering
- Universities:
  - Offering undergraduate degrees in *Software* Engineering, within & outside of traditional Engineering Departments
  - Limited consistency across curriculum

A Trend Setter….

Texas Board of Engineers:

- Decision to license software engineers

- A strategy with significant impact on:
  - individuals
  - industry (e.g. mobility of staff & training)
  - universities
  - policy bodies

  (+ engineering boards and universities)

Software Engineering

- What is it?
- Is it ‘engineering’?
- It is mature?

What is Software Engineering?

- IEEE 610.12:
  - "(1) The application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software; that is, the application of engineering to software.
  - (2) The study of approaches as in (1)."

Recognized Profession?

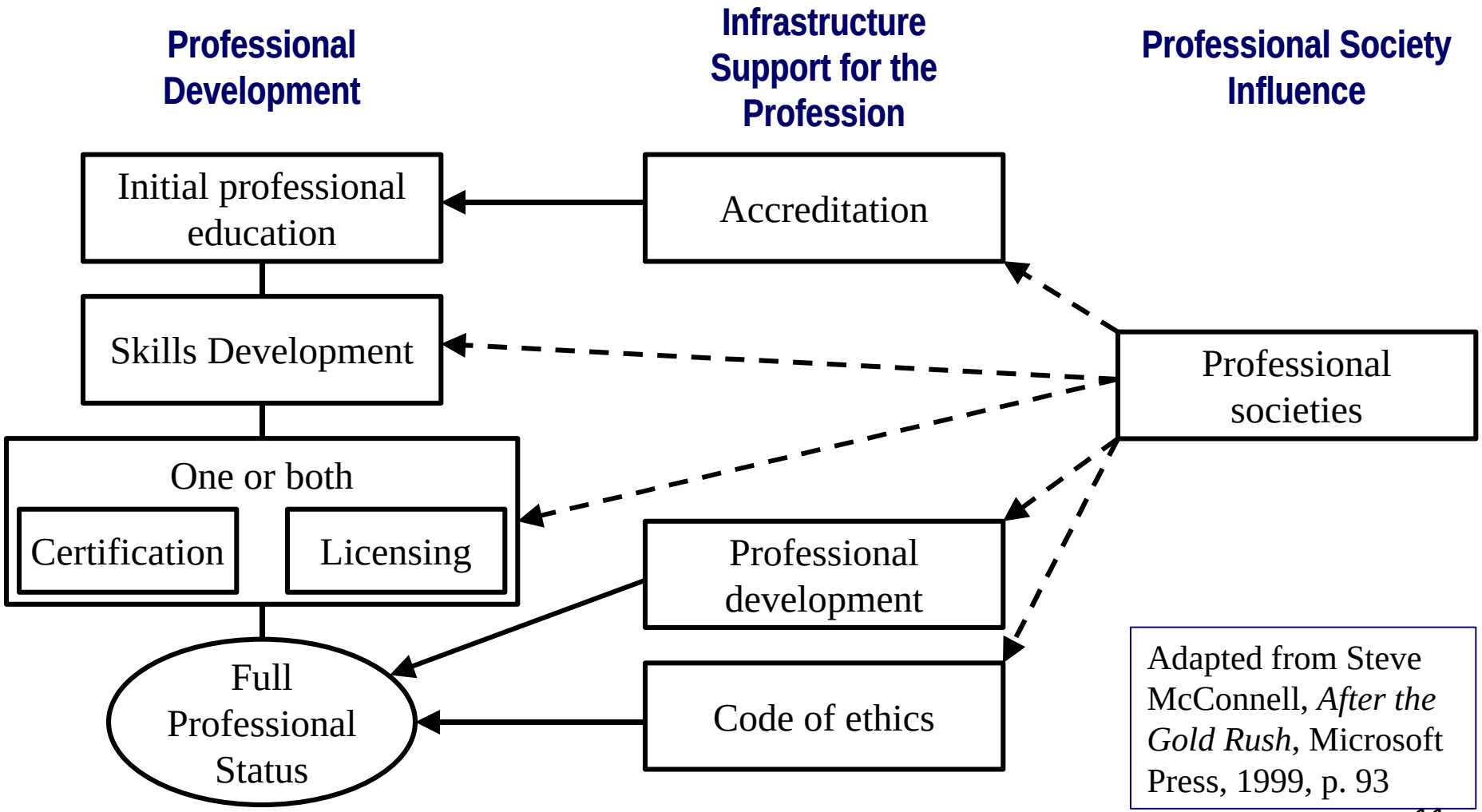
- P. Starr, *The Social Transformation of American Medicine*, BasicBooks, 1982:
  - Knowledge and competence validated by the community of peers
  - Consensually validated knowledge rests on rational, scientific grounds
  - Judgment and advice oriented toward a set of substantive values

Model of the Maturity of a Profession

- Ford and Gibbs:
  - Education
  - Accreditation
  - Skills development
  - Licensing/certification
  - Professional development
  - Code of ethics
  - Professional society or societies

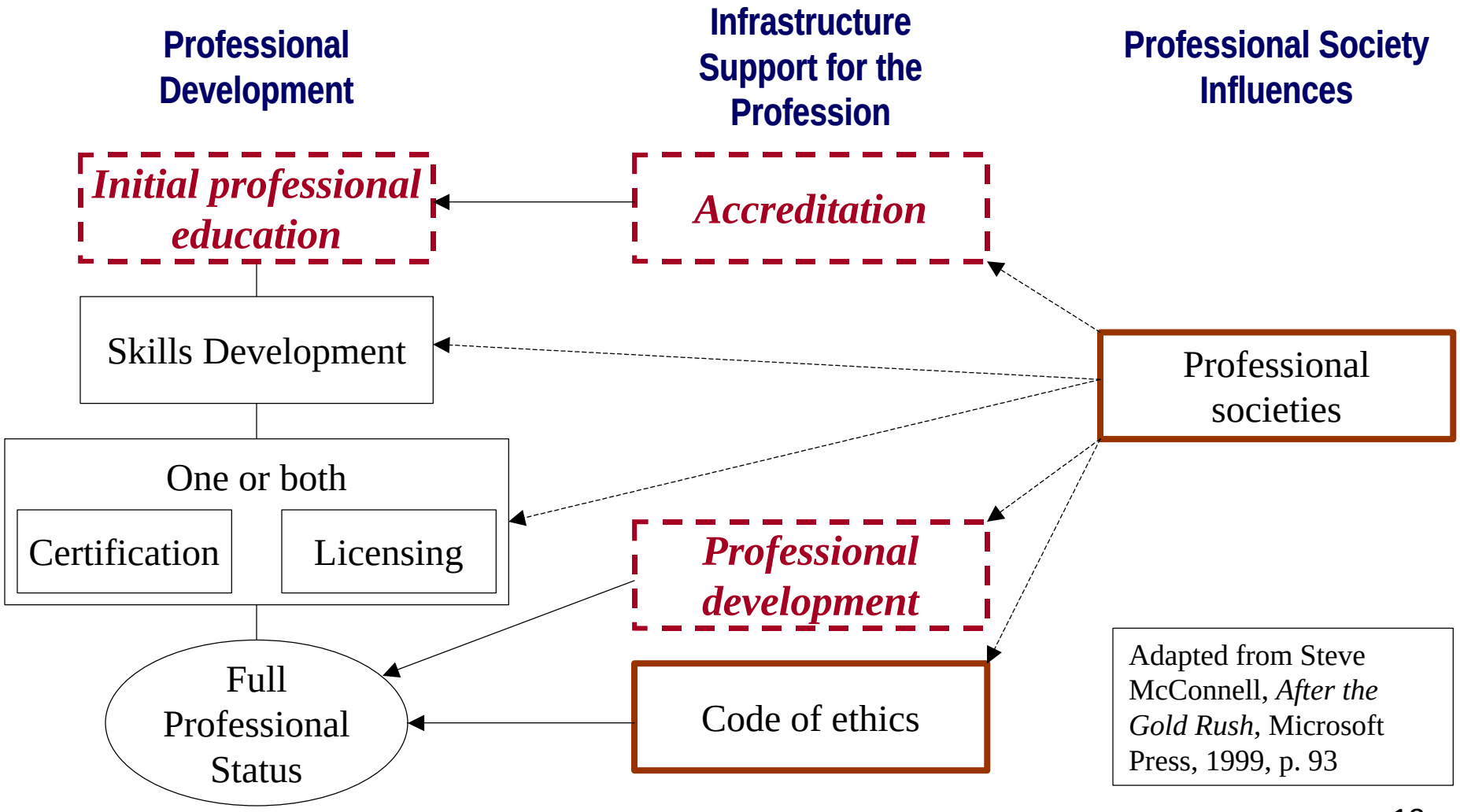
G. Ford and N. E. Gibbs, ***A Mature Profession of Software Engineering***, Software Engineering Institute, Carnegie Mellon University, Pittsburgh, Pennsylvania, Technical CMU/SEI-96-TR-004, January 1996.

Professional Development



Adapted from Steve McConnell, *After the Gold Rush*, Microsoft Press, 1999, p. 93

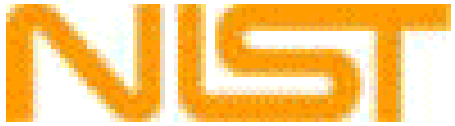
Professional Development



Adapted from Steve McConnell, *After the Gold Rush*, Microsoft Press, 1999, p. 93

Corporate Support by:

CANADIAN COUNCIL OF PROFESSIONAL ENGINEERS
CONSEIL CANADIEN DES INGÉNIEURS



National Research Council Canada

Conseil national de recherches Canada

Project managed by:

Université du Québec
École de technologie supérieure

www.swebok.org

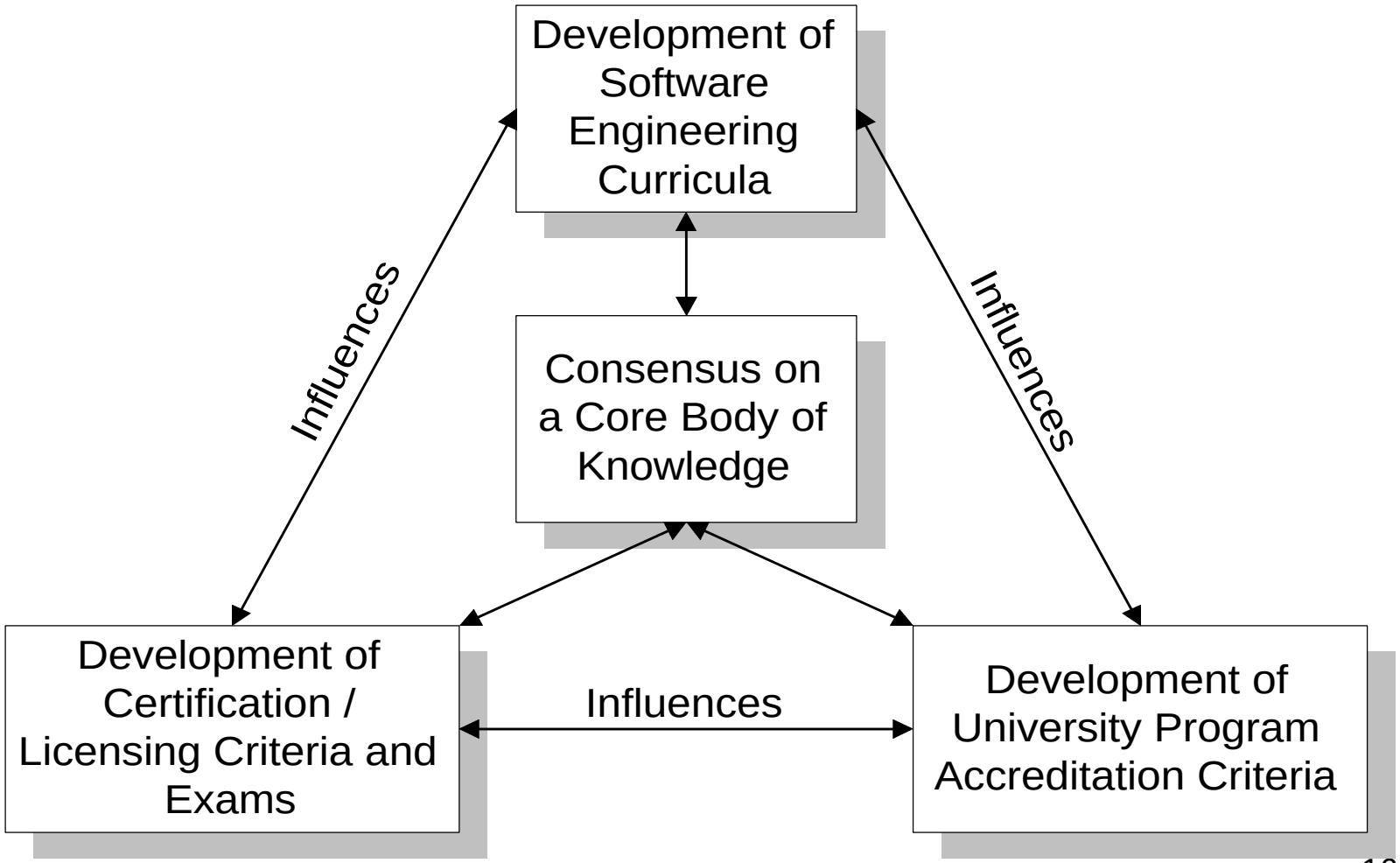
Presentation Plan

- Project background
- **Project objectives, audiences and plan**
- Content of the Guide
- Next steps
- Research issues

Project Objectives

- Promote a consistent view of *software engineering* worldwide
- Clarify the place of, and set the boundary of, software engineering with respect to other disciplines
- Characterize the contents of the Software Engineering Body of Knowledge - SWEBOK
- Provide a topical access to the Software Engineering Body of Knowledge
- Provide a foundation for curriculum development and individual certification and licensing material

Strategy: Build a consensus on a Core Body of Knowledge

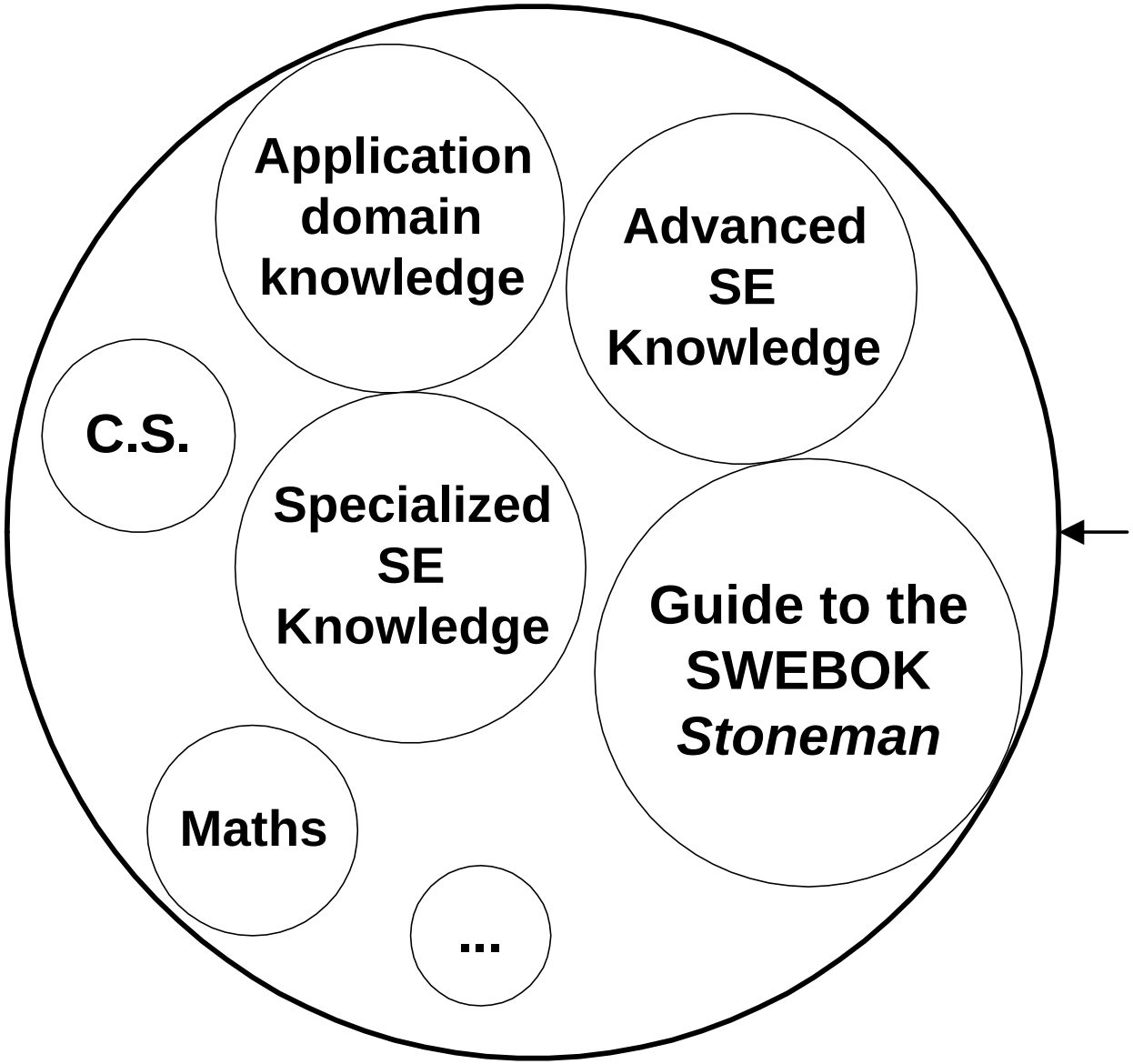


Intended Audiences

- Public and private organizations
- Practicing software engineers
- Makers of public policy
- Professional societies
- Software engineering students
- Educators and trainers

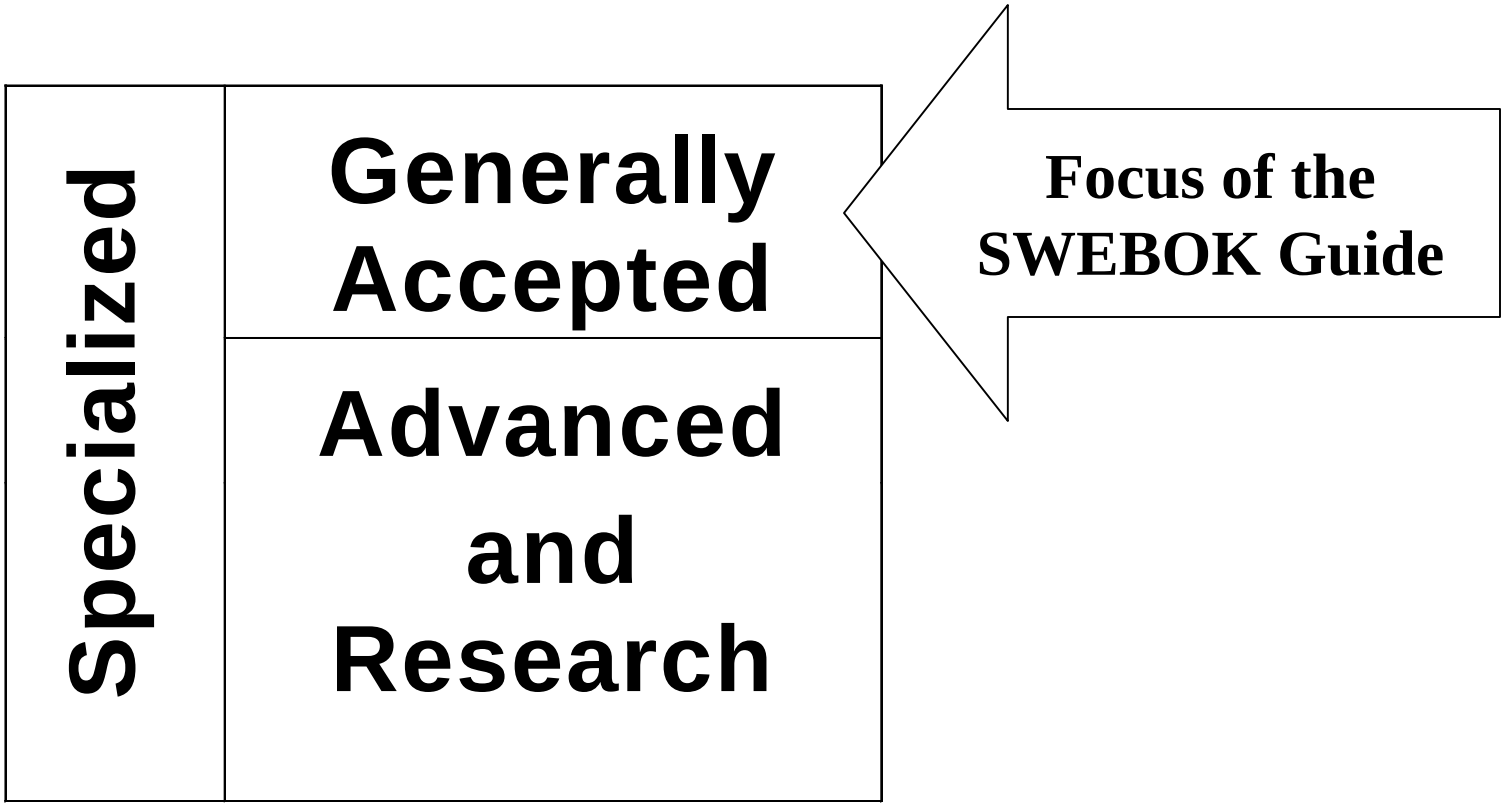
What Are we Not Trying to Accomplish?

- Not an all-inclusive description of the sum of knowledge in the field
- Not all categories of knowledge
- Not a curriculum development effort



Knowledge of a Software Engineer

Categories of Knowledge in the SWEBOK



Generally Accepted

- «Applies to most projects, most of the time, and widespread consensus validates its value and effectiveness»
  - Project Management Institute - PMI

- Bachelor + 4 years of experience

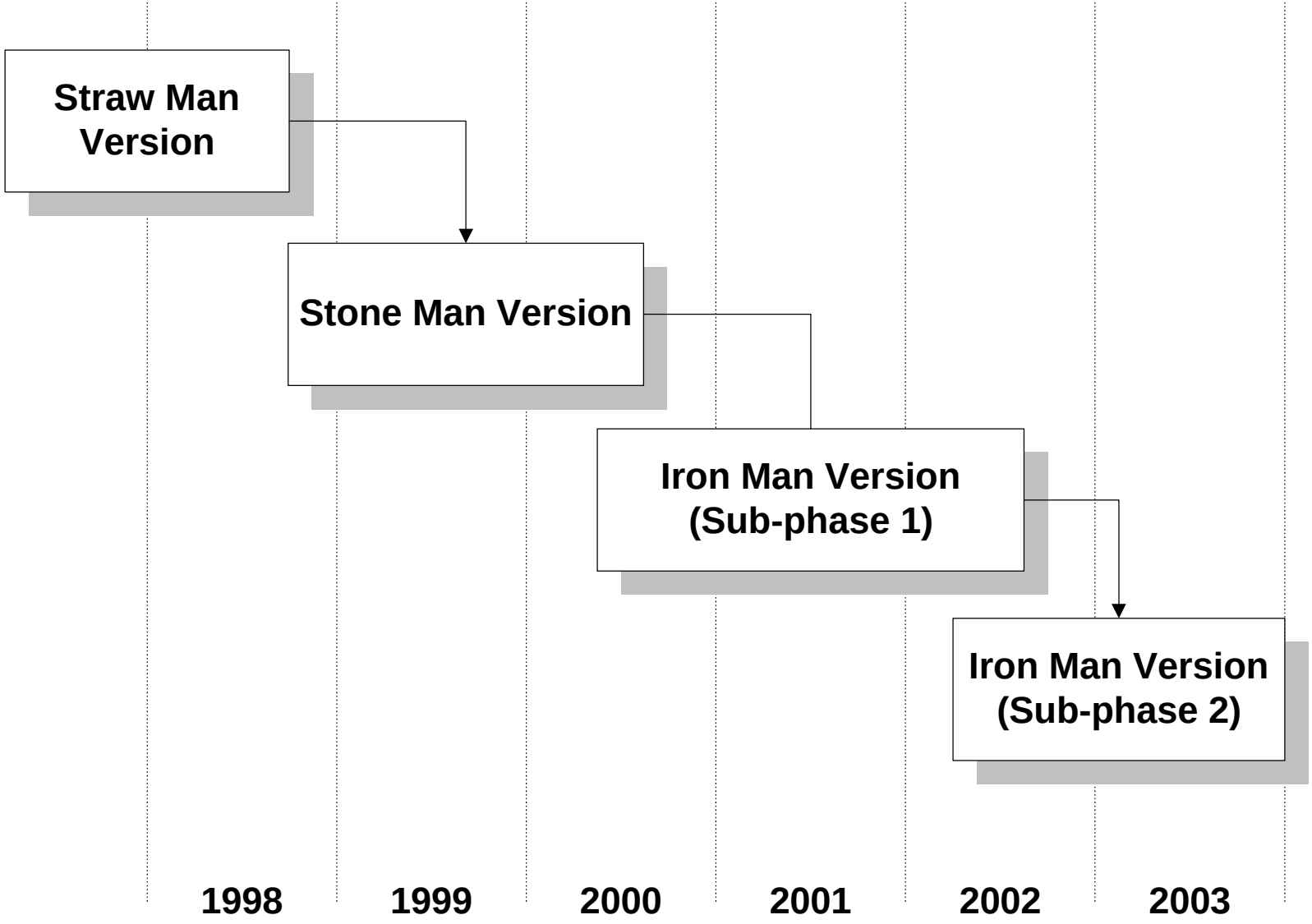
IEEE and ACM strategies

- IEEE-CS:
  - initial focus on generally accepted
  - strategy with intermediate deliverables
  - contributions to the maturation and consensus building
- ACM:
  - opposition to licensing
    - withdrawal from joint efforts with IEEE-CS
    - concerns limited to specialized knowledge

Three Underlying Principles of the Project

- ***Transparency***: the development process is itself published and fully documented
- ***Consensus-building***: the development process is designed to build, over time, consensus:
  - In industry, among professional societies and standards-setting bodies and in academia
  - Consensus does not equal Unanimity
  - Consensus does not equal an expert opinion which is not yet generally accepted
- Available ***free*** on the web

A Three-Phase Approach for Developing the Guide to the SWEBOK



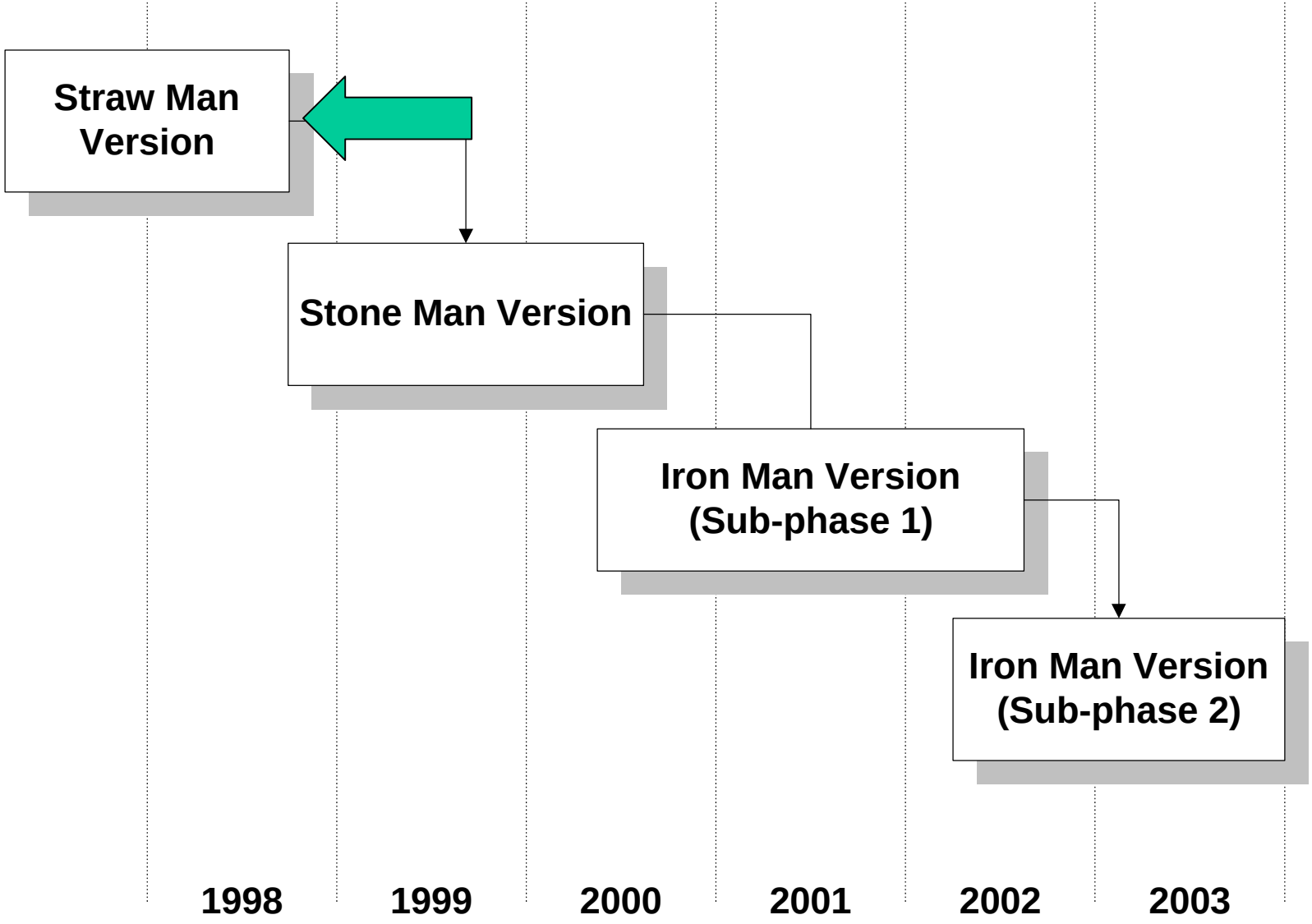
Project Team

- Editorial team
- Industrial Advisory Board
- Knowledge Area Specialists
- A very large international group of Reviewers

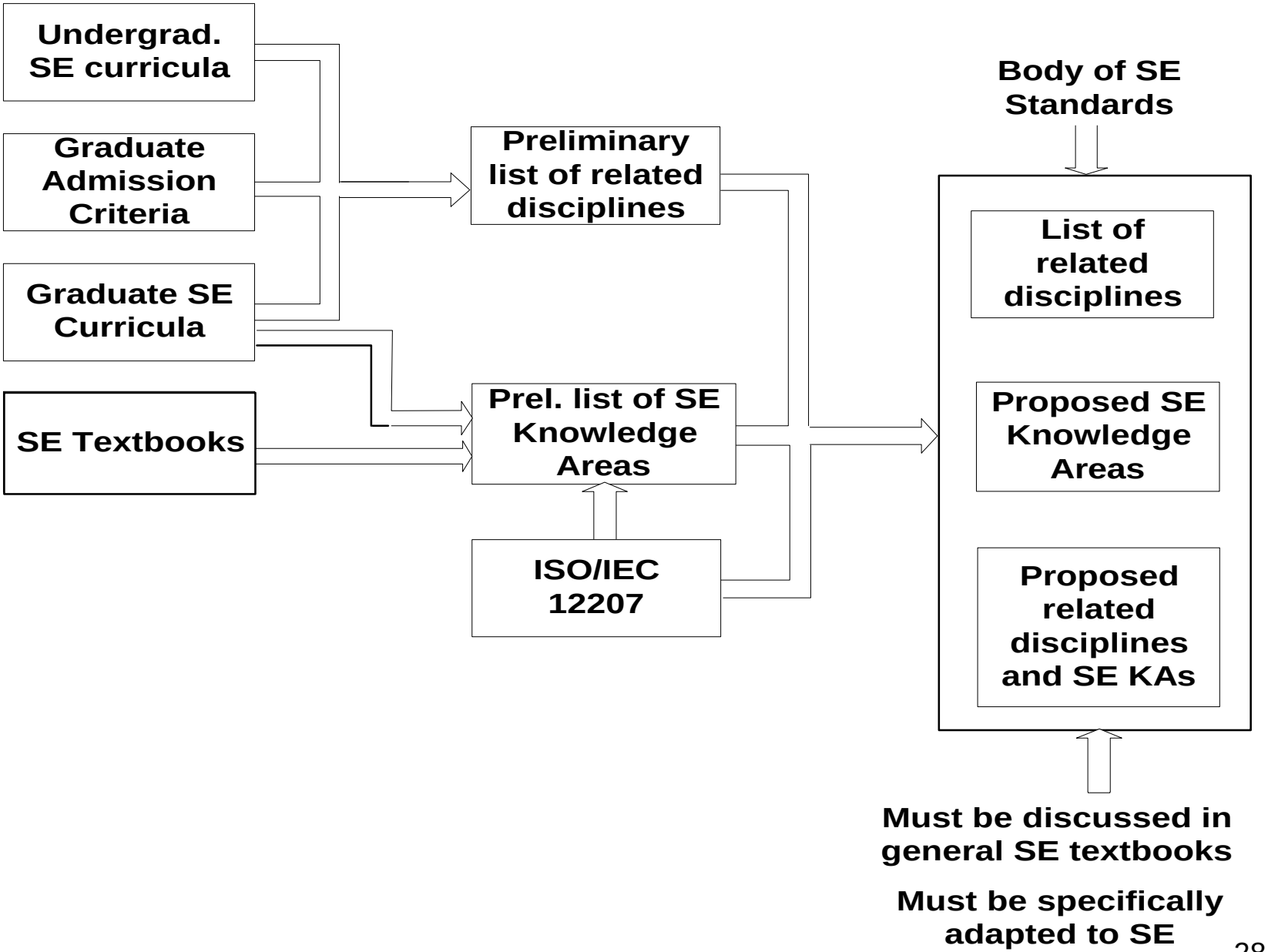
Editorial Team

- **Project "Champion":**
  - **Leonard Tripp, 1999 President, IEEE Computer Society**
- **Executive Editors:**
  - **Alain Abran, École de Technologie Supérieure**
  - **James W. Moore, The MITRE Corp.**
- **Editors:**
  - **Pierre Bourque, École de Technologie Supérieure**
  - **Robert Dupuis, UQAM**

A Three-Phase Approach for Developing the Guide to the SWEBOK



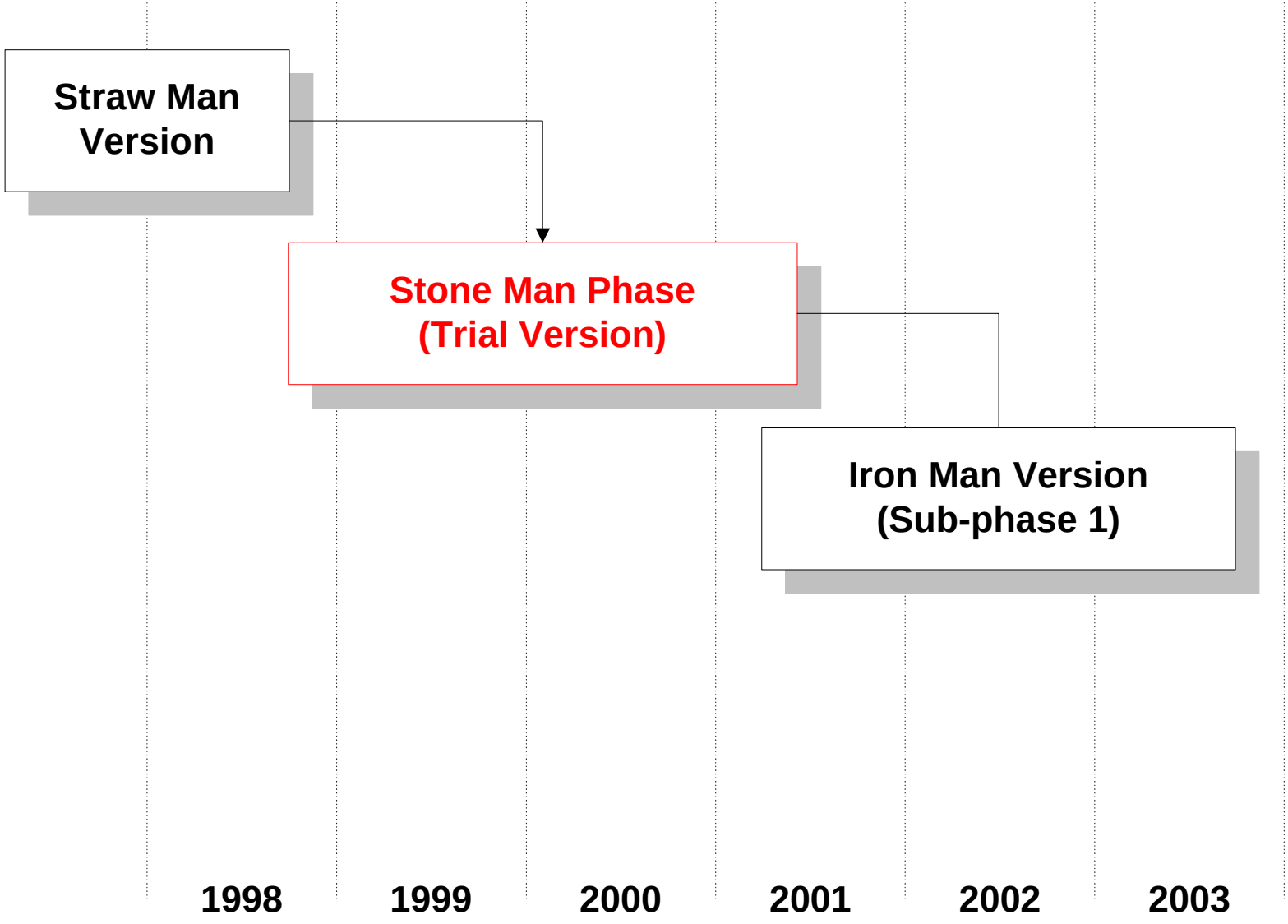
Strawman: Process



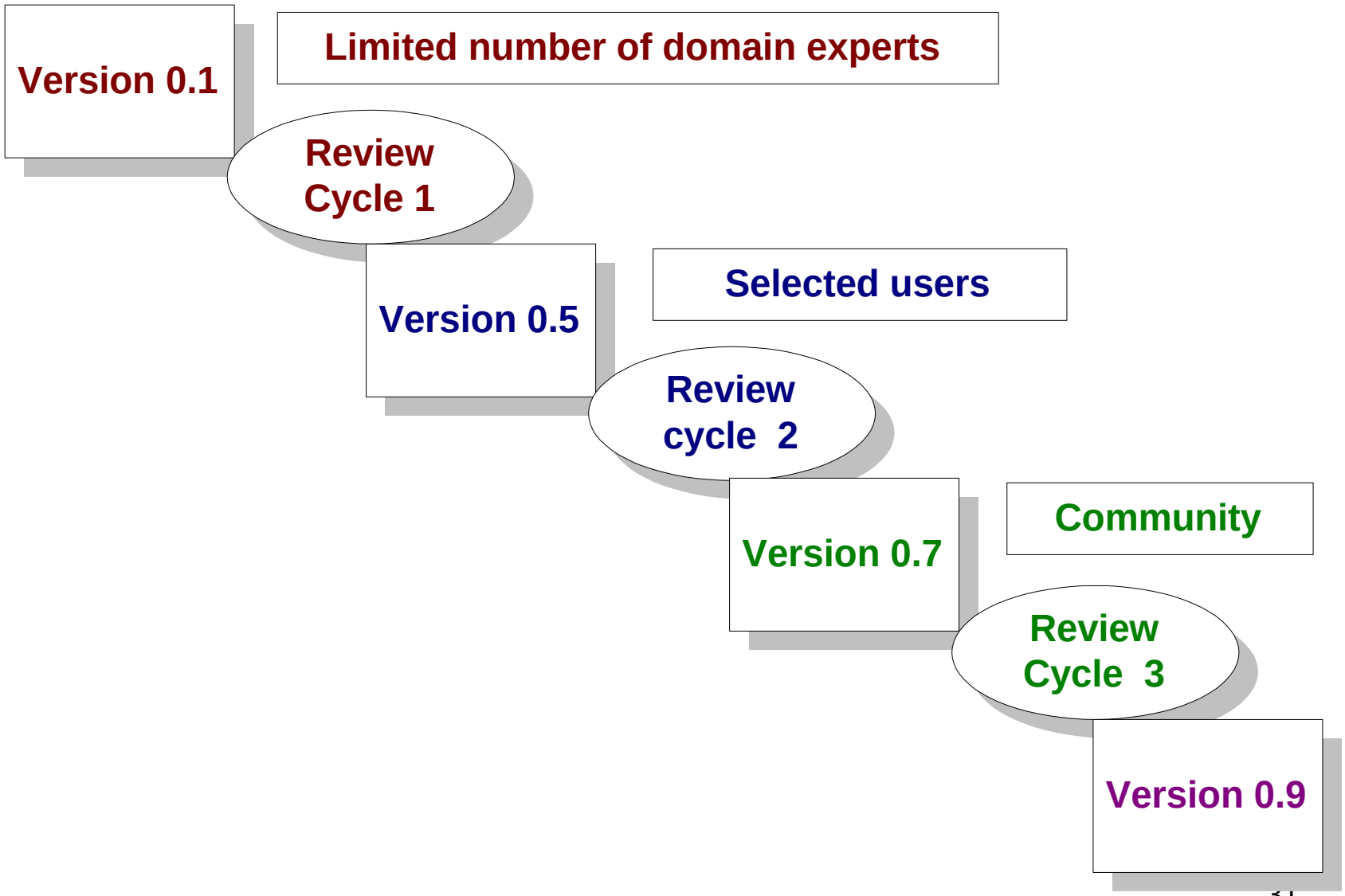
Knowledge Area Specialists

- Bertolino, Istituto Elaborazione Informazione, CNR, Italy
- Bollinger, MITRE, USA, Martin & Gabrini, UQAM
- Carrington, Queensland University, Australia
- El Emam, National Research Council, Canada
- MacDonell, University of Otago, New-Zealand
- Sawyer & Kotonya, Lancaster University, UK
- Scott, Lawrence Livermore National Lab., USA
- Tremblay, UQAM, Canada
- Pigoski, USA
- Wallace & Reeker, NIST, USA

A Three-Phase Approach for Developing the Guide to the SWEBOK



Phase 2: Stone Man Review Process



Stone Man Review Process

- Transparency and consensus-building
  - All intermediate versions of documents are published and archived on **www.swebok.org**
  - All comments are made public as well as the identity of the reviewers
  - Detailed comment disposition reports are produced for Review Cycle 2 and 3

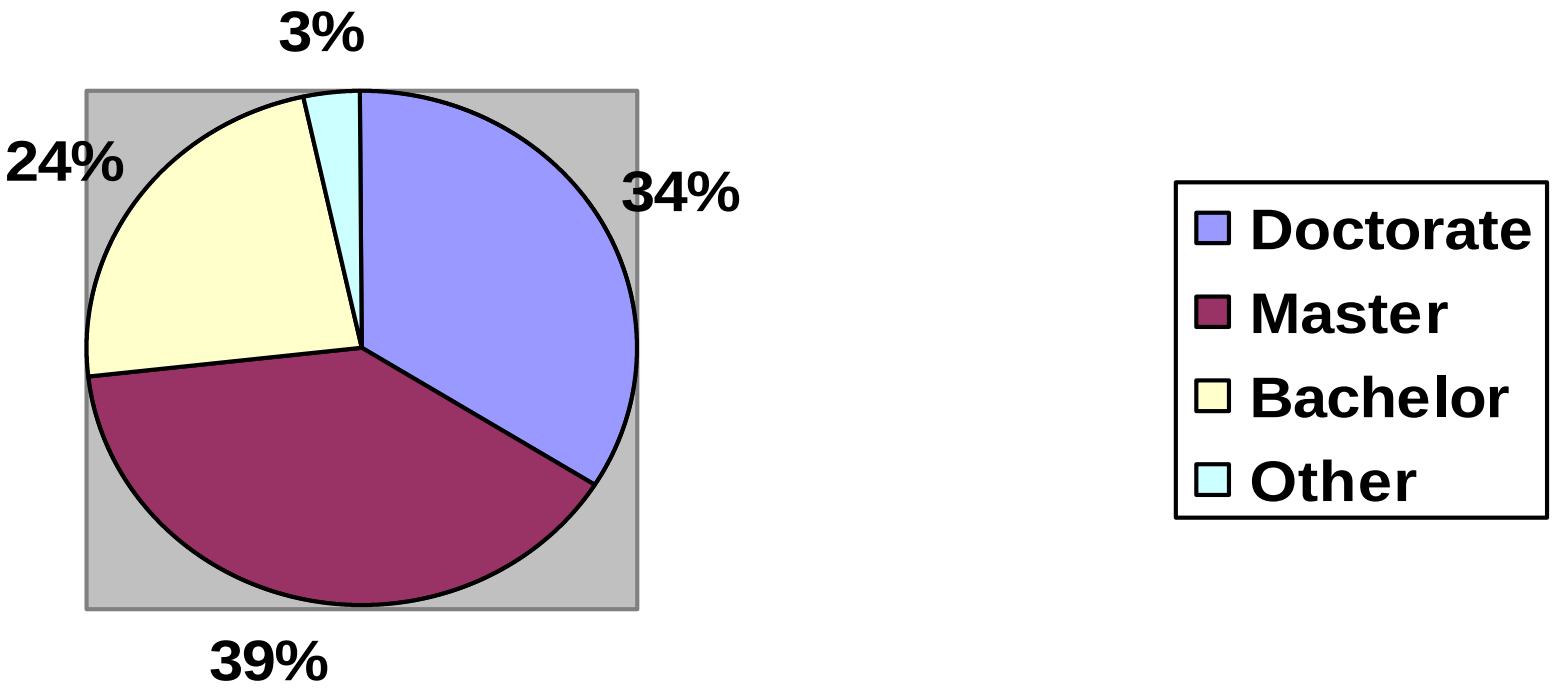
Data on reviewers

- Version 0,1: 33
- Version 0,5: 195
- Version 0,7: 378
  - + ISO reviews from 5 countries

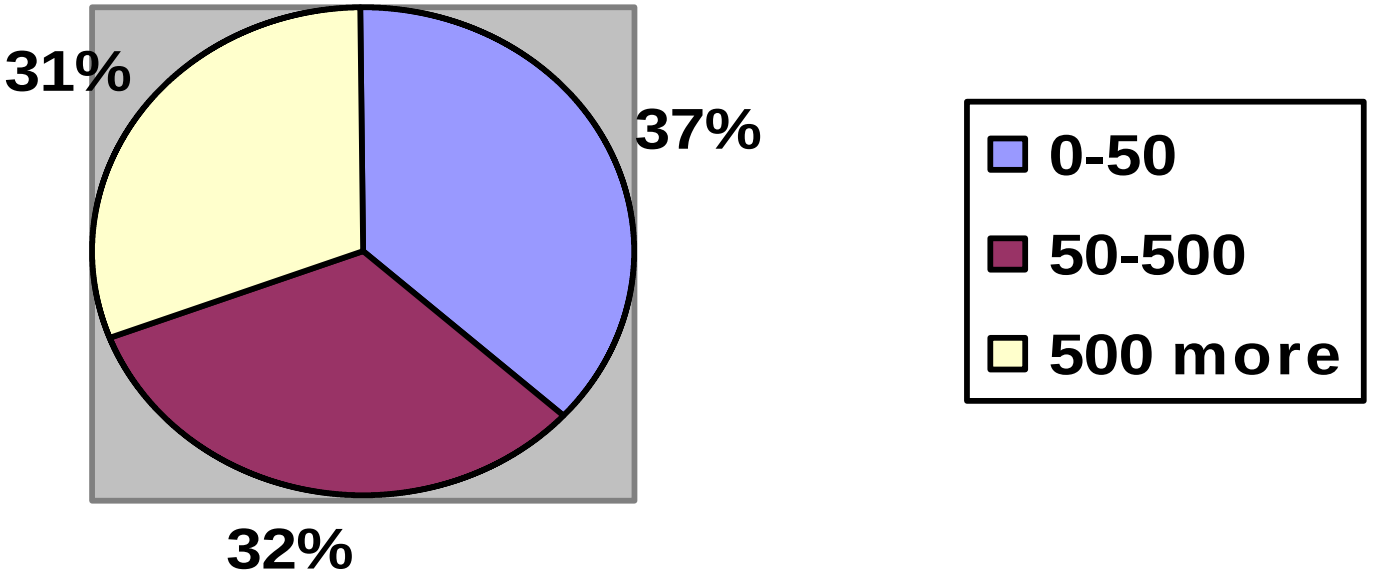
Geographic Distribution of Reviewers

- USA: 55%
- Europe: 18%
  - 90 reviewers from 25 countries
- Canada: 10%
- Australia: 5%
- Asia: 5%
- Latin America: 4%

Education of Reviewers



Organizations of Reviewers (no. of employees)

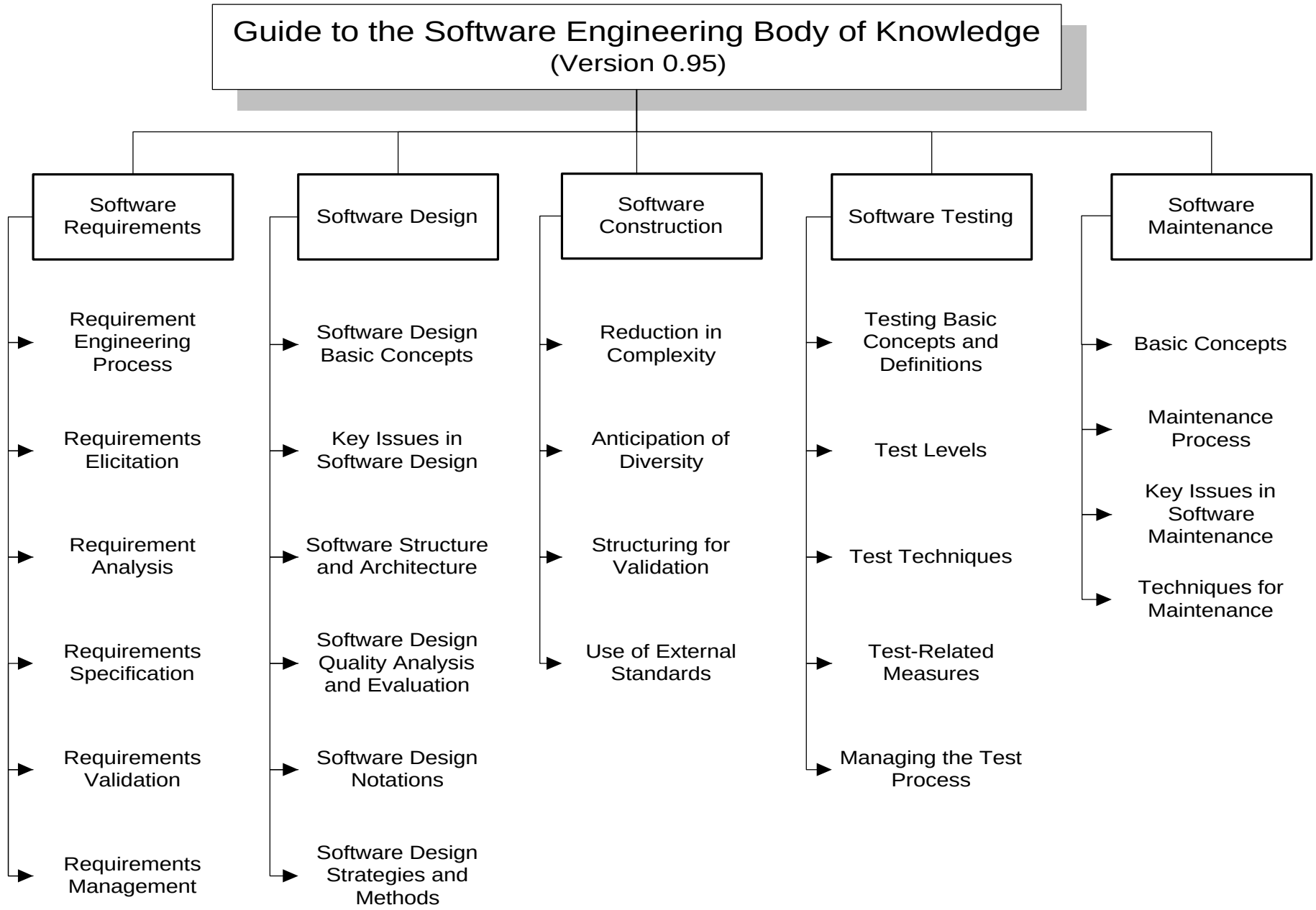


Project Overview Presentation Plan

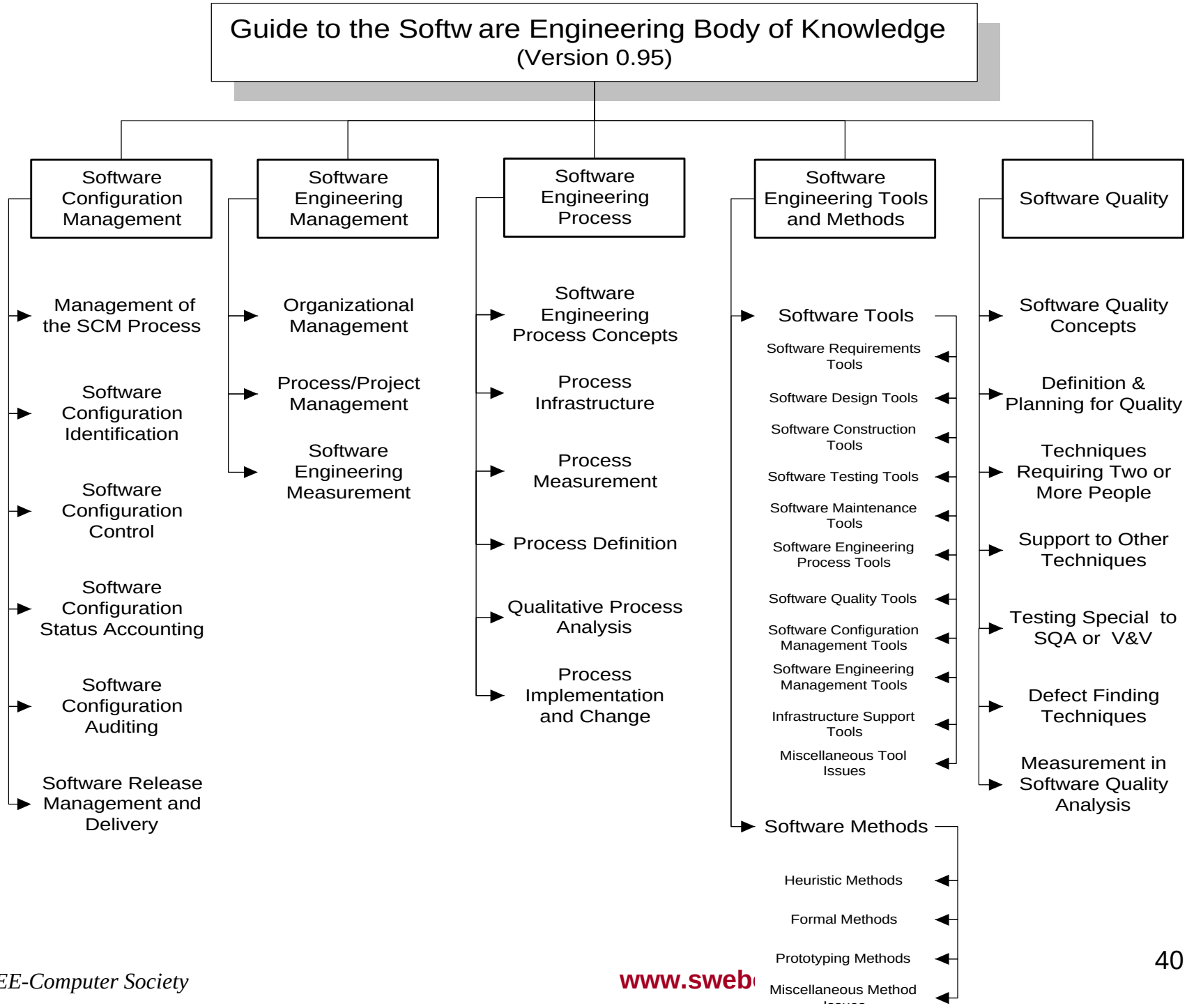
- Project background
- Project scope, objectives, audience and plan
- **Contents of the Guide**
- How you can leverage the Guide within your organization
- Conclusion

Stone Man Deliverables:

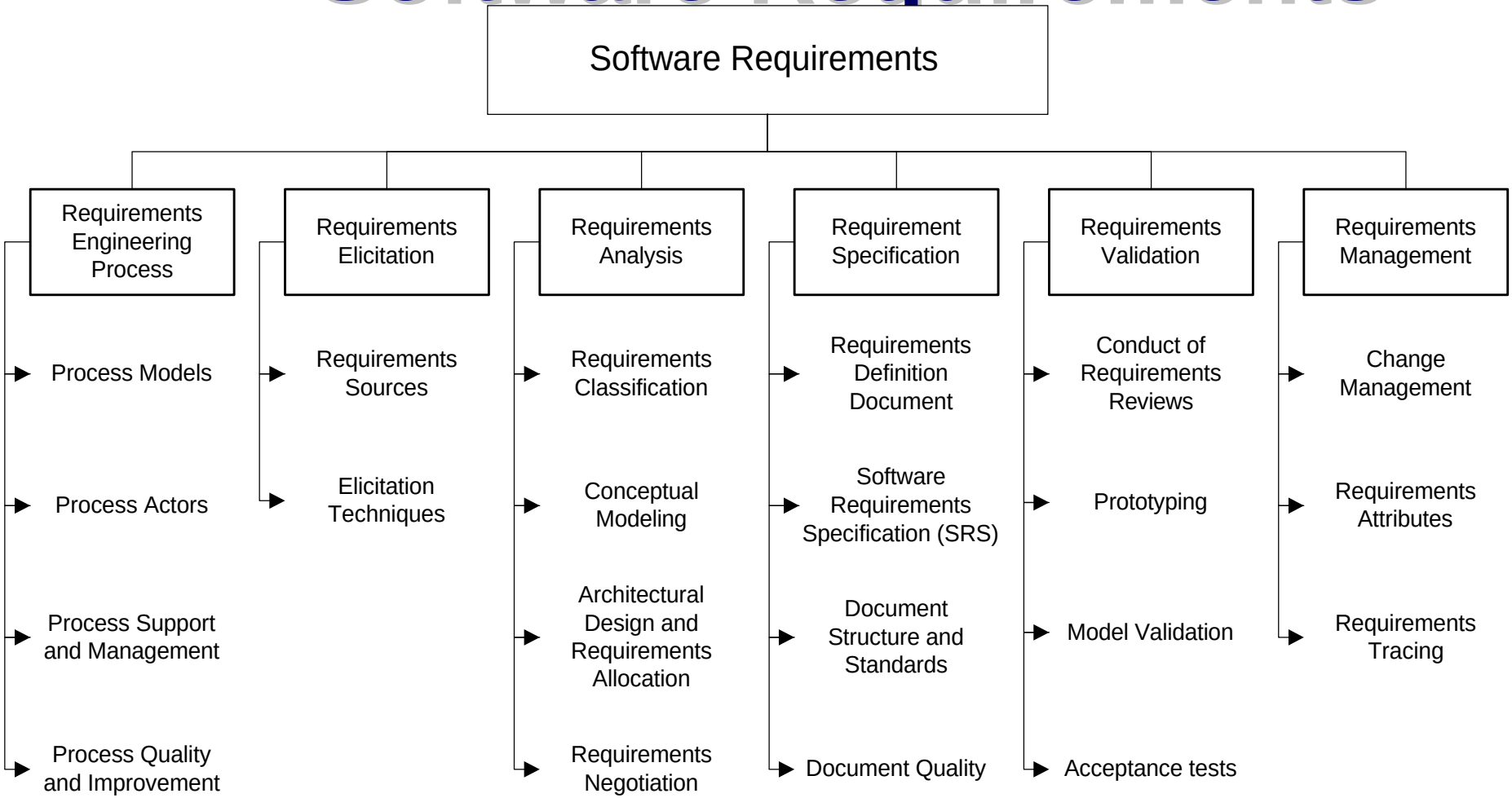
- **Consensus** on a list of Knowledge Areas
- **Consensus** on a list of **topics and relevant reference materials** for each Knowledge Area
- **Consensus** on a list of Related Disciplines



(a) (b) (c) (d) (e)



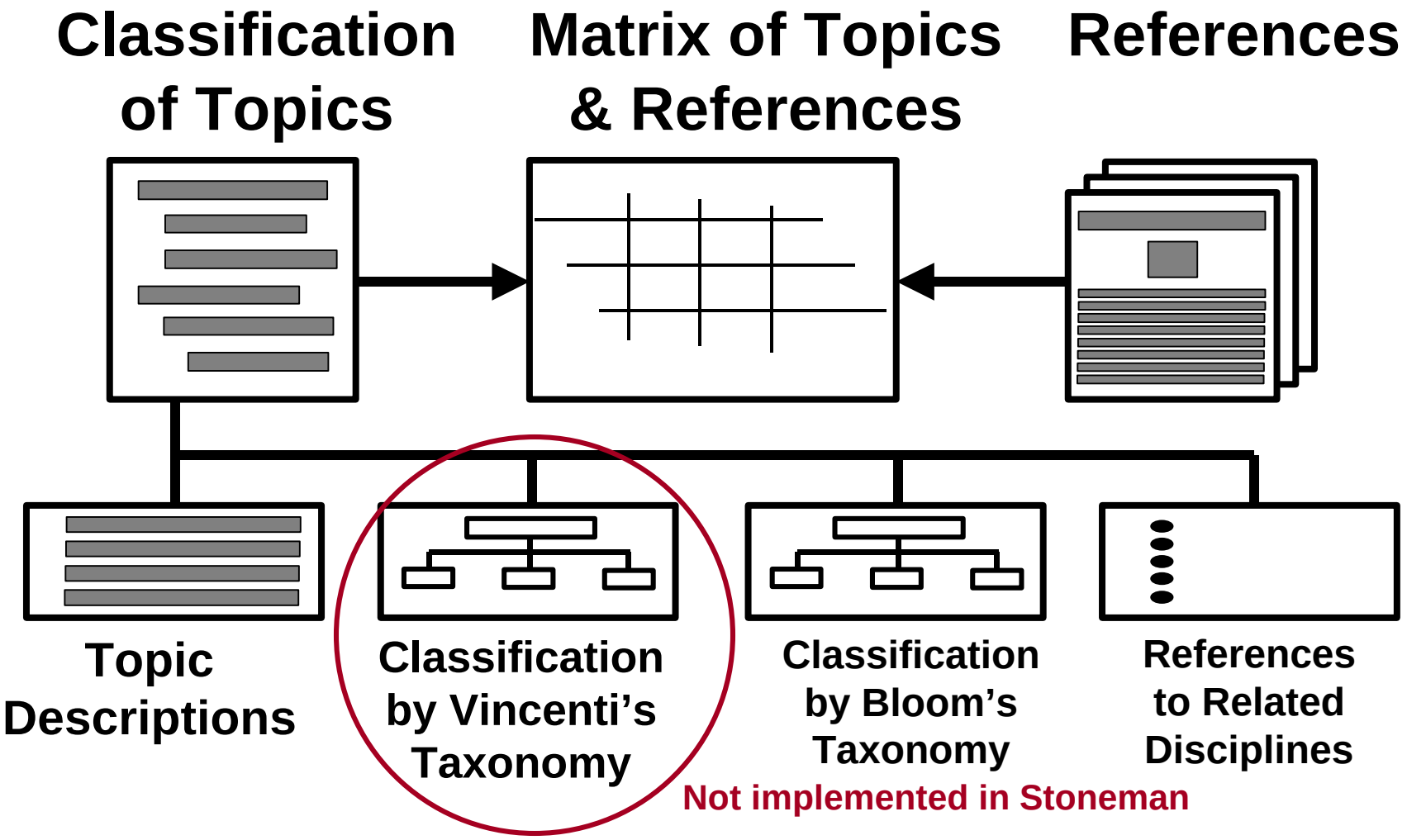
Software Requirements



Bloom's Taxonomy

- What level of "knowledge"?
  - Knowledge,
  - Comprehension,
  - Application,
  - Analysis,
  - Synthesis and
  - Evaluation

Knowledge Area Description



Related Disciplines

- Software Requirements
- Software Design
- Software Construction
- Software Testing
- Software Maintenance
- Software Configuration Management
- Software Eng. Management
- Software Eng. Tools & Methods
- Software Engineering Process
- Software Quality

Related Disciplines

- **Computer Science (CC2001)**
- **Mathematics (CC2001)**
- **Project Management (PMBOK)**
- **Computer Engineering**
- **Cognitive Sciences and Human Factors**
- **Systems Engineering**
- **Management and Management Science**

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- **Current Use**
- Next steps

Current Use

- Interim versions on the web since 1999
- Stoneman version:
  - Web version: May 2001
  - Book Version: Dec. 2001
  - ISO version: End of 2002
  - CD-ROM version: in progress
- Current Use:
  - Who, where and for what?

Initial web survey

- Summer 2002 = + 1,000 SWEBOK references
  - University
    - Software Engineering curriculum
    - University lectures
    - Research Papers
  - Professional development
    - Conferences & Workshops
    - Certification & Licensing
    - Government & Policy organizations
  - Individuals

University S.E. Curriculum

USA	National Technical University - NTU: ❖Distance teaching with a network of 24 US Universities. Kent State U. U. Central Florida Florida Institute of Technology Washington
Canada	U. Ottawa Université du Québec à Montréal - UQAM École de technologie supérieure (Engineering University) U. Waterloo

University Curriculum

Spain	U. Polytechnica Madrid U. Pais Basco
Switzerland	U. St-Gallen SWEED Curriculum initiative
Australia	Monash U. Swinburne U. Murdoch U.
France	Paris VI
UK	U. of Scranton

University Course Material - USA

U. Massasschuset	Clarkson U.	Walla Walla College
U. Maryland	Oregon U.	PACE
Milwaukee School Eng.	U. Omaha	Nova Southern U.
Kansas State U.	U. Texas	U.A.
Mississipi State U.	Drexel U.	U. Oklahoma
Stanford U.	Bucknell U.	Texas Wesleysan
Rochester Institute Tech.		Knox
Southern Polytechnic State		M.S. State

University Course Material - Canada

U. Ottawa U. Calgary U. Montréal U. Alberta U. Sherbrooke École de technologie supérieure Augustana College	U. Western Guelph U. UQAM

University Course Material - Germany

Germany	Technical U. Berlin U. Frankfurt U. Stutgartt U. Postdam Technical U. Chemnitz
Spain	U. Valladolid U.C.L.M. U. San Sebastian Escuela Superior Informatica

University Course Material - Others

Croatia	U. Zagreb
Ireland	U. ulster
New Zealand	Victoria U.
Denmark	Aalborg U.
Colombia	U. AEFIT
UK	
Scotland	Edinburg
Brazil	Unicam Federal U. Goias

University Course Material - Others

Australia	
Korea	K.A.I.S.T, C.A.U AC
Netherlands	Vrieje U., Nejmess U.
Austria	Vienna U. Technology
Finland	Joensu U., Oulu U., Tempere U.
South Africa	Pretoria U.
Sweden	Swedish School Economics
Slovakia	Stuba U.

Conferences & Workshops

- 1999-2002: 32 conferences and workshops:
  - North America
  - Europe
  - Australia, New-Zealand, Argentina, ..
- Editorial team presentations:
  - USA, Canada, Spain, Brazil, Japan, China, ……

Quality Related Issues

- Learning Tree (USA, Sweeden)
- Quality sources (Finland)
- Software Quality Management Center (Japan)
- Software Validation Accreditation lab.
  - (American Association for Accrediting Lab. Ref. 291)
- Certification, Licensing, Ethics & standards:
  - + 25 entries

Government related

- **China:**
  - **‘We are planning to introduce some worldwide recognized certification program.. Eg. SWEBOK, PMBOK, ..’ REF. 317**
- **Saudi Arabia:**
  - **‘An integrated professional software engineering study program based on international standards’ Ref. 375**

Web site references = ??

- Japan: 26
- Turkey: 10
- China = 7, including government
- Finland = 7
- Korea = 5
- Others: Germany, Netherlands, Croatia, Brazil, Vietnam, Norwqy, Tchekia, Greece, Argentina, Russia

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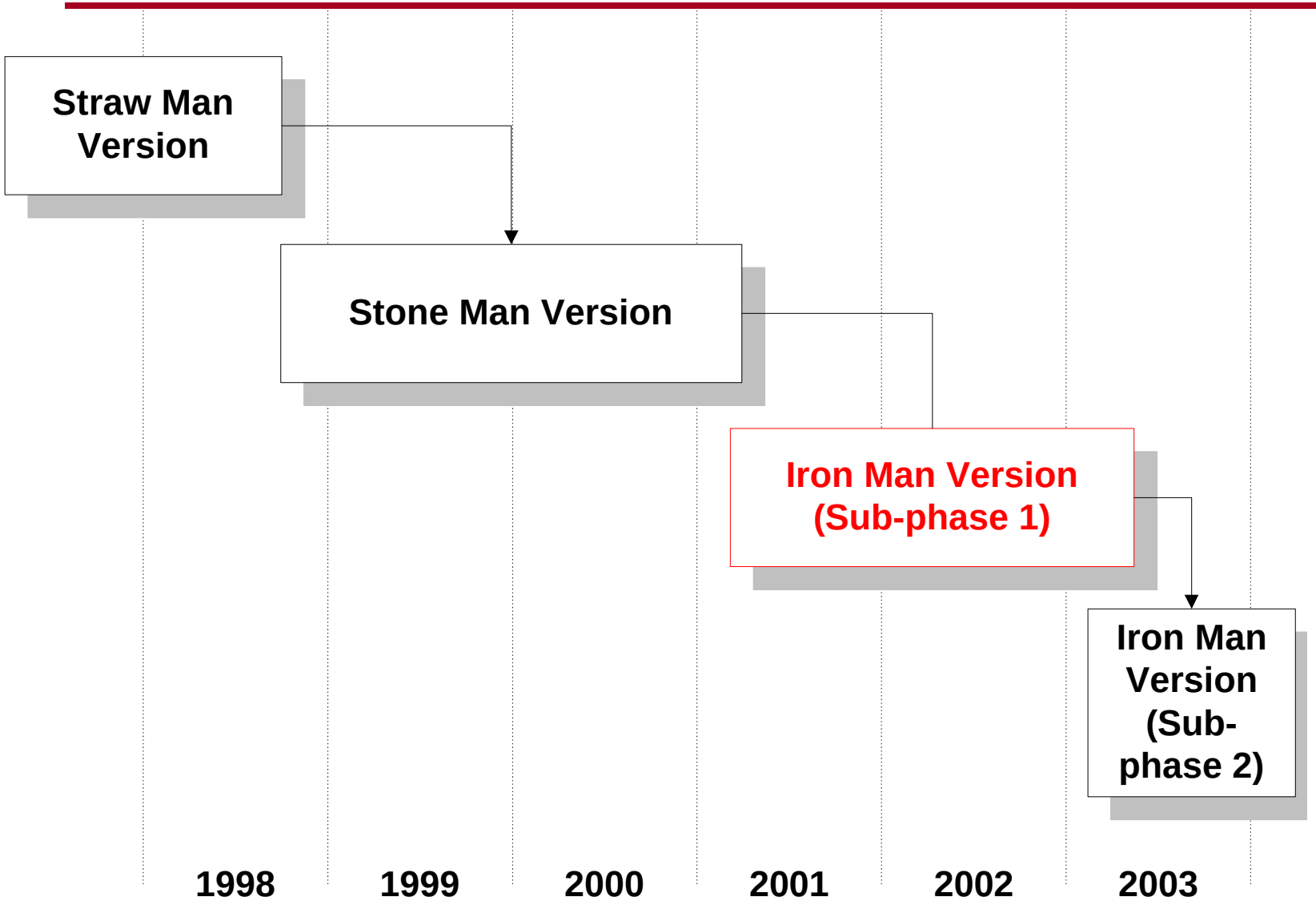

Collection of feedback from:

- Education:
  - Curriculum design/evaluation
  - Program accreditation
  - Course design/evaluation
  - Internal training, corporate universities

Collection of feedback from:

- Industry & Government
  - job description
  - hiring
  - staffing of projects
  - career planning
  - contracting

Collection of feedback from:

- Policy organisations
  - Licensing & Certification
    - licensing exam questions
    - study material
    - in software engineering and other IT fields
    - could be on subsets of Knowledge Areas

Collection of feedback from:

ASQ – Software Division and its specialized expertise on software quality

- Quality Body of Knowledge:
  - Across the 9 SWEBOK Knowledge Areas
  - Within the **Quality** Knowledge Area

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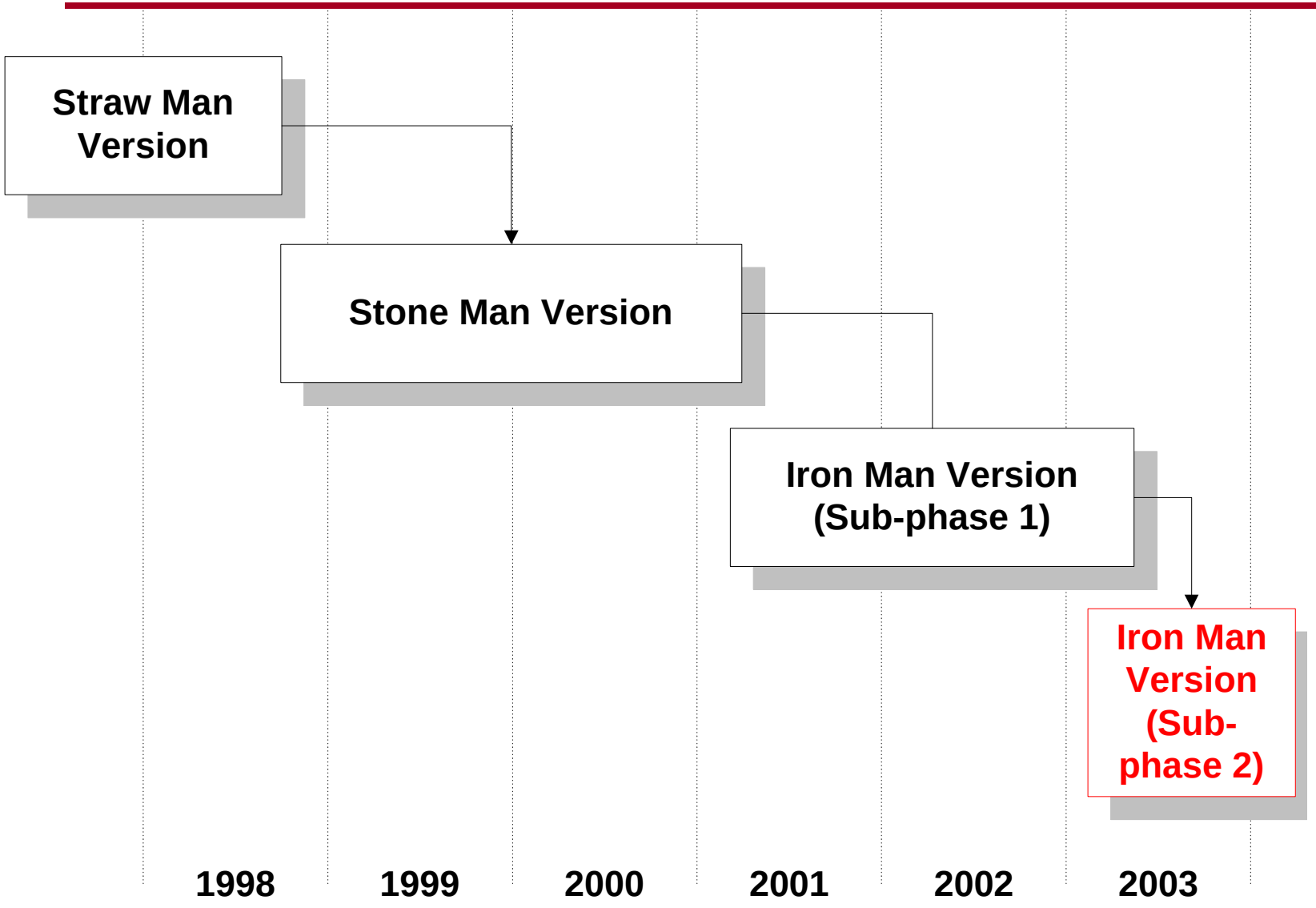
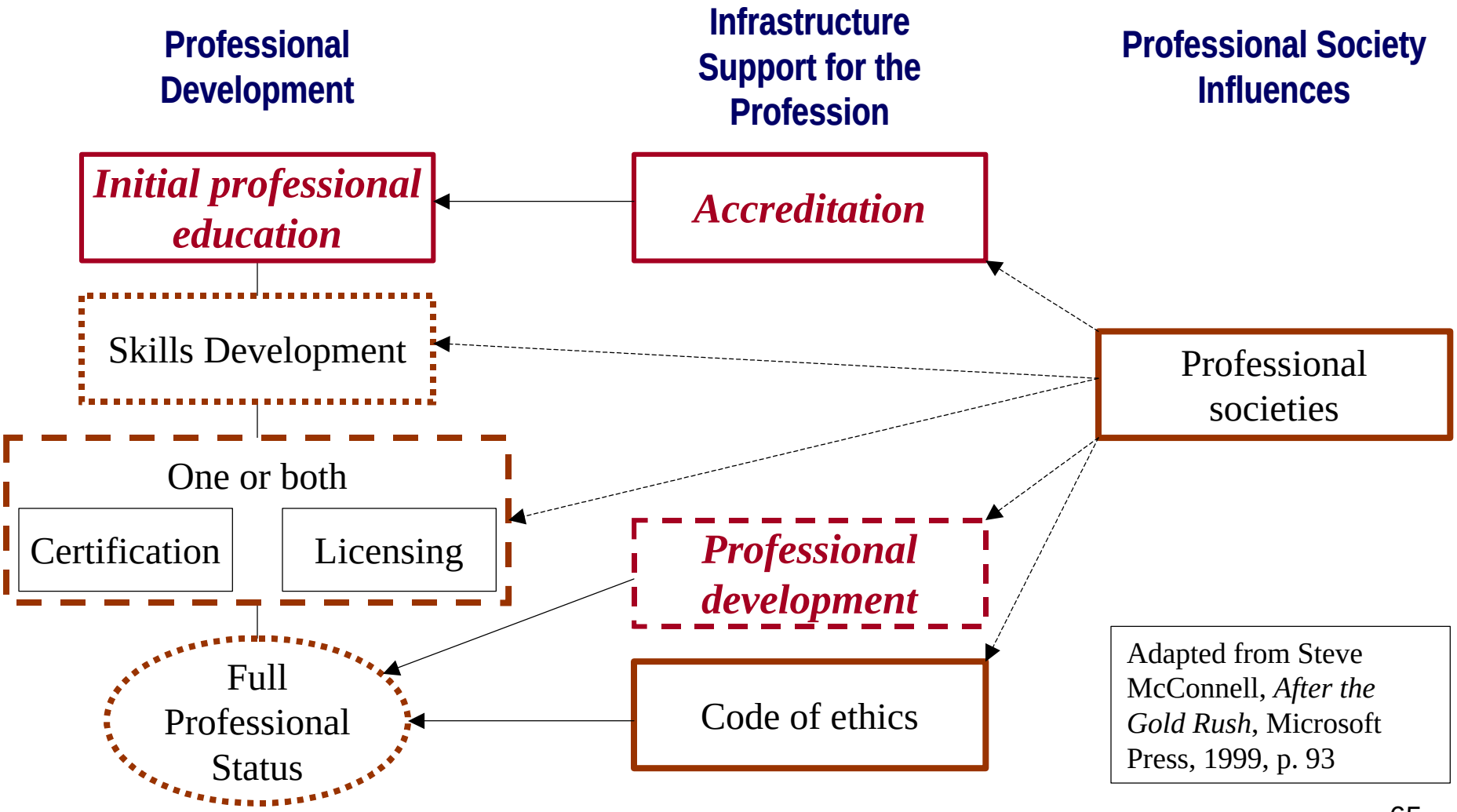


Professional Development



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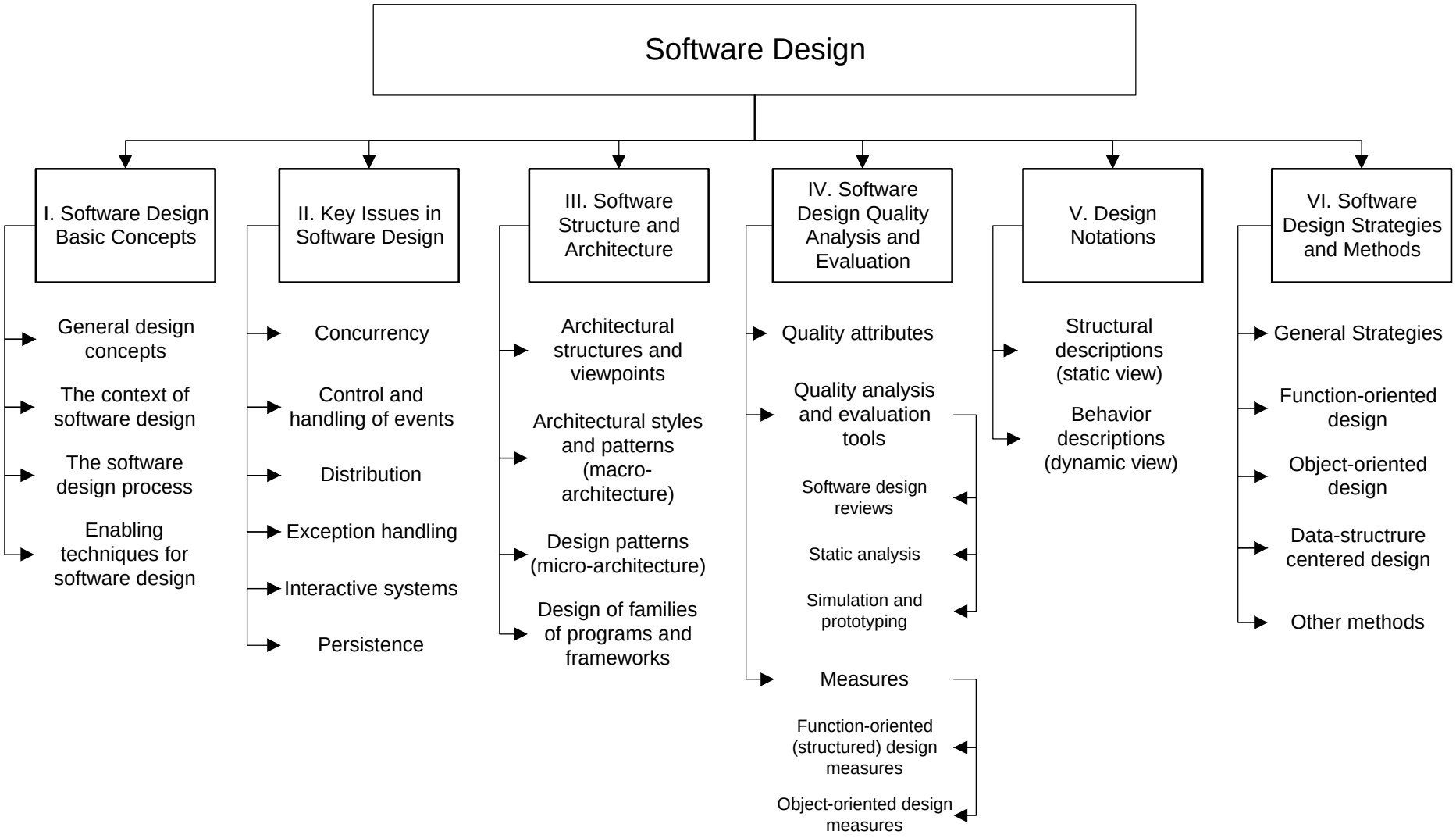
Concluding Remarks

- 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
  - IEEE 610.12

- Strengthening the Engineering Knowledge within this new discipline is required for a rapid maturation, and significant contribution to the global software industry

www.swebok.org

Software Design



University Curriculum

Lithuania	Kaumo Tech. U.
Japan	Gunma U.
Iceland	
Bangladesh	

SWEBOK & Research Issues

- The **Engineering** of:
  - Software Requirements
  - Software Design
  - Software Construction
  - Software Testing
  - Software Maintenance
  - Software Quality
  - Software Eng. Management
  - Software Eng. Tools & Methods
  - Software Engineering Process
  - Software Configuration Management

Research References -Papers

USA	U. California, Clamson U., Kentucky U., Denver U., Alabama U.
UK & Scotland	Sutherland, Brighton, Aberdeen, Sheffield
Netherlands	T. U. Delf, T.U. Eindhoven, Twente U.,
Spain	U. Polytechnica Catalunya,
Germany	T.U Chemnitz, U. Hannover
Dubai, Finland,New Zealand, Canada	

Dicusssion Groups & Newsletters

- 30 distincts groups
  - Including 2 in China
  - Project Management related
  - Brazil, Finland, Greece
  - Software Quality related