The Emerging Consensus on the Software Engineering Body of Knowledge

A. Abran,

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

NSERC

Ottawa, February 18, 2002

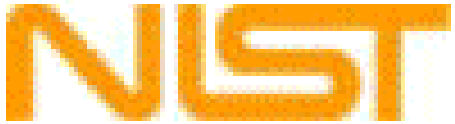
SWEBOK

ÉTS

UQÀM

Corporate Support by:

CANADIAN COUNCIL OF PROFESSIONAL ENGINEERS
CONSEIL CANADIEN DES INGÉNIEURS



National Research Council Canada

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Project managed by:

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Presentation Plan

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

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Key Issues

- Groups and individuals:
  - Different views of software engineering
- Universities:
  - Offering undergraduate degrees in *Software* Engineering, outside of traditional Engineering Departments
  - Limited consistency across curriculum
  - Different accreditation groups (Canada:CIPS and CCPE)
- Increased interest in the establishment of a profession

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Market Trends - Examples

Texas Board of Engineers:

- Decision to license software engineers: a strategy with significant impact on:
  - industry (e.g. mobility of staff & training)
  - universities
  - policy bodies
  - individuals

  (+ engineering boards in Canada and universities)

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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)."

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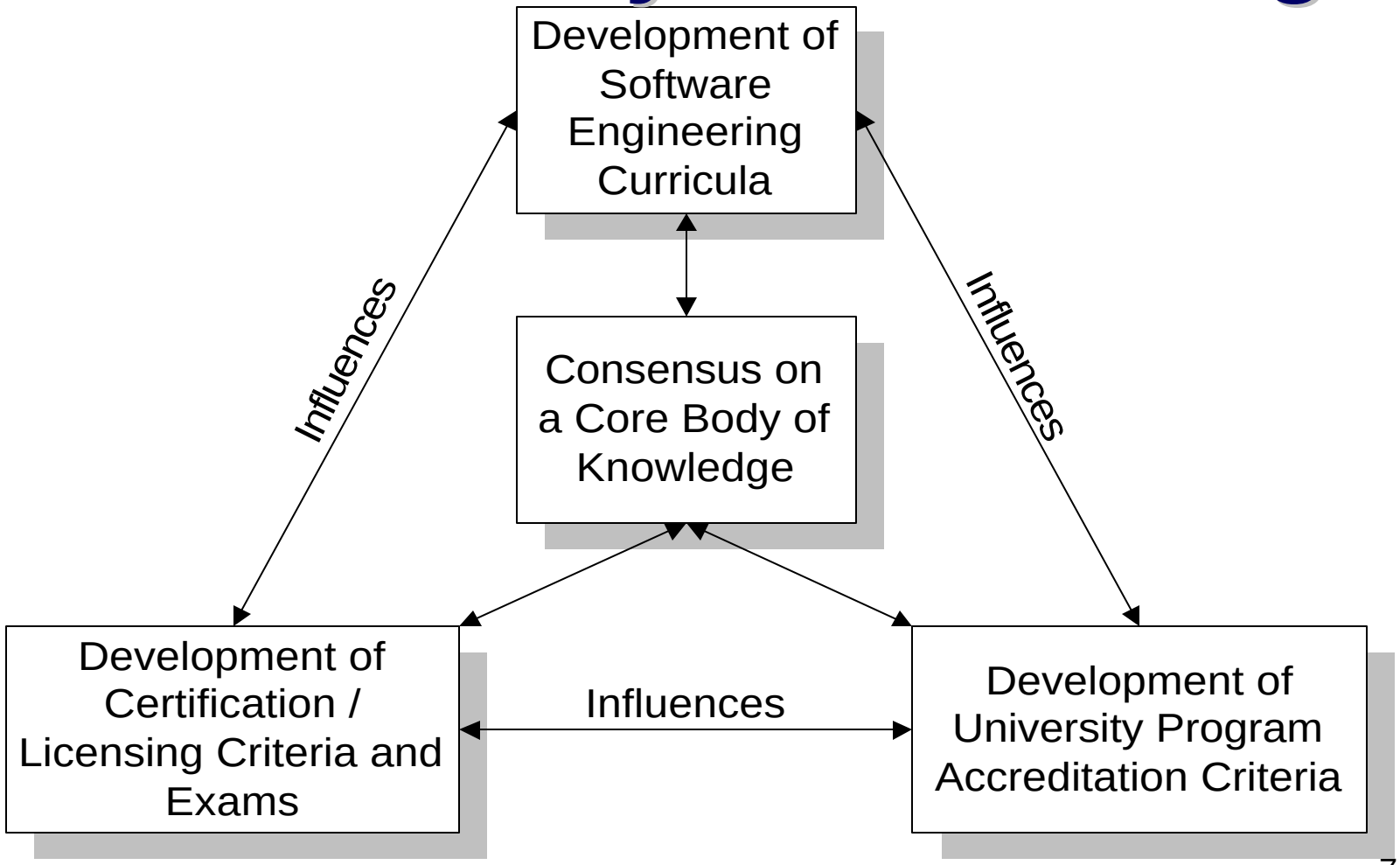
Key Interrelationships for a Core Body of Knowledge



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Presentation Plan

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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

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Intended Audiences

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

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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

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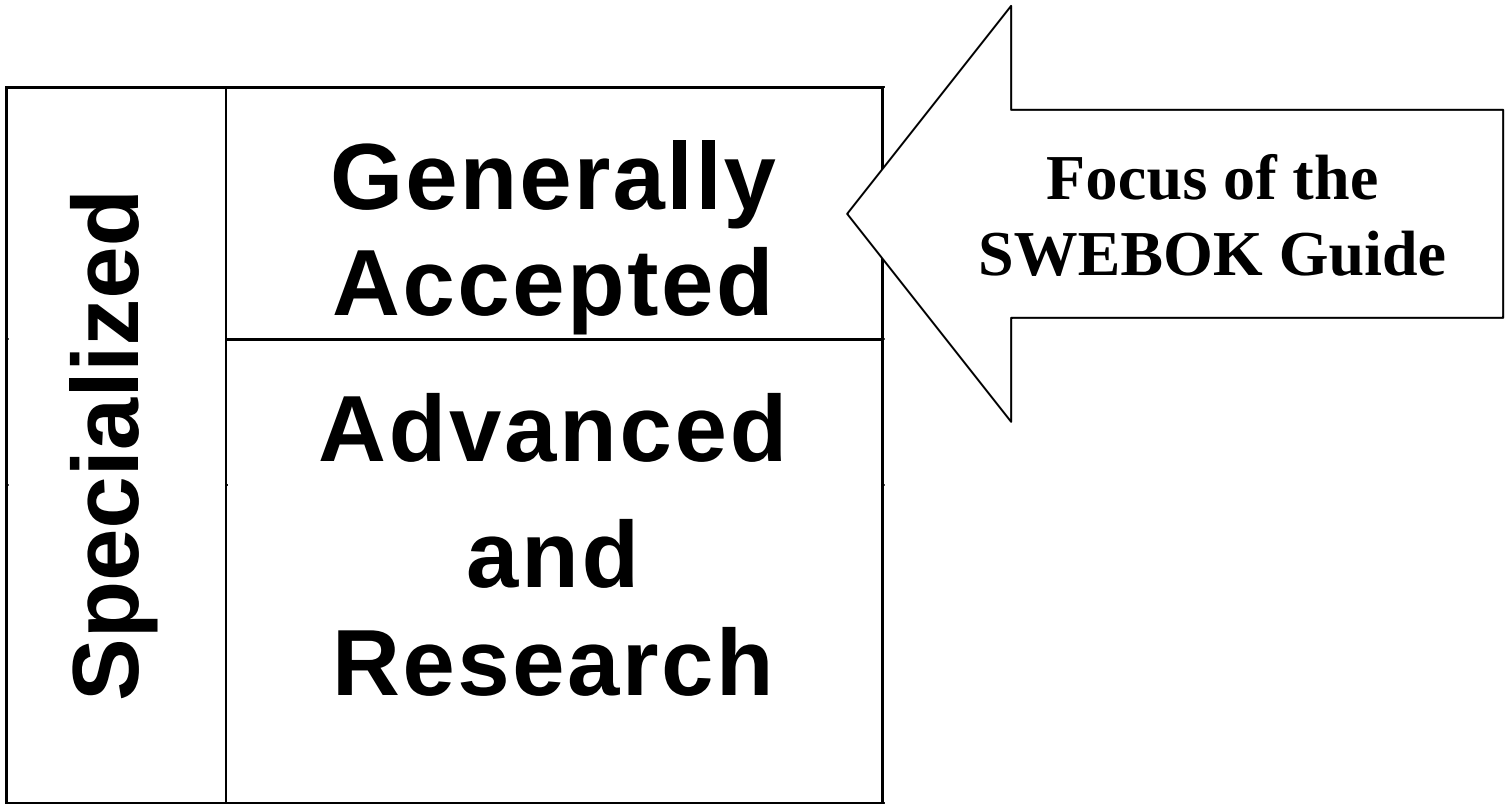
Categories of Knowledge in the SWEBOK



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Generally Accepted

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

- Bachelor + 4 years of experience

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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: focus on specialized knowledge

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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!
- Available ***free*** on the web

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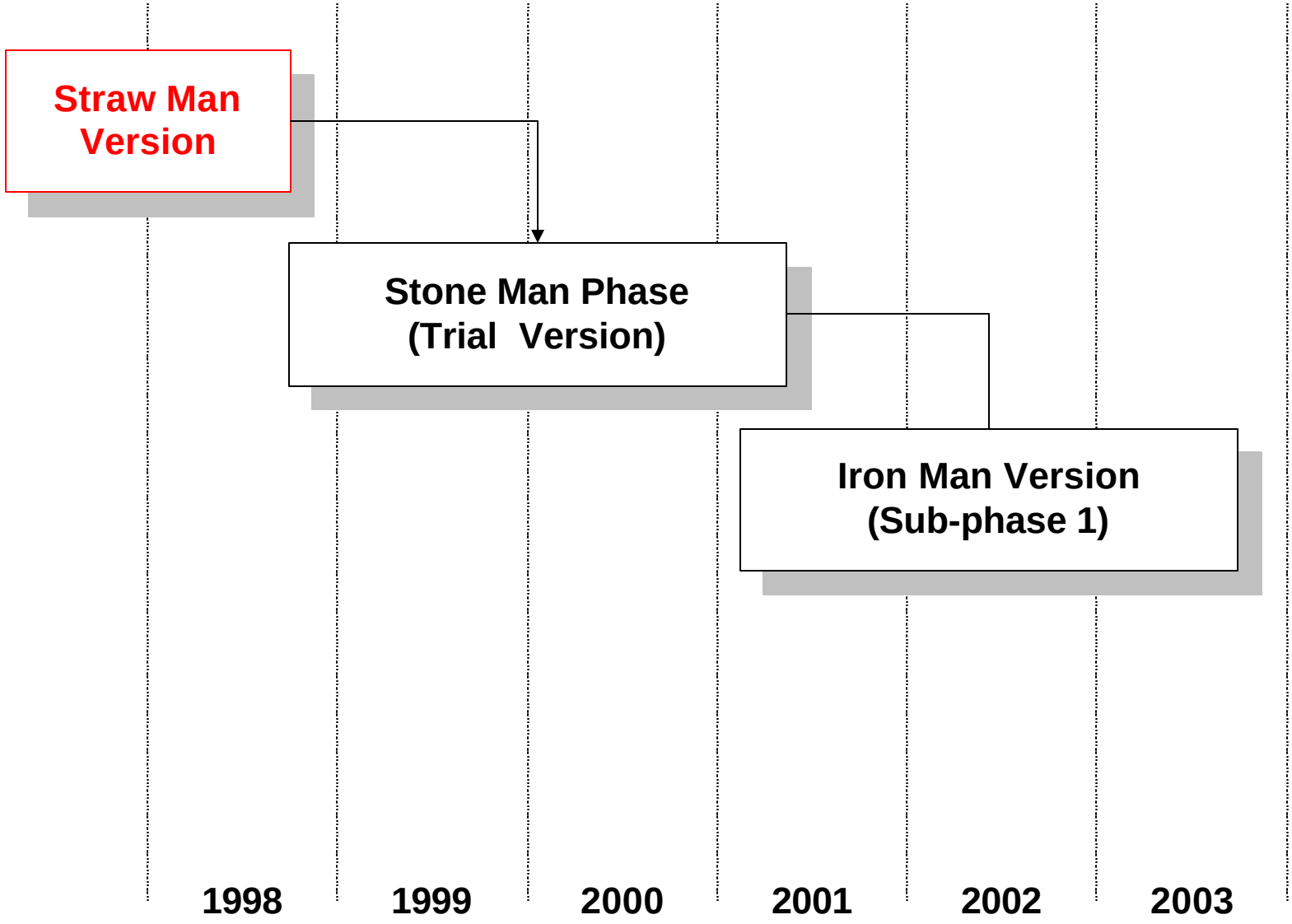
A Three-Phase Approach for Developing the Guide to the SWEBOK



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Project Team

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

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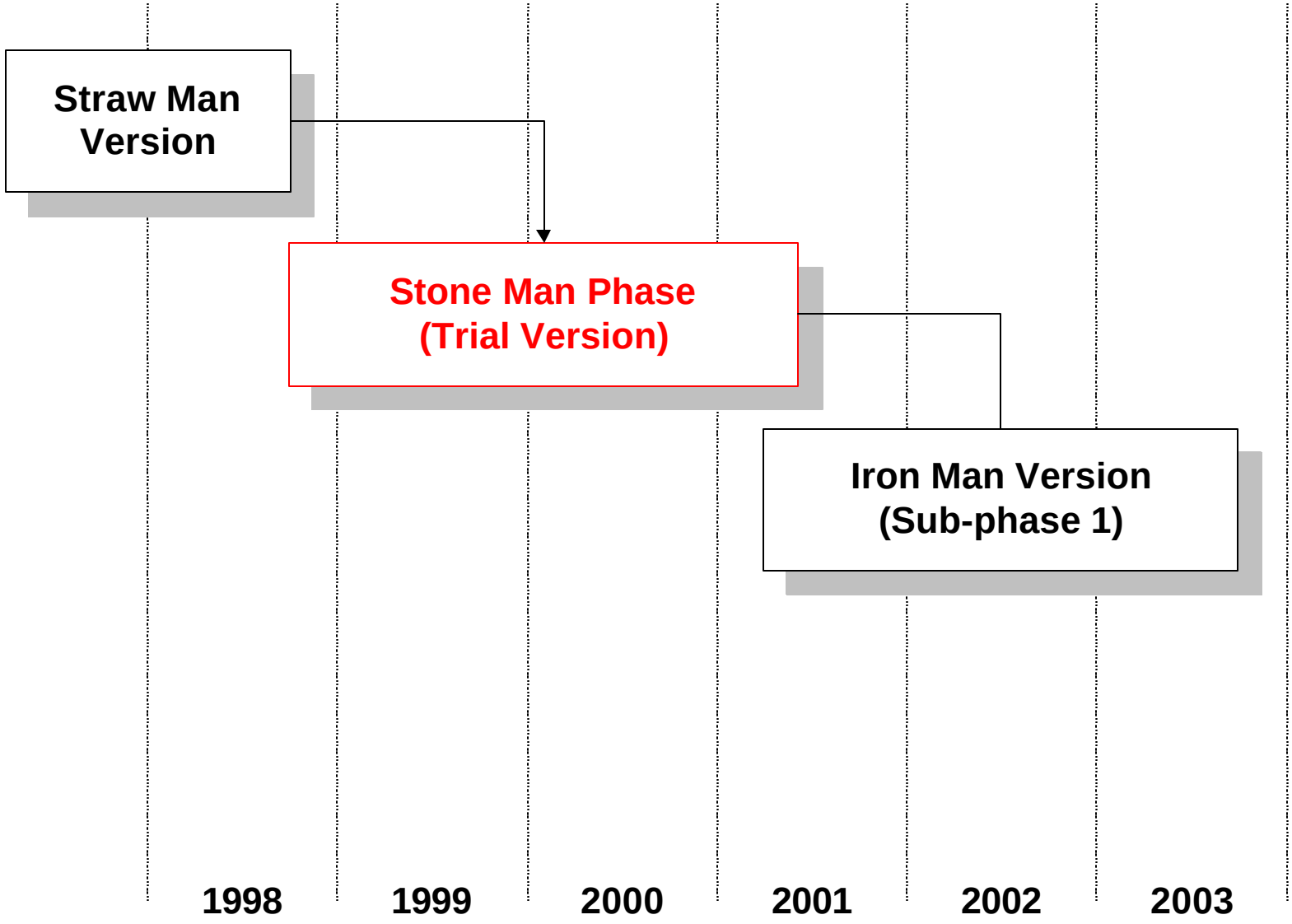
A Three-Phase Approach for Developing the Guide to the SWEBOK



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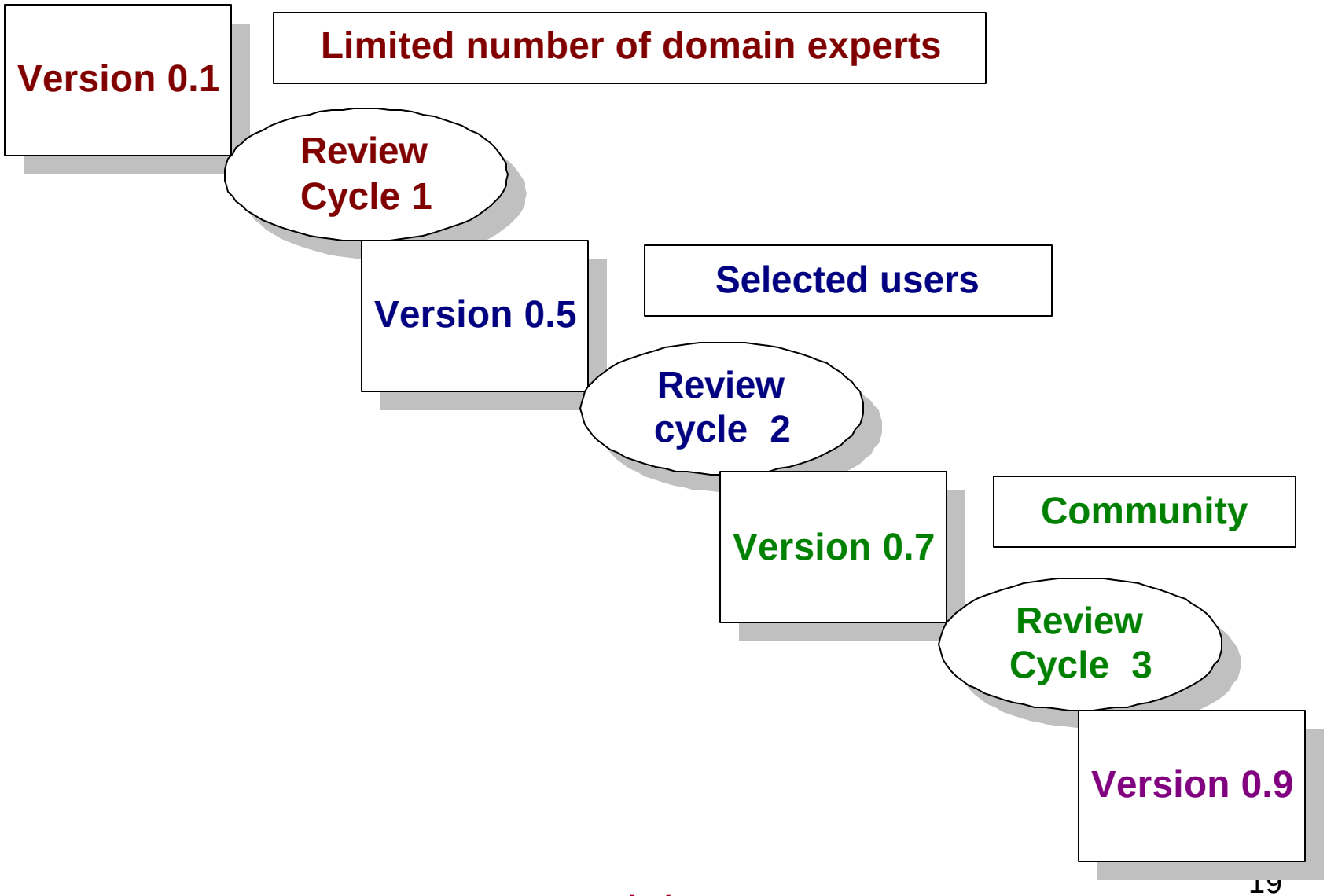
Phase 2: Stone Man Review Process



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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

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Data on reviewers

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

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Geographic Distribution of Reviewers

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

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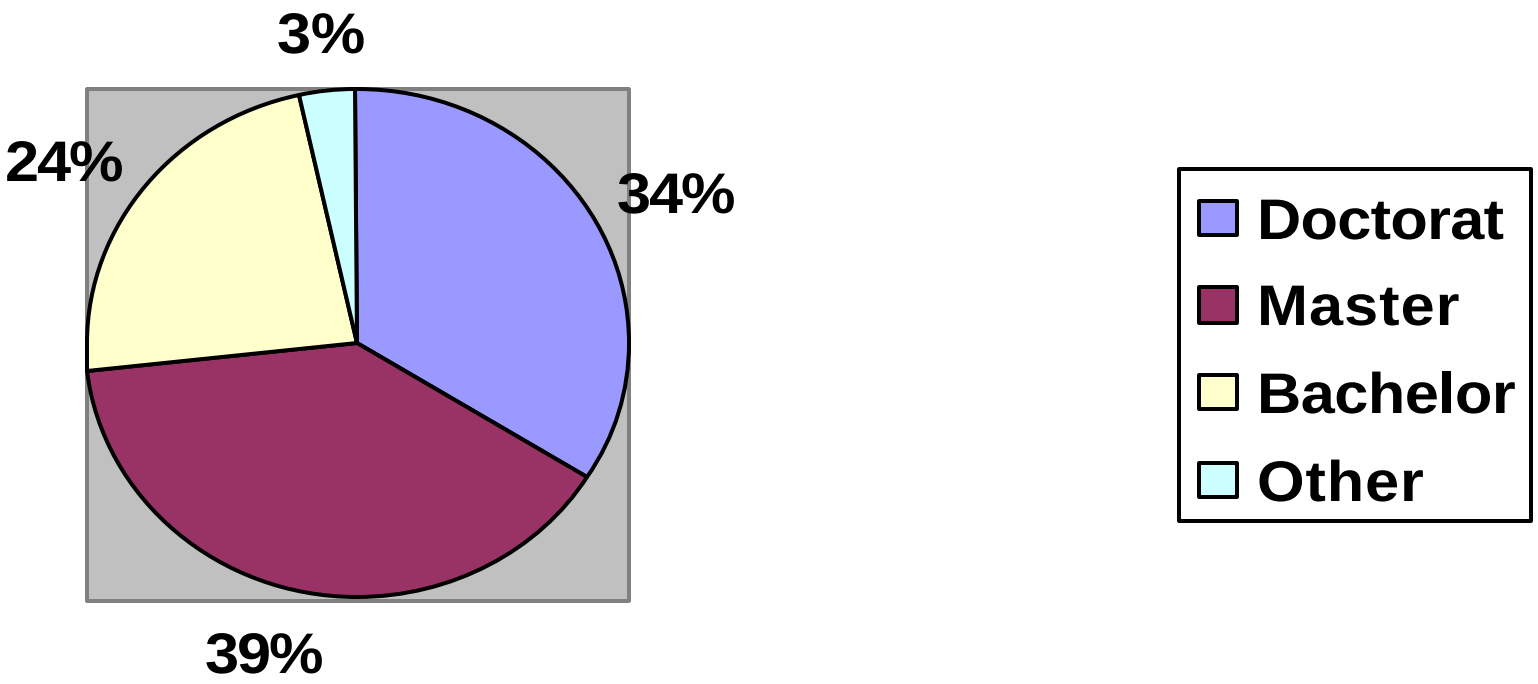
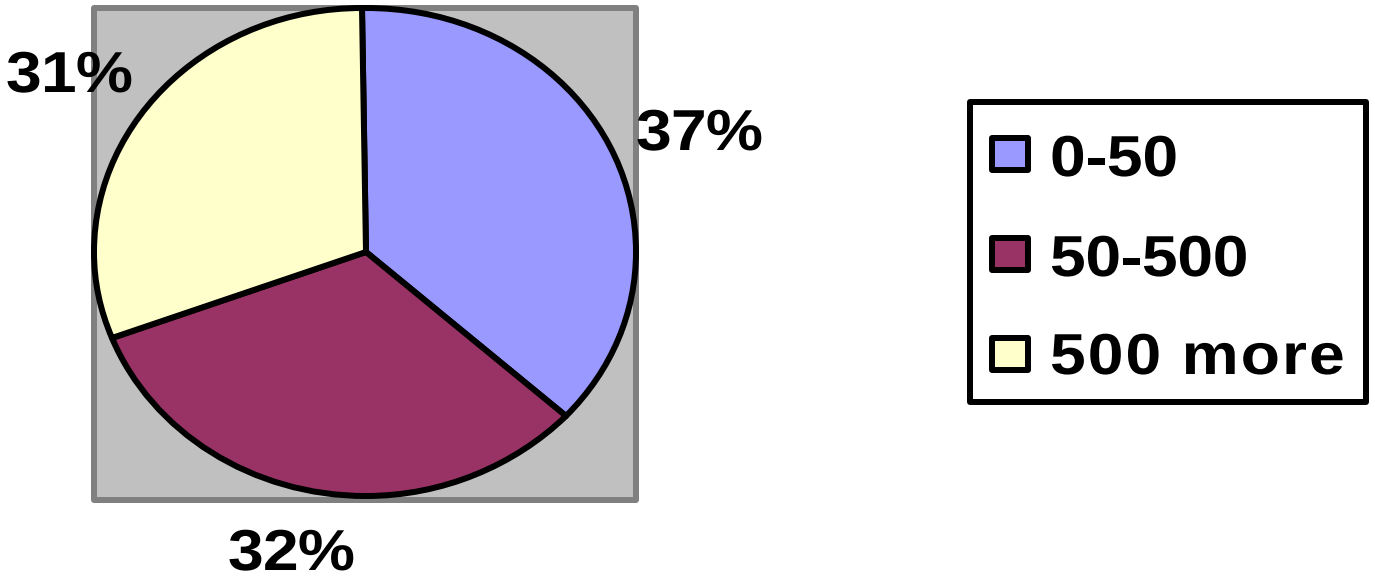
Education of Reviewers



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

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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

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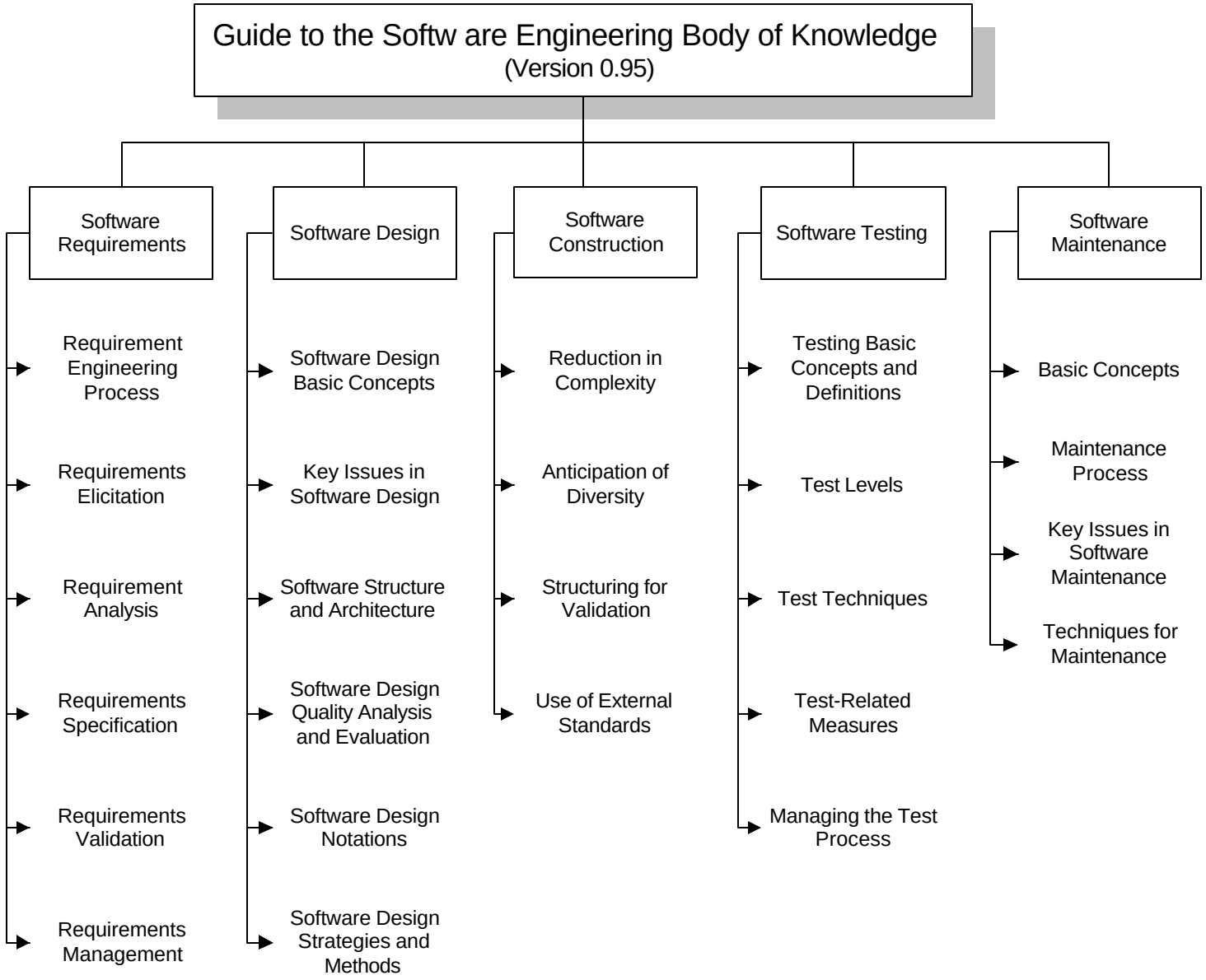
Guide to the Softw are Engineering Body of Knowledge
(Version 0.95)
Software Requirements
Software Design
Software Construction
Software Testing
Software Maintenance
Requirement Engineering Process
Requirements Elicitation
Requirement Analysis
Requirements Specification
Requirements Validation
Requirements Management
Software Design Basic Concepts
Key Issues in Software Design
Software Structure and Architecture
Software Design Quality Analysis and Evaluation
Software Design Notations
Software Design Strategies and Methods
Reduction in Complexity
Anticipation of Diversity
Structuring for Validation
Use of External Standards
Testing Basic Concepts and Definitions
Test Levels
Test Techniques
Test-Related Measures
Managing the Test Process
Basic Concepts
Maintenance Process
Key Issues in Software Maintenance
Techniques for Maintenance

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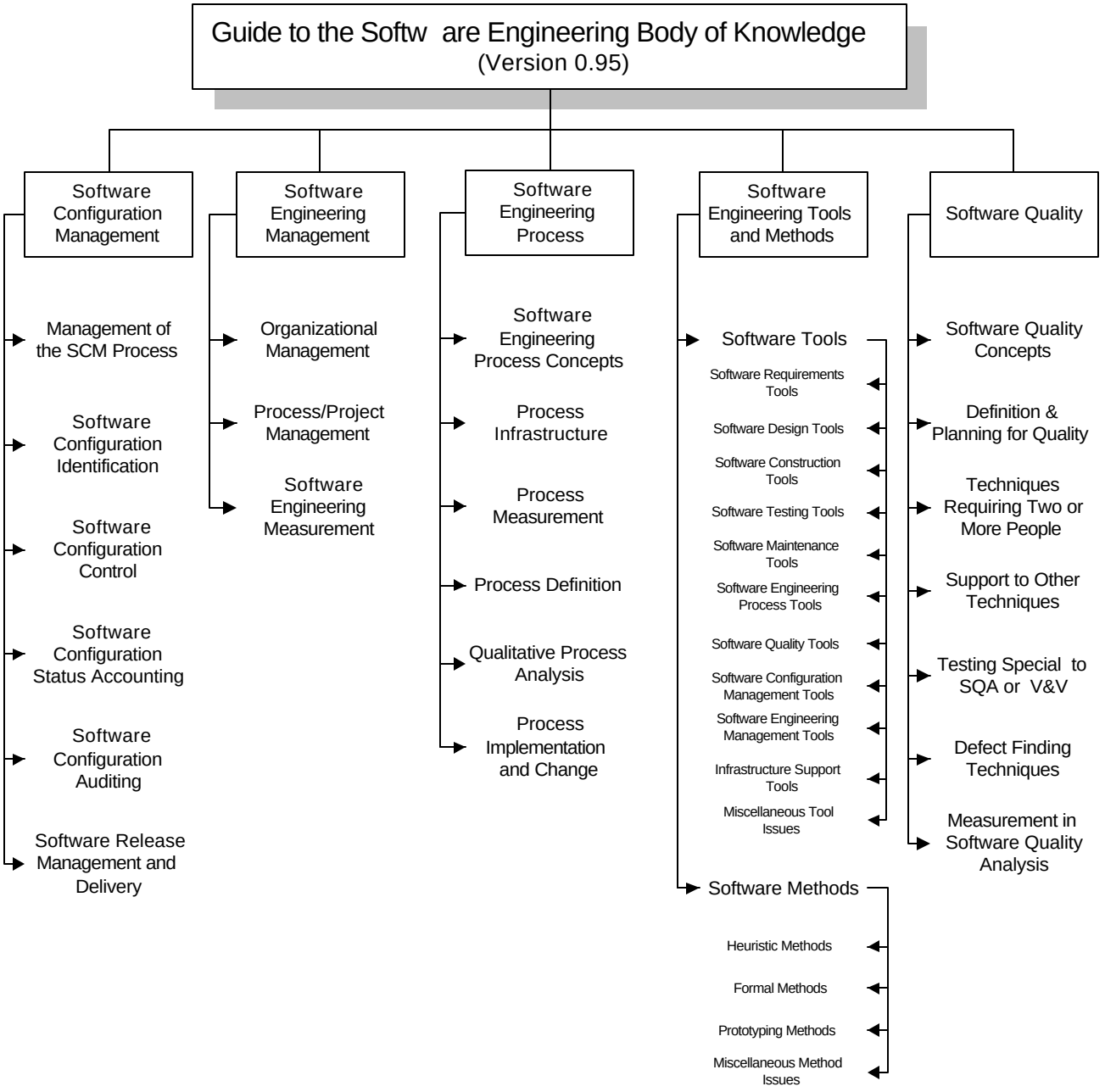
(a) (b) (c) (d) (e)


Guide to the Softw are Engineering Body of Knowledge
(Version 0.95)
Software Configuration Management
Management of the SCM Process
Software Configuration Identification
Software Configuration Control
Software Configuration Status Accounting
Software Configuration Auditing
Software Release Management and Delivery
Software Engineering Management
Organizational Management
Process/Project Management
Software Engineering Measurement
Software Engineering Process
Software Engineering Process Concepts
Process Infrastructure
Process Measurement
Process Definition
Qualitative Process Analysis
Process Implementation and Change
Software Engineering Tools and Methods
Software Tools
Software Requirements Tools
Software Design Tools
Software Construction Tools
Software Testing Tools
Software Maintenance Tools
Software Engineering Process Tools
Software Quality Tools
Software Configuration Management Tools
Software Engineering Management Tools
Infrastructure Support Tools
Miscellaneous Tool Issues
Software Methods
Heuristic Methods
Formal Methods
Prototyping Methods
Miscellaneous Method Issues
Software Quality
Software Quality Concepts
Definition & Planning for Quality
Techniques Requiring Two or More People
Support to Other Techniques
Testing Special to SQA or V&V
Defect Finding Techniques
Measurement in Software Quality Analysis

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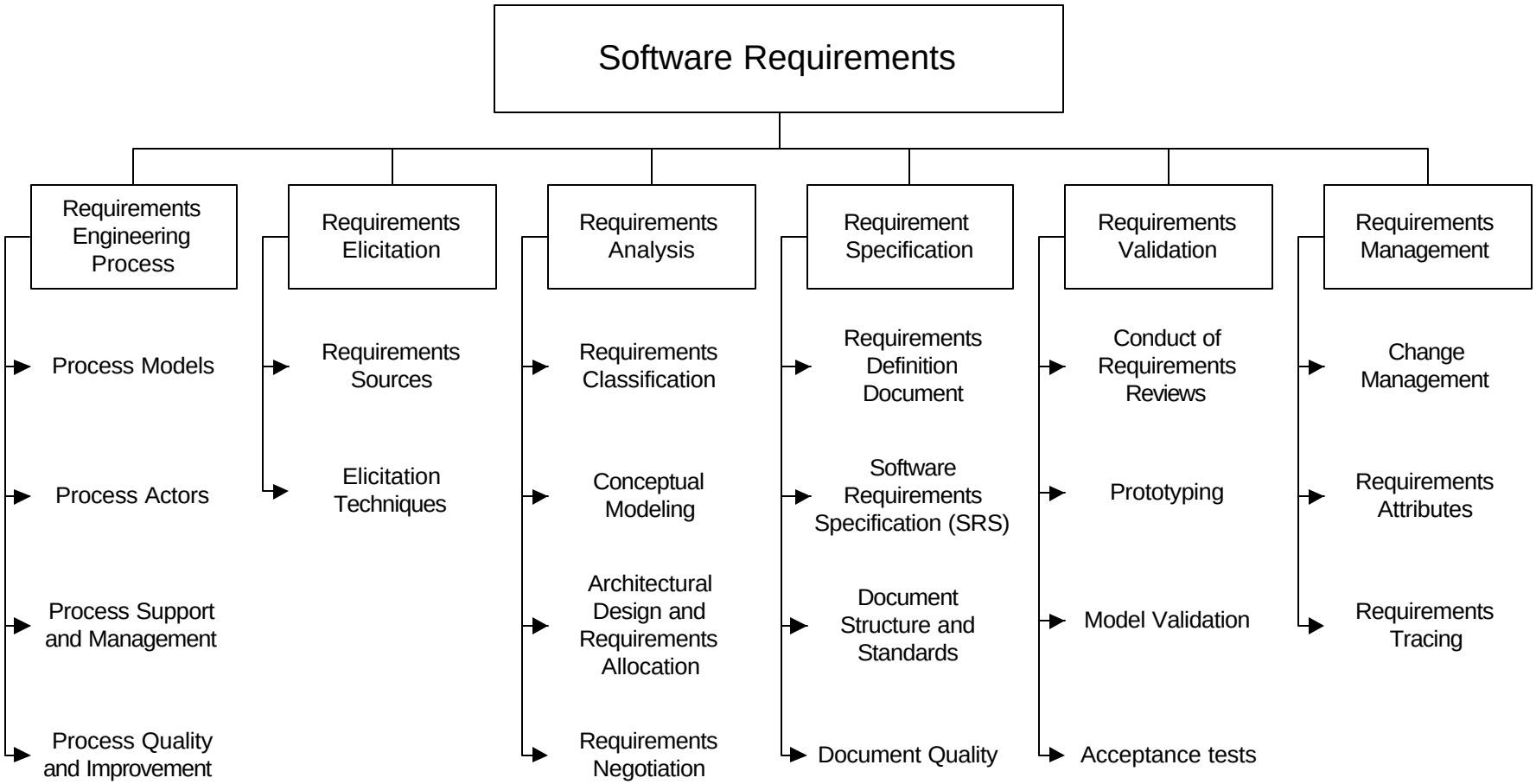
(f) (g) (h) (i) (j)

Software Requirements



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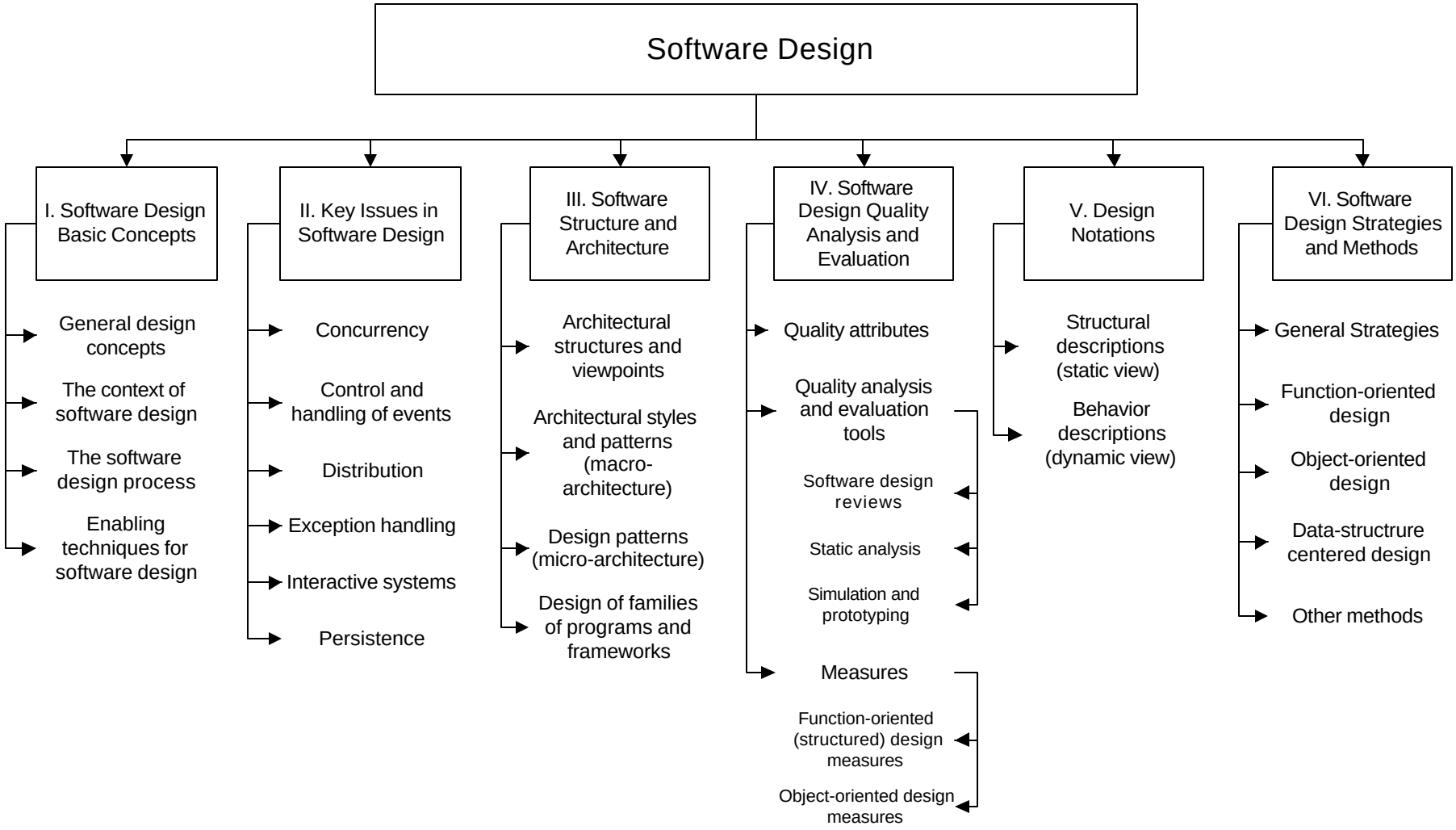
Software Design



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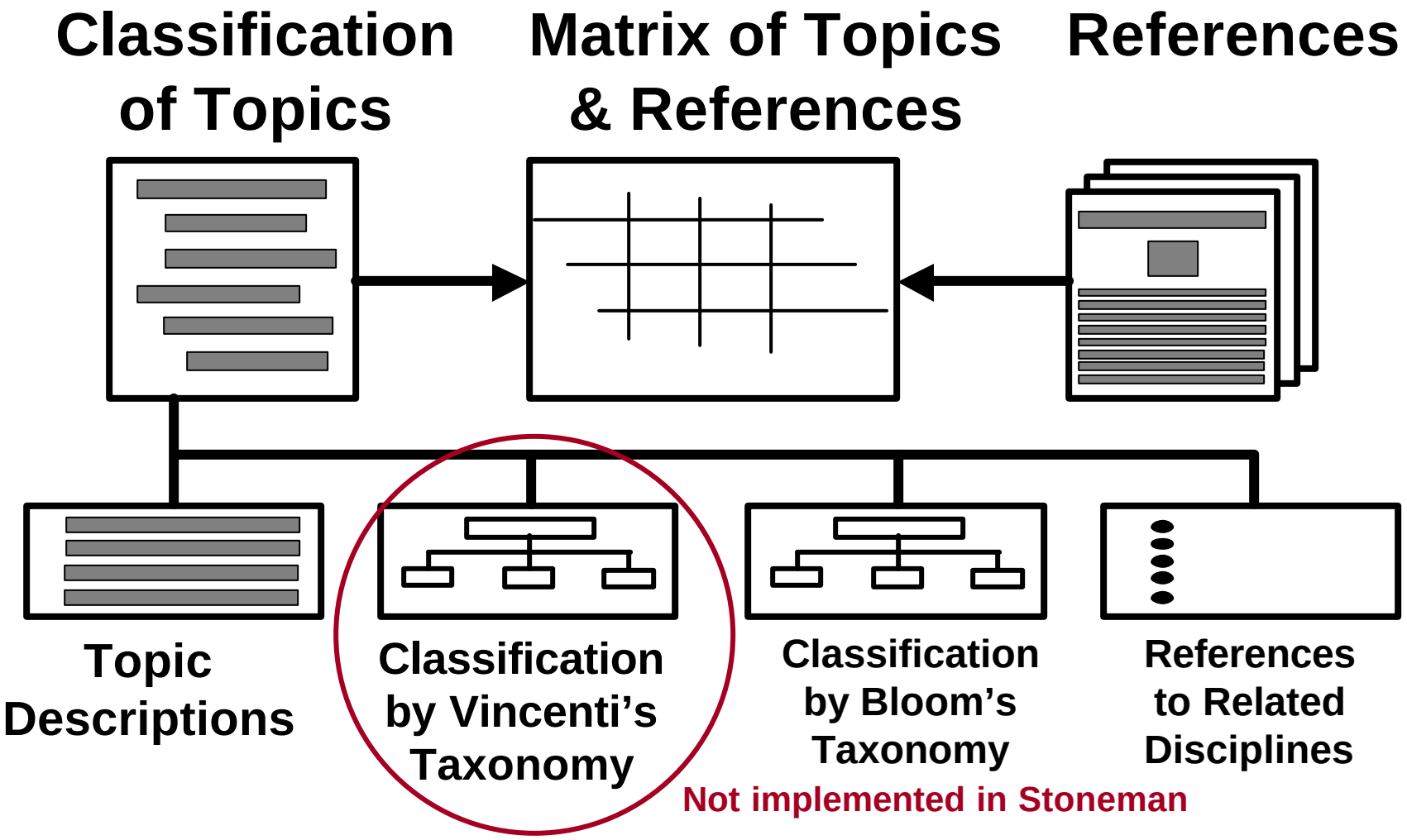
Knowledge Area Description



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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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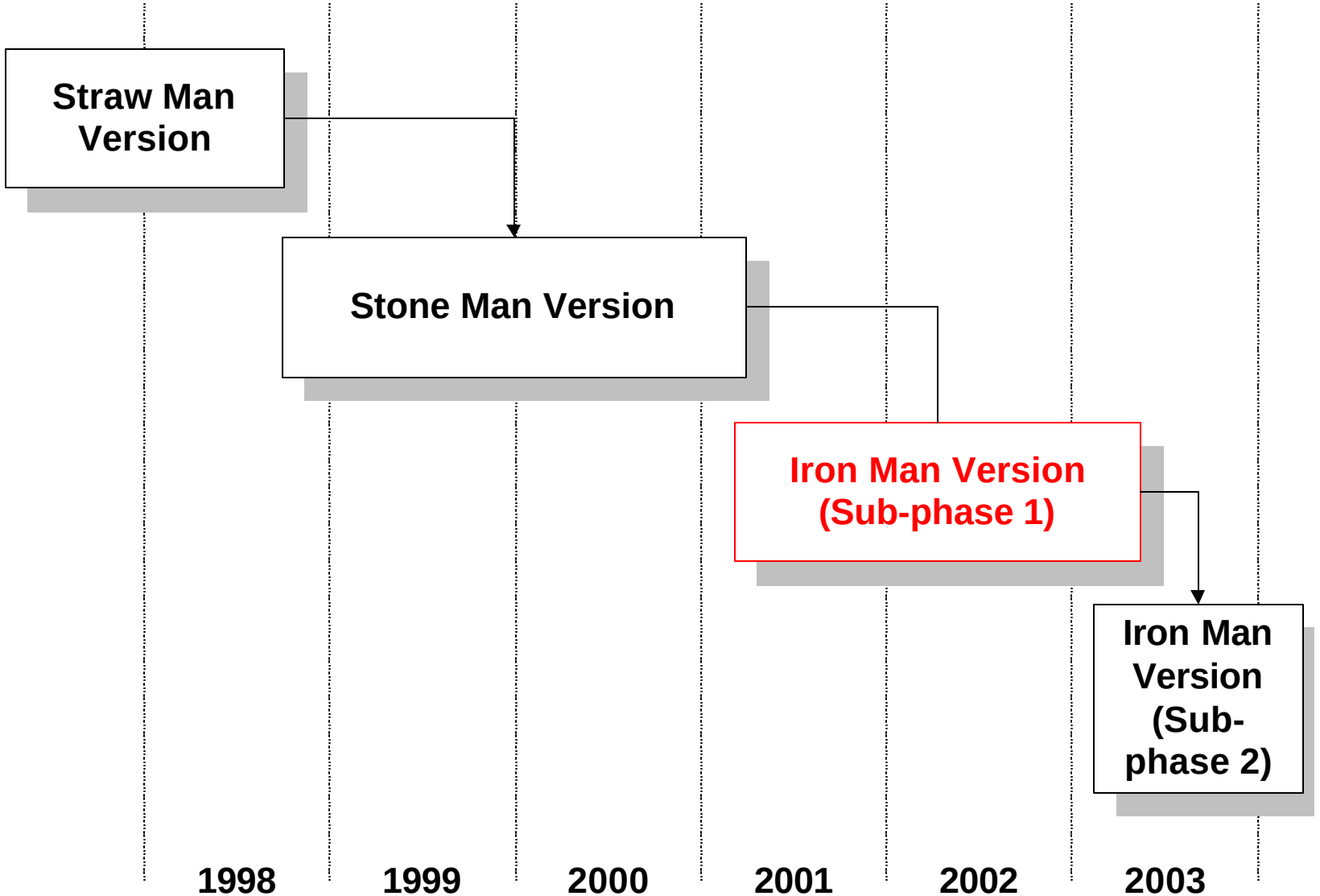

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Collection of feedback from:

- 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

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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
  - R & D agencies: strategies for increasing engineering maturity of the domain

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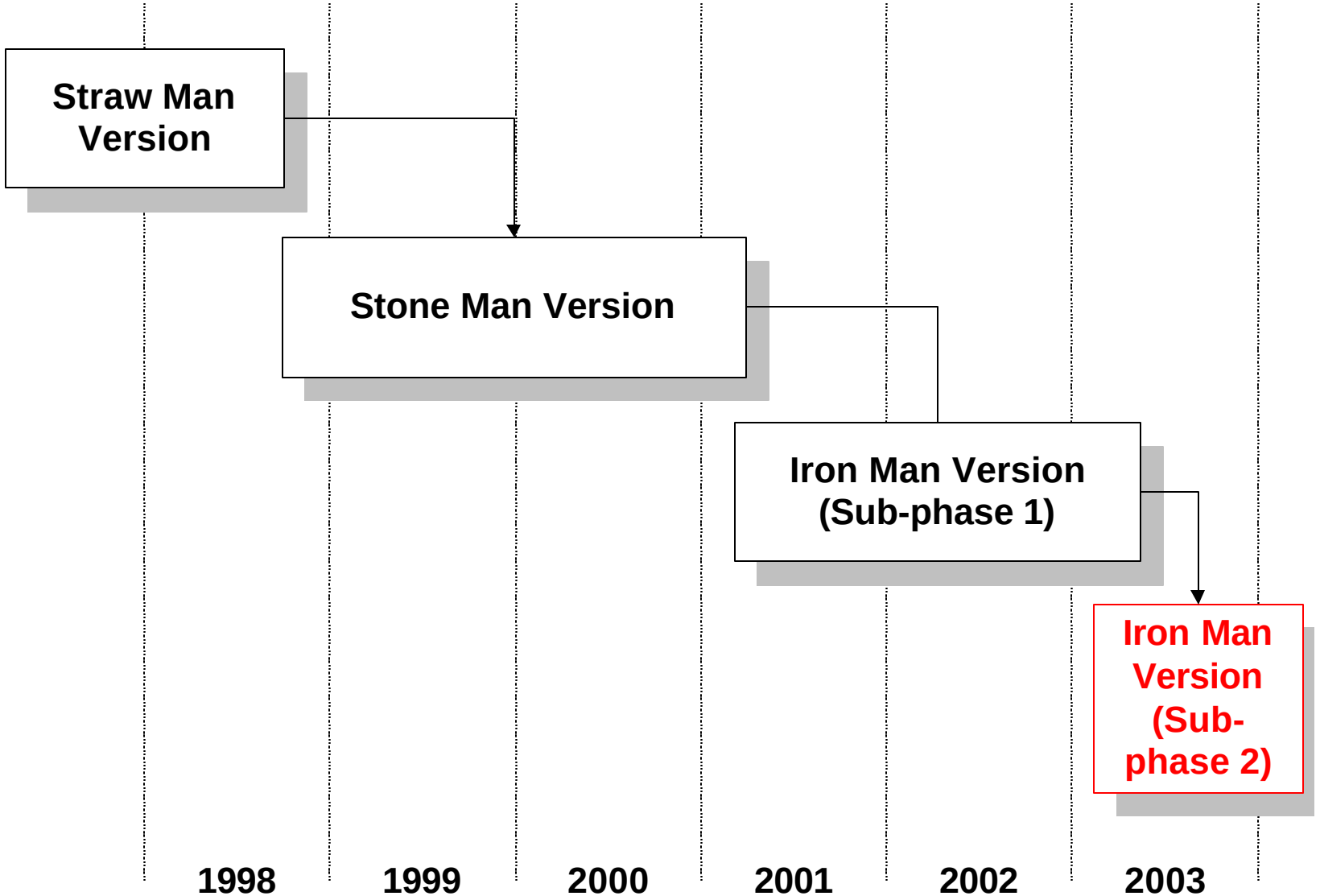

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SWEBOK & Research Issues

- 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

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SWEBOK & R&D Issues

How much of Engineering Knowledge types within each of the 10 Knowledge Areas?

- Fundamental Design Concepts
- Criteria Specifications
- Theoretical Tools
- Quantitative Data
- Practical Considerations
- Design Instrumentalities

- [Vincenti90] W. Vincenti, What Engineers Know and How They Know It: Analytical Studies from Aeronautical History, The Johns Hopkins University Press, 1990.

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Significant progress required from all engineering perspectives

- Fundamental Design Concepts
- Criteria Specifications
- Theoretical Tools
- Quantitative Data

- Practical Considerations
- Design Instrumentalities

- [Vincenti90] W. Vincenti, What Engineers Know and How They Know It: Analytical Studies from Aeronautical History, The Johns Hopkins University Press, 1990.

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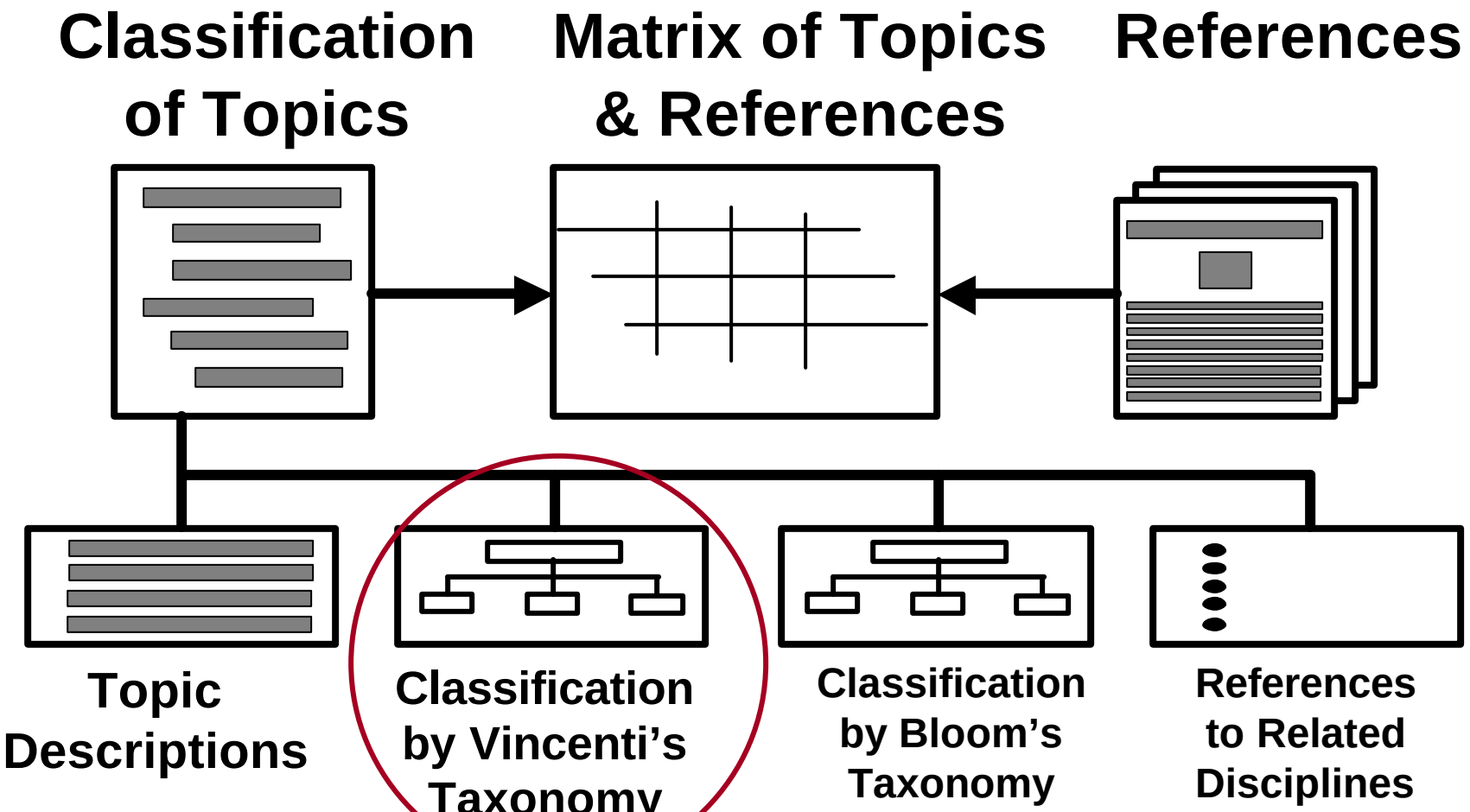
Knowledge Area Description



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Comparison of Research Areas

R & D Topics in Submission to NSERC Reallocations Committee ref Software Engineering:

- Software Development Process
- Software Engineering Environments
- Modelling and documentation
- Software patterns, structures and architecture
- Verification and validation

Source: 2001 - Jointly by Electrical/Computer Engineering and Computer Sciences

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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 Canadian software industry

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