APPENDIX A

KNOWLEDGE AREA DESCRIPTION SPECIFICATIONS FOR THE TRIAL VERSION OF THE GUIDE TO THE SOFTWARE ENGINEERING BODY OF KNOWLEDGE

Pierre Bourque and Alain Abran
École de technologie supérieure

Robert Dupuis
Université du Québec à Montréal

James W. Moore
The MITRE Corporation

Leonard Tripp
1999 President IEEE Computer Society

1   INTRODUCTION

This document presents a final version (version 0.9) of the specifications provided by the Editorial Team to the Knowledge Area Specialist regarding the Knowledge Area Descriptions of the Guide to the Software Engineering Body of Knowledge (Trial Version). The Editorial Team definitely views the development of these specifications as an iterative process and strongly encourages comments, suggested improvements and feedback on these specifications from all involved.

This set of specifications may of course be improved through feedback obtained from the next phase – Ironman – of the project.

This document begins by presenting specifications on the contents of the Knowledge Area Description. Criteria and requirements are defined for proposed breakdowns of topics, for the rationale underlying these breakdowns and the succinct description of topics, for the rating of these topics according to Bloom's taxonomy, for selecting reference materials, and for identifying relevant Knowledge Areas of Related Disciplines. Important input documents are also identified and their role within the project is explained. Non-content issues such as submission format and style guidelines are also discussed in the document.

2   CONTENT GUIDELINES

The following guidelines are presented in a schematic form in the figure found below. While all components are part of the Knowledge Area Description, it must be made very clear that some components are essential, while other are not. The breakdown(s) of topics, the selected reference material and the matrix of reference material versus topics are essential. Without them there is no Knowledge Area Description. The other components could be produced by other means if, for whatever reason, the Specialist cannot provide them within the given timeframe and should not be viewed as major stumbling blocks.

2.1   Criteria and requirements for proposing the breakdown(s) of topics within a Knowledge Area

The following requirements and criteria should be used when proposing a breakdown of topics within a given Knowledge Area:

a) Knowledge Area Specialists are expected to propose one or possibly two complementary breakdowns that are specific to their Knowledge Area. The topics found in all breakdowns within a given Knowledge Area must be identical.

b) These breakdowns of topics are expected to be "reasonable", not "perfect". The Guide to the Software Engineering Body of Knowledge is definitely viewed as a multi-phase effort and many iterations within each phase as well as multiple phases will be necessary to continuously improve these breakdowns. At least for the Stone Man version, "soundness and reasonableness" are being sought after, not "perfection".

c) The proposed breakdown of topics within a Knowledge Area must decompose the subset of the Software Engineering Body of Knowledge that is "generally accepted". See section found below for a more detailed discussion on this.

d) The proposed breakdown of topics within a Knowledge Area must not presume specific application domains, business needs, sizes of organizations, organizational structures, management philosophies, software life cycle models, software technologies or software development methods.

e) The proposed breakdown of topics must, as much as possible, be compatible with the various schools of thought within software engineering.

f) The proposed breakdown of topics within Knowledge Areas must be compatible with the breakdown of software engineering generally found in industry and in the software engineering literature and standards.

g) The proposed breakdown of topics is expected to be as inclusive as possible. It is deemed better to suggest too many topics and have them be abandoned later than the reverse.

h) The Knowledge Area Specialist are expected to adopt the position that even though the following "themes" are common across all Knowledge Areas, they are also an integral part of all Knowledge Areas and therefore must be incorporated into the proposed breakdown of topics of each Knowledge Area. These common themes are quality (in general) and measurement.

Please note that the issue of how to properly handle these "cross-running" or "orthogonal topics" and whether or not they should be handled in a different manner has not been completely resolved yet.

i) The proposed breakdowns should be at most two or three levels deep. Even though no upper or lower limit is imposed on the number of topics within each Knowledge Area, Knowledge Area Specialists are expected to propose a reasonable and manageable number of topics per Knowledge Area. Emphasis should also be put on the selection of the topics themselves rather than on their organization in an appropriate hierarchy.

j) Proposed topic names must be significant enough to be meaningful even when cited outside the Guide to the Software Engineering Body of Knowledge.

k) The description of a Knowledge Area will include a chart (in tree form) describing the knowledge breakdown.

l) Knowledge Area Specialists are also expected to propose a breakdown of topics based on the categories of engineering design knowledge defined in Chapter 7 of Vincenti's book. This exercise should be regarded by the Knowledge Area specialists as a tool for viewing the proposed topics in an alternate manner and for linking software engineering itself to engineering in general. Please note that effort should not be spent on this classification at the expense of the three essential components of the Knowledge Area Description. (Please note that a classification of the topics as per the categories of engineering design knowledge has been produced but will be published on the web site at a latter date in a separate working document. Please contact the editorial team for more information).

2.2 Criteria and requirements for describing topics and for describing the rationale underlying the proposed breakdown(s) within the Knowledge Area

a) Topics need only to be sufficiently described so the reader can select the appropriate reference material according to his/her needs.

b) Knowledge Area Specialists are expected to provide a text describing the rationale underlying the proposed breakdown(s).

2.3 Criteria and requirements for rating topics according to Bloom's taxonomy

a) Knowledge Area Specialists are expected to provide an Appendix that states for each topic at which level of Bloom's taxonomy a "graduate plus four years experience" should "master" this topic. This is seen by the Editorial Team as a tool for the Knowledge Area Specialists to ensure that the proposed material meets the criteria of being "generally accepted". Additionally, the Editorial Team views this as a means of ensuring that the Guide to the Software Engineering Body of Knowledge is properly suited for the educators that will design curricula and/or teaching material based on the Guide and licensing/certification officials defining exam contents and criteria.

Please note that these appendices will all be combined together and published as an Appendix to the Guide to the Software Engineering Body of Knowledge.

2.4 Criteria and Requirements for selecting Reference Material

a) Specific reference material must be identified for each topic. Each reference material can of course cover multiple topics.

b) Proposed Reference Material can be book chapters, refereed journal papers, refereed conference papers or refereed technical or industrial reports or any other type of recognized artifact such as web documents. They must be generally available and must not be confidential in nature. Please be as precise as possible by identifying what specific chapter or section is relevant.

c) Proposed Reference Material must be in English.

d) A reasonable amount of reference material must be selected for each Knowledge Area. The following guidelines should be used in determining how much is reasonable:

♦ If the reference material were written in a coherent manner that followed the proposed breakdown of topics and in a uniform style (for example in a new book based on the proposed Knowledge Area description), an average target for the number of pages would be 500. However, this target may not be

attainable when selecting existing reference material due to differences in style, and overlap and redundancy between the selected reference material.

◆ The amount of reference material would be reasonable if it consisted of the study material on this Knowledge Area of a software engineering licensing exam that a graduate would pass after completing four years of work experience.

◆ The Guide to the Software Engineering Body of Knowledge is intended by definition to be selective in its choice of topics and associated reference material The list of reference material for each Knowledge Area should be viewed and will be presented as an "informed and reasonable selection" rather than as a definitive list.

◆ The classification of topics according to Bloom's taxonomy should be used to allot the appropriate amount and level of depth of the reference material selected for each topic.

◆ Additional reference material can be included in a "Further Readings" list. These further readings still must be related to the topics in the breakdown. They must also discuss generally accepted knowledge. However, the further readings material will not be made available on the web nor should there be a matrix between the reference material listed in Further Readings and the individual topics.

e) If deemed feasible and cost-effective by the IEEE Computer Society, selected reference material will be published on the Guide to the Software Engineering Body of Knowledge web site. To facilitate this task, preference should be given to reference material for which the copyrights already belong to the IEEE Computer Society or the ACM. This should however not be seen as a constraint or an obligation.

f) A matrix of reference material versus topics must be provided.

2.5 Criteria and Requirements for identifying Knowledge Areas of the Related Disciplines

a) Knowledge Area Specialists are expected to identify in a separate section which Knowledge Areas of the Related Disciplines that are sufficiently relevant to the Software Engineering Knowledge Area that has been assigned to them be expected knowledge by a graduate plus four years of experience.

This information will be particularly useful to and will engage much dialogue between the Guide to the Software Engineering Body of Knowledge initiative and our sister initiatives responsible for defining a common software engineering curricula and standard performance norms for software engineers.

The list of Knowledge Areas of Related Disciplines can be found in the Proposed Baseline List of Related Disciplines. If deemed necessary and if accompanied by a justification, Knowledge Area Specialists can also propose additional Related Disciplines not already included or identified in the Proposed Baseline List of Related Disciplines. (Please note that a classification of the topics from the Related Disciplines has been produced but will be published on the web site at a latter date in a separate working document. Please contact the editorial team for more information).

2.6 Common Table of Contents

a) Knowledge Area descriptions should use the following table of contents:

◆ Table of contents

◆ Introduction

◆ Definition of the Knowledge Area

◆ Breakdown of topics of the Knowledge Area (for clarity purposes, we believe this section should be placed in front and not in an appendix at the end of the document. Also, it should be accompanied by a figure describing the breakdown)

◆ Breakdown rationale

◆ Matrix of topics vs. Reference material

◆ Recommended references for the Knowledge Area being described (please do not mix them with references used to write the Knowledge Area description)

◆ List of Further Readings

◆ References used to write and justify the Knowledge Area description.

2.7 What do we mean by "generally accepted knowledge"?

The software engineering body of knowledge is an all-inclusive term that describes the sum of knowledge within the profession of software engineering. However, the Guide to the Software Engineering Body of Knowledge seeks to identify and describe that subset of the body of knowledge that is generally accepted or, in other words, the core body of knowledge. To better illustrate what "generally accepted knowledge" is relative to other types of knowledge, Figure 1 proposes a draft three-category schema for classifying knowledge.

The Project Management Institute in its Guide to the Project Management Body of Knowledge[1] defines "generally accepted" knowledge for project management in the following manner:

'"Generally accepted" means that the knowledge and practices described are applicable to most projects most of the time, and that there is widespread consensus about their value and usefulness. "Generally accepted" does not mean that the knowledge and practices described are or should be applied uniformly on all projects; the project management team is always responsible for determining what is appropriate for any given project.'

The Guide to the Project Management Body of Knowledge is now an IEEE Standard.

At the Mont-Tremblant kick off meeting, the Industrial Advisory Board better defined "generally accepted" as knowledge to be included in the study material of a software engineering licensing exam that a graduate would pass after completing four years of work experience. These two definitions should be seen as complementary.

Knowledge Area Specialists are also expected to be somewhat forward looking in their interpretation by taking into consideration not only what is "generally accepted" today and but what they expect will be "generally accepted" in a 3 to 5 years timeframe.

Figure 1 Categories of knowledge

2.8 Length of Knowledge Area Description

Knowledge Area Descriptions are currently expected to be roughly in the 10 pages range using the format of the International Conference on Software Engineering format

as defined below. This includes text, references, appendices and tables etc. This, of course, does not include the reference materials themselves. This limit should, however, not be seen as a constraint or an obligation.

2.9 Role of Editorial Team

Alain Abran and James W. Moore are the Executive Editors and are responsible for maintaining good relations with the IEEE CS, the ACM, the Industrial Advisory Board and the Panel of Experts as well as for the overall strategy, approach, organization and funding of the project.
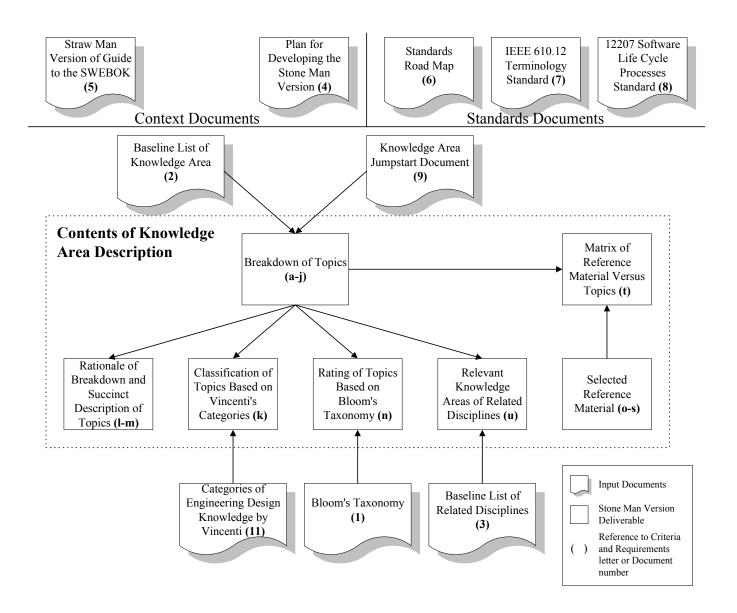
Pierre Bourque and Robert Dupuis are the Editors and are responsible for the coordination, operation and logistics of this project. More specifically, the Editors are responsible for developing the project plan, the Knowledge Area description specification and for coordinating Knowledge Area Specialists and their contribution, for recruiting the reviewers and the review captains as well as coordinating the various review cycles.

The Editors are therefore responsible for the coherence of the entire Guide and for identifying and establishing links between the Knowledge Areas. The resolution of gaps and overlaps between Knowledge Areas will be negotiated by the Editors and the Knowledge Area Specialists themselves.

2.10 Summary

The following figure presents in a schematic form the Knowledge Area Description Specifications

---

[1] See [1] W. R. Duncan, "A Guide to the Project Management Body of Knowledge," Project Management Institute, Upper Darby, PA 1996. Can be downloaded from www.pmi.org

The diagram shows boxes connected by arrows:

Top row — Context Documents: "Straw Man Version of Guide to the SWEBOK **(5)**", "Plan for Developing the Stone Man Version **(4)**"; Standards Documents: "Standards Road Map **(6)**", "IEEE 610.12 Terminology Standard **(7)**", "12207 Software Life Cycle Processes Standard **(8)**"

Second row: "Baseline List of Knowledge Area **(2)**", "Knowledge Area Jumpstart Document **(9)**"

Contents of Knowledge Area Description

"Breakdown of Topics **(a-j)**" → "Matrix of Reference Material Versus Topics **(t)**"

Lower boxes: "Rationale of Breakdown and Succinct Description of Topics **(l-m)**", "Classification of Topics Based on Vincenti's Categories **(k)**", "Rating of Topics Based on Bloom's Taxonomy **(n)**", "Relevant Knowledge Areas of Related Disciplines **(u)**", "Selected Reference Material **(o-s)**"

Bottom: "Categories of Engineering Design Knowledge by Vincenti **(11)**", "Bloom's Taxonomy **(1)**", "Baseline List of Related Disciplines **(3)**"

Legend:
- Input Documents
- Stone Man Version Deliverable
- ( ) Reference to Criteria and Requirements letter or Document number

IMPORTANT RELATED DOCUMENTS (in alphabetical order of first author)

1. Bloom *et al.*, Bloom's Taxonomy of the Cognitive Domain

Please refer to chiron.valdosta.edu/whuitt/col/cogsys/ bloom.html for a short description of Bloom's taxonomy. The original source is Bloom, B.S. (Ed.) (1956) Taxonomy of educational objectives: The classification of educational goals: Handbook I, cognitive domain. New York ; Toronto: Longmans, Green.

2. P. Bourque, R. Dupuis, A. Abran, J. W. Moore, L. Tripp, D. Frailey, A Baseline List of Knowledge Areas for the Stone Man Version of the Guide to the Software Engineering Body of Knowledge, Université du Québec à Montréal, Montréal, February 1999.

Based on the Straw Man version, on the discussions held and the expectations stated at the kick off meeting of the Industrial Advisory Board, on other body of knowledge proposals, and on criteria defined in this document, this document proposes a baseline list of ten Knowledge Areas for the Trial Version of the Guide to the Software Engineering Body of Knowledge. This baseline may of course evolve as work progresses and issues are identified during the course of the project.

This document is available at www.swebok.org.

3. P. Bourque, R. Dupuis, A. Abran, J. W. Moore, L. Tripp**.** A Proposed Baseline List of Related Disciplines for the Stone Man Version of the Guide to the Software Engineering Body of Knowledge, Université du Québec à Montréal, Montréal, February 1999.

Based on the Straw Man version, on the discussions held and the expectations stated at the kick off meeting of the Industrial Advisory Board and on subsequent work, this document proposes a baseline list of Related Disciplines and Knowledge Areas within these Related Disciplines. This document has been submitted to and discussed with the Industrial Advisory Board and a recognized list of Knowledge Areas still has to be identified for certain Related Disciplines. Knowledge Area Specialists will be informed of the evolution of this document.

The current version is available at www.swebok.org

4. P. Bourque, R. Dupuis, A. Abran, J. W. Moore, L. Tripp, D. Frailey, Approved Plan, Stone Man Version of the Guide to the Software Engineering Body of Knowledge, Université du Québec à Montréal, Montréal, February 1999.

This report describes the project objectives, deliverables and underlying principles. The intended audience of the Guide is identified. The responsibilities of the various contributors are defined and an outline of the schedule is traced. This documents defines notably the review process that will be used to develop the Stone Man version. This plan has been approved by the Industrial Advisory Board.

This document is available at www.swebok.org

5. P. Bourque, R. Dupuis, A. Abran, J. W. Moore, L. Tripp, K. Shyne, B. Pflug, M. Maya, and G. Tremblay, Guide to the Software Engineering Body of Knowledge - A Straw Man Version, Université du Québec à Montréal, Montréal, Technical Report, September 1998.

This report is the basis for the entire project. It defines general project strategy, rationale and underlying principles and proposes an initial list of Knowledge Areas and Related Disciplines.

This report is available at www.swebok.org.

6. J. W. Moore, Software Engineering Standards, A User's Road Map. Los Alamitos: IEEE Computer Society Press, 1998.

This book describes the scope, roles, uses, and development trends of the most widely used software engineering standards. It concentrates on important software engineering activities — quality and project management, system engineering, dependability, and safety. The analysis and regrouping of the standard collections exposes you to key relationships between standards.

Even though the Guide to the Software Engineering Body of Knowledge is not a software engineering standards development project per se, special care will be taken throughout the project regarding the compatibility of the Guide with the current IEEE and ISO Software Engineering Standards Collection.

7. IEEE Standard Glossary of Software Engineering Terminology, IEEE, Piscataway, NJ std 610.12-1990, 1990.

The hierarchy of references for terminology is Merriam Webster's Collegiate Dictionary (10th Edition), IEEE Standard 610.12 and new proposed definitions if required.

8. Information Technology – Software Life Cycle Processes, International Standard, Technical ISO/IEC 12207:1995(E), 1995.

This standard is considered the key standard regarding the definition of life cycle process and has been adopted by the two main standardization bodies in software engineering: ISO/IEC JTC1 SC7 and the IEEE Computer Society Software Engineering Standards Committee. It also has been designated as the pivotal standard around which the Software Engineering Standards Committee (SESC) is currently harmonizing its entire collection of standards. This standard was a key input to the Straw Man version.

Even though we do not intend that the Guide to the Software Engineering Body of Knowledge be fully 12207-compliant, this standard remains a key input to the Stone Man version and special care will be taken throughout the project regarding the compatibility of the Guide with the 12207 standard.

9. Knowledge Area Jumpstart Documents

A "jumpstart document" has already been provided to all Knowledge Area Specialists. These "jumpstart documents" propose a breakdown of topics for each Knowledge Area based on the analysis of the four most widely sold generic software engineering textbooks. As implied by their title, they have been prepared as an enabler for the Knowledge Area Specialist and the Knowledge Area Specialist are not of course constrained to the proposed list of topics nor to the proposed breakdown in these "jumpstart documents".

10. Merriam Webster's Collegiate Dictionary (10th Edition).

See note for IEEE 610.12 Standard.

11. W. G. Vincenti, What Engineers Know and How They Know It - Analytical Studies from Aeronautical History. Baltimore and London: Johns Hopkins, 1990.

The categories of engineering design knowledge defined in Chapter 7 (The Anatomy of Engineering Design Knowledge) of this book were used as a framework for organizing topics in the various Knowledge Area "jumpstart documents " and are imposed as decomposition framework in the Knowledge Area Descriptions because:

◆ they are based on a detailed historical analysis of an established branch of engineering: aeronautical engineering. A breakdown of software engineering topics based on these categories is therefore seen as an important mechanism for linking software engineering

- with engineering at large and the more established engineering disciplines;

◆ they are viewed by Vincenti as applicable to all branches of engineering;

◆ gaps in the software engineering body of knowledge within certain categories as well as efforts to reduce these gaps over time will be made apparent;

◆ due to generic nature of the categories, knowledge within each knowledge area could evolve and progress significantly while the framework itself would remain stable;

3 AUTHORSHIP OF KNOWLEDGE AREA DESCRIPTION

The Editorial Team will submit a proposal to the project's Industrial Advisory Board to have Knowledge Area Specialists recognized as authors of the Knowledge Area description.

4 STYLE AND TECHNICAL GUIDELINES

Knowledge Area Descriptions should conform to the International Conference on Software Engineering Proceedings format (templates are available at http://sunset.usc.edu/icse99/cfp /technical_papers.html).

Knowledge Area Descriptions are expected to follow the IEEE Computer Society Style Guide. See http://computer.org/author/style/cs-style.htm

Microsoft Word 97 is the preferred submission format. Please contact the Editorial Team if this is not feasible for you.

4.1 Other Detailed Guidelines:

When referencing the guide, we recommend that you use the full title "Guide to the SWEBOK" instead of only "SWEBOK."

For the purpose of simplicity, we recommend that Knowledge Area Specialists avoid footnotes. Instead, they should try to include their content in the main text.

We recommend to use in the text explicit references to standards, as opposed to simply inserting numbers referencing items in the bibliography. We believe it would allow to better expose the reader to the source and scope of a standard.

The text accompanying figures and tables should be self-explanatory or have enough related text. This would ensure that the reader knows what the figures and tables mean.

Make sure you use current information about references (versions, titles, etc.)

To make sure that some information contained in the Guide to the SWEBOK does not become rapidly obsolete, please avoid directly naming tools and products. Instead, try to name their functions. The list of tools and products can always be put in an appendix.

You are expected to spell out all acronyms used and to use all appropriate copyrights, service marks, etc.

The Knowledge Area Descriptions should always be written in third person.

5 EDITING

Knowledge Area Descriptions will be edited by IEEE Computer Society staff editors. Editing includes copy editing (grammar, punctuation, and capitalization), style editing (conformance to the Computer Society magazines' house style), and content editing (flow, meaning, clarity, directness, and organization). The final editing will be a collaborative process in which IEEE Computer Society staff editors and the authors work together to achieve a concise, well-worded, and useful a Knowledge Area Description.

6 RELEASE OF COPYRIGHT

All intellectual properties associated with the Guide to the Software Engineering Body of Knowledge will remain with the IEEE Computer Society. Knowledge Area Specialists were asked to sign a copyright release form.

It is also understood that the Guide to the Software Engineering Body of Knowledge will be put in the public domain by the IEEE Computer Society, free of charge through web technology, or other means.

For more information, See http://computer.org/ copyright.htm