

A Framework for the Measurement Concepts in the SWEBOK Guide

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Abstract

In the Guide to the Software Engineering Body of Knowledge (SWEBOK Guide), the measurement topics, and their underlying concepts, are unevenly distributed throughout the ten knowledge areas of the SWEBOK Guide, which makes it challenging to develop an overall understanding of the role of measurement in software engineering. This paper proposes a framework for all the measurement concepts contained in the knowledge areas of the SWEBOK Guide.

Keywords: *SWEBOK Guide, Software Measurement, ISO 19759, ISO 15939*

Introduction

In “Software Engineering Principles: Do They Meet Engineering Criteria?” [1-2], an analysis of 34 candidate principles is presented, based on a three phase methodology designed to verify whether or not they are indeed software engineering principles. Two sets of criteria were used: the engineering-related criteria of Vincenti [3], and the IEEE & ACM engineering criteria for the joint software engineering curriculum [4]. As a result of this analysis, 9 software engineering principles were found to conform to engineering criteria, including the following: “Apply and use quantitative measurements in decision making.” This is not surprising, of course, since measurement is an important activity in classical engineering disciplines, and software measurement is considered a primary tool for managing software life cycle activities, allowing managers to take appropriate decisions. For instance, in software engineering, the management and improvement of software processes and products in development must be supported by measurement. Similarly, measurement is a key activity in assessing the quality of software products and the capability of organizational software processes.

The Guide to the Software Engineering Body of Knowledge (SWEBOK Guide) [5-6], written under the auspices of the IEEE Computer Society, contains ten knowledge areas, each divided into subareas and topics – see Figure 1. The content of each knowledge area (KA) in the

SWEBOK Guide was developed by domain experts and extensively reviewed by an international community of peers to develop an international consensus on the following objectives:

- To characterize the content of the software engineering discipline;
- To promote a consistent view of software engineering worldwide;
- To provide access to the software engineering body of knowledge;
- To clarify the place, and set the boundary, of software engineering with respect to other disciplines;
- To provide a foundation for curriculum development and individual certification material.

KA01 - Requirements	KA02 - Design	KA03 - Construction	KA04 - Testing	KA05 - Maintenance
KA06 - Software Configuration Management				
KA07 - Software Engineering Management				
KA08 - Software Engineering Process				
KA09 - Software Engineering Tools and Methods				
KA10 - Software Quality				

Figure 1: Knowledge areas (KAs) of the SWEBOK Guide (ISO-TR-19759 2004)

The SWEBOK Guide covers software-related measurement concepts in almost all its KAs; however, this measurement coverage is dispersed unevenly across them, making understanding and consolidation difficult.

Table 1 highlights the presence of measurement-related concepts in the KAs described in the SWEBOK Guide listing: the knowledge areas and subareas on the left, and the topics on the right. We can see from this table that measurement topics are mentioned in all the KAs described in the SWEBOK Guide. There is one in each of the following KAs: Software design, Software construction, Software configuration management, and Software quality; and there are more than two in the Software engineering process, Software engineering management, and Software testing KAs.

The KA covering the largest number of measurement concepts is entitled Software engineering process. However, the fact that measurement is covered unevenly across all ten KAs of the SWEBOK Guide makes understanding this measurement principle challenging, as well as difficult to put in practice in any software engineering discipline.

This paper proposes a framework for the various measurement concepts dispersed among the KAs of the SWEBOK Guide (ISO 19759). In the next section, we propose building blocks for integrating the measurement concepts into our framework.

Table 1: Measurement-Related Concepts in the SWEBOK GUIDE KAs

SWEBOK knowledge areas	SWEBOK measurement topics
Software requirements	- Quantifiable requirements
	- Measuring requirements
Software design	- Design measures
Construction measurement	- Construction measurement
Software testing	- Evaluation of the program under test
	- Evaluation of the tests performed
	- Practical considerations
Software maintenance	- Maintenance cost estimation
	- Software maintenance measurement
Software engineering management	- Establish and sustain measurement commitment
	- Plan the measurement process
	- Perform the measurement process
	- Evaluate measurement
Software configuration management	- Monitor software configuration management
Software engineering process	- Software process measurement
	- Software product measurement
	- Quality of measurement results
	- Software information models
	- Measurement techniques
Software quality	- Software quality measurement

2. Building blocks proposed for the framework

A) Measurement from the engineering management perspective in ISO 15939

The elements that are useful for building a framework for the measurement concepts in the SWEBOK can be found in the generic set of measurement activities presented in the Software engineering management KA of the SWEBOK Guide. This set is entirely based on ISO 15939 [7] – Software Measurement Process, and it is composed of activities that specify what measurement information is necessary, how to plan and perform the measurement process, and how to evaluate the results; that is,

- **Establish and sustain measurement commitment**
- **Plan the measurement process**
- **Perform the measurement process**
- **Evaluate the measurement results**

B) Building blocks from the engineering perspective in the SWEBOK

Presented below are the additional blocks of concepts in the SWEBOK Guide from an engineering perspective; that is, the engineering processes and the supporting processes.

- **Engineering processes:** These processes are represented by the various phases required for the development of software: the Software requirements, Software design, Software construction, Software testing, and Software maintenance KAs of the SWEBOK.
- **Supporting processes:** These processes provide additional expertise to the engineering processes throughout any software development life cycle: the Software configuration management, Software engineering process, Software quality, and Software tools and methods KAs of the SWEBOK.

Figure 2 integrates the above building blocks into a framework for the measurement topics appearing in the 2004 version of the SWEBOK Guide: the four activities at the top originate from the Management KA (based on ISO 15939), while the bottom part illustrates the interaction of the measurement activities in the engineering processes (as part of a development life cycle) with the supporting processes. Figure 3 presents the measurement topics in these individual building blocks.

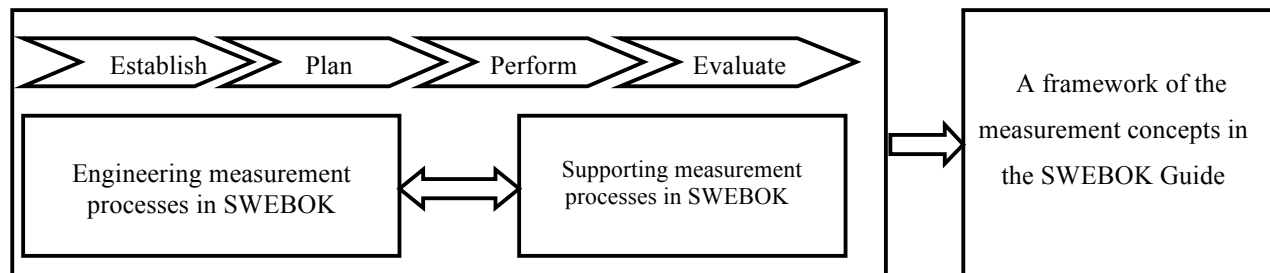


Figure 2: Proposed structure for the set of measurement concepts in the SWEBOK Guide

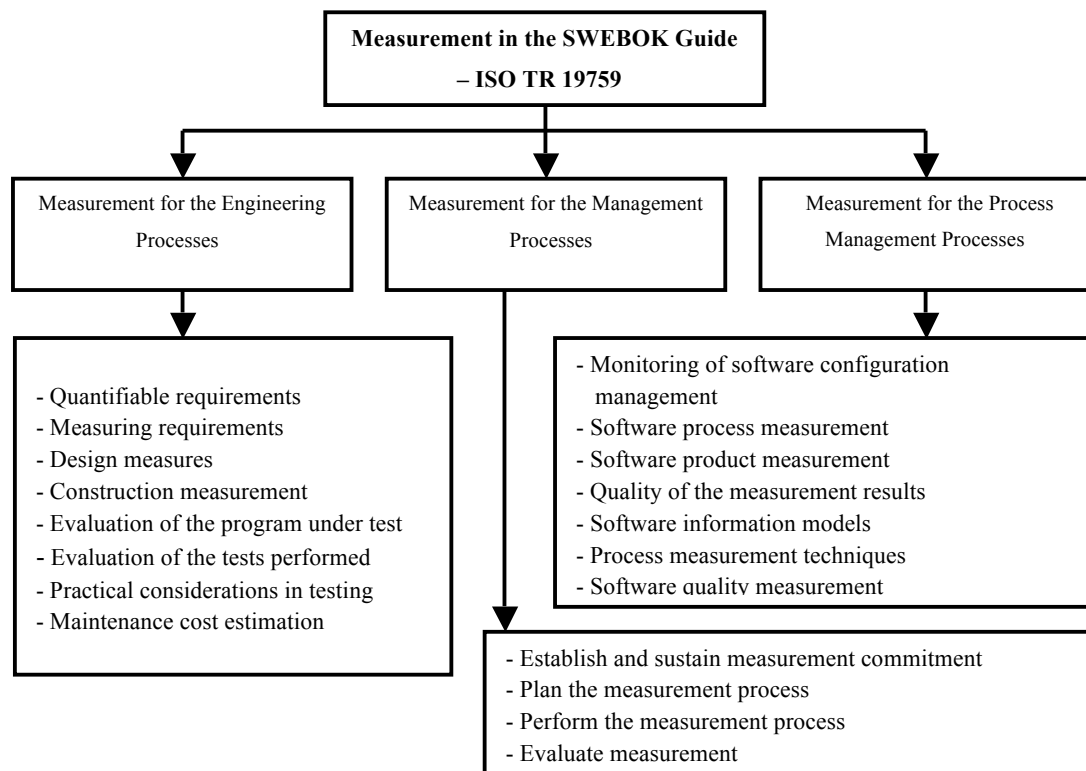


Figure 3: The SWEBOK measurement topics in the building blocks

C) Proposed framework for the measurement concepts in the SWEBOK Guide

All the measurement concepts that are dispersed among the KAs of the SWEBOK Guide can now be positioned in the appropriate blocks of the proposed framework. Figure 4 positions the various measurement topics from Table 1 in those building blocks. Every measurement concept in the SWEBOK Guide is first assigned to the appropriate category, whether the engineering measurement processes category or the supporting measurement processes category, and then it is assigned to the relevant activity of the measurement process itself (as listed in the left-hand column of Figure 3).

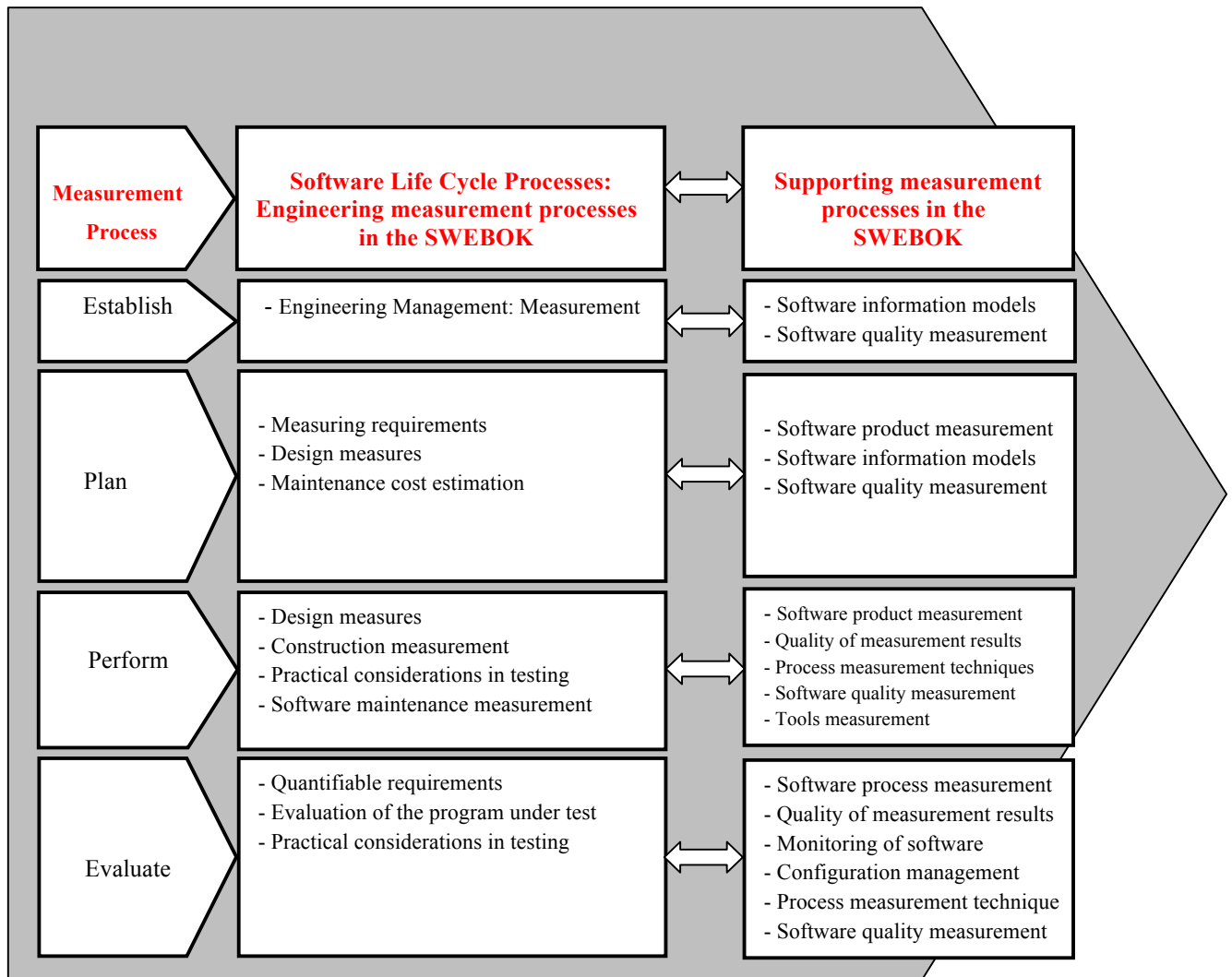


Figure 4: A framework of the Measurement Concepts in the SWEBOK Guide

D) Discussion

This paper has proposed a framework to address the issue of the uneven coverage of the measurement concepts across all the knowledge areas of the SWEBOK Guide. This framework makes it easier to understand the overall measurement process, as well as the links between the measurement topics listed in the SWEBOK Guide (ISO-TR-19759, 2004). However, the view

presented in Figure 4 is a high-level one, with only the labels of the measurement topics appearing. Moreover, they appear only once. A more refined analysis is required, since one SWEBOK topic may cover a number of sub-concepts, some of which may be at a lower level and belong to other sections of the building blocks of the proposed framework. Therefore, to develop operational guidelines based on the SWEBOK Guide to completely cover the software engineering principle, “Apply and use quantitative measurements in decision making,” will require further work based on examining the detailed content of the measurement topics in the SWEBOK Guide.

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