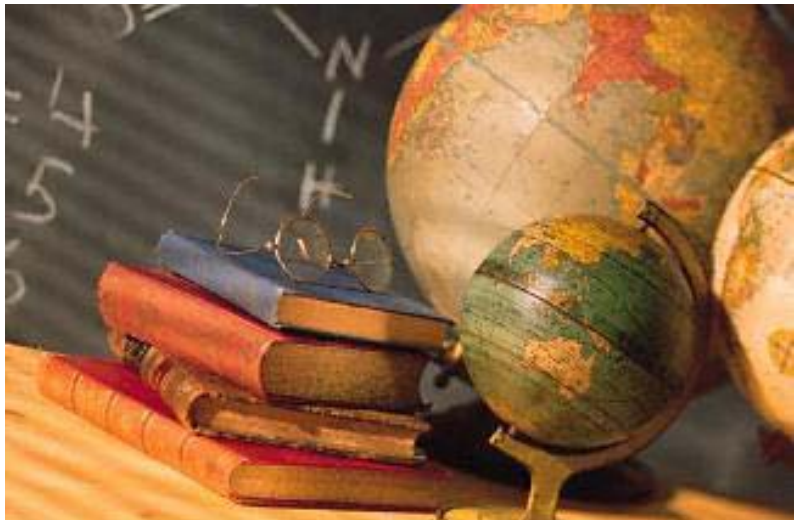
Software Measurement: Art or Sciences?



Alain Abran

List of topics

1. *Introduction: Arts?*
2. *Metrology Concepts*
3. *A Measurement Body of Knowledge*
4. *Discussion*

Introduction: Arts?

The dominant approach in software measurement:

- *The 'software metrics' approach*
  - *Intuitive approach to the design of 'metrics'*
  - *Large variety of individual proposals*
  - *Focus on 'measurement theory'*
    - *Representation conditions*
    - *Mathematical properties*

Introduction: Arts?

Consequences of the dominant approach

- *Direct:*
  - *Practitioners are not keen on using 'software metrics'*
  - *Experts disagree on the relevance of using 'software metrics': eg. Work on fundamental principles & SWEBOK*
- *Indirect:*
  - *Limited design expertise*
  - *Incomplete 'validation' framework*
  - *Weaknesses of models (quality, estimation, etc) based on 'unsound metrics'*

Introduction: Arts?

Widely held beliefs:

- *Software is an intellectual product*
- *Software is something new and different*
- *We have to 'invent' how to measure software*

☞ *Software measurement is so unique that there is:*

- ☞ *Not much in common from measurement of physical objects*
- ☞ *Not much to learn from other fields of sciences*

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Metrology Concepts

When we measure physical objects, what do we measure?

- *Objects*

Or

- *…..*

Metrology Concepts

- *What measurement infrastructure has been put in place at the national and international levels?*
  - *.....*
  - *.....*
  - *.....*

Metrology Concepts

Any profession dedicated to measurement?

- .....
- ....
- ....
- ....

Metrology Concepts

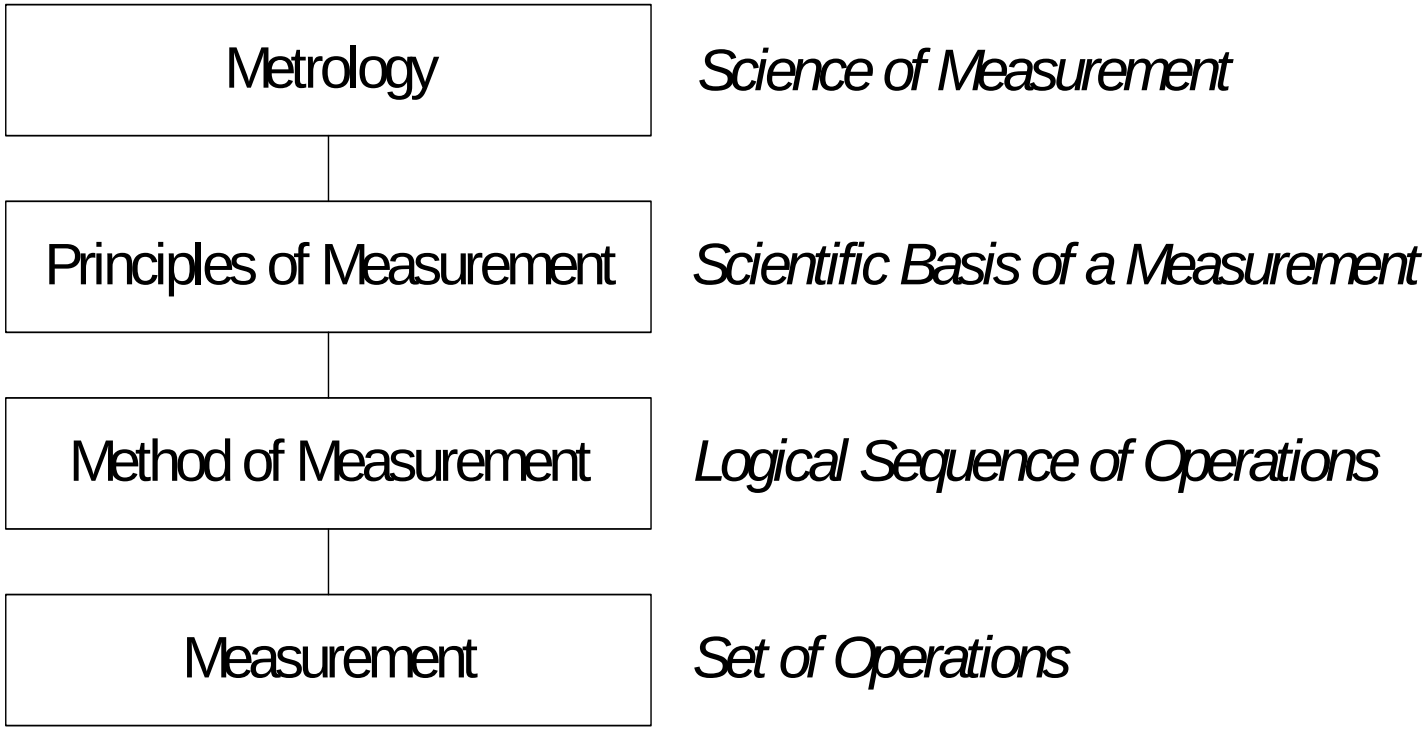

Figure 2: Measurement foundations [ABRA02a]

Metrology Concepts

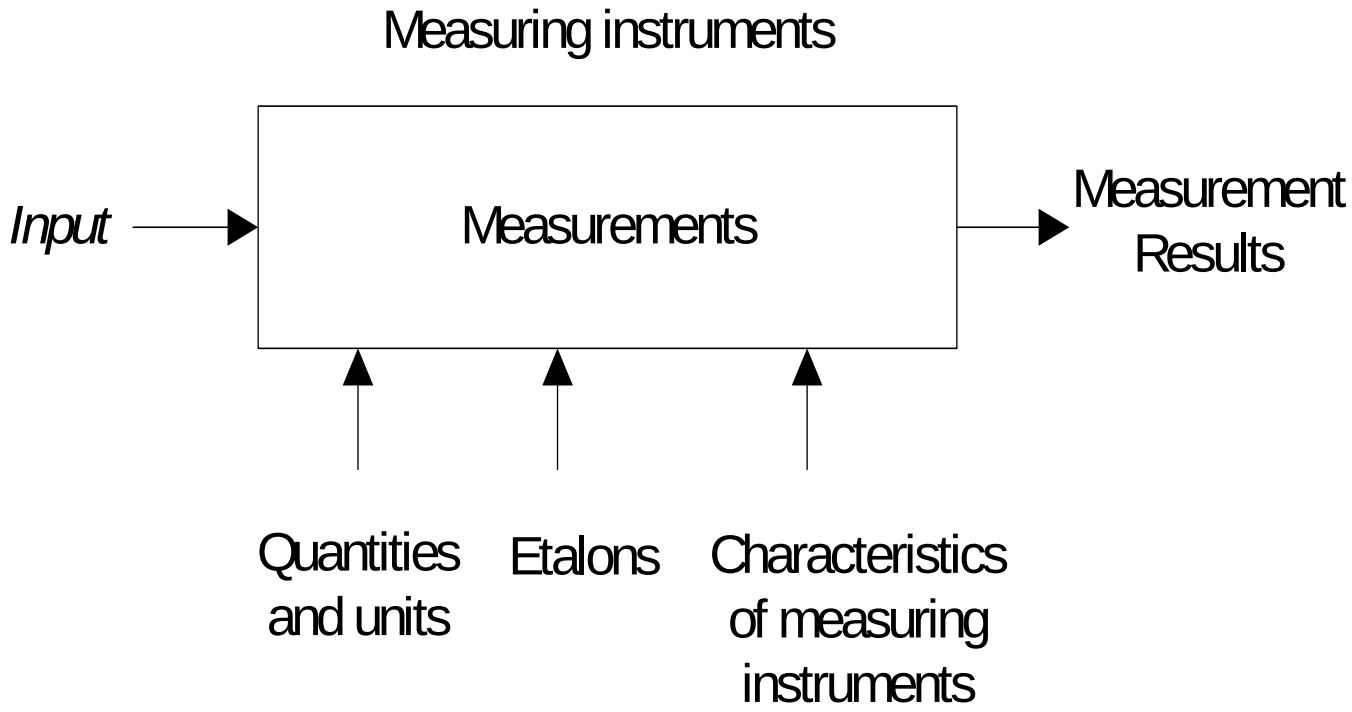

Figure 1: Model of the categories of metrology terms [ABRA02a]

Metrology Concepts

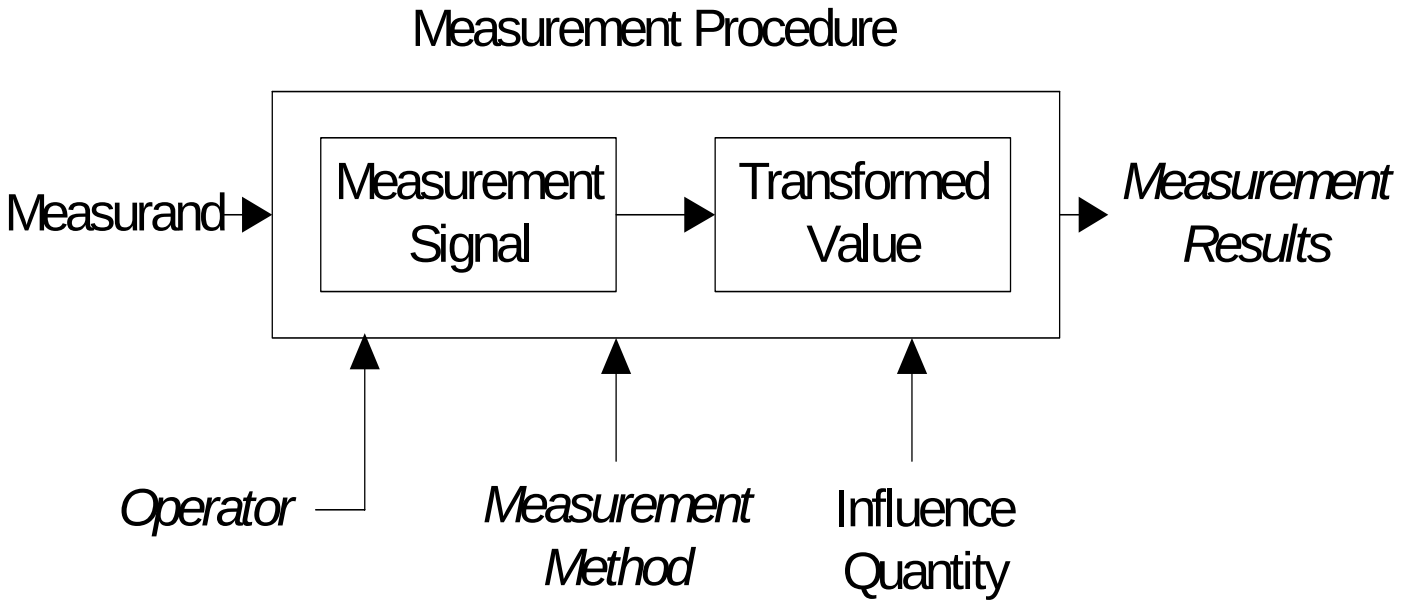

Figure 3: Measurement Procedure [ABRA02a]

Metrology Concepts

Classification of terms in the category of 'Measurement Results' [ABRA02a]

Types of measurement results	***Modes of verification of measurement results***	**Uncertainty of measurement**	
Indication (of a measuring instrument) Uncorrected result Corrected result	Accuracy of measurement Repeatability (of results of measurements) Reproducibility (of results of measurements)	Experimental standard deviation Error (of measurement) Deviation	Relative error Random error Systematic error Correction Correction factor

Functional Size

A unique set of measures in software engineering:

- *Designed in the late 1970's:*
  - *By Albrecht, from IBM, using 24 MIS projects*
- *Published in the early 1980's*
- *User group in the mid 1980's*
  - *Measurement Manual*
  - *Training & Certification*

Functional Size

Innovation = Standardization through ISO

A meta-standard to layout the ground rules about functional size measurement: ISO 14143

- *Part 1 = Definitions of Key Concepts*
- *Part 2 = Conformity Assessment*
- *Part 3 = Verification Guide*
- *Part 4 = Set of References*
- *Part 5 = Functional Domains*
- *Part 6 = A Guide*

Functional Size

Four specific methods approved by ISO

- *ISO 19761: COSMIC-FFP*
- *ISO 20926: IFPUG*
- *ISO 20968: MKII*
- *ISO 24570: NESMA*
  - *Will they withstand the test of time as measurement methods?*
  - *Are there good measuring instruments?*
  - *Are these instruments calibrated and certified?*

Software Quality?

ISO 9126 on Software Products Quality

- *Part 1: Quality Models and Definitions*
- *Parts 2 to 4: + 120 Metrics !*
  - *And little about:*
    - *measurement method for each of the +120 metrics*
    - *quality of measurement results.*
  - *Then (if used in a non consistent manner), how do you figure out how measurement results compare across contexts, across time, and across measurers?*
  - *How do you benchmark?*

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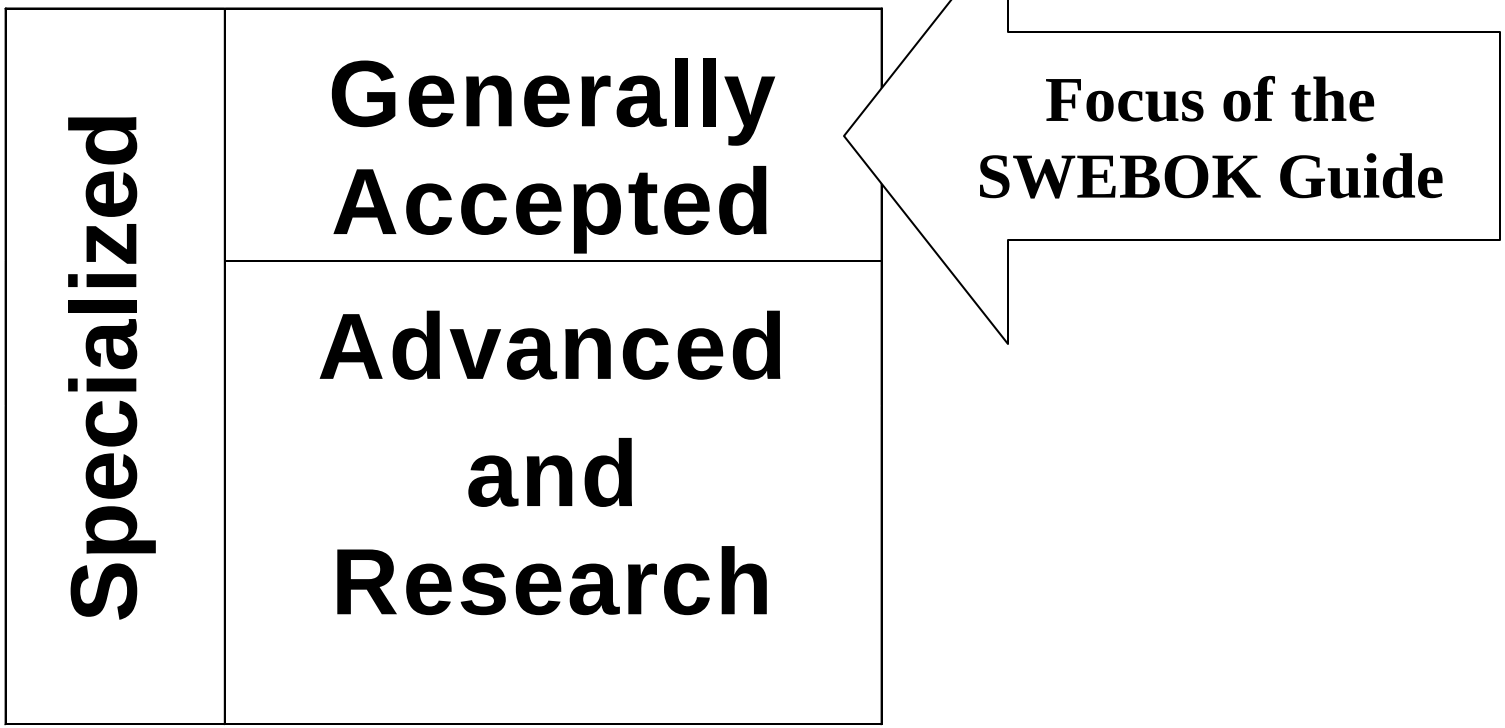
What is Software Engineering?

- *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)."*

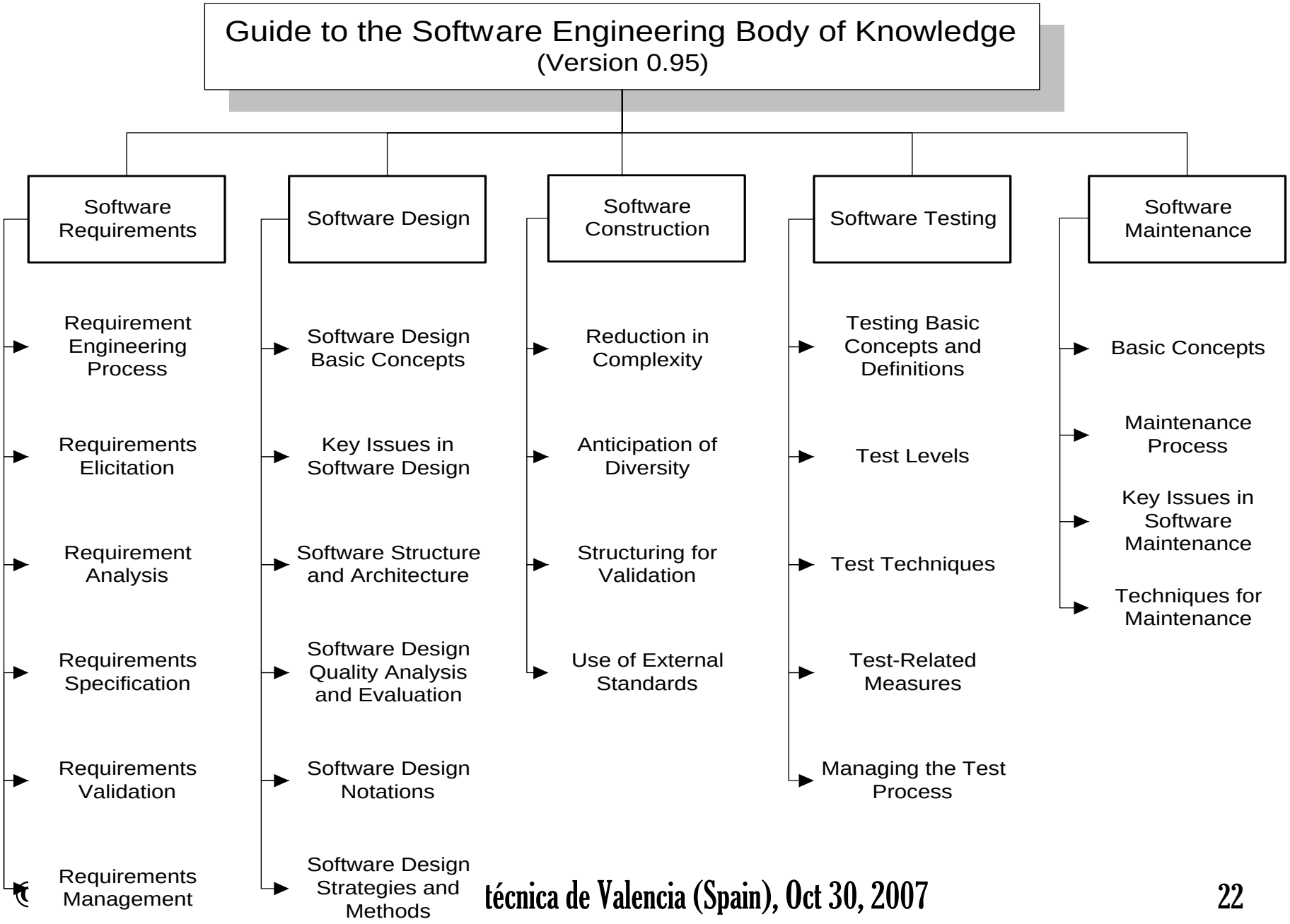
Categories of Knowledge in the SWEBOK

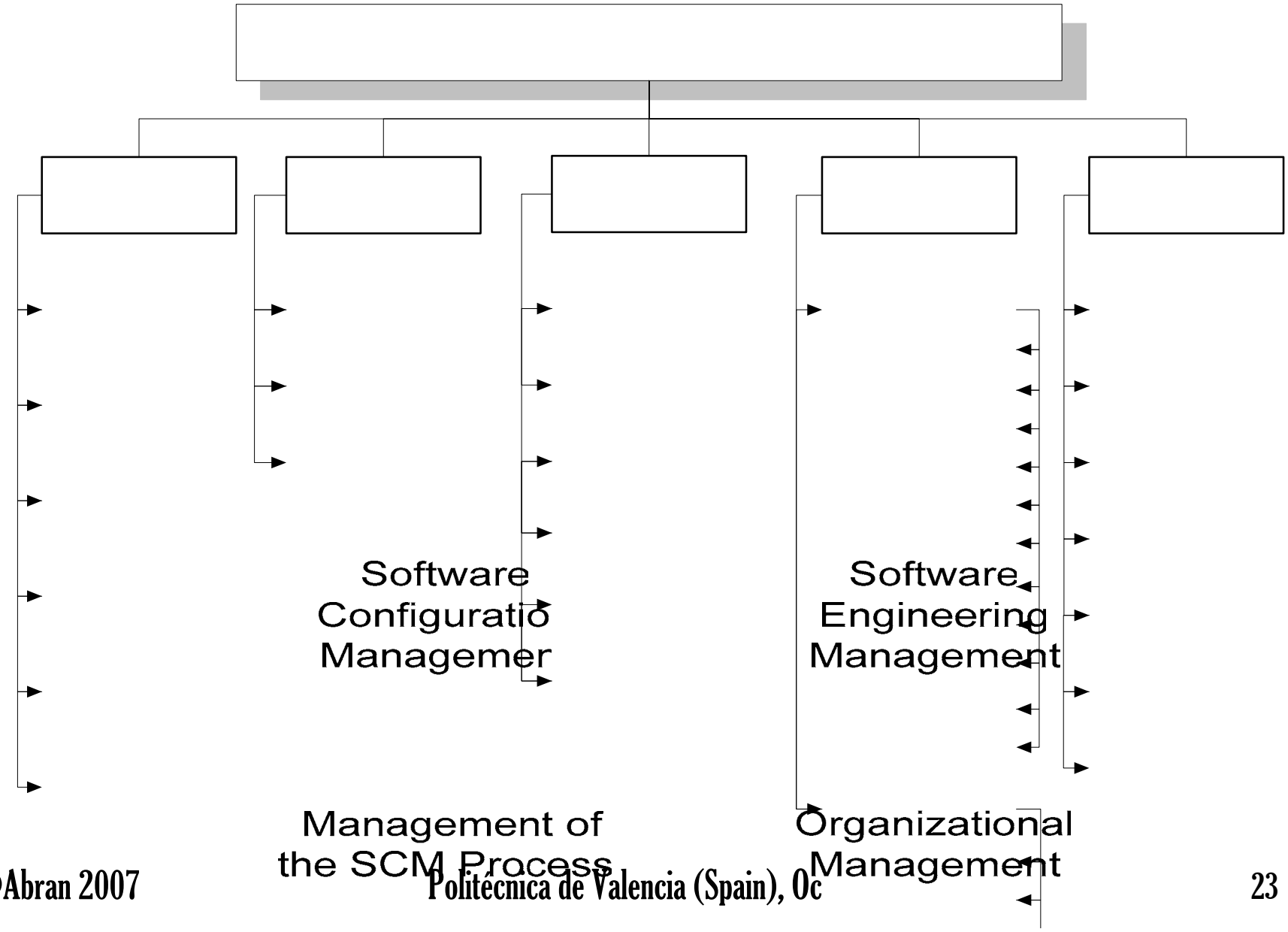


Generally Accepted

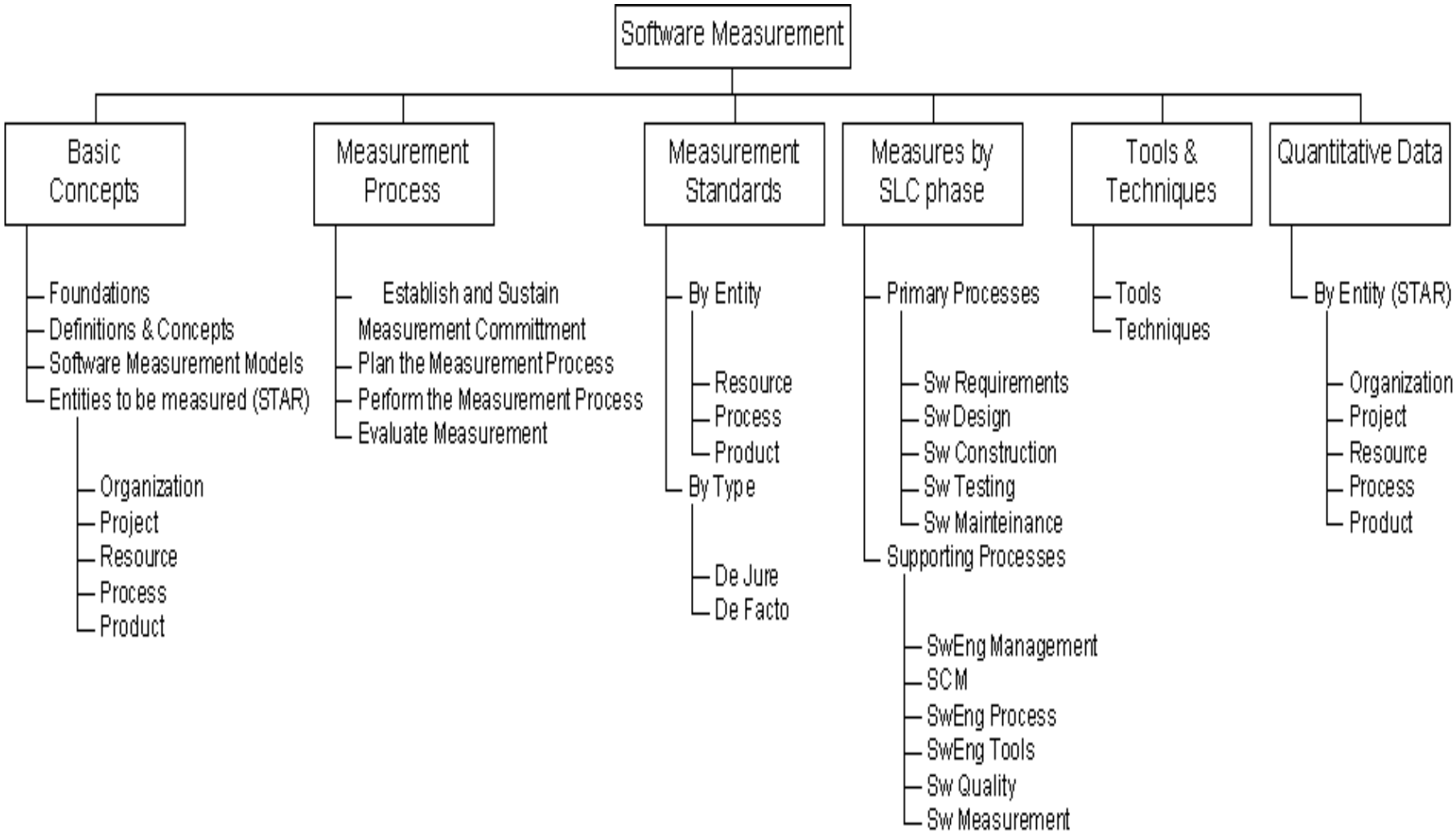
- *«Applies to most projects, most of the time, and widespread consensus validates its value and effectiveness»*
  - *Project Management Institute - PMI*

- *Bachelor + 4 years of experience*


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


Software
Configuratio
Managemer
Software
Engineering
Management
Management of
the SCM Process
Organizational
Management
Process/Project

Software Measurement Body of Knowledge - Draft



Software Measurement Body of Knowledge - Draft

- *Everybody's contributions are welcome to develop consensus:*
  - *IWSM-MENSURA workshop on SMEBOK*
  - *Evolution of SWEBOK*

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4- Discussion

Key challenge for the designers of software measures:

- *Innovation or consensus building?*
  - *Promoting:*
    - *our 'own new metrics' or*
    - *robutsness in terms of metrology related properties?*
- *How to figure out the key design aspects out of a bunch of alternative 'metrics' designs?*
  - *How to get to a consensus?*

4- Discussion

- *How do we build an infrastructure for software measures?*
- *What is the process to define an 'étalon' for a software measurement standard?*
  - *What are the design issues?*
  - *How do we tackled them?*
- *How to set up an 'étalon' for a specific software measure?*
  - *And how do we make it evolve?*

The roadmap to software maturity?

- *We must ensure that the fundamentals are right.*
- *We have to build upon centuries of knowhow on how to build measures*
- *We have to contribute to the building of a software measurement infrastructure*

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Thank You !

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