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

- Metrology
- Principles of Measurement
- Method of Measurement
- Measurement

Science of Measurement
Scientific Basis of a Measurement
Logical Sequence of Operations
Set of Operations

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]

<table>
<thead>
<tr>
<th>Types of measurement results</th>
<th>Modes of verification of measurement results</th>
<th>Uncertainty of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication (of a measuring instrument)</td>
<td>Accuracy of measurement</td>
<td>Experimental standard deviation</td>
</tr>
<tr>
<td>Uncorrected result</td>
<td>Repeatability (of results of measurements)</td>
<td>Random error</td>
</tr>
<tr>
<td>Corrected result</td>
<td>Reproducibility (of results of measurements)</td>
<td>Systematic error</td>
</tr>
<tr>
<td></td>
<td>Repeatability (of results of measurements)</td>
<td>Correction</td>
</tr>
<tr>
<td></td>
<td>Reproducibility (of results of measurements)</td>
<td>Correction factor</td>
</tr>
</tbody>
</table>
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?
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

<table>
<thead>
<tr>
<th>Specialized</th>
<th>Generally Accepted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced and Research</td>
<td>Focus of the SWEBOK Guide</td>
</tr>
</tbody>
</table>
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
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
    - robustness 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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