COSMIC-FFP (ISO 19761) Software size measurement: State of the Art 2004

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Abstract

This paper presents the state of the art of the new international standard ISO/IEC 19761, the Cosmic-FFP method for functional size measurement, and its future perspective.

1 Introduction

Software measurement is certainly getting a lot of managers and executives' attention. And measurement issues are certainly being explored at practitioners and academics' conferences.

- After almost 30 years of software engineering, is measurement mainstream in the management of your software projects?
- And what about functional size measurement?

2 Software Engineering & Measurement

'Software Engineering' is defined by the IEEE as:

"(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)"

In spite of the millions of software professionals worldwide and the ubiquitous presence of software in our society, software engineering is still maturing and still has to reach the status of a legitimate engineering discipline and a recognized profession.

- And could you think about any other branch of engineering without thinking about measurement?

And again:

- Where are we at in software measurement?
- What is the status of functional size measurement?
- And what about the new kid on the block, COSMIC-FFP?

3 Software Measurement

Measurement is a technology (indeed, there is a specialized field about measurement: 'Metrology'), and software measurement is a new technology.

- What does it take for an organization to adopt a technology?
- And what does it take for a technology to become mainstream in an industry?

For an organization to adopt a technology:

- the technology must appear to bring enough benefits to overcome the pain of changing to something unknown initially.
- the organisation must have (or gain) the technological know-how to make it work
- the organisation must be clever and enthusiastic enough to harvest the benefits, which takes time

For an industry to adopt a technology:

- the technology must become integrated into the technological environment of the industry
- it must become integrated within the business context (including legal and regulatory contexts).
- the technology must have been proven to work well in a large variety of contexts (that is, the technology must be mature, or maturing rapidly).

For an industry to promote a technology

- it must recognize that there is a direction that has been proven to work in other similar contexts
- it must recognize that the current practices are not good enough
- it must recognize that by themselves the individual players will not go over the pain to change (if the environmental-regulatory context does not force such a change)
- it must want to speed up the transition to the new technology

and…

- What about software measurement?
- Who, in the industry, is doing something about software measurement?

Well, big customers and governments want better quality, better price/performance and more reliable software delivery!

And these big customers and governments have decided:

- to assess the software organizations, and
- to require them, among other things, to implement measurement programmes

And over the years both the big customers and the governments have developed (and keep developing) the required technological fit and regulatory framework to make it happen, and to make it work.

Examples of the drive (and influence) of:

- the big players:
    - the design and deployment of software process assessment models (SEI – CMMi, SPICE, ISO 15504, ISO 9001)
- the governments:
    - idem + the regulatory framework, starting with the development of consensus on international standards, and their inclusion in the national technology framework (measurement process, measurement of quality, measurement of functional size, etc.).

4 Functional size measurement – Past and present

Functional size measurement is also a technology (No - it is not a religion!)

The first functional size measurement method, Function Point Analysis, is almost 25 years old.

It is difficult to think of any other software engineering technology that has made so little progress for so long.

And…

- What is driving this technology?
- Why are there barriers (technology or environment)?

Function Point Analysis (FPA) has a large name recognition in the market place, but….

- What is its real penetration in the market?
    - in the MIS market: ..at most 1%
    - in other software markets: ..close to o%
- Does such a small penetration rate mean that it is worthless and irrelevant?

NO…

But it most probably means that both:

- the technology itself was not ready (still too many weaknesses)
- the technological environment (of functional size measurement) and regulatory environment were not ready either!

5 Functional size measurement – Where is it going?

- What has changed over the past five years on functional size measurement?

In the mid 90's Function Point Analysis was proposed for international standardization.

- What happened?

The national legal authorities at ISO (and their respective national functional size measurement experts)…

- agreed on the expected benefits of functional size measurement
- did not agree that Function Point Analysis was the unique solution
- set the criteria for controlling the quality of functional size measurement methods,

and, through these actions, facilitated:

- the progressive recognition as ISO standards of the measurement methods with enough documented strengths (MkII FPA, IFPUG, NESMA)

- the emergence, and official recognition, of a second generation of functional size measurement method (COSMIC-FFP)

- the integration of functional size measurement within the software engineering standards infrastructure (assessment models and frameworks, plus individual standards related to management and measurement) to ensure that the technology fit did materialise.

This should result in increasing awareness of functional size standards not only to software people but also to all levels of management in software intensive organizations (for example, through ISO 9000-3).

6 COSMIC-FFP.

6.1 Its design and its acceptance as an ISO standard

COSMIC-FFP has been designed:

- to meet the constraints of the many new and complex types of business and real-time software, as well as the business application software served by first generation functional sizing methods

- to fit into the international regulatory environment (as an ISO standard)

- to be easy to train, understand, and use with consistency (key models of COSMIC-FFP are well structured and described to facilitate understanding without recourse to numerous inter-related rules and exceptions)

- to facilitate automated sizing (that is, simple enough to define interpretation rules for tool specifications, and for a variety of development paradigms)

- to fully meet the data collection rules of the established measurement repositories

- to facilitate the development of approximate size estimation on the basis of requirements as they emerge early in a project's life.

6.2 COSMIC-FFP in January 2004

Where is COSMIC at today – January 2004?

- It has been translated in multiple languages and adopted either as national standards (e.g. Spain) and/or by user groups (e.g. JFPUG in Japan).

- Its integration into the international regulatory infrastructure has been finalized

- It is a recognized as an international standard for data collection in the ISBSG repository for benchmarking and estimation studies.

- A project to establish industry benchmarks in progress in collaboration with the ISBSG (International Software Benchmarking Standards Group)

- Software tools are being designed for:

    - Automation of COSMIC-FFP measurement as one of the functions of a development platform

    - Support of manual measurement to improve the consistency of the measurement results

- Research community:

    - COSMIC-FFP is already a recognized field of research in measurement (including at international conferences such as METRICS-IEEE)

6.3 Key needs for 2004+

- Develop techniques for early size estimation (already in progress – in both industry and academia)
- Improve understanding and definition of software layers and tiers for measurement purposes
- Integrate within the education infrastructure; all software engineers should graduate with a working knowledge of measuring with COSMIC-FFP
- Support tool automation (and publicize)
- Develop the basis for certification of measurers and accreditation of trainers
- Develop an international repository of case studies
- Develop estimating processes for project effort and duration
- Develop guidelines for taking reuse into account, for productivity studies and estimation

7 Key competitive advantages of COSMIC-FFP

- Free: as for any classic measures in science and engineering, it is in the public domain
- Full ISO recognition
- Simplicity of its design
- Flexibility of application for a very wide range of software
- Ability to capture size from multiple viewpoints on software
- Compatibility of its underlying concepts with modern software engineering concepts

8 Temporary disadvantages

- Not yet mainstream:
  - currently being picked up and applied by the early adopters;
  - mainstream will follow, with some lag.
- Catch-up to do in data collection in international repositories
- Completion of tools to support industry
- US market:
  - IFPUG community: if it remains content with its existing methods, it will be the last to seek improvements
  - But the Non-IFPUG community is looking for a solution to its measurement needs
  - And SEI type assessments (CMMi) will strongly influence measurement in industry, and COSMIC-FPP will be seen to be the only viable option.

9 Conclusion

Performance measurement and benchmarking is a major concern of the software industry, and software estimation is a challenge that most software organizations are still struggling with after so many years, to the point that success in this technology has become a key competitive advantage.

There is a tremendous need for a measurement method to support software performance measurement, benchmarking and software project estimation, especially as more and more software is contracted out to third party suppliers.

And if it becomes known and recognised that a method such as COSMIC-FFP can contribute to improving measurement and estimation processes, it will have a major impact in software engineering.

But…

- How many software organizations have such successful measurement programs today?
- What is really the market share?

Most probably: a very small minority!

- Does it mean that organizations which do not yet measure should not measure because most of the market does not do so?

- Does it mean that these organizations think that measurement is useless in business?

Certainly not:

- They indeed have all kinds of measurements for every single department of their organisation (except the software department, of course), and they even pay dearly for it, for instance, through their accounting systems.
- Furthermore, the data collection is expensive, the reporting requirements are tremendous, controls are everywhere and they need all kinds of accounting specialists (and pay even more dearly for external accounting consultants), and every person throughout the organization collects data manually!

It is then obvious that it is not cost that impairs measurement use, nor manual data collection, nor the time it takes.

There is of course something else at work.

- What is it?

These measurement *technologies* meet the needs, there is a widespread *know-how* about these measurement *technologies*, and these measurement *technologies* are integrated within the (technology) infrastructure and it is part of the regulatory environment.

Then….

- What about functional size measurement in the software engineering community?

COSMIC-FFP, with its significantly improved technology features, …

- is meeting a much greater share of software technology measurement needs
- is intgegrated within the regulatory environment.

What is still missing is the *know-how* about it.

It is therefore up to you:

- to acquire such measurement *know-how*
- and run with it for the benefits of you organization!

For more information and background about functional size measurement and the COSMIC-FFP method, see the Appendices A and B

- Appendix A: Functional Size Measurement and International Standards

The new COSMIC-FFP method of sizing the functional requirements of software was approved as an International Standard (ISO/IEC 19761:2003) in early 2003.

For software developers, the ability to measure a size of software from its functional requirements or specifications early in the life of a project is a first key step for estimating development effort. Further, as the size measure is independent of the technology used, it provides a key component for software project performance measures such as productivity, defined as 'size / effort'.

Three other methods (IFPUG, originating in the USA, the MkII FPA method from the UK and the NESMA method from the Netherlands) have also been approved by ISO. These three 'first generation' functional sizing methods were all designed 15 – 25 years ago to work for business application software. They are used in that domain for performance measurement, estimating, benchmarking, etc. and in outsourced software contracts to control scope and price/performance.

Developers of other types of software have had to use counts of Source Lines of Code (SLOC) as their size measure. But as this size is only known accurately after the software is complete, it is difficult to use for estimating. And being technology-dependent, SLOC counts are difficult to use for performance comparisons, especially across multiple technologies.

To meet these challenges, the 'second generation' COSMIC-FFP method was designed from the outset to measure the functional size of real-time, multi-layered software such as used in telecoms, process control, and operating systems, as well as business application software, all on the same measurement scale. Such wide applicability is unique and a break-though for the world of software project performance measurement and estimating.

The COSMIC-FFP method has progressed from the germ of an idea to approval as an International Standard in the extremely short time of four years. The method is the first success of COSMIC, the COmmon Software Measurement Consortium, a team of software measurement experts from Europe, North America and Asia/Pacific. The method has been extensively tested and is now becoming increasingly used, especially in the real-time world. Having been developed in the last few years, the method is compatible with modern specification methods such as UML, and with OO techniques.

The ISO/IEC 19761:2003 standard for COSMIC-FFP can be purchased directly online from ISO at www.iso.ch. * The COSMIC Implementation Guide for ISO 19761 can be downloaded free-of-charge from: www.lrgl.uqam.ca/cosmic-ffp/manual.htm

For more information: www.uqam.lrgl.ca/cosmic-ffp, or www.cosmicon.com.

* The full ISO URL address for purchasing the official standard is:

http://www.iso.ch/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=33899&ICS1=35&ICS2=80&ICS3=

Appendix B: More Background on COSMIC-FFP – ISO 19761

COSMIC, the COmmon Software Measurement Consortium. was founded in late 1998 as a voluntary association of software measurement experts from Australia, Canada, Finland, Germany, Ireland, Italy, Japan, Netherlands and the UK. It is headed jointly by Professor Alain Abran of the École de Technologie Supérieure in Montreal, Canada, and by Charles Symons of Software Measurement Services Ltd in the UK.

The COSMIC-FFP method ('FFP' stands for 'Full Function Points') was submitted to ISO as a candidate for International Standardisation in mid 2000 and progressed through the full process in just 18 months.

In addition, the COSMIC group has set-up a Measurement Practices Committee (MPC) to deal with the evolution of the method itself.

Who is using Cosmic-FFP?

Companies are usually cautious to acknowledge publicly their use of a method until they are completely confident in its use. So few names have gone public on their use of COSMIC-FFP so far.

Initially, there was a particularly strong take-up in the world of real-time software, where functional sizing methods have not been previously available. Some known examples include:

- Nokia (Finland) and another of Europe's largest telecoms manufacturing companies have adopted the method, and one is advanced in developing its estimating methods. One person commented that he was 'astonished' at the correlation of functional size measured by COSMIC FFP and development effort in their environment.

- Nippon Telephone and Telegraph, the major Japanese telecoms operator (at CMM Level 4) has recently reported that from measurements with a dozen projects it has found a coefficient of correlation between size, measured with COSMIC FFP, and effort of over 90%.

- A major European defence contractor has successfully applied the method to size its avionics use of the method for business application software has been less urgent as existing functional sizing methods have worked adequately in this domain. However, it is noticeable that in 2003, several banks and insurance companies who need a method that will work for all layers of their infrastructure software have started to use the method. Rabobank in the Netherlands is one such organisation.

    - - The research laboratory of the University of Quebec at Montreal (UQAM), has completed the first phase of a project for a USA Regulatory Commission for safety critical systems in which COSMIC-FFP was used as a key methodology in the quality assessment of functional requirements.