

WHY YOU MUST CHANGE TO COSMIC FOR SIZING AND ESTIMATION

Jayakumar K R

Amityssoft Technologies, Chennai, India

jayakumar@amitysoft.com

Abstract

Estimation based on functional size is found to be more accurate and enable performance measurement and benchmarking. None of the existing software size measurement techniques is practically relevant, mathematically correct and applicable across all domains, other than the COSMIC. Many functional size measurement specialists have found that IFPUG Function Point Analysis (FPA) is less effective when measuring software, even when it is applied in its traditional MIS domain for which it was designed. *Results from industry demonstrate that the COSMIC measures can be used successfully for productivity monitoring and estimating, where other measures have been tried and were found to be lacking.* Whether you are looking at functional sizing for the first time or using any other method, if you do not adopt COSMIC, you are missing to exploit the game changing innovation!

1. Predators in the waiting

Development of new applications whether it is in business domain or in real-time domain have become complex with the advent of new technologies and development strategies. Multi layer/ multi-tier architecture with complex legacy integrations characterize the business application scenario. New devices and innovations in electronics often demand new embedded system software for effectively integrating them into end use system.

Object Oriented Analysis & Design (OOA/D) and Agile methodologies have invaded the software development life cycle landscape enjoyed by water fall. Data base management systems are evolving into data analytics powered by data ware housing and mining capabilities. Service Oriented Architecture and Cloud computing are defining the way software is developed and made available to end users.

Majority of the revenues in IT services is driven by software maintenance and support. Challenges of patching the existing system and improving their performances without access to the documentation of the whole system combined with delivering to stringent service levels are major concerns

in outsourcing scenario. Often, several of the change requests necessitate adopting new technologies, thus making the job of maintenance and support complex.

Customer demand for quality and predictability are at all time high. Customer expectations go beyond the delivery to the benefits derived and supplier innovations. Consistent and continuously better delivery has to be ensured to sustain contracts, where predators in the form of competitors are waiting to grab the customers.

2. Size, the costliest driver

The quantity of functional user requirements signifies the size of software. Functional size, as opposed to sizes such as the Lines of Code in terms of KLOC or number of programs is essential for productivity measurements and to benchmark with other organizations. Sizing enables building dependable predictability model.

Analysis of data from International Software Benchmarking Standards Group (ISBSG) reveals that when functional size based techniques are used for a cost estimate, the estimates are accurate most of the times compared to other approaches such as work break down [1]. Size remains as the single

largest cost driver in estimation and performance measurement.

Measurement of size using practically relevant, technically correct and simpler method is crucial in the current software development and maintenance scenario. While there exists an aging IFPUG Functional Point Analysis (FPA) and a couple of other sparingly used methods to measure size, I will focus on COSMIC, the game changing innovation in sizing and compare it predominantly with FPA for you to make your own conclusions.

3. COSMIC on a strong foundation

Charles Symons after spending several decades on measurements of software applications using FPA came out with Mark II Function Point method in 1990s to improve upon FPA. Originally proposed by Alan Albrecht in 1970s, FPA sustained due to valiant efforts of IFPUG (International Function Points User Group). It started becoming increasingly irrelevant with the emergence of client server and the Internet.

Alain Abran, a senior professor in Canadian University with industry background was disappointed with application of functional sizing for real-time systems and came out with Full Function Points in 1995 to address measurements in real-time domain. Being an academican, he also wanted the method to be mathematically correct. Meeting of these two minds – Charles Symons with practical approach to software sizing & estimation and Prof. Abran with academic brilliance and aspiring to extend the sizing to real-time domain resulted in the birth of COSMIC.

Unlike the way in which most of the other methods were pronounced, these two experts instead of working at their offices and announcing a new method to the world, conceived it as a project and involved measurement specialists from around the globe as members. The team later came to be known as COMmon Software Measurements International Consortium with COSMIC being its acronym, delivered the initial version of method called

COSMIC FFP. Being a project, there was a project charter with defined goals and milestones including ‘testing’. Japanese from car industry who know better how to carry out correct tests of new measurement instruments including software were involved during the piloting phase prior to the release of initial version in 1999.

COSMIC functional sizing method was seen as new generation functional sizing method and was immediately received by the early adopters due to its simplicity, applicability across domains, adoptability to current development methodologies and technologies besides its mathematical correctness.

COSMIC was also accepted as an ISO standard (ISO/ IEC 19761) in 2003 and soon became one of the measures to be used by ISBSG for benchmarking. In a little over a decade of its existence, COSMIC has seen three major versions and the last major 3.0 release was in 2007 followed by minor releases during the last three years.

During this entire period, COSMIC retained its original DNA and only the documentation underwent changes to bring in clarity and to remove ambiguity besides restructuring to address different types of audiences. It also dropped its suffix ‘FFP’ from its name and became just COSMIC. The natural applicability of COSMIC method, invented before the advent of the current century, to today’s Service Oriented Architecture reveals its strong foundation.

Don’t you think that foundation matters the most, when you want to build your mission critical software applications?

4. Measurement Scale

Let me start the argument with something as basic as the scale of measurement. FPA uses Nominal/ Ordinal scale for measurement. While calculating complexity ratings in FPA, weights are assigned to Low, Average and High complexity levels in such a way that intervals between Low & Average and Average & High are not equal. There is around two fold increase between

Low and High complexity, the specific values being different for different Base Functional Components (BFCs) such as Internal Logical File, External Interface File etc.

There is also a pertinent question as to the basis for weights such as 7, 10, 15 assigned to Low, Average and High complexity levels for a BFC. These weights were derived by Albrecht from correlations between measures of 'size and complexity factors' for projects developed in the period 1974-83 referring to several internal IBM estimating guidelines of that period. Data from 22 IBM projects, 16 of which were developed using COBOL were used to arrive at the above weights [2]. The world has changed a lot during the last 5 decades!

COSMIC, on the other hand uses a ratio scale of measurement. Like all physical measurements which are based on ratio scales such as length, weight and height, wherein we can meaningfully say that 100 Kg is twice as heavy as 50 Kg, functional sizes arrived using COSMIC can similarly be visualized for its scale. This leads to application of statistical techniques such as mean, median, mode, standard deviation, chi square, percentile, correlation, regression, analysis of variance, geometric mean, harmonic mean, coefficient of variation and logarithms for metrics using COSMIC functional size.

FPA, as it uses Nominal & Ordinal Scale yields only to median, mode, chi square and percentile calculations. FPA size data can be ranked but quantifying differences between size values is not possible due to 'cut off' weights [3].

If you are into building predictability models for achieving higher maturity levels expected by CMMI, you need to be more careful in applying right statistical techniques. It is essential to decide whether you want to use a method wherein you can visualize the relative sizes meaningfully and apply a host of statistical techniques or not.

5. Non functional Confusion

Functional sizing methods are expected to capture the size of the software derived by quantifying the functional user requirements. Functional user requirements describe the functionality delivery by the software to its users. They describe information processing requirements and exclude technical and quality requirements as per the International Standard ISO 14143 which is a Meta standard for functional sizing methods. There is no scope for non functional requirements here. A truly functional sizing method should conform 100% to ISO 14143.

FPA gets into adjustments to the size measure by applying a Value Adjustment Factor (VAF). This factor aims to measure the contribution of 14 technical and quality requirements to size, which are actually non functional in nature. When FPA was submitted for ISO standardization, it was accepted with exception to this adjustment business. Size of software can not change due to its non functional attributes. Non functional characteristics, of course play a role in estimation model, but size has to be measured independently. Further, the 14 technical and quality requirements are measured by assigning a value between 0 and 5 that paves way for inconsistency.

If you are already a user of FPA, you can possibly take a decision to stop the counting with unadjusted function point count. But what happens to your estimation model based on historic data, if it is based on FPA applying adjustments related to non functional requirements?

If you are getting into a functional sizing using FPA for the first time, then stopping with unadjusted count can be an option provided you are prepared to build your estimation model based on it. COSMIC is the only functional sizing method which meets all requirements of ISO 14143 without non functional confusion.

Is not ignoring COSMIC a highly functional method, a costly mistake?

6. Scope for domain

The nature of long term contracts can overlap several domains in the large outsourcing deals, where a particular business processes of the customer has to be taken care of by the vendor irrespective of types of applications that the business may demand. Pam Morris [4] observed that measuring all the software and not just MIS type is critical in monitoring productivity and performance monitoring in outsourcing contracts. Functionality delivered by real-time, infrastructure software, tools and utilities are different from that delivered by MIS applications.

The engagement that an organization gets into may warrant both MIS and real-time domain applications, as real-time software that drives a device also processes/ stores data and business applications often integrate with real-time devices. Software for process control, device driver software, software for embedded systems and software used for avionics fall under the scope of real-time. One would naturally expect a consistent way of measuring the size irrespective of the domain.

Real-time world largely depended on the lines of code based sizing and estimation as they find application of FPA not conducive to the characteristics of their domain. Lines of code based estimation is non functional in nature and is technology dependent. The only functional sizing method that works across domains such as MIS or real-time or complex business applications spanning multiple layers/tiers is COSMIC. Irrespective of whether the software is a system or an application or a utility or a tool or a component, it can be sized using COSMIC.

There is no alternative to COSMIC when it comes to domain independence and hence you need to examine whether it is wise not to adopt COSMIC!

7. Agility, the need of the hour

Use Cases, OOA/D, Incremental development and agile have invaded the software development life cycle arena, where water fall with all its variants still find a place. The sizing method should go in line with the approach chosen for development, for the users to adopt and practice consistently. COSMIC is compatible with modern methods of requirement analysis while FPA is based only on 1975-85 based data model concepts. FPA is designed for MIS systems with flat, indexed files, batch systems and OLTP systems and one has to use the mapping rules for Relational DBMS. There is a good correlation to Use Case Scenarios and Interaction Sequence Diagrams to the concepts in COSMIC, resulting in size actually becomes a by-product of requirements analysis. [5]

Agile methods such as Scrum, is fast spreading into every organization. User story serves as specification of requirements and are sized using either values from Fibonacci series or powers of 2. Story points thus arrived at are not standardized and are not stable over the duration of a project. They only estimate the effort input and as such can not be used to derive productivity, velocity or defect density that can be benchmarked with other organizations. The better alternate is to size user stories in terms of COSMIC functional processes as demonstrated by Grant Rule [6].

Whether you use Agile, OOA/D, incremental or the ever-green Waterfall, when COSMIC neatly fits into your scheme of things, is it worth attempting on anything else?

8. Future proved

While we struggle to relate 'Files' and 'External inputs/ outputs' of FPA, COSMIC directly maps to the way software is engineered today. While the FPA appears more like an old building that is not yet fallen, thanks to the guidelines for interpretations serving as scaffoldings,

COSMIC is able to support emerging software technologies and development methodologies. During the first decade of COSMIC there were new developments to the likes of SOA, Cloud computing in technology arena. It has now been found that COSMIC can be applied to SOA based software development. Data mining has gained prominence during recent times as data analytics has become important. Documents from COSMIC on SOA and Data warehousing convincingly demonstrate mapping of COSMIC to Data warehousing and SOA. [7] [8]

Even though COSMIC measurement method has not been designed to take into account functionality of mathematically intensive software characterized by complex algorithms, recent application of COSMIC has proved otherwise. So, if you are into developing software with complex rules as in expert systems or simulation software or processing continuous variables, you can give a try with COSMIC, while it is a clear 'no' with any other functional sizing method. This has lead COSMIC to publish a Method Update Bulletin [9], which proposes to replace 'Non-applicable domain' with 'Possible limitations on applicability' which encourages users to try out COSMIC.

If you want to invest on a method, which is future proof, do you think there are any other alternatives?

9. Taste of pudding

There are plenty of user experiences strongly in favor of COSMIC irrespective of whether the domain is Business Applications or Real-time systems.

In fact, one of the earliest applications of COSMIC was a replacement for FPA at Rabobank. They were challenged by the need to measure the 'change' when their existing application was to be web enabled. They wondered what the change in functionality was as required by FPA to measure. The core functionality remained same and only a new mode of delivery of service through the Internet was to be

introduced. COSMIC helped exactly in this context according to Frank A Vogelesang[10] as it can peep through various tiers when required for sizing.

Nortel reported major improvement in estimating accuracy resulting in better decisions on release content and time to market.

The size measured using COSMIC known as CFP (COSMIC Function Point) on the basis of final agreed specifications is used to fix a "price-per-unit-size" that remains fixed for the duration of the contract with suppliers by Taxation and Customs Union Directorate of the European Commission in Brussels, Belgium.

Luca Santillo of Informatica Trentina agrees that COSMIC has proved excellent for measuring business application projects implemented with modern architectures with and without significant batch components.

A Scandinavian IT giant which supplies software and services throughout Europe and USA has selected COSMIC as a preferred means of sizing requirements in order to improve planning, estimating and to support high-maturity CMMI practices such as organizational process performance model after trying out with SLOC and FPA as alternative approaches.

Estimation based on COSMIC sizing reduces uncertainty, enables bid teams to better understand the commercial risk of proposed solutions according to Atos Origin, which has integrated COSMIC into overall approach suitable for estimating in a tough, competitive and commercial environment. COSMIC was easily adopted here due to simplicity of the method and ability to size real-time and infrastructure software as well as business applications.

The development center of Computer Sciences Corporation (CSC) with around 14000 staff in India out of about 95,000 global staff cites ease of use, estimation accuracy and client appreciation as the major benefits from adopting COSMIC for sizing Java and main-frame software.

Prediction models based on COSMIC at the project level as well as at the organization level resulted in 'the estimated effort being very close to the actual effort' according to CSC.

Do you still need more proof?

10. Data at rest, do we trust?

The much talked about half a century of data from FPA measurements is considered to be its strength, the data generated by using FPA with all its flaws and limitations. While FPA based project data is really at rest, COSMIC based project data is gaining positive momentum. COSMIC size based project data from around the globe are periodically submitted for benchmarking. ISBSG has published COSMIC benchmarking report which indicates growing acceptance of COSMIC.

COSMIC functional size measures have been successfully used with estimation methods such as Regression Analysis, Estimation by Analogy, COCOMO and Putnam Norden Rayleigh (PNR).

Estimation tool vendors too have integrated COSMIC sizing with their tools, not to loose out on the market share. KnowledgePLAN from Software Productivity Research, MeterIT from Telmaco and SEER from Galorath are popular tools with interface to COSMIC sizing.

Whether you want use published data or use an estimation tool or build your own estimation model or any combinations of these, COSMIC has a better edge, if you are concerned with accuracy.

It is not too late, if you want to move ahead with COSMIC!

11. Conclusion

It is left to you!

Significant advantages of COSMIC

- Applicable for all types of projects (new development, enhancements, maintenance, etc.)
- Produces statistically significant results
- Can be applied early in the development life cycle
- Compatible with latest software engineering methodologies – OOAD, UML, Use cases besides traditional development methodologies
- COSMIC can be used in agile approach to software development using 'Scrum' and story based or test driven development
- Used in developing Data ware housing applications and hence in data analytics
- Used in Service Oriented Architecture (SOA) platform applications paving way for cloud computing

Distinctions of COSMIC

- Completely 'open source'. Manual, Guidelines, case studies, papers are freely accessible from the web portal.
- Only method applicable for all types of software (scientific, business applications, web portals, embedded systems, OS, Avionics etc.)
- Simplest among the existing methods for measurement of Functional size.
- First method to be adopted as an ISO Standard in fast track mode and has been announced as ISO/ IEC 19761

- Only method 100% compliant to ISO 14143, a Meta standard for Functional Sizing Methods.
- ISBSG publishes bench mark reports based on COSMIC size measurements
- COSMIC has been increasingly adopted by many software suppliers around the globe including Indian software houses.

About COSMIC

A group of software metrics experts, participating in the ISO Working Group established COSMIC, the Common Software Measurement International Consortium (www.cosmicon.com). Prof. Alain Abran, author of Software Engineering Body of Knowledge (SWEBOK), IEEE and Head, Software Engineering Lab, University of Quebec, Canada serves as the Chairperson. Charles Symons, inventor of Mark II Function Point Analysis serves as President of the COSMIC. Measurements Practices committee consisting of experts from around the globe and International Advisory Council consisting of representatives from various countries constitute the organization structure of COSMIC. COSMIC has announced International Certification Examination which is held in several countries.

Benchmarking Standards Group, www.isbsg.org, pp 24, February 2005

- [2] Cigdem Gencel, From performance measurement to project estimating using COSMIC functional sizing, SMEF 2009
- [3] Grant (PG) Rule, 'The most common Functional Size Measurement (FSM) Methods compared, , Software Measurement Services, 2010
- [4] Pam Morris, Measuring ALL the software not just what the Business Uses, IFPUG Fall Conference, Sep 1998
- [5] Malcolm S Jenner , COSMIC FFP 2.0 and UML, UKSMA Conference, October 2001.
- [6] Grant (PG) Rule, Sizing User Stories with the COSMIC FPA Method, Software Measurement Services, September 2010, www.measuresw.com
- [7] Harold van Heeringen, Guideline for sizing Data Warehouse Application Software, COSMIC, www.cosmicon.com, May 2009.
- [8] Peter Fagg, Guideline for sizing Service-oriented Architecture Software, COSMIC, www.cosmicon.com, April 2010
- [9] COSMIC Method Update Bulletin #8, Proposal to remove limitations on the scope of applicability of the COSMIC Method v3.0.1 as defined in the 'Measurement Manual', www.cosmicon.com September 2010.
- [10] Frank A Vogelesang, Implementing COSMIC as a replacement for FPA, IWSM, MetriKon, 2004

Acknowledgements

The Chairperson, The President of COSMIC and the members of Measurement Practices Committee (MPC) and the members of International Advisory Council (IAC) have shared quite a lot of information without which it would not have been possible for me to make such a strong case for COSMIC. I gratefully acknowledge inputs from all of them.

References

- [1] Peter R Hill, Practical Project Estimation, 2nd Edition, 2005 International Software