

# RUN-TIME MEASUREMENT OF COSMIC FUNCTIONAL SIZE FOR JAVA BUSINESS APPLICATIONS: IS IT WORTH THE COST?

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# Software Size Measurement

- Measurements done during product implementation (or coding) can be used for evaluating the project progress by making comparisons between planned and actual software sizes.
- The values can be stored within the scope of historical data that belongs to project team for future use in later project planning efforts.
- Software errors are normalized according to functional sizes for making quality comparisons among different software products.

# Research Topic

- Run-time measurement of COSMIC functional size for Java business applications
  - A.A.Akca and A.Tarhan. Run-time Measurement of COSMIC Functional size for Java Business Applications: Initial Results, in proceedings of IWSM-Mensura 2012, pp. 226-231, IEEE CPS, 2012.
    - A semi-automatic measurement method and library
    - It is observed that semi-automatic and manual measurement values are 92% convergent.
    - The ratio of added lines of code is 2% of the whole application in this study, but the cost-efficiency is not mentioned.
- This study addresses;
  - **Is the method worth the cost?**

# Related Work

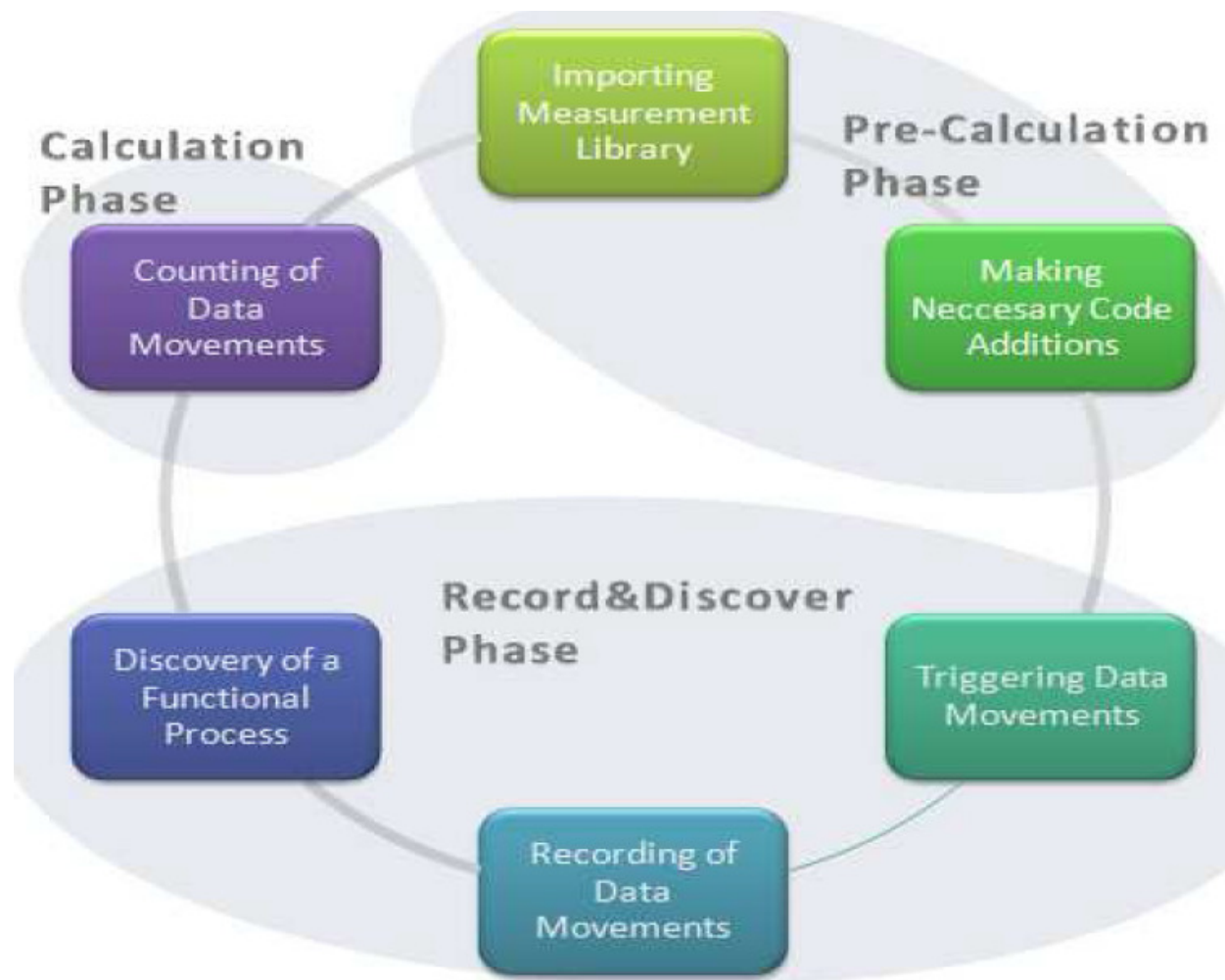
- A number of studies exist for automatic size measurement, most of which aim size measurement from analysis/design models or documents.
- Limited number of studies on the effort required for size measurement
  - A. Abran, R. Meli, and C. Symons, “COSMIC-FFP (ISO 19761) software size measurement: State of the Art”, Software Measurement European Forum (SMEF2004), Rome, Italy, January 28-30 2004
  - Condori-Fernández, N., Pastor, O.: Evaluating the Productivity and Reproducibility of a Measurement Procedure. In: ER Workshops, pp. 352–361, 2006
  - G. Robiolo , How Simple is it to Measure Software Size and Complexity for an IT Practitioner?, Empirical Software Engineering and Measurement (ESEM), Sept 22-23, 2011

# Measurement Library

- Measurement Library is set up within the frame of the rules according to COSMIC method and it enables automatic measurement.
- It can be used by being imported from a three-tier Java business application and by making small code additions into the application for calling methods.
  - Additions to the code to use the library will affect only the GUI and database (DB) tiers. No updates are required to be made to the business tier of the application.

Measurement
-ID : String
+FunctionalProcessIndex : int
-EntryTime : long
-DbTime : long
-ExitTime : long
-EventID : List<Integer> = new ArrayList<>()
-functional : List<FunctionalProcess> = new ArrayList<>()
+NotifyEntryMovement(evt : ActionEvent) : void
+ControlID(id : int) : int
+NotifyDBMovement(query : String) : void
+NotifyExitMovement() : void
+CalculateCosmic() : void

# Semi-Automatic Measurement Method



# Research Questions

- **RQ-1: Is the suggested method cost efficient in measuring functional size of newly developed applications?**
  - RQ-1.1: Is the suggested method cost efficient in measuring functional size of newly developed applications when it is used by someone who is not familiar with COSMIC method?
  - RQ-1.2: Is the suggested method cost efficient in measuring functional size of newly developed applications when it is used by someone who is familiar with COSMIC method?
- **RQ-2: Is the suggested method cost efficient in measuring functional size of previously developed applications?**
  - RQ-2.1: Is the suggested method cost efficient in measuring functional size of previously developed applications when it is used by someone who is not familiar with the application?

# Case Study Design

- Three case studies, named A, B, and C, are designed
  - **The case studies A and B are prospective studies** and conducted relating to RQ-1
    - CS-A: A software developer (Developer-1), who had no knowledge about measurement of functional size and use of Measurement Library, integrated and used the library from the onset of the “Internet Banking-1” application that he implemented by the help of “User Guide for Measurement Library”.
    - CS-B: A software developer (Developer-2), who is an expert of COSMIC measurements, implemented “Internet Banking-2” application which has same functionality as the application implemented in CS-A.
    - In both case studies, code addition costs and manual measurement costs are recorded at certain times.
  - **Case Study C is a retrospective study** and conducted relating to RQ-2.
    - A previously implemented “Hospital Appointment System” application is tackled. This time, the cost efficiency of semi-automatic size measurement was compared to manual measurement in an application whose implementation was already completed by a developer external to the case study.



# The Results of CS-A

TABLE II. CASE STUDY A - TIME MEASUREMENTS

CASE STUDY A	Cost of Application Implementation	Cost of Measurement Library Utilization (Code addition)	Cost of Manually Performed Measurement *
MEASUREMENT 1	7 h 15 min	42 min	2 h 10 min
MEASUREMENT 2	13 h 55 min	57 min	3 h 15 min
TOTAL AMOUNT OF TIME	17 h 25 min	1 h 10 min	4 h 15 min

\* Manual measurement is performed by Developer 2 (Cosmic Expert).

Functional size measured is 39

# The Results of CS-B

TABLE IV. CASE STUDY B – TIME MEASUREMENTS

CASE STUDY B	Cost of Application Implementation	Cost of Measurement Library Utilization	Cost of Manually Performed Measurement
MEASUREMENT 1	5 h 20 min	4 min	25 min
MEASUREMENT 2	10 h	15 min	1 h 10 min
TOTAL AMOUNT OF TIME	14 h 30 min	25 min	1 h 35 min

Functional size measured is 39

# The Results of CS-C

TABLE VI. CASE STUDY C – TIME MEASUREMENTS

Measurement Conducted	Cost of Application Implementation	Cost of Measurement Library Utilization	Cost of Manually Performed Measurement
Hospital Appointment System	Unknown	6 h 10 min	5 h 20 min

Functional size measured is 46

# Comparative Results



Figure 3. Cost Savings of Semi-automatic Measurements compared to Manual Measurements in the Case Studies

# Threats To Validity

- As the internal threat to validity; in CS-B, Developer-2 implemented the software and conducted manual measurement because there was no other COSMIC expert around. This made Developer-2 familiar with the software, and because of this reason, the manual measurement results are quite different for CS-A and CS-B.
- As the external threat to validity; the sizes of applications in the case studies are relatively small and the results may change for bigger applications. It is therefore not feasible to generalize the labor gaining results because of the size and scope of the case studies.

# Conclusions & Future Work

- The utilization of Measurement Library is **cost-efficient when it is integrated early into the product implementation**. The values obtained in the studies reveal that up to 280% labor force gain is possible by semi-automatic measurement compared to manual measurement.
- The utilization of the Measurement Library **does not present cost efficiency in the case that the software developer is not familiar with the architecture of the code and its functions**. The library is seen to linger the semi-automatic measurement process.
- Future studies aim to automate code addition operations for the utilization of Measurement Library made under the scope of “Pre-Calculation Phase” as well as to automate data movement triggering actions on user interface under the scope of “Record and Discover Phase”.