Research in Software Measurements

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List of topics

- Introduction
- Current status
- Convertibility
- Tools Survey
- Innovative uses in quality
List of topics

- COSMIC - Introduction:
  - History
  - Key Concepts
  - Examples of uses for benchmarking and estimation

- Current status
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Evolution of Functional Size Methods - ISO standards

- COSMIC FFP V. 2 → V. 3
- IFPUG 4.0
- Full FP's V.1
- MkII FPA 1.3
- 3-D FP's
- Feature Points
- Allan Albrecht FPA

Concurrent Viewpoints

Customer

Supplier

Users

Functional Requirements

User Requirements

Software Functional Size

Outsourcing Company

Software Layers
Measurement Viewpoints

COSMIC can handle all the viewpoints: You must select the relevant one, and document it when recording the measurement results.

Examples:

– Supplier
– Customer
– Human
– Sub-contractor,
– Etc.
**COSMIC model of software FURs**

F.U.R.

**Software**

- Functional process type

**Sub-process types**

- Data movement types
- AND
- Data manipulation types

*Functionality = Data movements and Data manipulations*
The COSMIC model of software FURs focuses on Functional Unit Representations (F.U.R.).

- **Software** is divided into **Sub-process types** and **Functional process types**.

- **Data movement types** involve only a reasonable approximation, assuming each data movement has an associated constant average amount of data manipulation.

- The **Functionality** is defined as the sum of data movements and some processing:

  \[ \text{Functionality} = \text{Data movements} + \text{some processing} \]
User view of software functional requirement components

- Users
  - OR
  - Engineered devices
  - OR
  - other Software

- Boundary
  - DATA IN ('ENTRY')

- Software
  - STORE PERSISTENT DATA ('WRITE')
  - DATA MANIPULATION OR TRANSFORMATION
  - RETRIEVE PERSISTENT DATA ('READ')
  - DATA OUT ('EXIT')
Boundary: example 1

NOTE: Each piece of software is the user of the next piece across their shared boundary.
Boundary: example 2

NOTE: All physical devices and the “Input & Display” software are users of the “controller” software.
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Web-based linguistic Software
(15 projects)

Source: Abran, Silva, Primera 2002
Web-based Linguistic Software Regression Model - 1 Variable: Size in Cfsu
N = 15 projects

Source: Abran, Silva, Primera 2002
Defence - Real-time Software N = 14 projects
Multiplicative model with Size and Difficulty

\[ y = 0.6396x + 41.005 \]
\[ R^2 = 0.4706 \]

\[ y = 4.4917x + 82.949 \]
\[ R^2 = 0.7787 \]

Source: Abran, Silva, Primera 2002
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Current Status

- ISO standard 19761
- Recommended in ISO 90003
- Recognized as a standard for benchmarking data collection:
  - International Software Benchmarking Standards Group – ISBSG
- Available free on the web
  - www.gelog.etsmtl.ca/cosmic-ffp
- Certification – Entry level
- 2006 Award Medallist – British Computer society
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# Convertibility Studies

<table>
<thead>
<tr>
<th>Source</th>
<th>Convertibility Equation</th>
<th>$R^2$ Max=1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fetcke 1999</td>
<td>$Y_{(Cfsu)} = 1.1 \times (UFP) - 7$</td>
<td>0.97</td>
</tr>
<tr>
<td>Letherthuis 2003</td>
<td>$Y_{(Cfsu)} = 1.2 \times (UFP) - 87$</td>
<td>0.99</td>
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<tr>
<td>Desharnais 2005</td>
<td>$Y_{(Cfsu)} = 0.84 \times (UFP) + 18$</td>
<td>0.91</td>
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<tr>
<td>2006</td>
<td>$Y_{(Cfsu)} = 1.0 \times (UFP) - 3$</td>
<td>0.93</td>
</tr>
</tbody>
</table>
Figure 4: Convertibility model on Total FPA Size (N=14)

\[ y = 1.0x - 3 \]

\[ R^2 = 0.93 \]
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<thead>
<tr>
<th>FSM Key Dimensions (4)</th>
<th>Tool Categories (10)</th>
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<tbody>
<tr>
<td>A) Measurement Support</td>
<td>- Documentation</td>
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<tr>
<td></td>
<td>- Training</td>
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<tr>
<td>B) Measurement</td>
<td>- Data Collection &amp; Calculation</td>
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<td></td>
<td>- Expert System for Measuring</td>
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<td></td>
<td>- Automatic Measurement</td>
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<td>- High-Level Sizing</td>
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<tr>
<td>C) Storage</td>
<td>- Software Measurement Repository</td>
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<td>D) Utilization</td>
<td>- Estimation &amp; Prediction</td>
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<td>- Project Management</td>
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<td></td>
<td>- Evaluation (Benchmarking, etc.)</td>
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## Tool Categories (10)

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<tr>
<th>Tool Categories (10)</th>
<th>COSMIC Xpert</th>
<th>ISBSG</th>
<th>MeterIT-Cosmic MeterIT-Project PredictIT</th>
<th>Experience Pro</th>
<th>Knowledge Plan</th>
<th>SIESTA</th>
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<tbody>
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● **Major gap in automation**

● **Research prototypes in progress:**
  
  ● **XForms-Format** – Li – Waseda U.
  
  ● **µcROSE, ROOM** – Diab et al. U. Sherbrooke
  
  ● **COSMIC-RUP** – Azzouz – UQAM-ETS
  
  ● **Ontological formalization** – Bevo – UQAM
  
  ● **OO-Method RMFFP** – Condori-Pastor - Valencia
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Innovative Uses in Quality

- Functional complexity
- Scenario-driven black-box testing strategies:
  - Real-time software with state diagrams
  - SAP projects
- Reliability prediction
- Reviews & Inspection support

- Early estimation: scaling factors
Usefull Web Addresses

- [www.gelog.etsmtl.ca](http://www.gelog.etsmtl.ca)
- [www.gelog.etsmtl.ca/publications](http://www.gelog.etsmtl.ca/publications)
- [www.gelog.etsmtl.ca/cosmic-ffp](http://www.gelog.etsmtl.ca/cosmic-ffp)
- [www.swebok.org](http://www.swebok.org)
- [www.jtc1sc7.org](http://www.jtc1sc7.org)
Thank You!

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