COSMIC C-FFP
Some results from the field trials

Oligny, S., Abran, A., Symons, C.

Presented at

15th International Forum on COCOMO and Software Cost Estimation
Los Angeles, USA

October 24-27, 2000
Agenda...

- Context
- COSMIC-FFP - Brief review of key points
- Field trials results - first analysis
- Field trials results - second analysis
- Conclusion
A new functional size measurement method, COSMIC-FFP, was put in the public domain a year ago,

Field trials were conducted essentially until the end of summer 2000,

The first experimental results of the field trials are presented here.
COSMIC-FFP – Key points...

Software model

F.U.R.

Functional process type

Sub-processes types

Data movement types

AND

Data manipulation types

Functionality = Data movements and Data manipulations
COSMIC C-FFP - Key points...

Measurement process

COSMIC C-FFP Measurement Manual, p. 12
COSMIC-FFP - Key points...

Measurement system

- Unit of measure: COSMIC Functional Size Unit (Cfsu).
- Yardstick (by convention): 1 Cfsu = 1 elementary data movement.
- Base Functional Components (BFC): entry (E), exit (X), read (R) and write (W)
- Therefore each BFC receives 1 Cfsu.
- FFP results can be aggregated at the desired level of detail by arithmetically adding the size units assigned to sub-processes.
Field trials results

1st analysis: Study the range of functional process size.

2nd analysis: Study the role of the number of data attributes per data movement
Field trials results - data sample

- One organization, a world class manufacturer of real-time systems,

- Sample of 93 functional process taken from 6 software delivered in 1999 or 2000,

- Sample of 456 individual data movements from the same 6 software.
# Field trials results - data sample

<table>
<thead>
<tr>
<th>Software ID</th>
<th>No. of functional processes</th>
<th>Software size (Cfsu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>9</td>
<td>32</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
<td>76</td>
</tr>
<tr>
<td>C</td>
<td>8</td>
<td>56</td>
</tr>
<tr>
<td>D</td>
<td>46</td>
<td>142</td>
</tr>
<tr>
<td>E</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>F</td>
<td>18</td>
<td>142</td>
</tr>
<tr>
<td>Overall</td>
<td>93</td>
<td></td>
</tr>
</tbody>
</table>
# Field trials results - 1st analysis

<table>
<thead>
<tr>
<th>Software ID</th>
<th>No. of func. processes</th>
<th>Software size (Cfsu)</th>
<th>Average size (Cfsu)</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>9</td>
<td>32</td>
<td>3,6</td>
<td>0,5</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
<td>76</td>
<td>9,5</td>
<td>1,9</td>
</tr>
<tr>
<td>C</td>
<td>8</td>
<td>56</td>
<td>7,0</td>
<td>2,1</td>
</tr>
<tr>
<td>D</td>
<td>46</td>
<td>142</td>
<td>3,1</td>
<td>0,7</td>
</tr>
<tr>
<td>E</td>
<td>4</td>
<td>8</td>
<td>2,0</td>
<td>0,0</td>
</tr>
<tr>
<td>F</td>
<td>18</td>
<td>142</td>
<td>7,9</td>
<td>7,1</td>
</tr>
<tr>
<td>Overall</td>
<td>93</td>
<td>456</td>
<td>4,9</td>
<td>4,1</td>
</tr>
</tbody>
</table>
Field trials results - 1st analysis

Hypothese:
Establish an equivalence between COSMIC-FFP functional process and IFPUG elementary process...
Field trials results - 1st analysis

Range of possible values according to the IFPUG method

Correctly sized by IFPUG

« under » sized by IFPUG

« over » sized by IFPUG

Overall 25% of the 93 functional processes would have been mis-sized by the IFPUG method.

Overall 25% of the 93 functional processes would have been mis-sized by the IFPUG method.
Field trials results - 1st analysis

- COSMIC C-FFP was designed to better capture the amount of functionality within functional process
- We have corroborative evidence that the design of the method meets its goal
- The granularity of COSMIC C-FFP allow to better capture the variations in functional size, as it is often observed in real-time software.
Field trials results - 2nd analysis

- Number of data attributes counted for 344 of the 456 individual data movements,

- Is there a significant difference in the number of data attributes moved by each type of data movement?

- Would it justify different “weights” for each type of data movement?
Field trials results - 2nd analysis

<table>
<thead>
<tr>
<th>Data movement types</th>
<th>Average no. of data attribute</th>
<th>Standard deviation</th>
<th>Number of observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENTRY</td>
<td>3.1</td>
<td>2.9</td>
<td>96</td>
</tr>
<tr>
<td>EXIT</td>
<td>2.9</td>
<td>2.7</td>
<td>121</td>
</tr>
<tr>
<td>READ</td>
<td>3.5</td>
<td>4.1</td>
<td>63</td>
</tr>
<tr>
<td>WRITE</td>
<td>4.7</td>
<td>3.3</td>
<td>64</td>
</tr>
</tbody>
</table>
Field trials results - 2nd analysis

Null hypotheses: there is no significant Difference between the number of data Attributes moved by each type of data movement.

\[ P(H_0) = 0.0025, \text{ thus null hypotheses is rejected at the 0.05 level.} \]

Then, which data movement type differs from which others? … conduct paired t-test...

Pre-requisite: variance are equals \( (H_0) \) then verify with Levene’s test.

Result: 0.1882, thus \( H_0 \) is confirmed at the 0.05 level and paired t-test can be applied.
Field trials results - 2nd analysis

$H_0$: both type (i,j) move on average the same number of data attributes.

$P(H_0)$ below:

<table>
<thead>
<tr>
<th></th>
<th>ENTRY</th>
<th>EXIT</th>
<th>READ</th>
<th>WRITE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENTRY</td>
<td></td>
<td>0.6098</td>
<td>0.5188</td>
<td>0.0022</td>
</tr>
<tr>
<td>EXIT</td>
<td></td>
<td></td>
<td>0.2620</td>
<td>0.0003</td>
</tr>
<tr>
<td>READ</td>
<td></td>
<td></td>
<td></td>
<td>0.0271</td>
</tr>
<tr>
<td>WRITE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$H_0$ rejected at the 0.05 level.
Field trials results - 2nd analysis

- Analysis indicate a difference between WRITE and the other three data movement type (as a group),

- Magnitude of the difference is small though,

- Unless there would be experimental data supporting a difference of a larger magnitude, each type of data movement will be considered of equal “weight”.
Conclusion...

- From the 1st analysis:
  - The granularity of COSMIC C-FFP allows to better capture the variations in functional size, as it is often observed in real-time software for instance.

- From the 2nd analysis:
  - Unless there would be experimental data supporting a difference of a larger magnitude, each type of data movement will be considered of equal “weight”.

Conclusion...

- These two analysis are the first field trial results to be published,
- There is much more to come in the following months,
- Disclosure of field trial results can be monitored at:

  http://www.lrgl.uqam.ca/ffp.html
Acknowledgments

- The Software Engineering Management Research Laboratory of the Université du Québec à Montréal is supported through a partnership with Bell Canada.

- Additional funding is provided by the National Research Council of Canada.