Functional Size of Real-Time Software: Overview of Field Tests

Serge Oligny, Alain Abran, Jean-Marc Desharnais, Pam Morris

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Agenda...

- Context
- Real-Time Software Limitations of FPA
- Full Function Points Core Concepts
- Initial Test Results
- Recognition from ISBSG
- Additional Field Tests
- Conclusion
Context...

**IFPUG's Function Points (FPA, v. 4.0):**

- Designed and refined for the characteristics of business applications type of software,

- Measures software delivered to external *human* business users,

**BUT...**
Since 1986, FPA has been criticized as not being applicable to all types of software:

"A problem with the function point approach is that it assumes a limited band of application types: typically, large file-based systems produced by agencies such as banks ..., and is unable to cope with hybrid systems such as a stock control system with a heavy communication component."

Although the FPA measurement method generates results in such cases, these results do not constitute an adequate size measurement.

Real-Time systems (RTS) are examples of software that differs from "business application" software,

RTS are thus examples of software for which FPA is not an adequate FSM.

...Is the functional size of real-time systems is worth measuring?
Context...

○ RTS represent approximately 50% of the software in production in the United-States.

○ RTS contributes to the software portfolio; it has to be purchased, customized, documented, maintained, etc.

○ Supported RTS should be included in the assignment scope when calculating support productivity, development and maintenance budgets, etc.

○ RTS delivered as part of a project will need effort assigned to it and should be included in total project size for accurate estimates.
Real-Time software limitations of FPA...

So, what are the limitations of FPA when applied to RTS?

- Value Adjustment Factor does not adequately cover the impact on productivity for RTS.

- DATA LIMITATIONS:
  - As opposed to "external business application software", the primary role of RTS is NOT to maintain and report stored data (primary role is to process input data for immediate response or output),
  - In RTS, most of the data input is not stored permanently,
  - RTS data is simple and typically includes
    - historical logs of input values
    - threshold values
    - parameter control values.
Real-Time software limitations of FPA...

PROCESS LIMITATIONS:

- RTS processes contain many internal sub processes where functionality is not represented by data crossing the external boundary,

- RTS processes display an exponential difference in functional size that cannot be recognized by the twofold increment in allocated FPA,

- RTS processes do not usually display a predominant input or output characteristic and thus cannot easily and consistently be classified as "IFPUG input, output or inquiry".
Full Function Points core concepts...

- By design, the FFP measurement method:
  - adopts a FULL functional perspective spanning more than the functionality perceived by RTS's human users; it includes functionality interacting with other software and physical devices,
  - does not impose a maximum size to a process; the size of a process is the SUM of the size of its individual sub processes,
  - does not assign a predominant functional role (input or output) to each process,
  - does not use "value adjustment factors".
Full Function Points core concepts...

**USERS**
Human, Hardware devices, Other software

**Control Processes**

**READ-ONLY DATA GROUP**

**UPDATE DATA GROUP**

**Measurement Boundary**
Full Function Points core concepts...

THEREFORE, FFP:

- ... can be used to measure the functional size of any type of software, including RTS,

- ... offers a result that is not restricted to a twofold maximum range for each identified process,

- ... enables processes to be consistently sized when they do not display a predominant input or output characteristic,

- ... can be applied to processes whose functionality does not pass data externally,

- ... enables measurement of simple groups of data.
Initial test results...

○ First set of field tests (1997):
  ○ conducted by the research team,
  ○ 3 RTS or embedded software products measured,
  ○ 2 industrial partners in USA and Canada,

○ GOAL: compare IFPUG 4.0 FPA with FFP
○ RESULTS:
  ✓ FFP results close to FPA when processes contained small number of sub processes,
  ✓ FFP results yield larger size measure when processes contained large numbers of sub processes.
Initial test results...

- Second set of field tests (1997):
  - conducted **without assistance** from the research team,
  - RT operational software products,
  - 1 industrial partner in Japan,
  - **GOAL**: evaluate FFP for **relevance** and **usability**
  - **RESULTS**:
    - concepts and procedures are clear and easy to understand, usable without assistance from measurement specialists,
    - FFP functional coverage established at 97% of control processes expected to be measured.
Recognition from ISBSG...

- ISBSG: International Software Benchmarking Standards Group
- Maintains a repository of measured software products and projects,
- Currently over 500 historical software projects available,
- Rigorous entry and validation methodology,
- Functional size measure MANDATORY for acceptance of project’s data
Recognition from ISBSG...

- FFP recently recognized as a valid FSM by ISBSG
  - FFP accepted based on list of rigorous criteria,
  - Interim status: accept project where software measured with FFP,
  - After submission of a minimum number of FFP measured software products, ISBSG will modify entry and validation software.
Additional set of field tests...

○ CONTEXT:
  ○ 4 industrial partners
    ▶ 3 in North-America,
    ▶ 1 in Asia (not Japan).
  ○ 10 software products
    ▶ never measured before with FFP,
    ▶ 8 products related to the telecom. industry,
    ▶ 1 product related to operation of a power utility org.,
    ▶ 1 product related to the military sector.
  ○ All software products measured by the same individual
    ▶ CFPS,
    ▶ 12 years of experience in FSM.
**Additional set of field tests...**

1st GOAL: further compare IFPUG 4.0 FPA and FFP

**RESULTS:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Type</th>
<th>FPA size</th>
<th>FFP size</th>
<th>Difference</th>
<th>Diff.as %</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>HRS</td>
<td>240</td>
<td>316</td>
<td>76</td>
<td>24%</td>
</tr>
<tr>
<td>B</td>
<td>EES</td>
<td>64</td>
<td>62</td>
<td>2</td>
<td>3.2%</td>
</tr>
<tr>
<td>C</td>
<td>EES</td>
<td>517</td>
<td>610</td>
<td>93</td>
<td>18.3%</td>
</tr>
<tr>
<td>D</td>
<td>EES</td>
<td>90</td>
<td>101</td>
<td>11</td>
<td>100.3%</td>
</tr>
<tr>
<td>E</td>
<td>Mostly MIS</td>
<td>764</td>
<td>791</td>
<td>27</td>
<td>3%</td>
</tr>
<tr>
<td>G</td>
<td>MIS</td>
<td>878</td>
<td>896</td>
<td>18</td>
<td>2%</td>
</tr>
</tbody>
</table>

Size is similar when measuring typical MIS software products.
Additional set of field tests...

1st GOAL: further compare IFPUG 4.0 FPA and FFP

RESULTS:

<table>
<thead>
<tr>
<th>Product</th>
<th>Type</th>
<th>FPA size</th>
<th>FFP size</th>
<th>Difference</th>
<th>Diff.as %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>341</td>
<td>191</td>
<td>150</td>
<td>78%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>311</td>
<td>68</td>
<td>243</td>
<td>37%</td>
</tr>
<tr>
<td>C</td>
<td>Real-Time</td>
<td>0</td>
<td>2604</td>
<td>2604</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>372</td>
<td>716</td>
<td>344</td>
<td>46%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>76</td>
<td>97</td>
<td>21</td>
<td>3%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>404</td>
<td>402</td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>89</td>
<td>10</td>
<td>83</td>
<td>12%</td>
</tr>
</tbody>
</table>

One R-T software product could only be sized with FFP
Additional set of field tests...

1st GOAL: further compare IFPUG 4.0 FPA and FFP

RESULTS:

<table>
<thead>
<tr>
<th>Product</th>
<th>Type</th>
<th>FPA size</th>
<th>FFP size</th>
<th>Difference</th>
<th>Diff.as %</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Real-Time</td>
<td>210</td>
<td>794</td>
<td>584</td>
<td>74%</td>
</tr>
<tr>
<td>B</td>
<td>Real-Time</td>
<td>115</td>
<td>183</td>
<td>68</td>
<td>37%</td>
</tr>
<tr>
<td>C</td>
<td>Real-Time</td>
<td>0</td>
<td>2604</td>
<td>2604</td>
<td>100%</td>
</tr>
<tr>
<td>D</td>
<td>Real-Time</td>
<td>43</td>
<td>318</td>
<td>275</td>
<td>86%</td>
</tr>
<tr>
<td>F</td>
<td>MIS (batch)</td>
<td>272</td>
<td>676</td>
<td>404</td>
<td>60%</td>
</tr>
</tbody>
</table>

Larger functional size for software products with numerous R-T processes (A through D); even for MIS with fewer direct user interactions (F).
Additional set of field tests...

2nd GOAL: explore magnitude of key economic values

RESULTS:

These 3 software products are all R-T software

<table>
<thead>
<tr>
<th>Product</th>
<th>Size (FFP)</th>
<th>Effort (ph)</th>
<th>Duration (mth)</th>
<th>Unit effort (ph/FFP)</th>
<th>Sched. del. Rate (FFP/mth)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>205,4</td>
<td>3 913</td>
<td>26</td>
<td>19,1</td>
<td>7,9</td>
</tr>
<tr>
<td>I</td>
<td>138,0</td>
<td>6 580</td>
<td>16</td>
<td>47,7</td>
<td>8,6</td>
</tr>
<tr>
<td>J</td>
<td>198,0</td>
<td>7 448</td>
<td>14</td>
<td>37,6</td>
<td>14,1</td>
</tr>
</tbody>
</table>

Until further data is available to allow statistically significant analysis, these should be interpreted as "order of magnitude" figures.
Conclusion...

- **FIELD TEST RESULTS SUMMARY:**
  - **1st set of field test**
    - FFP functional size results reflect the varying functional size typically found in RTS processes,
  - **2nd set of field test**
    - FFP concepts and procedures can be applied without the help of an FSM specialist,
    - From a practitioner’s point of view, FFP offers a high degree of functional coverage when applied to RTS,
Conclusion...

○ FIELD TEST RESULTS SUMMARY:
  ○ 3rd set of field test
    ✓ Further illustrates the difference in functional size obtained from FPA and FFP when both methods are applied to the same software products,
    ✓ Provides first indications on order of magnitude for key economic ratios related to FFP.
Acknowledgments

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