COSMIC C-FFP

A summary

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Agenda

1. Context - Software size
2. COSMIC-FFP - Key aspects
3. COSMIC-FFP - the field trials
4. A simple example in 4 steps
5. Want to know more?
6. Conclusion
Context - Software size
Size of what ...

Project Size
The total effort, estimated or actual in work-hours or staff-months

Software size
the size of the requirements (functions) or of the deliverables (modules, lines of code)
Software size measurement

Context...

HOW BIG IS IT?

Mmm... so many programs, so many lines of code...

- Meaningful to the technical staff,
- Meaningless to management,
- Poor portability,
- Only known precisely when too late to use

Mmm... so much functionality delivered to the users...

- Meaningful to management,
- Meaningful to technical staff,
- Portable,
- Can be measured early on,
- Must be independent from effort, method or technology
The ‘Functional Size’ of software

- ISO/IEC/JTC1/SC7 Standard #14143 definition:

  “Functional Size: A size of software derived by quantifying the functional user requirements”
An analogy...

Context...

Software Functionality

2000 sq. ft.

500 cfsu

4000 sq. ft.

1000 cfsu
Different kinds of software

‘APPLICATIONS’

‘MIS’ = Management Information Systems, i.e. Business ‘data-rich’ software

‘INFRASTRUCTURE’

SYSTEM SOFTWARE

Utility

Users tools

Dev. tools

Embedded or Real-time software

‘APPLICAT IONS’
“So you want to measure Software Functional Size?”

Context...

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COSMIC C-FFP - Key aspects
Software context model

Users

OR

Engineered devices

OR

other Software

Boundary

Software

RETRIEVE PERSISTENT DATA

DATA IN

MANIPULATION

DATA OUT

STORE PERSISTENT DATA

COSMIC FFP - Key aspects

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Functionality = Data movements and Data manipulations
Software model (v. 2.0)

- **F.U.R.**

- **Software**
  - Functional process type
  - Data movement types

- **Sub-processes types**
  - ... only, as a reasonable approximation in version 2.0

Functionality = Data movements + some processing

Note: discussion on handling algorithms presented later on
Overview of the model


Functional User Requirements of the Software to be measured

Mapping Phase

COSMIC-FFP software F.U.R. model

Measurement Phase

COSMIC-Framework functional size model

Rules and Methods

Functional size of the software Functional User Requirements model
SCOPE may define a subset of the software to be sized

If the PURPOSE is for estimating or for performance measurement, size the various components separately
Software layers

Product Requirements → Requirements allocated to hardware

Requirements allocated to software → Principal software item

Modification to O.S. → New device driver

STORAGE HARDWARE

LAYOUTS

1: Human, engineered devices or other software
Identifying functional processes

Triggering event

Boundary of the software

Functional Process

Initial Entry

Final Exit

NOTE:
Data movement. A data movement moves attributes belonging to a single data group.
## Summary

### Functional process

<table>
<thead>
<tr>
<th>Data group</th>
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<th>Data group</th>
<th>Data group</th>
</tr>
</thead>
</table>
Identifying sub-processes types

Including formatting, presentation manipulations and validations (*).

Including processing and computation to move the data.

Including formatting, presentation manipulations, output data computing and routing.

Including processing and computation to store moved data.

USERS

STORAGE

E

R

X

W

(*) Excluding validation required by reading persistent data.
Unit of measure

- 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.
Aggregation function

- FFP results can be aggregated at the desired level of detail by arithmetically adding the size units assigned to sub-processes.

- There is no upper limit to the functional size of a functional process.

- The aggregation function is scalable. A functional size figure can thus be obtained for functional constructs (process, layer, ...) composed of sub-processes.
A simple example in 4 steps

- 1. Identification of external interactions,
- 2. Identification of functional processes,
- 3. Analyzing functional processes interactions,
- 4. Apply measurement function
External interactions...

What are the devices interacting with the software?

- Mode switch
- Cook light
- Warm light
- Heater
- Temp. sensor

Outside (users) → Inside (software)
The rice-cooker operation is controlled by time...

- **Start switch**
- **Mode switch**
- **Cook light**
- **Warm light**
- **Heater**
- **Temp. sensor**

**Control time**
- 5 sec
- 30 sec
- E_time

Clock signals are potential triggering events for functional processes belonging to the software.

Inside (software)

Outside (users)

Clock are considered to be outside the software by convention.
Functional processes...

The rice-cooker state is communicated via two lights...

- **Mode switch**
- **Cook light**
- **Warm light**
- **Heater**
- **Temp. sensor**

**Control lamps**

- **Control time**
  - 5 sec
  - 30 sec
  - E_time

Cooking and warming lamps are functionally related because they are mutually exclusive.

Outside (users) → Inside (software)
Functional processes...

Lights operation is governed by the cooking mode...

Mode switch
Cook light
Warm light
Heater
Temp. sensor

Set mode
Control lamps

Control time
5 sec 30 sec E_time

Since this requirement has been allocated to software

Outside (users)

Inside (software)
Step 2

Functional processes...

Temperature controlled according to a pre-determined time profile...

So the software "know" what the temperature should be at any time

Calc. target temperature

Inside (software)

Control time

5 sec 30 sec E_time

Set mode

Control lamps

Mode switch
Cook light
Warm light
Heater
Temp. sensor

Outside (users)
Functional processes...

And the heater is controlled according to the difference actual/target...

Control time
5 sec 30 sec E_time

Requirements indicate open loop control so the two functions are independent

Calc. target temperature
Inside (software)

Set mode

Control lamps

Control temperature

Mode switch
Cook light
Warm light
Heater
Temp. sensor

Outside (users)

Step 2

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Processes interactions...

Starting with time triggered processes...

Control time
- 5 sec
- 30 sec
- E_time

Control time

Set mode

Control lamps

Control temperature

Calc. target temperature

Mode switch
Cook light
Warm light
Heater
Temp. sensor

Outside (users)

Inside (software)
Processes interactions...

Then with processes triggered by other events...

- **Control time**
  - 5 sec
  - 30 sec
  - E_time

- **Calc. target temperature**

- **Set mode**

- **Control lamps**
  - E_time
  - 30 sec

- **Control temperature**
  - 5 sec

- **Outside (users)**
  - Mode switch
  - Cook light
  - Warm light
  - Heater
  - Temp. sensor

- **Inside (software)**
  - Control lamps
Processes interactions...

Let's now look at the Set mode process...

- **Mode switch**
- **Cook light**
- **Warm light**
- **Heater**
- **Temp. sensor**

**Outside (users)**

**Inside (software)**

- **Control time**
  - 5 sec
  - 30 sec
  - E_time

- **Set mode**

- **Control lamps**
  - mode

- **Control temperature**
  - mode
  - E_time
  - 5 sec

- **Calc. target temperature**

**Step 3**
Processes interactions...

Let's now look at the lights control process...

- **Mode switch**
- **Cook light**
- **Warm light**
- **Heater**
- **Temp. sensor**

**Outside (users)**

**Control time**
- 5 sec
- 30 sec
- E_time

**Control lamps**

**Set mode**

**Control temperature**
- 5 sec
- E_time

**Calc. target temperature**

**Inside (software)**

Diagram showing interactions and control processes.
Processes interactions...

Let's now look at the “Calculate target temperature” process...

Step 3

Control time
5 sec 30 sec E_time

Set mode
Sel_mode

Control lamps
E_time
30 sec

Control temperature
5 sec

Calc. target temperature

Mode switch
Cook light
Warm light
Heater
Temp. sensor

Outside (users)

Inside (software)
Processes interactions...

Let's now look at the "Control temperature" process...

Step 3

Control time
- 5 sec
- 30 sec
- E_time

Set mode
- Sel_mode

Control lamps
- E_time
- 30 sec

Control temperature
- 5 sec
- R_temp

Calc. target temperature
- Inside (software)

Outside (users)

Mode switch
Cook light
Warm light
Heater
Temp. sensor

0/1
A_temp
Status
Status

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Measurement ...

The calculate target temperature functional process...

- **30 sec**
- **E_time**
- **Sel_mode**

<table>
<thead>
<tr>
<th>ID</th>
<th>Triggering event</th>
<th>Sub-processes</th>
<th>Functional size</th>
</tr>
</thead>
<tbody>
<tr>
<td>30sec</td>
<td>Yes</td>
<td>ENTRY</td>
<td>1 cfsu</td>
</tr>
<tr>
<td>E_time</td>
<td></td>
<td>ENTRY</td>
<td>1 cfsu</td>
</tr>
<tr>
<td>Sel_mode</td>
<td></td>
<td>READ</td>
<td>1 cfsu</td>
</tr>
<tr>
<td>R_temp</td>
<td></td>
<td>WRITE</td>
<td>1 cfsu</td>
</tr>
</tbody>
</table>

Step 4
### Summary

<table>
<thead>
<tr>
<th>Layers</th>
<th>F. Process</th>
<th>Entry</th>
<th>Exit</th>
<th>Read</th>
<th>Write</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>Set Mode</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>2 cfsu</td>
</tr>
<tr>
<td>-</td>
<td>Control lamps</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>3 cfsu</td>
</tr>
<tr>
<td>-</td>
<td>Calc. target temp.</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>4 cfsu</td>
</tr>
<tr>
<td>-</td>
<td>Control temp.</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>4 cfsu</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>6</strong></td>
<td><strong>2</strong></td>
<td><strong>3</strong></td>
<td><strong>2</strong></td>
<td><strong>13 cfsu</strong></td>
</tr>
</tbody>
</table>

**Step 4**

**Measurement ...**
COSMIC C-FFP - the field trials
The Field Trials process

**Initial Planning**
- Gain commitment
- Select projects

**Preparation**
- Training
- Repeatability Exercise

**Data Collection**
- Mainly a Partner task
- COSMIC Team support

**Central Analysis (UQAM)**
- Method refinements
- Calibration
- Convertibility
- Benchmarks

**Individual Performance Reports**

**Local/Regional Feedback**
GOAL: Standardize a minimum subset of data for later benchmarking and improvement of the measurement method...

... based on the framework already developed by ISBSG
Project

- The organization (type of business),
- Type of software,
- Type of project (dev., maintenance, ...),
- Development and target platform,
- Duration

Effort

- Effort recording method
- Completeness of effort data
- Confidence in effort data
- Level of effort
- High level breakdown of effort
Want to know more?
Publications

Already published:

23 papers already published by COSMIC team members or by independent authors.

Downloadable for free at:

www.lrgl.uqam.ca/ffp.html

Coming months:

FESMA Conference, October, Madrid, Spain
COCOMO Conference, October, Los Angeles, USA
ACOSM Conference, November, Sydney, Australia
ESCOM Conference, April 2001, London, UK
Research underway

- Inter-measurer consistency study (P. Nolin, UQAM with Hydro Quebec);
- Conversion from FFP V1, MkII and IFPUG (V. Ho, UQAM)
- Early COSMIC-FFP (Chapter 7) - UQAM & R. Meli (Italy)
- Correlation of expert view of functionality with COSMIC FFP size, using AHP (G. Wittig, E. Rudolph, Australia)
- Procedure for UML-based specifications (V. Bevo, UQAM)
- Automatic measurement from source code (V. Ho, UQAM)
- Size contribution of Technical and Quality requirements (C. Lokan, Australian Defence Academy & UQAM)
- Other aspects of size - algorithmic complexity N. Kececi (USNRC), F. Bootsma, (Nortel) planning to study
- Supporting requirements identification with CBR approach (J.M. Deshamais, UQAM)
Tools and Benchmarks

- Hierarchy Master - FFP v. 1 fully supported, V. 2 in development (J. Ng, Australia)

- Sphera - measurement support and estimating tool for V. 2 in development (R. Meli, Italy)

- Commitment to deliver Field Trial results to ISBSG
On the Web...

Complete documentation on the Web

- Concepts and definitions,
- Measurement Manual,
- Publications,
- http://www.lrgl.uqam.ca/ffp.html
- http://www.cosmicon.com
Conclusion
Final remarks...

- COSMI C-FFP was designed for ISO compliance,
- COSMI C-FFP has been designed FOR the industry, WITH the industry,
- COSMI C-FFP is an open and transparent initiative, fully documented and easily available.