Functional Size of Real-Time Software

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Agenda

A - Project history
B - Lessons from previous attempts
C - Full Function Points (FFP)
D - Industry field tests (North America & Japan)
E - Conclusion
A - Project Objectives

- Measure adequately the functional size of real-time software
- ISO compliant
- Facilitate migration path and ease of transition for organizations with historical databases (IFPUG)
A - Project Structure

Université du Québec à Montréal

SELAM

Partners

NORTEL
Dallas, Toronto, Ottawa

JSR
Tokyo (Japan)

Hydro Québec
Montréal

Bell Canada
Québec, Montréal

- Project initiation:
  - Identification of industrial partners
  - Analysis of previous attempts

- Design of measurement structure

- Field tests - North America & Japan:
  - Observations & feedback
  - Partner sites reports
A- Project Scope

1) Before measuring, you need a measurement method
2) The rules of the measurement method are applied to software (or piece of software)
3) Output of Step 2 is a result (it should be auditable)
4) The result is exploited (quantitative or qualitative)
A- Research Strategy

Project strategy accepted by research partners:

- **Phase A (95-97):**
  - Step 1: Measurement Design
  - Step 2: Measurement in practice

- **Phase B (98+):**
  - Step 3: Results analysis
  - Step 4: Productivity, Estimation & Quality Models
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B - FPA Limitations for Real-time Software

FPA limitations recognized by the research & practitioners communities:

- Conte (1986)
- Jones (1988-...)
- Symons (1988)
- Ince (1991)
- Grady (1992)
- Whithmire (1992)
- Kan (1993)
- Hetzel (1993)
- Murali (1997)
- Etc.
B - FPA Limitations for Real-time Software

Does not capture well real-time functional characteristics:

- Large number of sub-processes
- Many transient data
- Many control functions
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C - Full Function Points (FFP) for Real-time Software

- Key Concepts
- Example
- Why FFP is easier
C - Key Concepts

- Generic Process

\[ \text{In} \xrightarrow{} \text{Process} \xrightarrow{} \text{Out} \]
C - Key Concepts

- Software Process:

  Data → Process → Data
C - Key Concepts

- Measured Software Processes:

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Application Boundary

Users: data → Processes → Users: data
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C - Key Concepts

- REAL-TIME Software Processes:

Users:
- Persons,
- Other Applications,
- Mechanical Devices

Application Boundary

Processes

Users:
- Persons,
- Other Applications,
- Mechanical Devices

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C - Model of Real-time Software

Users: Persons, Other Applications, Mechanical Devices

Application Boundary

Processes

Groups of data
READ

Groups of data
WRITTEN
C- Model with multiple sub-processes
C - Example

Requirement Specifications

Oven Temperature Control

1. The Oven Temperature is **received** from a sensor

2. A message is **sent** to the oven heating element, turn on or turn off depending on Oven Temperature and **Desired Temperature**

3. A new entry is created in the **Message Log** (for diagnostic purposes)
C - Process Identification

All processing associated with a unique trigger: “Temperature is received from the sensor”
C - Sub-process Identification

Requirement specification 1:
“The Oven Temperature is received from a sensor”
C- Sub-process Identification

Requirement specification 2:
“A message is sent to the oven heating element, turn on or turn off depending on Oven Temperature and Desired Temperature”

The Oven Temperature is received from a sensor

A message is sent to the oven heating element

Application Boundary

Entry

Read

Desired Temperature

Exit

Oven Temperature Control

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C- FFP Measurement Model
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D - Industry Field Tests

North America:
- Tests with researchers
- USA: Richardson (Texas)
- Canada: Toronto, Montréal, Ottawa, Québec

Japan:
- Independent field tests
D- Field tests in Japan

Description:

- Business: Real-time software for the automotive industry in Japan including fuel injection systems
D- Field tests in Japan

STEPS:

1. Construction and measurement of a Case Study (Rice Cooker)

2. Measurement of small software in-house samples with «FFP» (Jan-Apr 1997)

2. Visit to research team to verify measurement results and rules interpretation (May 1997)

3. Expansion of the testing to larger in-house software (June 1997)
D- Field tests in Japan

SAMPLES:

Characteristics of real-time software tested:

- Few IFPUG-Inputs and IFPUG-Outputs
- Few Files in boundary
- Some processes with a few sub-processes and some processes with a lot of sub-processes to control objects. Control dimension is essential
- Many very simple formula because of the very tight cycle time constraints
RESULTS
Criteria 1: To measure **WELL** real-time software functional size at our corporation

- In large test: FFP takes into account 79 sub-processes out of 81 expected to be measured.
- Measurement coverage rate: **97%**

(2 sub-processes not measured with FFP: internal algorithms)
D- Field tests in Japan

OBSERVATIONS

Parallel tests with IFPUG method:

- IFPUG method provides a size similar to FFP in SMALL samples,

but

- DOES NOT scale up to LARGE software as well as expected from a user functional viewpoint (in JSR environment, and confirmed later in further industrial tests).
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E - CONCLUSION

- Re-design criteria met
- Deliverables
- Closing Remarks
E- Re-design Criteria Met

Criteria No. 1:

- Practitioners agree that Functional Size **ADEQUATELY** captured for real-time software

- Verification method: field tests feedback
  (Further verification required with methods yet to be developed in the field of software metrics!)
E- Re-design Criteria Met

- Measurement criteria:
  - Current practices of documenting
  - Concepts & vocabulary in real-time software
  - Procedures to ensure: repetitiveness, ease of use

- Strategic criteria:
  - Alignment with ISO framework in-progress
  - Facilitate migration path for IFPUG
E- Deliverables

- FFP: Documented and in the public domain
  - Concepts & Definitions
  - Measurement Structure
  - Measurement Rules
  - Examples
E- Other Deliverables

Project Services:

- Case Studies
- Validation procedures
- FFP Training Services
- FFP Measurement Support
E- International Recognition

- International Software Benchmarking Standards Group (ISBSG): adopted as a new functional size standard for real-time software

- Japan: being promoted to the national JFPUG

- Germany, Australia, France, Netherlands, Canada

- Inquiries: South America and Asia
E- Next Steps: Research Project

Phase B:
- Degree of repetitiveness
  - IFPUG/M.I.T. - type studies required
- Usefulness of FFP in productivity, estimation and quality models
  - Research requirements: FFP measurement of completed projects WITH effort data in semi-controlled environments at industrial sites

Phase C: Automation
- Industry partners required
E- Closing Remarks

- The problem of the relevance of measuring real-time software with Function Points has been known for at least 10 years!
- Who has put money and resources on the table to contribute to the development of a solution?
E- Closing Remarks

Thanks to the consortium partners:

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  - $$$$$
  - Time
  - Access to their software
  - Access to their staff
  - Their most valuable feedback
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Questions Period

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