The PSP Size Estimating Approach
Goals and Outline of Presentation

Goals
An overview Proxy Based Estimating (PROBE) in the Personal Software Process (PSP) context

- What they are & how PROBE works
- Principles behind PROBE
- PROBE's particular advantages
- How PROBE fits in PSP

Outline

- What is PSP – Context for PROBE
- PROBE
- Conclusions
What is PSP – Context for PROBE

Overview

A process for individuals to use

Applies to structured personal tasks

- Writing small programs or documents
- Defining requirements or processes
- Conducting reviews or tests, etc.

Introduced

- In steps
- With small software problems

Is a discipline for software engineering

Provides an effective foundation for large scale development practices
PROBE – The PSP Size Estimating Approach

What is PSP – Context for PROBE

PSP0 Process Flow (Framework)
## PROBE - The PSP Size Estimating Approach

### What is PSP - Context for PROBE

#### PSP0.1 Project Plan Summary

<table>
<thead>
<tr>
<th>Student</th>
<th>Program</th>
<th>Instructor</th>
<th>Date</th>
<th>Program #</th>
<th>Language</th>
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</table>

<table>
<thead>
<tr>
<th>Program Size (LOC)</th>
<th>Plan</th>
<th>Actual</th>
<th>To Date</th>
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<tbody>
<tr>
<td>Base (B)</td>
<td>(Measured)</td>
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<tr>
<td>Deleted (D)</td>
<td>(Counted)</td>
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<td>Modified (M)</td>
<td>(Counted)</td>
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<td>Reused (R)</td>
<td>(Counted)</td>
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<td>Total New &amp; Changed (N)</td>
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<td>(Measured)</td>
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PROBE-SE DOC-5

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### What is PSP – Context for PROBE

**PSP0.1 Project Plan Summary (cont.)**

<table>
<thead>
<tr>
<th>Defects Injected</th>
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<th>To Date %</th>
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PROBE – The PSP Size Estimating Approach

What is PSP – Context for PROBE

PSP0.1 Process Time Recording Log

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# PROBE - The PSP Size Estimating Approach

## What is PSP - Context for PROBE

### PSP Defect Recording Log

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**Description:**

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</tr>
</tbody>
</table>

**Description:**

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**Defect Types**

- 10 Documentation
- 20 Syntax
- 30 Build, Package
- 40 Assignment
- 50 Interface
- 60 Checking
- 70 Data
- 80 Function
- 90 System
- 100 Environment
What is PSP - Context for PROBE

PSP Methods, Techniques and Technologies

**PSP0**
- Current process
- Time recording
- Defect recording
- Defect type standard
- Linked Lists
- Statistics overview and standard deviation

**PSP0.1**
- Coding standard
- Size measurement
- Process improvement proposal (PIP)
- LOC Standard
- Object and LOC Counters
- Defect Analysis

**PSP1**
- Size estimating
- Test report
- Linear Regression
- PROBE

**PSP1.1**
- Task planning
- Schedule planning
- Prediction Intervals
- Time and schedule estimating
- Earned Value Tracking

**PSP2**
- Code reviews
- Design reviews
- Correlation
- Checklists for reviews
- Goal-Question-Metric Paradigm

**PSP2.1**
- Design templates
- Process benchmarking
- Yield management
- Defect removal and prevention strategies
- Design Notations
- Operational scenarios
- Functional, State & Logic specifications

**PSP3**
- Cyclic development
- Design Verification: Object state machines, Verifying program correctness
- Defining and evolving processes

**PSP Methods, Techniques and Technologies**

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PROBE – The PSP Size Estimating Approach

What is PSP – Context for PROBE

PSP Size Estimating Approaches Discussed

Fuzzy logic
- Divide historical product size data into size ranges and characteristics
- Compare the planned product with these prior products
- Based on this comparison, select the size that seems most appropriate for the new product

Function points

Standard Components

Delphi
What is PSP – Context for PROBE

PSP Size Estimating Approaches Discussed (cont.)

Standard Components

- Historical Data
  - Establish the principal product size levels (components, modules, screens, etc.)
  - Determine typical sizes of each level

- New Product
  - Determine the component level at which estimation is practical
  - Estimate how many of those components will likely be in the product
  - Determine the maximum and minimum numbers possible
  - Calculate the maximum, minimum and likely sizes as total of
    - number of components of each type
    - times typical sizes of each type
  - Calculate size = (maximum + 4*likely + minimum)/6

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PROBE – The PSP Size Estimating Approach

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PSP Size Estimating Approaches Discussed (cont.)

Delphi

- Uses several estimators
  - each makes an independent estimate
  - each submits estimate to a coordinator

- Coordinator
  - calculates average estimate
  - enters on form: average, other estimates (anonymously), and previous estimate

- When reestimates stabilizes
  - average is the estimate
  - range is range of original estimates

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⇒ PROBE ⇐

Conclusions
Basic issues

- Good size measures are detailed
- Early estimators can rarely think in detail

Alternatives

- Delay estimate until detail available
- Identify a suitable proxy

Good proxies

- Correlate closely to development costs
- Are easy to visualize early in development
- Should be physical entity that can be counted

Example Proxies

- Function points
- Objects
- Product elements (components; screens, reports, scripts, files; chapters)
Correlation with development hours

- Numbers of objects correlate reasonably well
- Object lines of code (LOC) correlate very closely

**Object LOC**: estimated using the standard component estimating method

**Total LOC**: estimated from historical relationship Object\_LOC::Total\_LOC

Objects (as application entities) – can be visualized early in development

[Functions and procedures can often be estimated the same way]

Counting can be automated for

- Objects, and their LOC
- Functions and procedures, and their LOC

**What's Needed**

- Object and LOC counter(s)
- Historical data for standard component object LOC
- Historical relationship of Object\_LOC to Program\_LOC
- Rules for when to apply
LOC & LOC per Object Counters

- Personal Coding and Line of Code counting standards:
  developed as Report Exercises 1 & 2 in PSP course

- LOC and LOC per Object counters:
  developed as Programming Exercises 2 & 3

- LOC and LOC per Object results for Programming Exercises 1..3:
  called for as "test results" from Programming Exercise 3

<table>
<thead>
<tr>
<th>Program Number</th>
<th>Object Name</th>
<th>Number of Methods</th>
<th>Object LOC</th>
<th>Total Program LOC</th>
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<tbody>
<tr>
<td>1A</td>
<td>ABC</td>
<td>3</td>
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<td>DEF</td>
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<td>GHI</td>
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<td>2A</td>
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<td>212</td>
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</table>

Historical data for standard component object LOC

Historical relationship of Estimated Object LOC to Actual Program LOC:
Linear Regression Parameters calculated by Programming Ex. 4
PROBE – The PSP Size Estimating Approach

PROBE Process Details

PSP0.1 Postmortem Process – Size Data

1. Enter LOC output (LOC(out))

2. Determine LOC:
   - Count LOC in the completed program
   - Reused, deleted, modified, added, total, new and changed, and new reused LOC

3. Enter Project Exercise Source (PESC)

4. Review TRL:
   - Review the completed Time Recording Log

5. Enter time per phase on PPS
   - Enter the total time spent in each PSP01 phase under Actual on the PSP01 Plan Summary form

Your LOC Counter

LOC C

PSP01_Wrap
& Revisit:
Postmortem
Size Data only
v0.2 09/96

PSPO1
PSPO1-Planning
PSPO1-Development
PSPO1-Postmortem

PSPO1_Plan
PSPO1_Plan
PSPO1_Plan

Process Improvement Proposal (PIP)

Your LOC Counter (LOC_C)

PSPO1-Postmortem

1. Defects Injected
2. Defects Removed
3. Size

Determine LOC:
- Determine the LOC
- Reused, deleted, modified, added, total, total new and changed, and new reused LOC

Enter Data
- Enter these data on the Project Plan Summary form

Finalize PPS
- Review the completed Time Recording Log

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PROBE - The PSP Size Estimating Approach

PROBE Process Details

Size Estimating Overview

Product requirement

Obtain historical data

Produce conceptual design

Subdivide the product into parts

Do the parts resemble parts in the database?

Yes

Select the database parts most like new ones

Estimate the new part's relative size

Sum the estimated sizes of the new parts

Estimate the total product size

No

Repeat until the product parts are the right size

More

Repeat for all parts

Done

Size Estimate

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# PROBE Process Details

## PSP Size Estimating Template

<table>
<thead>
<tr>
<th>Student</th>
<th>Instructor</th>
<th>Date</th>
<th>Program #</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

### BASE PROGRAM

**BASE SIZE (B) =>**

**LOC DELETED (D) =>**

**LOC MODIFIED (M) =>**

### PROJECTED LOC

**BASE ADDITIONS:**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>METHODS</th>
<th>REL. SIZE</th>
<th>LOC</th>
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**TOTAL BASE ADDITIONS (BA) =>**

**NEW OBJECTS:**

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<th>TYPE</th>
<th>METHODS</th>
<th>REL. SIZE</th>
<th>LOC (NewReuse*)</th>
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</table>

**TOTAL NEW OBJECTS (NO) =>**

---

1 L-Logic, I-I/O, C-Calculation, T-Text, D-Data, S-Set-up

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## PROBE Process Details

### PSP Size Estimating Template (cont.)

<table>
<thead>
<tr>
<th>REUSED TOTAL (R)</th>
<th>Proj LOC: ( P = BA + NO )</th>
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<tbody>
<tr>
<td>Regression Param: ( \beta_0 )</td>
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<td>New and Changed LOC: ( N = \beta_i + \beta_i \ast (P + M) )</td>
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<tr>
<td>Total LOC: ( T = N + B - D - M + R )</td>
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<tr>
<td>Estimated Total New Reused (sum of * LOC):</td>
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<td>Prediction Range: Range</td>
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<tr>
<td>Upper Prediction Interval: ( UPI = N + \text{Range} )</td>
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</tr>
<tr>
<td>Lower Prediction Interval: ( LPI = N - \text{Range} )</td>
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Historical data on object LOCs

- Highly variable
  - language & design style influences
  - helps to normalize by number of methods

- Divided into basic types:
  logic, control, I/O, files, display, data, text, calculation, set-up, error handling

- Size range for object types based on log-normal distribution

Prediction Intervals – Reality check

- 70% and 90% likely range around the estimate
- Calculated from same data used to calculate the regression factors
- Uses the student-t
Outline

What is PSP – Context for PROBE

PROBE

⇒ Conclusions ⇐
PROBE – The PSP Size Estimating Approach

PROBE Process Details

PSP1 Framework

1. Customer Need → Define the requirements → Estimate the product size. (Chapter 5)
2. Estimate the resources. (Chapter 6) → Produce the conceptual design.
3. Produce the schedule. (Chapter 6)

Historical size database
Historical productivity database
Resources available

Management

Postmortem

Size, resource, schedule data → Analyze the process.

Tracking Reports

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PROBE – The PSP Size Estimating Approach

Conclusions

Actual Results – Estimating Error

UNISYS PSP Class

Actual Size Range

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<tr>
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Program Number

WCU PSP OC2

Actual Size Range

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Program Number

UNISYS PSP Class

Size Estimating Error Range

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Program Number

WCU PSP OC2

Size Estimating Error Range

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Program Number

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PROBE: SE Doc-26

v1.0 - 09/11/96
Teachable

Practical

Actual results indicate: Improvement over time

Improvable?: regression based on % error rather than absolute error