Measurement in the Software Process

Outline

- Review of PSP Levels
- Introduction
- Fundamental Process Measures
- The GQM Paradigm
- General PSP Objectives, Goals, & Questions
- An Example
- Gathering Data
- Impact of Data Gathering
- Establishing Your Baseline
- Homework #6
Review of PSP Levels (Humphrey, 1995, p. 11)

- PSP0
  - Current process
  - Time recording
  - Defect recording
  - Defect type standard

- PSP1
  - Size estimating
  - Test report

- PSP1.1
  - Task planning
  - Schedule planning

- PSP2
  - Code reviews
  - Design reviews

- PSP2.1
  - Design templates

- PSP3
  - Cyclic development

Introduction (cf. Humphrey, 1995, p. 207)

- This chapter covers:
  - Principles of process measurement
  - The GQM Paradigm
**Why Make Measurements?**
(cf. Humphrey, 1995, p. 207-208)

- To gain a quantitative understanding
- To evaluate a product, process, or organization
- To control a product or process
- To make an estimate or plan

**Principal Measurement Categories**
(cf. Humphrey, 1995, p. 208)

- **Objective / Subjective**
  - count vs. judgment
- **Absolute / Relative**
  - invariant vs. change wrt others
  - Ex: program size vs. average
- **Explicit / Derived**
  - primary vs. secondary
- **Dynamic / Static**
  - time dimension vs. final result
  - Ex: To date vs. total
- **Predictive / Explanatory**
  - in advance vs. after the fact
Mental Models (cf. Humphrey, 1995, p. 208, 209)

- **Definition**
  - A defined process
  - A defined context for data gathering

- **Conclusion**
  - “At least a basic process definition should always precede data gathering.”
  - Each task should have explicit entry/exit criteria… (This is very difficult at times, especially for Analysis & Design.)

- **Start general and refine**

- **Benefits:**
  - Provides useful data
  - Ex: how long tests take
  - Ex: # of defects found in each type
  - Ex: Whether additional cost to find each defect is worth it
  - ...

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- **Start with objective, absolute, explicit measures.**
- **Build derived ones upon these.**
- **Three categories of process measures:**
  - Product
  - Process
  - Resource
Fundamental Process Measures (cont.)

- **Product**
  - Volume of product produced
  - Ex: system capability (throughput, ...), complexity, ...

- **Process**
  - Process behavior
  - Objective, absolute, explicit, dynamic
  - Event counts & time measures

- **Resource**
  - Labor hours are the primary resource.
  - Secondary resources are tools & systems, support, ...
  - You probably need to track time are the minute level
  - Many types of "interruptions" reduce "productive" time:
    - meetings
    - lack of clerical service
    - poor support
    - phone calls
    - ...
  - Three costs of these "interruptions":
    - lost time
    - additional time to get going again
    - increased likelihood of error
  - Conclusion:
    - Track time to determine where and how to improve
The GQM Framework

- GQM = Goals, Questions, Metrics
- Define primary (business related)
goals for the activity (and for those
above you in the organization).
  • What are you / they trying to achieve?
- Create questions, answer to which
will help achieve these goals.
- Define / gather data necessary for
answering the questions.

GQM: The Goals Hierarchy
(cf. Humphrey, 1995, p. 212)

- Attempt to identify a hierarchy of
organizational goals and relate your
goals to the broader set.
  • What, how, when, how much, &
  improvement.
- cf. Fig. 7.1, p. 212, Goals Hierarchy
**GQM: Questions**
(cf. Humphrey, 1995, p. 213)

- You are starting with rather vague goals and would like to end up with useful numbers (data collected, metrics).
- **Questions** are the connection between the two.
- Questions tell what you want to know about each goal.
- Ex:
  - For each process goal, where did I start, where am I now, and where do I want to go?
  - What is the best that has been achieved against this goal?
  - Is there a limit above which this goal cannot be improved?
  - cf. Manager/Developer GQM paper

**GQM: Metrics**
(cf. Humphrey, 1995, p. 213)

- Metrics are the precise, exact ways you will collect the data.
- Start, be precise, recognize the need for additional data, and refine or add to the metrics you are collecting.
- Designing forms facilitates the data collection. It:
  - Is precise
  - Makes data collection easier
  - Improves the data-gathering efficiency
  - Helps point out weaknesses in the process
  - ...

General PSP Objectives / Goals
(cf. Humphrey, 1995, p. 214)

The overall PSP data-gathering goals are:
• Understand how personal SW development works
• Determine steps to improve product quality
• Determine the impact of process changes on your productivity
• Establish benchmarks to measure process improvement

You should:
• Set more explicit goals
• Start with learning about your process

General PSP Questions, Metrics, and Process
(cf. Humphrey, 1995, p. 214)

Questions:
• What aspects of my performance are important?
• How could I measure them?
• What is the best performance I have achieved?
• What can I learn from them?
• What are others achieving?
• What methods do they use that could help me?

Metrics:
• Define measures for the questions
• Gather data on these measures

Process:
• Refine & improve
Some Examples

- **Book’s example:**
  - **Goal:** Produce defect-free programs.
  - **Question:** How can you produce SW of such quality such that no defects will be found in later testing or use?
  - **Note:** There is no way to guarantee this, but we can take steps to minimize it.
  - cf. Table 7.1, p. 218, on how to update a Project Plan Summary when defects are found after development is completed - running it later or using it as the base for another program.

- **My Mgr/Dev GQM paper examples**
  - Look at paper

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Gathering Data

- **There are three issues with respect to gathering data, since you will probably not have special tools:**
  - **Forms**
    - You will need to create forms to facilitate the collection process.
  - **Place to keep the data**
    - You will need to decide on a place to store the data.
  - **Engineering notebook**
    - You will want a convenient place to record many kinds of thoughts and information, and log it for later reference.
Gathering Data Manually

- Tools would be nice, but personal judgment is necessary:
  - What category of activity are you engaged in right now? You need to log this. The computer cannot know this all the time.
  - Counting defects from code changes.
  - Determining where a defect was injected.
  - cf. Orlikowski

- Therefore, gather data manually.
- You can automate some of the analysis.
- There are readily-available tools:
  - Logs
  - Forms
  - Databases
  - Spreadsheets
  - Summary reports
  - ...

Gathering Data: Forms & Templates
(cf. Humphrey, 1995, p. 219-220)

- Definitions:
  - Forms = for fixed amount of data
  - Template = for unpredictable volume of data - expandable

- How to develop forms & templates
  - Use a test & modify cycle
  - Create the form and do a dry run with prior project data
    revise and do another dry run
  - Finally test on a real project
  - Revise...
Gathering Data: The Defect Database
(cf. Humphrey, 1995, p. 220-221)

- Look at Table 7.2, p. 221, Defect Database Example
- Sample Uses:
  - Number of defects injected & removed by phase
  - Number & types of defects found in a specific phase
  - Number of defects in the product at phase entry, but which were not found during that phase
  - Time to fix a defect as a function of phase removed
- Suggestions:
  - Enter data promptly (post-mortem is a good time)
  - DBMS is a good method (spreadsheet could be used too)

Gathering Data: The PSP Spreadsheet
(cf. Humphrey, 1995, p. 221-225)

- The spreadsheet has places for all Project Summary form data
- Walk through Table 7.3, p. 222-4
- Some potential analyses:
  - Regression - use spreadsheet
  - Yield = % defects removed in phase X…
  - Productivity
    - Development
    - Defect-finding in phase X
  - Charts - graphs, plot progress
Gathering Data: The Engineering Notebook
(cf. Humphrey, 1995, p. 219-220)

- **Uses & Value**
  - record thoughts (ideas)
  - document ideas (patents, …)
  - prove competency (liability)

- **Practice: combine notebook & time log**
  - Page 1 = index
  - Notebook from front and onward
  - Log from back and forward

Impact of Data Gathering

- **It takes time**
  - Time consuming and tedious
  - You must be convinced of its value
  - You must understand your goals, questions, and how you’ll use the data
  - This will guide your choice of what to keep / change about the PSP

- **It can affect your performance**
  - When you gather data for yourself - you can be objective
  - When you gather data for your boss - you make the results look as good as possible
  - Be careful / sensitive / private about how you share your personal data
Establishing Your Baseline
(cf. Humphrey, 1995, p. 227-228)

- You need a good volume of data to tell if you are improving.
- Bolstering = Selectively remembering good results
- Clutching = Results are so important that your performance is effected.
  - Ex: you must do well, and you don’t, even though you usually do.
- Pressure introduces unknown factors which change your performance.
- Personal performance data can be discouraging, so focus on changing behavior, not simply on trying harder.

Homework #6

- Program 6A
  - Enhance 4A linear regression to calculate prediction interval
  - See p. 757-758, and Assignment Kit #6