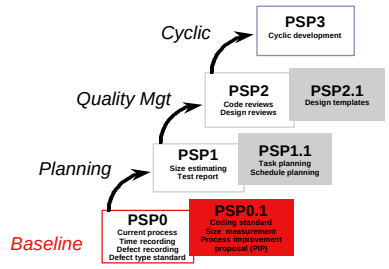
Measurement in the Software Process

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 - Part 1*

Review of PSP Levels *(Humphrey, 1995, p. 11)*



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
  -

Fundamental Process Measures *(cf. Humphrey, 1995, p. 209-210)*

- Start with objective, absolute, explicit measures.
- Build derived ones upon these.
- Three categories of process measures:
  - Product
  - Process
  - Resource

Fundamental Process Measures (cont.) *(cf. Humphrey, 1995, p. 209-210)*

- Product
  - Volume of product produced
  - Ex: system capability (throughput, …), complexity, …
- Process
  - Process behavior
  - Objective, absolute, explicit, dynamic
  - Event counts & time measures

Fundamental Process Measures (cont.) *(cf. Humphrey, 1995, p. 209-210)*

- 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 *(cf. Humphrey, 1995, p. 211-214)*

- 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 <u>organizational</u> goals and relate <u>your</u> 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
(cf. Humphrey, 1995, p. 215-217, and Turk, 1994)

- 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. 218,219, 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

Gathering Data (cf. Humphrey, 1995, p. 217-226)

- 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

(cf. Humphrey, 1995, p. 217-219)

- *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

(cf. Humphrey, 1995, p. 226-227)

- *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 - Part 1

- See "Homework Assignments" list and textbook instructions.