Design & Code Reviews

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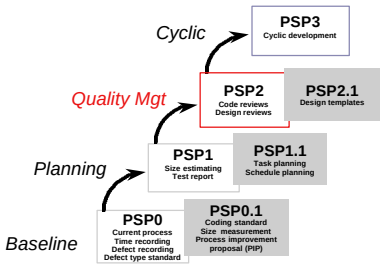
Review of PSP Levels *(Humphrey, 1995, p. 11)*



Introduction *(cf. Humphrey, 1995, p. 231)*

- *"Design and code reviews… [provide] more improvement… than… any other single change you can make in your personal software process."*
- *"Doing reviews is the most important step you can take to improve your software engineering performance."*

Three Types of Reviews

(cf. Humphrey, 1995, p. 231-233)

- *Inspection - team review*
  - *Prepare at initial meeting*
  - *Inspect separately, then in meeting*
  - *Author repairs, report is made, track to closure*
- *Walkthrough - less formal team review*
  - *Author makes presentation*
  - *Developers & users can participate*
    - *ID omissions & misunderstandings*
    - *educate*
  - *Little advance preparation or follow-up is necessary*
- *Personal review - ID/fix as many defects as possible before compile, inspection, compile, or test*
  - *This was the standard practice before PC's, fast compilers, and integrated graphical environments became the norm.*
  - *They save time later*

Products to Review

(cf. Humphrey, 1995, p. 233)

- *All SW products can be reviewed*
- *Reviewing early products provide most benefit.*
  - *Early products are even more critical for the whole SW development process.*
  - *They are easier and cheaper to review.*
- *Products:*
  - *Analysis*
  - *Design*
  - *Code*
  - *Documentation*
  - *Development plans*
  - *Test cases / plans*
  - *...*

Why Review? (cf. Humphrey, 1995, p. 233-237)

- The secret to good writing is re-writing.
- Many beginning PSP-users spend more than 33% of their development time on compiling and testing. At the end of the A-series programs students spend about 10% (or less).
- Conclusion:
  - Reviews improved time, efficiency, predictability, and quality
  - cf. student data graphs, Fig. 8.1 & 2, p. 234

Review Efficiency (cf. Humphrey, 1995, p. 235)

- The biggest single problem with reviews is convincing yourself of their value.
- It doesn't seem worthwhile when you have a powerful compiler / debugger to find (some) defects for you…
- The only way to convince yourself is to collect data and see.
  - **Table 8.1, p. 235, shows 8-12 times more time for unit test fix vs. code review, and 16-60 times for post unit-test fix…!**
  - **Fig 8.3, p. 236 shows 3-5 times more defects per hour for code review than test.**

Review Efficiency (cont.)
(cf. Humphrey, 1995, p. 236-237)

- Code reviews are more efficient than testing:
  - Reviews
    - Defects are found directly
    - You build a mental model of the program
    - Thus it's easier to fix errors when they are found
  - Testing
    - Only symptoms of defects are found
  - Debugging
    - You must search for the causes of the defects which were found in testing
  - Examples:
    - Three months searching vs. 2 hours inspection: inspection found the error plus 71 others!
    - Three days searching for one misplaced semicolon after a for statement….

Review Efficiency (cont.)
(cf. Humphrey, 1995, p. 237)

- Debuggers are good for stepping through program logic and checking parameter values.
  - This is helpful if you know what the values should be.
  - In order to know this you have to understand the program logic.
  - Conclusion: Why not thoroughly check the logic ahead of time since you need to know it anyway?!
- Most professional programmers have about 100 defects / KLOC.
  - Before using reviews, PSP students found approximately 50% of their defects in compile.
  - Thus 50% were left for test.
- You must decide the most efficient way to find them.
- Collect personal data to convince yourself.

Review Principles (cf. Humphrey, 1995, p. 239-243)

- Establish review goals
- Follow a defined review process
- Measure & improve your review process

Review Principles: Establish Goals (cf. Humphrey, 1995, p. 239-240)

- Ex:
  - 100% defect removal before first compile
- Reality:
  - Most people will achieve 50-80%

Review Principles: Follow Defined Process

(cf. Humphrey, 1995, p. 240-243)

- A defined process will include for each activity:
  - Entry & exit criteria
  - Tasks to perform
  - cf. Table 8.2, Code Review Script (Design script is very similar)
  - cf. Table 8.3, Checklist
- Keep script and checklist separate
  - Facilitates planning
  - Easier to update

Review Principles: Measure & Improve Your Process

(cf. Humphrey, 1995, p. 243)

- You measure reviews in order to improve their quality
- A high-quality review finds the most defects in the least amount of time
- In order to track this you must know:
  - Review time
  - Number of defects found
  - Number of defects found after review

Review Principles: Keep Design & Code Reviews Separate

(cf. Humphrey, 1995, p. 243)

- Keeping design and code reviews separate helps:
  - Make designs more understandable
  - Save implementation time
  - Avoid missing product defects
  - Spot possible design improvements
- When design & code reviews are kept separate you are more likely to:
  - Look for design alternatives
  - Look for ways to make the design neater and/or cleaner

Four Design Review Principles

(cf. Humphrey, 1995, p. 244-247)

- Produce reviewable designs
- Follow an explicit review strategy
- Review the design in stages
- Verify that the logic correctly implements the requirements

Design Review Principles: Reviewable Designs

(cf. Humphrey, 1995, p. 245)

- For a design to be reviewable:
  - It's purpose and function must be explicitly stated.
    - Explicitly list program's required functions and constraints, conditions, standards.
  - The design description must be complete and precise.
    - System issues that affect the design should be noted.
    - Ex: performance, memory, usability
  - The design must be segmented into logical elements.
    - This facilitates limited reviews at one time.
    - Rule of thumb: One page of text.
- Gather data and find out what works best for you.
  - Have we seen this theme before?!

Design Review Principles: Explicit Strategy

(cf. Humphrey, 1995, p. 245-246)

- Following a specific design / development sequence provides a context and the ability to coordinate and/or integrate designs.

Design Review Principles: Review in Stages

(cf. Humphrey, 1995, p. 246-247)

- Guidelines:
  - Check for all required program elements.
  - Verify overall program structure and flow.
  - Check correctness of logical constructs.
  - Check logic for robustness. (Stress test.)
  - Check function calls - parameter number, order, & type; valid values.
  - Check special variables, data types, files.
- Human vs. Compiler checking of names & types
  - If you don't have name / type defects then don't worry about this during design review
- Humphrey:
  - During design review manually check global variables and state controlling parameters, and all specially declared types.
  - Check all others during code review

Design Review Principles: Verify Logic vs. Requirements

(cf. Humphrey, 1995, p. 247)

- Checking that the program's logic meets the requirements is:
  - Hard work
  - The only way to check for oversights and/or omissions

Review Measures (cf. Humphrey, 1995, p. 247-248)

- There are 4 explicit review measures:
  - Reviewed program size - LOC
    - PC and PI would help to have common size measure throughout
  - Review time - minutes
  - Number of defects found
  - Number of escapes - defects found later
- Derived measures:
  - Review yield = % defects found during review
  - Defects / KLOC design or code reviewed
  - Defects / Hour
  - LOC reviewed / Hour
  - DRL = defect removal leverage
    - relative rate of defect removal for any two process phases

Review Measures: Review Yield

(cf. Humphrey, 1995, p. 248-251)

- Review yield
  - Is the best measure of review quality
  - Is the % of defects in design or code at the time of review which were found by the review
  - You can't calculate this precisely until later
- cf. Table 8.4, Yield Calculation Ex.
  cf. Table 8.5, corresponding Defect Log
  cf. Table 8.6, Ex. defect summary (net escapes, …) and formulas
- cf. Fig 8.5, Ex C++ Code Review Yield
  cf. Fig 8.6, Ex Student yield data

Instant Review Measures

(cf. Humphrey, 1995, p. 251-256)

- You need measures which can be gathered at the current time which correlate with yield.
  - This tells how good you're doing <u>while</u> you're doing reviews.
  - % yield is not known until the end.
- Examples:
  - Defects / KLOC
    - Problem:
      - Is low yield due to superficial review or did you start with few defects?
      - Fig. 8.7, p. 253 doesn't show strong correlation.
  - Defects / Hour
    - 200 LOC / Hour optimal
    - cf. Fig 8.9, p. 255

Instant Review Measures: DRL

(cf. Humphrey, 1995, p. 256-257)

- DRL = Defect Removal Leverage
  - Measures relative effectiveness
  - Ratio of defects removed / Hour for any two phases
- Most used to compare test phase with some other phase
- Examples
  - cf. Table 8.7, Student PSP 10a data
  - cf. Table 8.8 & Fig 8.11, Humphrey's PSP data

Checklists (cf. Humphrey, 1995, p. 257-260)

- Checklists are very important
  - Example: airline pilots' preflight checks
- Using Checklists
  - Review 1 topic at a time
  - Review 1 program section at a time
  - Design reviews are best performed top-down
  - Code reviews are best performed bottom-up (unless you are unfamiliar with the code)

Checklists (cont.) (cf. Humphrey, 1995, p. 260-263)

- Building Checklists
  - Review your defect data to see where you should focus
  - Start with the PSP0 defect standard (Tables 8.9 & 10) information the checklist
  - Modify the checklist based on your defects-found (Pareto) distribution
    - Categories not to worry about
    - Subcategories
    - cf. Fig 8.12, p. 261, Pareto distribution (sorted by frequency)
    - Focus on most-frequently found defect types, and see how you can improve your rate.
    - Don't drop checking for low-frequency "found" review items, just those that you are not having.
      - You're finding these!
      - If you drop them you'll have to find them in test…
  - Check coding standard items in your reviews

Reviewing Before vs. After Compiling (cf. Humphrey, 1995, p. 263-264)

- This is not a simple issue
- Not 100% of syntax errors are caught by the compiler
  - 8.7-9.3% of Humphrey's weren't
  - These may actually be thought of as semantic, not syntax, errors: the code does not do what was intended.
- cf. Fig 8.13, p. 264, Defect types found / missed

Reviewing Before vs. After Compiling: Pros & Cons

(cf. Humphrey, 1995, p. 264-265)

- Compiling First:
  - Compiling has 2x DRL for some defect types
  - 90% of syntax & naming defects found
  - Individual review effectiveness varies: may miss from 20-50% of syntax defects
  - Syntax defects missed by compiler are easy to find
- Reviewing First:
  - Compiler misses about 9% of syntax defects
  - Finding defects in review saves both compile time and makes it more predictable
  - It generally takes longer to fix syntax errors in test than in review
  - Unit testing generally finds about 1/2 of a program's defects. If you find more defects before test then your total found is likely to go up.
  - Later test phases are even less efficient than unit test
  - Hard to do thorough job reviewing pre-compiled code because there are few defects. You lose interest…
  - You won't save any time by compiling first; reviewing first saves time in compile and in later test.

Reviewing Before vs. After Compiling: Objectives

(cf. Humphrey, 1995, p. 265-266)

- What is your goal?
  - Do you want to get to test as soon as possible, or do you want to remove the most defects?
- Don't confuse speed with progress!
- If you are trying to remove the most defects, then you might as well review where it is most effective.

Reviews & Inspections

(cf. Humphrey, 1995, p. 267-268)

- You should perform (group) inspections in addition to your personal reviews
  - Include all involved people's time in your Time Log
- Question: Where to inspect?
  - Review code before inspection?
  - Compile code before inspection?
- Answers
  - Give inspectors as clean code as possible - review it first: polite, they'll focus better.
  - When improving your review process - inspect before compile.
  - When you have a good review process - compile before inspection.
  - Don't unit test first.

Homework #6 - Part 2

- *See "Homework Assignments" list and textbook instructions.*