Design & Code Reviews

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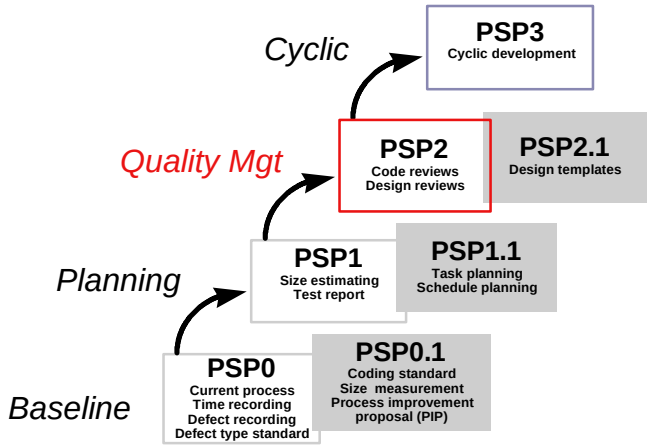
Review of PSP Levels *(Humphrey, 1995, p. 11)*



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 <u>your</u> 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 <u>finding</u> 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 #7

- *Report R4*
  - *Midterm report: Define a process for analyzing your PSP data and use this process to produce report R4.*
  - *See p. 771-2 and Assignment Kit #7*