Peer Reviews

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Three Mechanisms for V&V

Testing

- **"test" can be a generic word – see Weinberg's Perfect Software and Other Illusions About Testing**
  - **does (not) meet need**
  - **does (not) meet all requirements**
  - **(un)acceptable costs or constraints**
  - **grossly unreliable**
  - **poor performance**
- **assume dynamic execution of a program**
  - **black box, white box, unit, integration, system, regression, etc., testing**

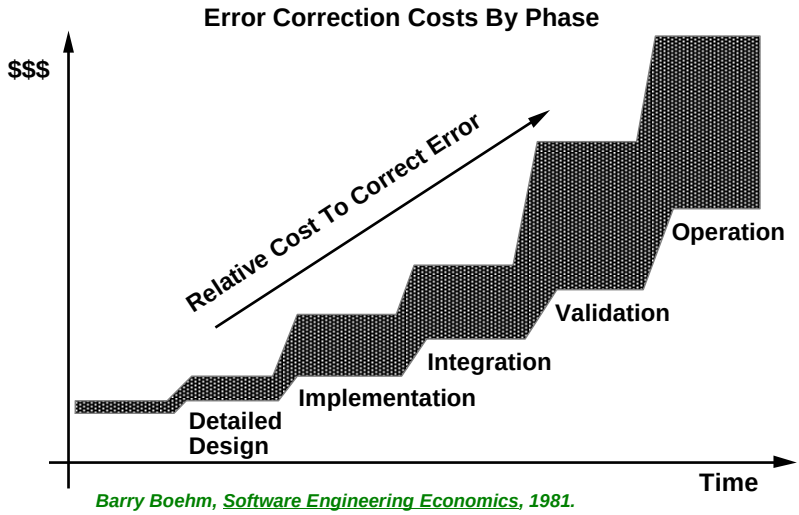
Formal methods

- **formal specifications**
- **model / property checking**
- **proofs of correctness**

Peer reviews

- **A review of a software work product, following defined procedures, by peers of the producers of the product for the purpose of identifying defects and improvements. (Software CMM)**

Value of Fixing Defects Early



Barry Boehm, Software Engineering Economics, 1981.

Value of Peer Reviews

Any kind of peer review is better than none.
- **inspections (approximately 5:1 ROI)**
- **structured walkthroughs (approximately 3:1 ROI)**

No longer an argument over whether peer reviews are worthwhile.
- **debates are over "how"**
- **recognizing the value does not mean that we do them systematically**
- **knowing how to do them does not mean we do them correctly or consistently**

Forms of Peer Review

Variants of peer reviews include
- **(structured) walkthroughs**
- **(Fagan-style) inspections**
- **scenario-based inspections**
- **active design reviews**
- **…**

Alternative practices
- **pair programming**
- **formal methods, proof of correctness**

Walkthrough

A static analysis technique in which a designer or programmer leads members of the development team and other interested parties through a segment of documentation or code, and the participants ask questions and make comments about possible errors, violation of development standards, and other problems.
- **IEEE 610**

See Weinberg's The Psychology of Computer Programming for a discussion of walkthroughs, democratic teams, and egoless programming.

Some ROI Numbers

A testing step will remove roughly 30% of the defects in the software.
- ***Capers Jones, "Software Estimating Rules of Thumb," IEEE Computer, March 1996.***
- **assumes "typical" testing criteria are used!**

Walkthroughs and reviews will remove roughly 30% of the defects in the work product being reviewed.
- **Jones, 1996**

Inspections will remove 60-90% of the defects in the work product being inspected.
- **60% for newly trained teams; 90% with experience (Radice)**
- **highest return inspections are of requirements and design**

Elements of Inspections

Six well-defined inspection steps
- **planning**
- **overview**
- **preparation**
- **meeting**
- **rework**
- **follow-up**

Four well-defined inspection roles
- **moderator**
- **recorder**
- **reader**
- **producer**

Formal collection of process and product data

The product being inspected

A supporting infrastructure

A.F. Ackerman, L.S. Buchwald, and F.H. Lewski, "Software Inspections: An Effective Verification Process," IEEE Software, May 1989.

Fagan's "Rules" for Inspections

Optimum number of inspectors is four.

Review rate should be about 140 lines of text / hr (no more than 280 LOT/hr) for design documents.

Review rate should be about 125 SLOC/hr (no more than 250 SLOC/hr) for code.

Inspection meetings should not last more than two hours.

No more than two inspection meetings per day.

M.E. Fagan, "Design and Code Inspections to Reduce Errors in Program Development," IBM Systems Journal, 1976.
M.E. Fagan, "Advances in Software Inspections," IEEE Transactions on Software Engineering, July 1986.

Fagan's Key Properties of Inspections

Formal moderator training

Defined participant roles

Moderator "drives" the inspection

Use of "how to find errors" checklists

Use distribution of error types to look for

Follow-up to reduce bad fixes

Less future errors because of detailed error feedback to the individual programmer

Improved inspection efficiency from analysis of results

Analysis of data identifies process problems which leads to improvement – *systemic defects*

Evidence-Based Inspections

Ron Radice, High Quality Low Cost Software Inspections, 2002.

Preconditions

- **clear and visible management support**
- **defined policy**
- **good training for all**
- **effective procedures**
- **proper planning**
- **adequate resources**

Cost of Inspections

Typically between 8% and 20% of project budget for inspections

Radice, page 9-295 & 9-296

Software CMM Level	Inspection as % Cost
1	8.5
2	10.2
3	11.4
4	13.6
5	15.3

Return-on-Investment (1 of 3)

Defects Found Without Inspections			
	Found	Relative Cost/Defect	Full Cost
Inspections	0	1	0
All Tests	90	10	900
Users	10	100	1000
Total	100	-	1900

Radice, pages 9-298 to 9-299

Return-on-Investment *(2 of 3)*

Defects Found With Inspections at 50% Effectiveness			
	Found	**Relative Cost/Defect**	**Full Cost**
Inspections	**50**	**1**	**50**
All Tests	**45**	**10**	**450**
Users	**5**	**100**	**500**
Total	**100**	**-**	**1000**

Return-on-Investment *(3 of 3)*

Defects Found With Inspections at 90% Effectiveness			
	Found	**Relative Cost/Defect**	**Full Cost**
Inspections	**90**	**1**	**90**
All Tests	**9**	**10**	**90**
Users	**1**	**100**	**100**
Total	**100**	**-**	**280**

Case Studies of Inspections

IBM inspections showed up
- **82% of all detected faults (1976)**
- **70% of all detected faults (1978)**
- **93% of all detected faults (1986)**

Switching system
- **90% decrease in the cost of detecting faults (1986)**

JPL
- **four major faults, 14 minor faults per 2 hours (1990)**
- **savings of $25,000 *per inspection***
- **number of faults decreased exponentially by phase (1992)**

Inspection Effectiveness and Maturity

Software CMM Level	Inspection Effectiveness
1	<50%
2	50-65%
3	65-75%
4	75-90%
5	>90%

Radice, page 1-40

Preparation and Meeting Rates

Work Product Type	Rates
Architecture & requirements documents	2-3 pages/hr
High-level & low-level design	3-4 pages/hr
Code & test cases	100-150 LOC/hr
Unit test plan	4-5 pages/hr
All test plans	5-7 pages/hr
User documentation	8-12 pages/hr
Fixes & changes	50-75 LOC/hr

Radice, page 3-95

Team Size

Fagan: Four people constitute a good-sized inspection team.

Buck: Little difference in effectiveness for teams of 3, 4, and 5 participants.

Freedman and Weinberg: Select the reviewers to ensure that the material is adequately covered.

Porter and Votta: Inspections with two reviewers were no less effective than those with four.

Systemic Defects

Causal analysis at the end of the inspection

What "systemic defects" should be prevented by process changes?

Target: 90% of systemic defects fixed within five working days.

Michael Fagan, 2002

Some Lessons Learned

Ed Weller, "Lessons from Three Years of Inspection Data," IEEE Software, September 1993.

- **You may have to sacrifice some data accuracy to make data collection easier.**
- **Inspect before unit test.**
- **An inspection team's effectiveness and efficiency depend on how familiar they are with the product and what their inspection-preparation rate is.**
- **Ensure that the definitions of metrics are clearly understood, and that guidelines for size of material inspected are followed.**
- **Expect a drop in effectiveness as you transition from pilot to general use, and be prepared to address the problems with process metrics.**
- **Good inspection results can create false confidence. Inspections are not a silver bullet. Be sure to inspect all basic design documents.**
- **Inspections can improve the quality of maintenance fixes.**
- **Investigate the work product before deciding that process metrics indicate an ineffective inspection process.**
- **Inspections can replace unit test with significant cost savings.**
- **No matter how well they are executed, inspections cannot overcome serious flaws in the development process.**

Inspection Effectiveness Factors

Moderator effectiveness

Material meets entry criteria

Domain knowledge

Language knowledge

Phantom inspector (synergy of meeting)

Meeting length within two hours

Size of team is four

Inspection rate (code = 125 LOC/hr, max 250 LOC/hr)

Preparation rate (code = 100 LOC/hr, max 200 LOC/hr)

Michael Fagan, 2002

Barriers to Peer Reviews

Belief that peer reviews are too expensive
- **four engineers per review**
- **150 SLOC/hr for code reviews**
- **max of 2 hours per review**
- **max of 2 reviews per day for an engineer**

Schedule pressure leaves no time for reviews

Hostile reviews – poor interpersonal skills, poor facilitation

Use of review results for performance evaluations

Questions and Answers