A Cost Model and Tool to Support Quality Economic Trade-off Decisions

William Nichols

Software Engineering Institute
Pittsburgh, PA 15213

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From the Boehm and Basili Top 10 List


Finding and fixing a software problem after delivery is often 100 times more expensive than finding and fixing it during the requirements and design phase.

About 80 percent of avoidable rework comes from 20 percent of the defects.

Peer reviews catch 60 percent of the defects.

Disciplined personal practices can reduce defect introduction rates by up to 75 percent.

All other things being equal, it costs 50 percent more per source instruction to develop high-dependability software products than to develop low-dependability software products. However, the investment is more than worth it if the project involves significant operations and maintenance costs.
What Have We Learned?

We still hear

“We had to release yesterday. We’ll take the shortcut and polish it later.”

What do you rush?

• Completing test cases? Reduced test coverage?
• Designs? Design inspections?
• Coding? Code inspections?

Peer review might improve quality, but will delay release, right?

Can you really buy time in the short run by trading-off the long run?
Debt or Liability?

We’ve all heard “Quality is free.” Do you believe it?
How do you make the right trade-off for the short term and long term?
How do you know and how do you convince others?

Start with “What does done look like?”

Does it have to be unit tested?
Does it have to get through an integration and system test?
Does it have to pass a user acceptance test?
How long will test take? What is the model?

How long it takes and what it costs to get through these activities depends
the quality of the product going into test.
Defect Injection-Filter Model

For personal and team plans, calibrate directly with real data.

Similar to Jones “Tank and Pipe.” Simplifies assumptions found in Boehm/Chulani COQUALMO.
Defects Require Time to Find and Fix

![Bar Chart]

- Design Review: 5 minutes
- Design Inspect.: 22 minutes
- Code Review: 2 minutes
- Code Inspect.: 25 minutes
- Unit Test: 32 minutes
- System Test: 1405 minutes

Source: Xerox
Quality Process Measures

The TSP uses quality measures for planning and tracking.

1. Defect injection rates [Def/hr] and removal yields [% removed]
2. Defect density (defects found and present at various stages and size)
3. Review/inspection rates [LOC/hr]
Parameters

Phase Injection Rate [defects/hr]
Phase Effort Distribution [%] total time
Size [LOC]
Production Rate (construction phase) [LOC/hr]
Phase Removal Yield [% removed]
Zero Defect Test time [hr]
Phase “Find and Fix” time [hr/defect]
Review/Inspection Rate [LOC/hr]
Make the Theoretical Concrete

Do you achieve your goals?

• How much functionality do you want to deliver?
• What are the non-functional targets? (performance, security…)
• What is your desired schedule?
• How many defects do you expect the user to find?

Build the model.

Use real data.

Visualize the result.
Control Panel

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Total Development and Test Time

Baseline
Revised

Defect Density Phase Profile

Density Goal [Def/KLOC]

Compare your performance to a baseline.
Perform a personal design review.
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Total Development and Test Time

- Dev
- UT
- IT
- ST

Defect Density Phase Profile

Include a peer design review.
## Control Panel

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### Total Development and Test Time

- **Baseline**
- **Revised**

### Defect Density Phase Profile

- **Baseline** [Def/KLOC]
- **Revised** [Def/KLOC]
- **Density Goal** [Def/KLOC]

### Have a peer inspect the code.
Control Panel

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Total Development and Test Time

Baseline

Revised

Defect Density Phase Profile

At some point we cross the “quality is free” point.
Here’s where you reach the “quality is free” point!
The “quality is free” point depends on your personal parameters.
In Construction Through Test

When you hear the claim, we have to take a short cut to save time “we’ll deal with consequences later…”

…Respond with, “Build code, not liability. Doing it right is faster and cheaper.”

The “Long Run” is already here! Deal with it!
Contact Information

William Nichols – wrn@sei.cmu.edu

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Atlanta, GA

http://www.sei.cmu.edu/tsp/symposium/
Implicitly Use
Intertemporal equity exchange theorem

Time is Money

$ = e^{-it}$
Total Development and Test Time

Defect Density Phase Profile

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Planning Effort and Defects

Phase Effort

Defects Injected

Phase Effort

Defects Removed
Plan and Actual Effort for Components

- **Design**
  - Equation: $y = 0.7213x + 0.0377$
  - $R^2 = 0.5672$

- **Test Case Review**
  - Equation: $y = 0.7536x + 0.0511$
  - $R^2 = 0.11$

- **Design Review**
  - Equation: $y = 0.1592x + 0.13$
  - $R^2 = 0.1236$

- **Test Case Inspect**
  - Equation: $y = 0.9161x + 0.0866$
  - $R^2 = 0.572$

- **Design Inspect**
  - Equation: $y = 0.9385x + 0.2516$
  - $R^2 = 0.6408$

- **Test**
  - Equation: $y = 0.9385x + 0.2516$
  - $R^2 = 0.6408$
Leading vs. Lagging Indicators
You Don’t Want to Be This Person