“If you torture the data long enough, it will confess to anything.”

– Ronald Coase
It would be a pure function if not for the side effects on your sanity

Turning Coffee Into Code
The Definitive Guide

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Key Embedded Software Metrics

Anti-Patterns:
- Development effort > validation effort
- Too many lines of code per hour
- Peer review finds <50% of all bugs

Healthy project metrics:
- About 2-3 hours of validation effort per hour development
  - Tester:Developer head count ratio is about 1 to 1
- Productivity of 1-2 lines of code per hour for solid software
  - This includes entire process (requirements through acceptance test)
- Peer review should be finding >50% of all defects
Software = Design + Testing

Figure H.1 – V-Model for the software life cycle

IEC 60730 Appliance Safety
Typical Effort Distribution

Tester to Developer ratio varies depending on situation
- Web development: 1 tester per 5-10 developers
- Microsoft: 1 tester per 1 developer
- Aircraft controls: ~5 testers per 1 developer

EMBEDDED SW PROJECT EFFORT

25% DEV: Peer Reviews & Unit Test
25% DEV: Design & Implementation
45% TEST: Integration Test
5% SQA/PPQA

50%/50% Head Count
20 Person Project

25%/75% Effort

25% DEVELOPMENT
DEV: Design & Implement

75% VALIDATION & QUALITY
TEST: Integration Test & System Test

25% SQA/PPQA

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Code Productivity

Productivity 1-2 lines of code/hr (including testers)
- Perhaps 3 lines/hr with Agile, but that speed increases quality risk

High lines of code/hr ⇒ cutting corners
- Partial requirements, no design?
- No peer reviews?
- Only system level testing?

$25-$75 / line of source code
- All-in cost, including entire V process, until field testing
- “Maintenance” can cost more, but might count as new project
Peer Review Effectiveness

- Good peer reviews find 50%-70% of the defects
  - Fewer than 40%-50% of defects found in peer reviews mean they are BROKEN

- Peer Reviews cost perhaps 5%-10% of total project cost
  - Let’s do the math:
    - Peer reviews process about 100 lines of code per hour total
    - Three reviewers ➔ 33 lines of code per person-hr
      = 0.033 hours per line of code reviewed (2 minutes)
    - 0.033 hours review / .5 hours per LOC total = 6.7% for code review
    - Plus review requirements & design … but still a great ROI

- Are peer reviews finding half your bugs?
  - Are you spreading them out or bunching them together?
  - If they’re not finding bugs, consider improving review culture
2-3 hours of validation for each 1 hour of development

- Head count ratio generally 1 Tester to 1 Developer
- About 5% of effort for SQA

Code productivity of about 1 to 3 lines per hour

- At or above 3 lines/hr, you probably are cutting corners

Peer reviews should find 50% (or more) of defects

- At about 5%-10% of total project cost

Metric Pitfalls

- Use only metrics that provide value – don’t go crazy with metrics!
- Gaming the metric doesn’t improve software quality
- Reward/punish based on metric values will render metric useless
- Fast, good, cheap: pick any two.