18-642: Key Development Metrics

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“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 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

IEC 60730 Appliance Safety
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

Typical Effort Distribution

EMBEDDED SW PROJECT EFFORT

50%/50% Head Count

20 Person Project

10 DEVELOPERS 50%

9 TESTERS + 1 SQA/PPQA 45% + 5% = 50%

25%/75% Effort

25% DEVELOPMENT

DEV: Peer Reviews & Unit Test

DEV: Design & Implementation

TEST: Integration Test
System Test
Regression Tests

5% SQA/PPQA

25% 75% VALIDATION & QUALITY

TEST: Integration Test & System Test

PPQA/SQA

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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
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
Best Practices For Key Software Metrics

- **2 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.