The Open Source Quality Paradox: How Can Code Done Bad Be So Good?

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Background & Goals

The author
- Makes no claim to be an expert in anything
- Tries hard to ask really annoying questions
- Always encourages questions on quantum mechanics

The goals of this talk
- Take a few pokes at what is meant by “software quality”
- Discuss if-why-how open source software has quality
- Introduce a few ideas about component-based quality

The approach
- Examine a few critical definitions and assumptions
- Try to understand how open source relates to the past
- Look for a synthesis and a way forward
Two Types of Risk

Risk of design flaws

Define ➔ Explore ➔ Elaborate ➔ Finalize ➔ Deploy

Risk of replication flaws

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Design Risks

Design risks = What you *don’t* know

Design risks include:

- Omissions (missing features, missing checks)
- Wrong understandings (wrong needs, wrong theories)
- Deleterious emergent behaviors (*big problem!*)
  - Emergent performance issues
  - Emergent interface issues
  - Emergent reliability issues
  - Emergent security issues
  - … (one for every ility) …

Metrics

- Metrics *must* encourage searches for emergent issues
- Analytical creativity and insight are vital for success
Replication Risks

- Replication risks = Not following rules

- Replication risks include:
  - Poor training (not enough information to perform well)
  - Sloppy execution (indifference to what should be done)
  - Poor memory (people always forget)
  - Inaccuracy (people are not machines)
  - Using groups or teams amplifies the risks enormously:
    - Well-trained individuals do not translate into well-trained groups
    - The huge “communications gap” between people masks training
    - The communications gap is even more damaging to execution
    - Forgetfulness easily becomes rampant at the group level

- Metrics
  - Must enforce machine-like memory and rote repetition
Matching Risks to Players

- The two types of risk:
  - Design risks (needed: creativity, prediction, insight)
  - Replication risks (needed: memory, precision, diligence)

- The two types of players:
  - Humans (sloppy, slow, forgetful… and oh yes, creative)
  - Computers (precise, incredibly fast, perfect memories)

- The quandary: Who should do what?
  - How does this one sound?
    - Train people to replicate better. Grade their performance not on creativity, but on how well they can overcome human frailties of bad memories and sloppiness… all in the worst-case team setting.
  - Here’s an alternative:
    - Use **computers** to **replicate**; keep people focused on **creativity**.
The Internet as a Global Replicator

Software as machinery:
- Like machinery, software performs useful functions
- Like machinery, software must be designed and built
- The difference: Software is machinery built out of pure information (no permanent physical resources needed)

For information machinery, transmission and remote storage are replication

The Internet enables global replication:
- Millions of people can receive software tasks & products
- The ease and richness of work product replication allows new modes of interaction between participants
- Self-selection enables creativity in such interactions
Open Source Software and Creativity

1970-80s: **Era of the Software Firm**
(costly data transport drives structure)

1990s-on: **Free Market**
(cheap transport dominates)

RESULT: Innovation is enabled, but “invisible hand” is limited

RESULT: “Invisible hand” is unleashed

Source: “Software Cooperatives” by Terry Bollinger (http://www.terrybollinger.com/)
The Emergence of Open Source Software

Open source software exists because:
- A low-cost global internet enables synergistic sharing
- The distance from hardware to apps has grown too large
- Cost of rebuilding software infrastructure is too high
- Economic attraction of composability rises over time

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What are the Quality Consequences?

- **Self-selecting groups** with high *internal cohesion* can emerge
- Group communications improve through shared knowledge
- **Focused testing** by a group raises reliability levels over time

**IMPLICATION:** Self-selection of groups can directly benefit quality
Nice Theory — Any Proof?

- At least a quarter of federal web servers now run on open source technology

- U.S. DoD views open source software as indistinguishable from proprietary
  - Source: John P. Stenbit, DoD CIO, in a May 28, 2003 memo “Open Source Software (OSS) in the Department of Defense (DoD)”

- The military uses open source software in high-value & security-critical situations
Summary of DoD Survey Results (2003)

- 115 FOSS applications identified
- 251 typical examples of FOSS use found
  - Highly diverse & “tip of the iceberg”
  - *Not* just Linux; many different applications & uses

Some surprises:
- Many DoD intranets depend heavily on FOSS
- Software development makes heavy use of FOSS
- FOSS is used extensively in security applications (!)
- Research uses FOSS to exchange ideas & cut costs
- Cost is seldom the only reason for using FOSS
- FOSS and proprietary can be used together
How Does the U.S. DoD Use FOSS?

- **Infrastructure Support**
  - Network support, especially Internet technologies

- **Software Development**
  - C, C++, Ada, Perl, Python, debugging, code control

- **Security**
  - Operating systems, auditing, cyberattack responses

- **Research**
  - Math tools, low-cost supercomputing, display tools
## 115 FOSS Applications (DoD, 2003)

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However: Why you *don’t* want free source

**A generous gift?**
- Imagine: A major vendor offers to give you all of their operating system source code, with *no* strings attached!
- Well, actually, two strings: You are fully responsible for maintaining your source copy; and you cannot resell it.

**Factors to consider**
- Expert support staff needed… 10, 100, 1000… more?
- Where is your revenue stream? You cannot resell it!
- Will you grow isolated? What if you lose compatibility?

**Do the comparison**
- Consider: How does the above differ from grabbing open source code to customize for internal-only use?
An Alternative: Share Support Costs

Why share the software burden?
- Your profits don’t come from selling software
- You and your competitors are tired of high support costs
- You form a consortium to share software support costs

Factors to consider
- What will your company’s total costs and duties be?
- Which works best: Just a few members, or very many?
- Can you reduce total costs enough to get a net benefit?

Do the comparison
- Consider: Consortia maximize their benefits if they are:
  1. global, 2. “funded” via direct sharing of resources
- Question: How is that different from open source?
Choose What You Share!

Which sharing strategies sound right?

Your company donates time, money, and expert personnel to a consortium that:

A. Ensures that your generic operating system kernels and communications packages are reliable, efficient, and fully capable of supporting your company’s needs

B. Builds tools that are unique, but well understood overall, within your particular industry

C. Asks members to share all forms of software, even if that includes your most market-critical innovations
The Open Source Pyramid: An Architecture for Maximizing Open Source Cost Benefits

**Innovation:** Software that solves a hard problem, or is unexpected

**Industry:** Shares the cost of industry-wide tools

**Isolation:** Limit license issues

**Infrastructure:** Software whose value increases when it is shared more

- Uses proprietary or cooperative licenses
- Allows reassignment as proprietary (e.g., BSD)
- Simplifies I/F (e.g., LGPL)
- Broad mix of cooperative and consortia licenses (e.g., GPL, LGPL, BSD)
Open Source Adoption Errors: Relying on “FOSS Magic” to Replace QA

“Let’s make this government software package open source.”
- Problem 1: No one will understand it (internal “dialects”)
- Problem 2: For many apps, very few people will care
- Problem 3: The modularity is all wrong
- Problem 4: You just made your bugs a lot more visible

Better solutions:
- Don’t release it!
- Freeze and encapsulate the application in new FOSS
- Look for FOSS combinations that do the same job
- Create & support a new FOSS effort to replace it
- Look for a COTS solution
Open Source Adoption Errors: Assuming Others will Work for You for Free

**Scenario:** You create a license that:
- Opens up your code for anyone to see, and
- Retains 100% ownership for your organization

**Question:**
- Will FOSS developers flock to help you?

**Answer:**
- Of course not!
- Reason: Software cooperatives only work when *everyone* benefits comparably from the resulting product
- Only when licenses give users equality of ownership do the cooperative incentives truly “kick in”
- A good sanity check: Rural electric cooperatives
Open Source Adoption Errors: Disallowing All Proprietary Ownership

- Scenario:
  - A government group hires FOSS experts to create new software that will “glue together” FOSS applications
  - Without really thinking it through, the group insists that the new paid-for, fully custom code also be made FOSS

- Likely outcomes:
  - The contractors produce a quick prototype, then refuse to have anything more to do with it after funds run out
  - The contractors try to resell the code (which is perfectly legal), but also get very upset when the government group sends out copies of their code under FOSS rules

- A Better Solution (others are possible):
  - Use a timed proprietary license that converts into FOSS
Open Source Adoption Errors: Going it Alone (Source Code Cloning)

- **Scenario**
  - A government project begins a complex effort using all FOSS resources
  - The effort includes adaptation and extension of several FOSS applications
  - The effort is done mostly in-house, since the needs addressed are unique to the government organization

- **Results**
  - After initially low startup costs, development costs escalate and begin to resemble proprietary development
  - The problem: FOSS cost savings only occur for the *cooperatively* maintained parts of your infrastructure

- **Solution**: *Always* minimize unique adaptations of FOSS
Open Source Adoption Errors: “All FOSS Applications Are the Same”

- **Scenario**
  - FOSS applications are chosen based solely on whether they have the right functionality

- **Results**
  - Some work, and some are dismal failures

- **Solution**
  - Like proprietary apps, FOSS varies hugely in maturity
  - Choose solutions based on maturity of:
    - FOSS product itself (e.g., Apache is very mature)
    - FOSS project (e.g., the support group for Apache is very mature)
  - A good resource:
FOSS Quality: Better or Worse?

- Overall, is FOSS higher or lower in quality than proprietary software?
  - It varies! Very good (and very bad) apps exist for both.
  - Biggest Open Source issues: Bad designs; lack of $$
  - Biggest Proprietary issues: Tendency to rely on comforting (but highly deceptive) replication metrics

- How does FOSS use impact total cost of ownership?
  - Potentially quite favorably, *if* the products have strong community support *and* you join that community fully.
  - Potentially quite badly, *if* you are foolish enough to clone source code and try to support it without any help.
A Component-Oriented Approach to QA

- QA helps select, validate, and integrate components of the Open Source Pyramid
  - Use maturity models to assess FOSS projects/products
  - Share validations as broadly as possible
  - *Always* look at final-product performance, as judged by technically astute users with hands-on experience:
    - Any “mature” process that produces buggy products is... a charade
    - Any “certification” that produces buggy products is... a charade

- Minimize development of new code:
  - Take the component model to heart
  - Think in terms of *inheriting* both quality and quality support, rather than creating it new each time.

- Look for automation! (e.g., Coverity)
A Vector Addition Model of QA (Preliminary!)

Component-base design requires new interpretations of the QA problem. E.g.:

- Assign quality metrics to components based on prior assessments (local, community, or both)
- Represent the quality of that component as a vector (arrow) pointing to the right, with a length that is initially proportional to the product of (a) capabilities it provides and (b) the prior assessment of its quality
- Shorten the vector based on how much additional new code is required to make the component functional. Weigh “distant” changes higher than “local” changes.
- The shortening process can cancel or even reverse the initial quality vector for the component.
- An interesting result: High-quality individual components and applications can end up at negative overall quality.
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