What goes wrong when thousands of engineers share the same continuous build?

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Goals

- Demonstrate feasibility of working from head
- Prove the importance of reliable, automated tests.
- Show how complex engineering tasks can be achieved with robust, basic tools.
- Convince you that releases doesn’t have to be painful
Background

● Over 15,000 engineers in over 40 offices
● 4,000+ projects under active development
● 5500+ code submissions per day (20+ p/m)
● Over 75M test cases run daily
● 50% of code changes monthly
● Single source tree
● |DevInfra eng| << |Google eng|
Overview of dev. practices

- Single, searchable repository
- Each change requires a code review (ownership, readability)
- Unified build system (local/cloud).
- Continuous integration with presubmit capabilities.
- Single repository for test results (semi-structured).
- Integration testing
Developer workflow

- Check-out code
- Hack hack hack
- Build, test
- ... more hacking
- ... more building and testing
- Code out for review
- Code committed
- Pushed to production
Developer workflow

- Check-out code => Optimize with FUSE
- Hack hack hack => IDE support
- Build, test => In the cloud
- ... more hacking
- ... more building and testing
- Code out for review => Standardized tool
- Code committed => Triggers post-submit
- Pushed to production => Pick a green CL
Common scenarios

- Catching up with head
- Somebody else breaking your build
- Working with open-source & external code
- Good citizenship: codebase clean-up
- Pushing to production
Catching up with head

A simple matter of synchronizing...

- This is where merge happens (always rebasing)
- Cached build artifacts from the cloud.
- FUSE makes this fast

In practice, not very exciting..
Somebody broke your build

- Early detection mechanisms available (global presubmit)
- Have they announced the change?
  - Procedure for breaking changes
- Are your tests stable?
- Cultural commitment to keeping things green.
  - Short time window for fixing
  - Rollback if not feasible
  - No hard definitions
Working with external code

- Easy process for importing external open-source code.
  - Incl. open-source review
- Exactly one version of each library
  - No exceptions!
- “Public spaces” - shared maintenance burden.
  - Yes, it’s expensive
- Tools exist for open-source development
Codebase clean-ups

- Pre-requirements: good tools
- What will break if I change X?
- No need for individual project approval (global review)
- Tests transform fear to boredom

Appreciate and acknowledge such efforts
Pushing to production

- Code approved, submitted
- Post-submit triggers, test affected code.
- Good mix of small, medium and end-to-end tests.
- Separate method for bringing up systems in isolation.
- Easy deployment UI.

Release in hours instead of weeks
What we (think) we got right

● Getting started on the codebase
● New “checkout” and build.
● Effortless testing.
● Navigating around the code
● “Did that ever work?”
What doesn’t work?

- Code change turn-around time: Bandwidth vs. change size
- Cost of test creation & maintenance
  -Mocks at different levels (class, module, system)
  -Creating hermetic tests is hard
  -Sometimes need specialists
- Resources consumption
- Churn - external and internal
Beyond the basics...

- Stack-trace analysis of failing tests
- Overcoming infrastructure failures
- Automated detection of dead code.
- Flakiness detection
Summary

- Collaborating over one source tree is possible, but non-trivial.
- Basic CI tools are hard to build at such a scale.
- Reliable automated tests will make your release easy.
- Nothing can replace good eng. citizenship.
Questions?
Additional resources

Talks:
“Continuous integration at Google Scale”
“Development at the Speed and Scale of Google”
“Tools for Continuous Integration at Google Scale”

Blog: Google Eng Tools blog