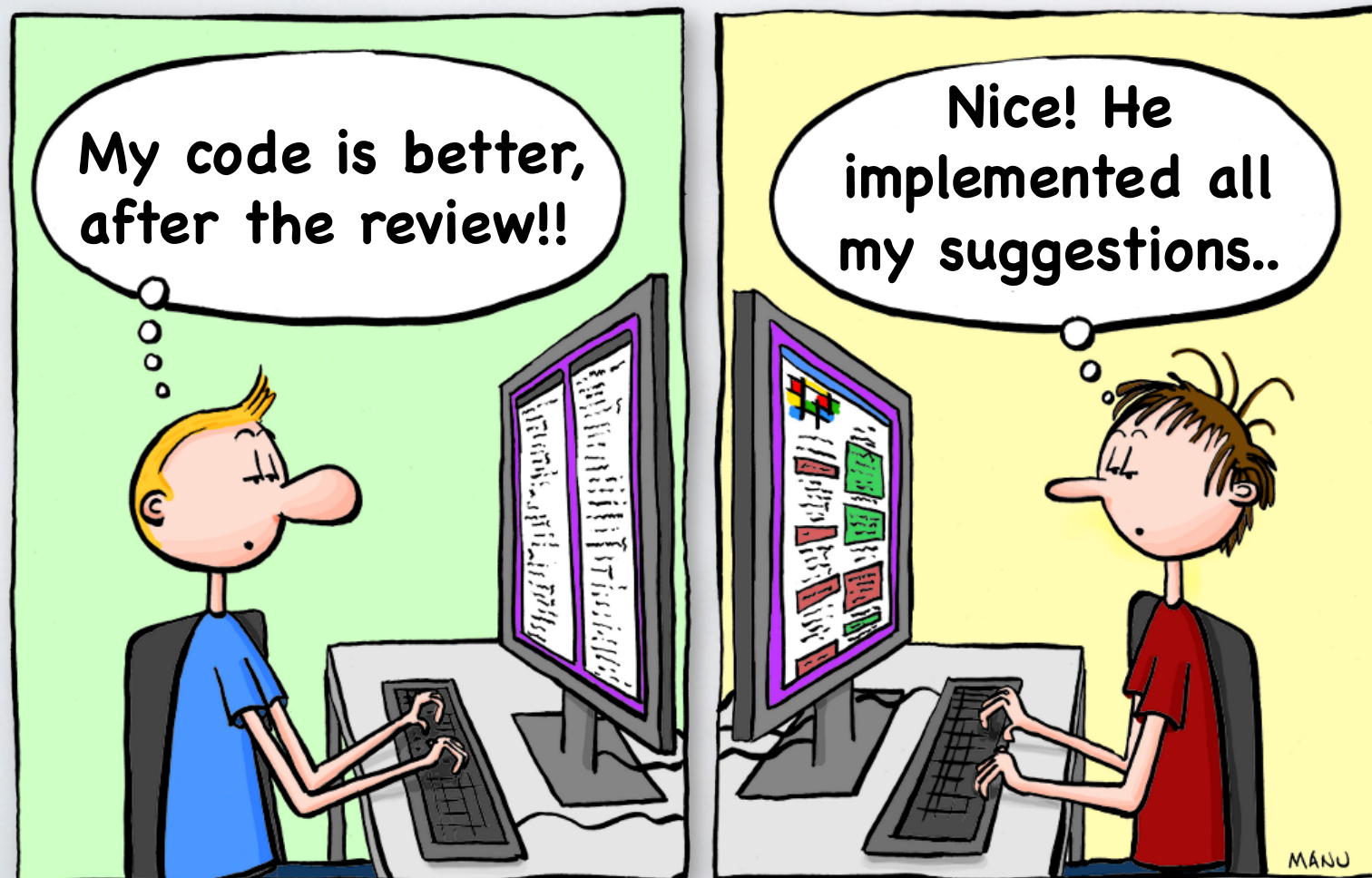


Alberto Bacchelli

University of Zurich,
Switzerland

Delft University of Technology,
The Netherlands

Evidence-based Code Review



My research team

SORCERERS

Delft University of Technology



ZEST

University of Zurich



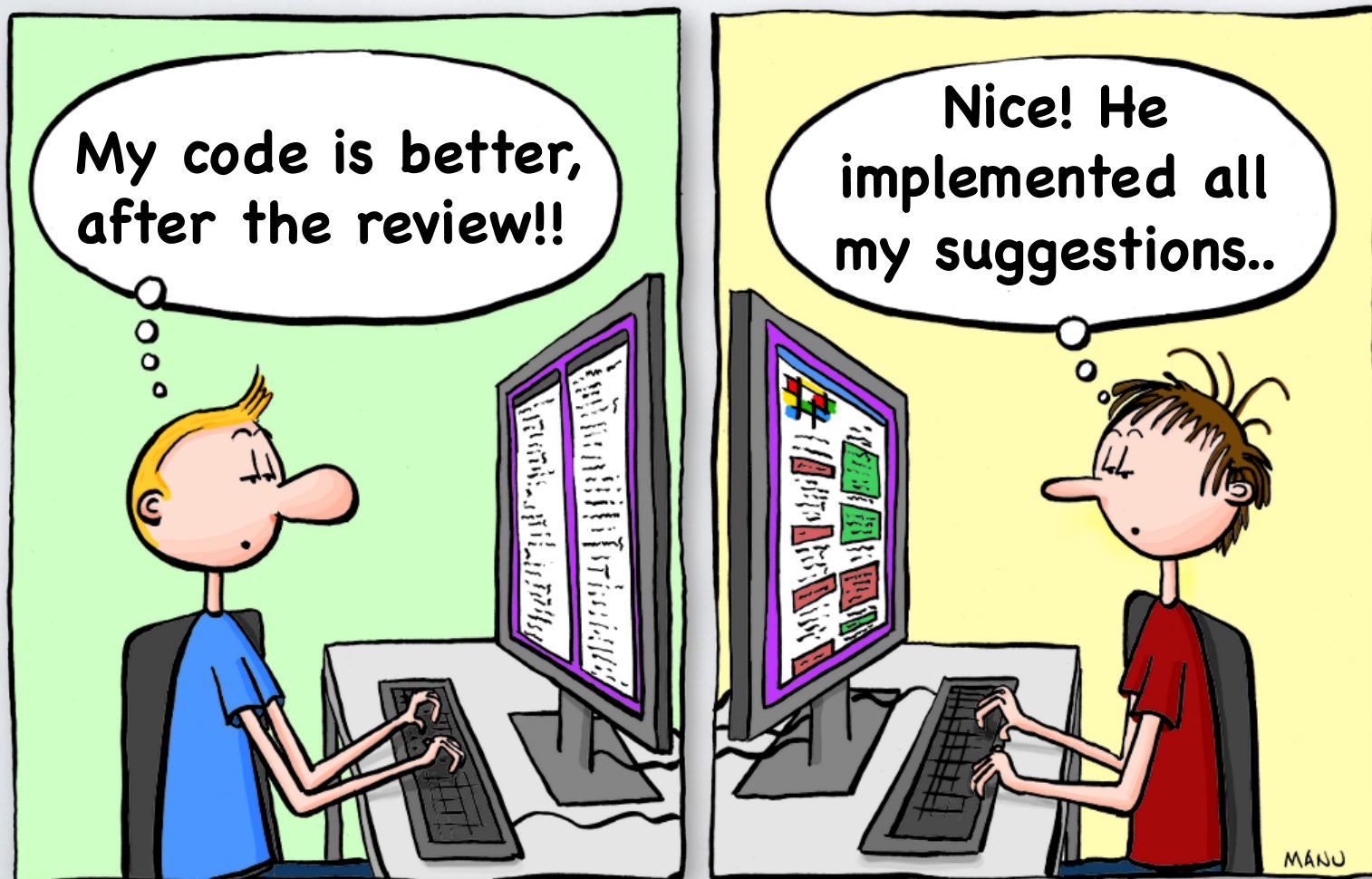
FNSNF

FONDS NATIONAL SUISSE
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FONDO NAZIONALE SVIZZERO
SWISS NATIONAL SCIENCE FOUNDATION

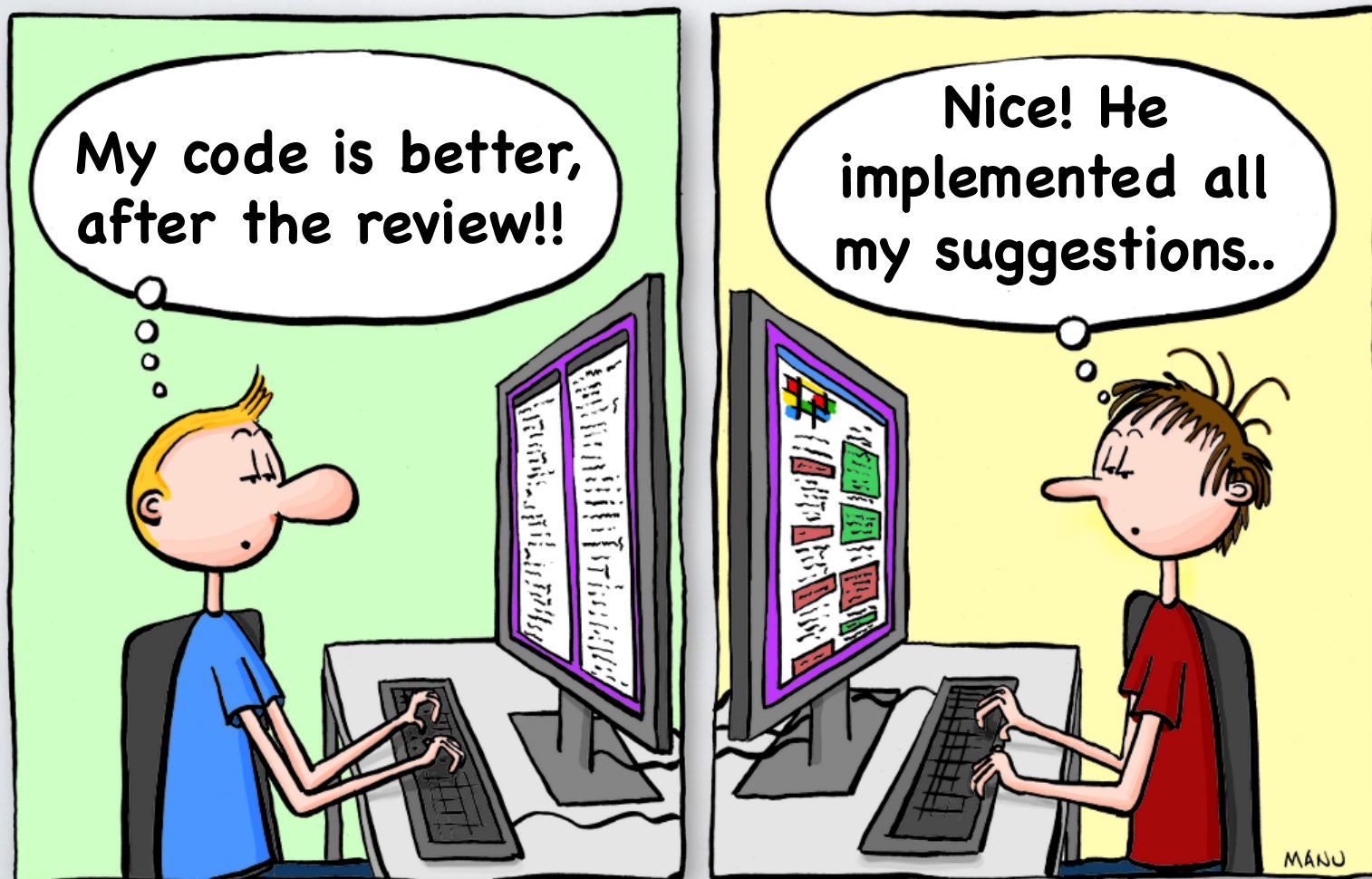
...and awesome
regular collaborators



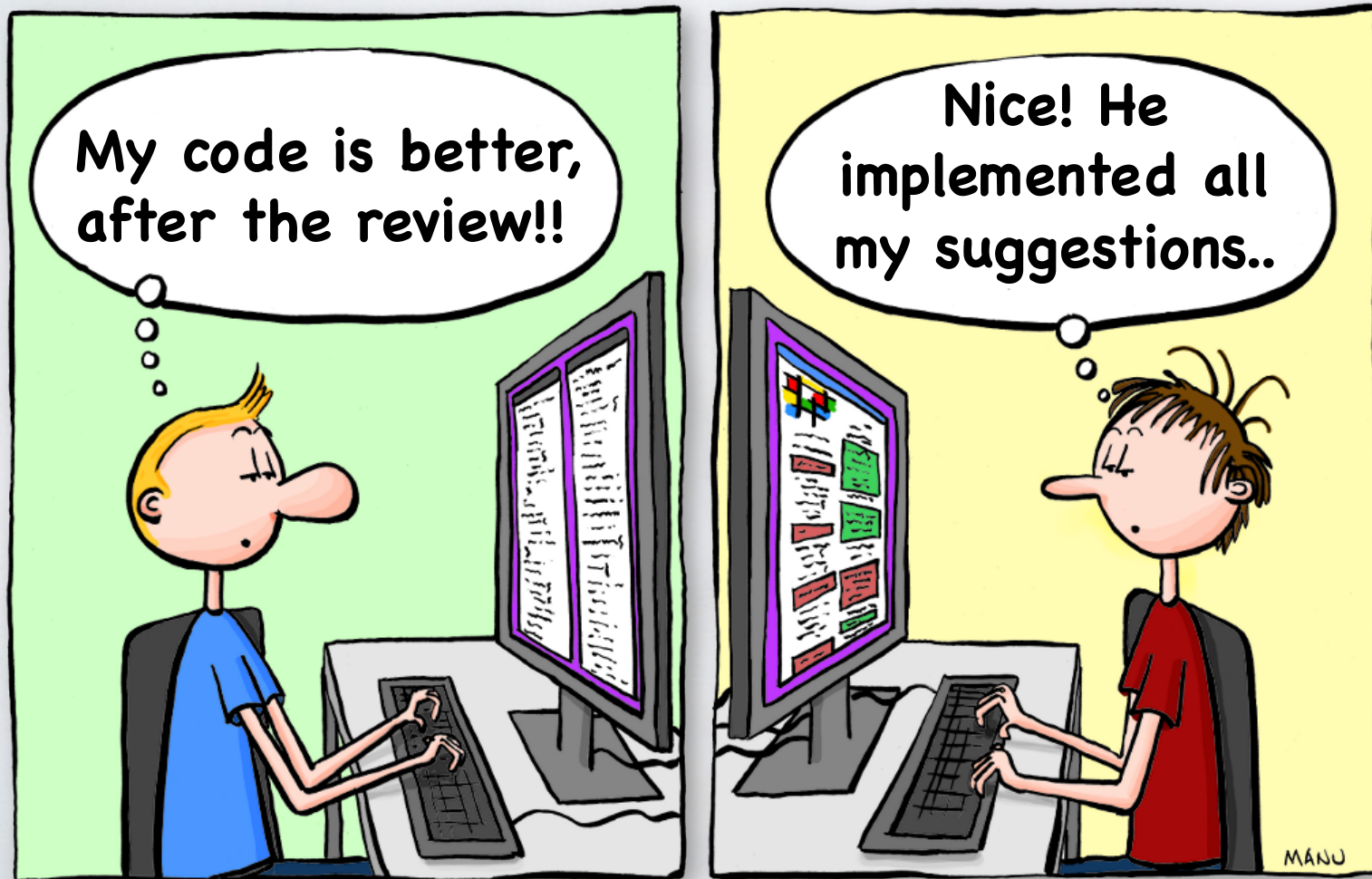
Evidence-based Code Review



Evidence-based Modern Code Review



Evidence-based Modern Code Review



- 1. informal**
- 2. change-based**
- 3. tool-based**

What is modern code review?

apps/downloads/models.py

```
from django.db import models

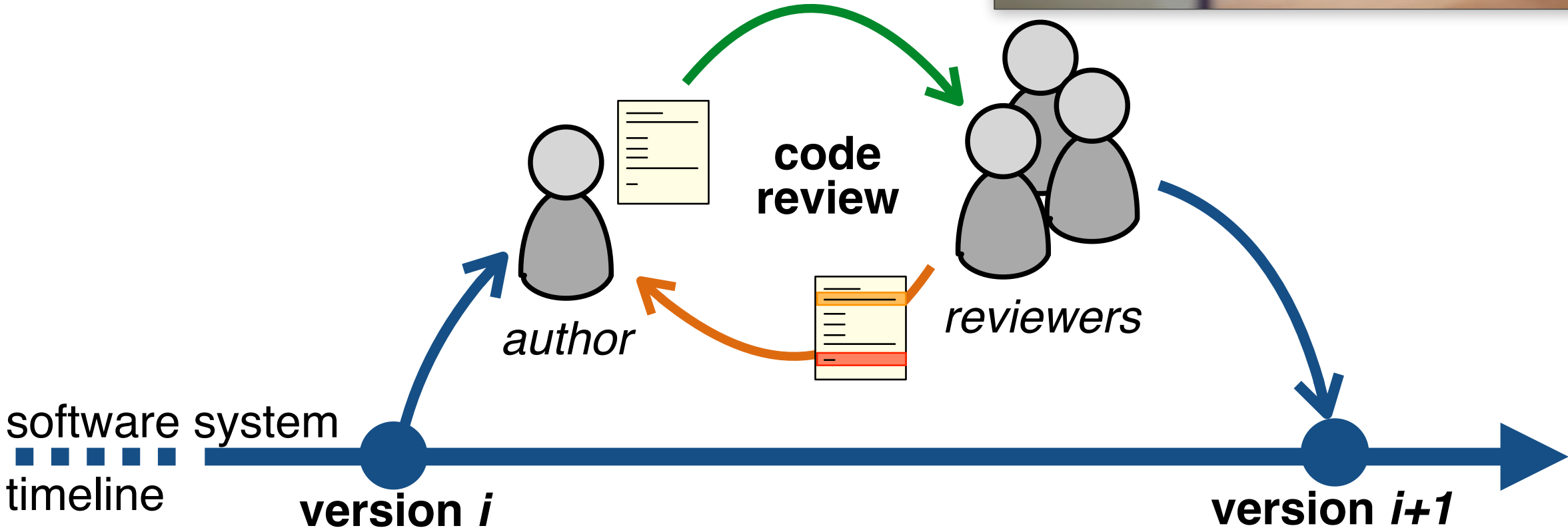
from bitbucket.apps.bb.cname import cpermalink
from bitbucket.apps.bb.models import Repository
from bitbucket.apps.downloads import s3helpers

class Download(models.Model):
    """Represents a user-created download, available in the Downloads
    tab.
    """
    repository = models.ForeignKey(Repository, related_name='downloads')
    filename = models.CharField(max_length=255)
    size = models.BigIntegerField(null=True, blank=True)
    created_by = models.ForeignKey(User, null=True, blank=True,
                                  on_delete=models.SET_NULL)
    created_on = models.DateTimeField(auto_now=True)
    download_count = models.BigIntegerField(default=0)
    deleted = models.BooleanField(default=False)

    class Meta:
        app_label = 'bb'

    def _tokenized_url(self):
        """
        If a 'Repository' is private, we can't use the public
        URL, as it will be restricted. This generates and caches
        tokens for 30 minutes. Used in 'get_download_url'.
        """
        ck = 'downloadtoken:%d' % self.id
        cached = cache.get(ck)
        if not cached:
            key = s3helpers.get_key(self.filename)
```

```
7 11 from bitbucket.apps.bb.models import Repository
8 12 from bitbucket.apps.downloads import s3helpers
9 13 from bitbucket.apps.lib.storage.backends.s3boto import S3BotoStorage
10 14
11 15 download_storage = S3BotoStorage(bucketprefix=settings.S3BUCKET,
12 16                                  bucket="",
13 17                                  access_key=settings.SECRET_S3AKEY,
14 18                                  secret_key=settings.SECRET_S3KEY)
15 19
16 20 class Download(models.Model):
17 21     """Represents a user-created download, available in the Downloads
18 22     tab.
19 23     """
20 24     def upload_to(self, filename):
21 25         if not filename:
22 26             raise ValueError('Invalid download filename: %r'
23 27                               % filename)
24 28         return self.repository.download_prefix() + filename
25 29
26 30     repository = models.ForeignKey(Repository, related_name='downloads')
27 31     file = models.FileField(db_column="filename", storage=download_storage,
28 32                             upload_to=upload_to, blank=True, null=True,
29 33                             max_length=255)
30 34
31 35     size = models.BigIntegerField(null=True, blank=True)
32 36     created_by = models.ForeignKey(User, null=True, blank=True,
33 37                                   on_delete=models.SET_NULL)
34 38     created_on = models.DateTimeField(auto_now=True)
35 39     download_count = models.BigIntegerField(default=0)
36 40     deleted = models.BooleanField(default=False)
37 41
38 42     class Meta:
39 43         app_label = 'bb'
```



What is modern code review? A sample tool

The screenshot displays the CodeFlow web interface for a code review session. The title bar reads "Make the greeting changeable - CodeFlow". The main window shows "Viewing Iteration 1" of the file "Program.cs".

Left Panel:

- File List:** Includes "description.txt", "S/esereseach/Code/CBirdUtil/Hello.csproj", "Program.cs", and "Test.cs".
- Reviewer Status:** Lists "Christian Bird (author)", "Alberto Bacchelli", "Tom Zimmermann", and "Nachi Nagappan".
- Buttons:** "Complete Review", "Recall", and a "Review" icon.

Main Code Editor:

```
37 for (int i = 0; i < Times; i++)
38 {
39     Console.WriteLine("Hello {0}!", Name);
40     Console.WriteLine("{0} {1}!", Greeting, Name);
41 }
42
43
44
```

A review comment is displayed over the code:

Wouldn't it be better to put this as a parameter of the SayGreeting method?

Alberto Bacchelli

I wouldn't. Greeting is already a field! If you do that, you'd want to make Times a parameter as well.

Tom Zimmermann

Good point. I'll leave it as is.

Christian Bird

Resolved

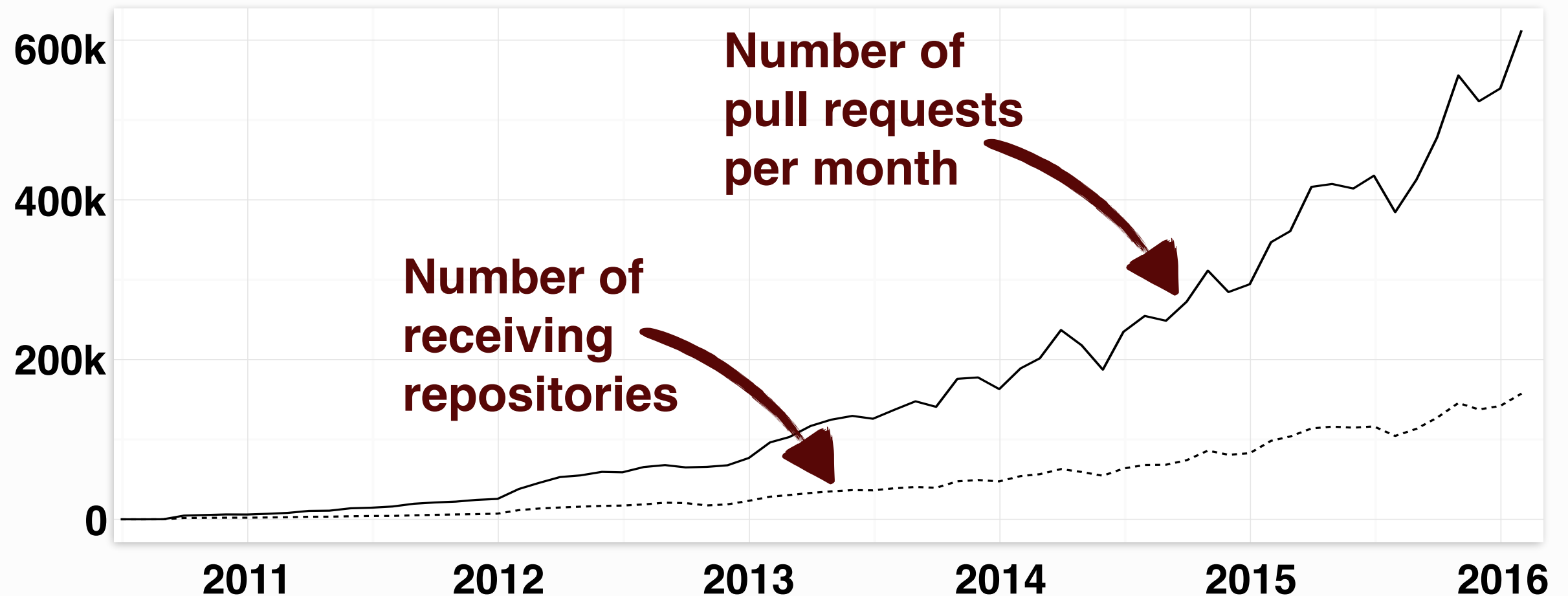
Hide

Bottom Panel:

Status	File name
Active	S/esereseach/Code/CBirdUtil/Hello/Program.cs
[Tom Zimmermann] Don't forget to initialize.	
[Christian Bird] Should we initialize to "Hello" or throw an error if the user does	
Resolved	S/esereseach/Code/CBirdUtil/Hello/Program.cs

How popular is it?

Monthly growth of pull request usage on GitHub (OSS)



Popularity in industrial setting

Code review tool is used by more than 70,000 developers at Microsoft

[Czerwotka, Greiler, Tilford — ICSE 2016]



Each code change in the main repository at Google is reviewed

[Potvin, Levenberg — Communications of the ACM, 2016]

Most other companies have similar policies and big players then to develop their own review tools (e.g., Facebook)

Why code reviews? How? What is the outcome?

Let's look for “code review” on Google...




[All](#)[Images](#)[Videos](#)[News](#)[Maps](#)[More](#)

[Settings](#)[Tools](#)

About 230,000,000 results (0.45 seconds)

Code review is systematic examination (sometimes referred to as peer **review**) of computer source **code**. It is intended to find mistakes overlooked in software development, improving the overall quality of software.

[Code review - Wikipedia](https://en.wikipedia.org/wiki/Code_review)
https://en.wikipedia.org/wiki/Code_review




[About this result](#) [Feedback](#)


Code review


Code review is systematic examination of computer source code. It is intended to find mistakes overlooked in software development, improving the overall quality of software. [Wikipedia](#)


[Feedback](#)

People also ask

What is a security code review? 

What is code review in software engineering? 

What is the code inspection? 

What do you mean by code coverage? 


[Feedback](#)

[Code review - Wikipedia](https://en.wikipedia.org/wiki/Code_review)
https://en.wikipedia.org/wiki/Code_review ▼

Code review is systematic examination (sometimes referred to as peer **review**) of computer source **code**. It is intended to find mistakes overlooked in software development, improving the overall quality of software.

[Introduction](#) · [Types](#)





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Code review

From Wikipedia, the free encyclopedia



This article **is written like a personal reflection or opinion essay** that states a Wikipedia editor's personal feelings about a topic. Please [help improve it](#) by rewriting it in an [encyclopedic style](#). *(October 2017)* [\(Learn how and when to remove this template message\)](#)

Code review is systematic examination (sometimes referred to as [peer review](#)) of computer [source code](#). It is intended to find [mistakes](#) overlooked in [software development](#), improving the overall [quality of software](#). Reviews are done in various forms such as [pair programming](#), informal walkthroughs, and formal [inspections](#).^[1]

Contents

[hide]

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1.2

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Criticism

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Further reading

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External links

Introduction [edit]

Simple Definition [edit]

A code review is a process where two or more developers visually inspect a set of program code, typically, several times. The code can be a method, a class, or an entire program. The main code-review objectives are:

1. Best Practice ~ A more efficient, less error-prone, or more elegant way to accomplish a given task.

Software development

Core activities

Processes · Requirements · Design · Engineering · Construction · Testing · Debugging · Deployment · Maintenance

Paradigms and models

Agile · Cleanroom · Incremental · Prototyping · Spiral · Waterfall

Methodologies and frameworks

DevOps · DSDM · FDD · IID · Kanban · Lean SD · MDD · MSF · PSP · RAD · SAFe · Scrum · SEMAT · TSP · UP · V-Model · XP

Supporting disciplines

Configuration management · Documentation · Software quality assurance (SQA) · Project management · User experience

Practices

ATDD · BDD · CCO · CI · CD · DDD · PP · Stand-up · TDD

Tools

Compiler · Debugger · Profiler · GUI designer · Modeling · IDE · Build automation · Release automation · Infrastructure as Code · Testing

Standards and BOKs

CMMI · IEEE standards · ISO 9001 · ISO/IEC standards · SWEBOK · PMBOK · BABOK

V · T · E

Wikipedia page on code review — an embarrassing stub

The main code-review objectives are (1) best practice, (2) error detection, (3) vulnerability exposure, (4) malware discovery [...]. Of the four objectives, malware is the only one that requires human detection.

Code review is systematic examination (sometimes referred to as **peer review**) of computer **source code**. It is intended to find **mistakes** overlooked in **software development**, improving the overall **quality of**

Code reviews can often find and remove common vulnerabilities such as format string exploits, race conditions, memory leaks and buffer overflows, **thereby improving software security.**

Lightweight code review typically requires **less overhead** than **formal code inspections**, though it can be **equally effective when done properly**.^[citation needed]

are:

1. Best Practice ~ A more efficient, less error-prone, or more elegant way to accomplish a given task.

V • T • E

I love Wikipedia



WIKIPEDIA
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Languages

العربية

Català

Article



A large puzzle globe made of white interlocking pieces, each featuring a different character or symbol from various alphabets. A small brown teddy bear wearing a blue shirt with the Wikipedia logo is perched on top of the globe. The globe is set against a solid blue background.

Log in

Create account

personal

(Learn how)

Development

Core activities

Requirements · Design · Construction · Testing · Deployment · Maintenance

Designs and models

Waterfall · Incremental · Prototyping · Spiral · Waterfall

Methodologies and frameworks

Agile · DM · FDD · IID · Kanban · Lean · SF · PSP · RAD · SAgile · Scrum · TSP · UP · V-Model · XP

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Practices

Agile · DD · CCO · CI · CD · DDD · PP · Stand-up · TDD

Tools

Debugger · Profiler · GUI designer · IDE · Build automation · Release management · Infrastructure as Code · Testing

Standards and BOKs

IEEE standards · ISO 9001 · ISO/IEC standards · SWEBOK · PMBOK · BABOK

V · T · E

A code review is performed several times. The code can be a method, a class, or an entire page. The reviews are:

1. Best Practice ~ A more efficient, less error-prone, or more elegant way to accomplish a given task.

Code review “best practices”

Let’s look for “code review best practices” on Google...

11 proven practices for more effective, efficient peer code review - IBM

<https://www.ibm.com › Learn › Rational> ▼

25 Jan 2011 - Aim for an inspection rate of fewer than 300–500 LOC per hour. Establish quantifiable goals for **code review**, and capture metrics so you can improve your processes. Verify that the defects are actually fixed. Foster a **good code review** culture in which finding defects is viewed positively. Beware of the Big Brother ...

Code Review Best Practices - Kevin London's blog

<kevinlondon.com/2015/05/05/code-review-best-practices.html> ▼

5 May 2015 - I think it's a **good** idea to crystalize some of the things I look for when I'm doing **code reviews** and talk about the **best** way I've found to approach ...

Best practices for effective code reviews - WillowTree Apps

<https://willowtreeapps.com/ideas/best-practices-for-effective-code-reviews> ▼

27 Oct 2016 - Today, I'd like to share our process and some **best practices** we follow when conducting **code reviews**. The process. The **code review** process ...

Effective Code Reviews: Code Review Best Practices

<https://nyu-cds.github.io/effective-code-reviews/02-best-practices/> ▼

What are some **best practices** for **code reviews**? Objectives. Learn about effective practices for **code reviews**. Learn what makes reviews work better and what ...

7 best practices for doing code reviews - The Asana Blog

<https://blog.asana.com/2016/12/7-ways-to-uplevel-your-code-review-skills/> ▼

20 Dec 2016 - The Asana engineering team shares **code review best practices** that will help you become a better reviewer. Learn how Asana reviews code.

Code Review in Agile Teams - part II - Atlassian Blog

https://www.atlassian.com/blog/archives/code_review_in_agile_teams_part_ii ▼

8 Mar 2010 - Ready to try adopting **code review** within your team or across your reveal a few **best practices** around **code review** that evolved at Atlassian.

Best Practices: Code Reviews - MSDN - Microsoft

<https://msdn.microsoft.com/en-us/library/bb871031.aspx> ▼

Code review “best practices”

Two examples

11 PROVEN PRACTICES FOR MORE EFFECTIVE, EFFICIENT CODE REVIEW

- Review **fewer than 200–400 lines** of code at a time
- Aim for an inspection rate of **fewer than 300–500 LOC per hour**
- Take enough time for a proper, slow review, but **not more than 60–90 minutes**
- Be sure that **authors annotate source code before the review** begins
- Establish **quantifiable goals** [...] and capture metrics [to] improve your processes
- **Use checklists**, because they substantially improve results
- **Verify** that the defects are actually fixed
- Foster a **good code review culture** in which finding defects is viewed positively
- Beware of the **Big Brother effect**
- **Review at least part of the code**, even if you can't do all of it, [for] The Ego Effect
- **Adopt lightweight, tool-assisted code reviews**

7 WAYS TO UPLEVEL YOUR CODE REVIEW SKILLS

- **Prioritize the goals** of code reviews with your team
- **Run the app** and try playing with the feature
- Visualize **method call hierarchies**
- Do code reviews **as soon as you see the request**
- **Imagine** how you would make this change before you read it
- Read the change in a **realistic development environment**
- **Always give approval**, unless you can prove that there is a bug

Code review “best practices”

Two examples

11 PROVEN PRACTICES FOR MORE EFFECTIVE, EFFICIENT CODE REVIEW

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Code review “best practices” are very skeptical

Two examples

11 PROVEN PRACTICES

- Review fewer than 200 lines of code
- **Aim for an inspection** rather than a review
- Take enough time for a review (30 minutes)
- Be sure that authors are available for questions
- Establish quantifiable goals for the review process
- **Use checklists, because they work**
- **Verify** that the defects found are real
- Foster a good code review culture
- Beware of the Big Ego Effect
- **Review at least pairs** of code
- **Adopt lightweight** review processes

CODE REVIEW

minutes

s
r processes

d positively

The Ego Effect

7 WAYS TO UP

- Prioritize the good
- Run the app and
- **Visualize meth**
- **Do code review**
- **Imagine** how y
- Read the char
- **Always give appro**

EDZARD ERNST

Editor in Chief of two medical journals and the first Professor of Complementary Medicine in the known universe.

SPECIAL POWER	Rigorous scientific scrutiny	
WEAPON OF CHOICE	Systematic reviews and Meta Analysis of clinical trials	95%
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ARCH NEMESIS	Prince Charles	85%
		60%

Illustrations by Neil Davies <http://www.caricatureclub.co.uk/>
Cards by Crispian Jago <http://www.crispian-jago.blogspot.com/>

In-field study on modern code review at Microsoft

Microsoft
Research



Dr. Christian Bird

Microsoft setting



Microsoft setting: Several different separate “software organizations”



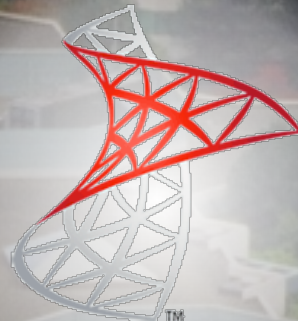
Excel



**Windows
Phone**



XBox

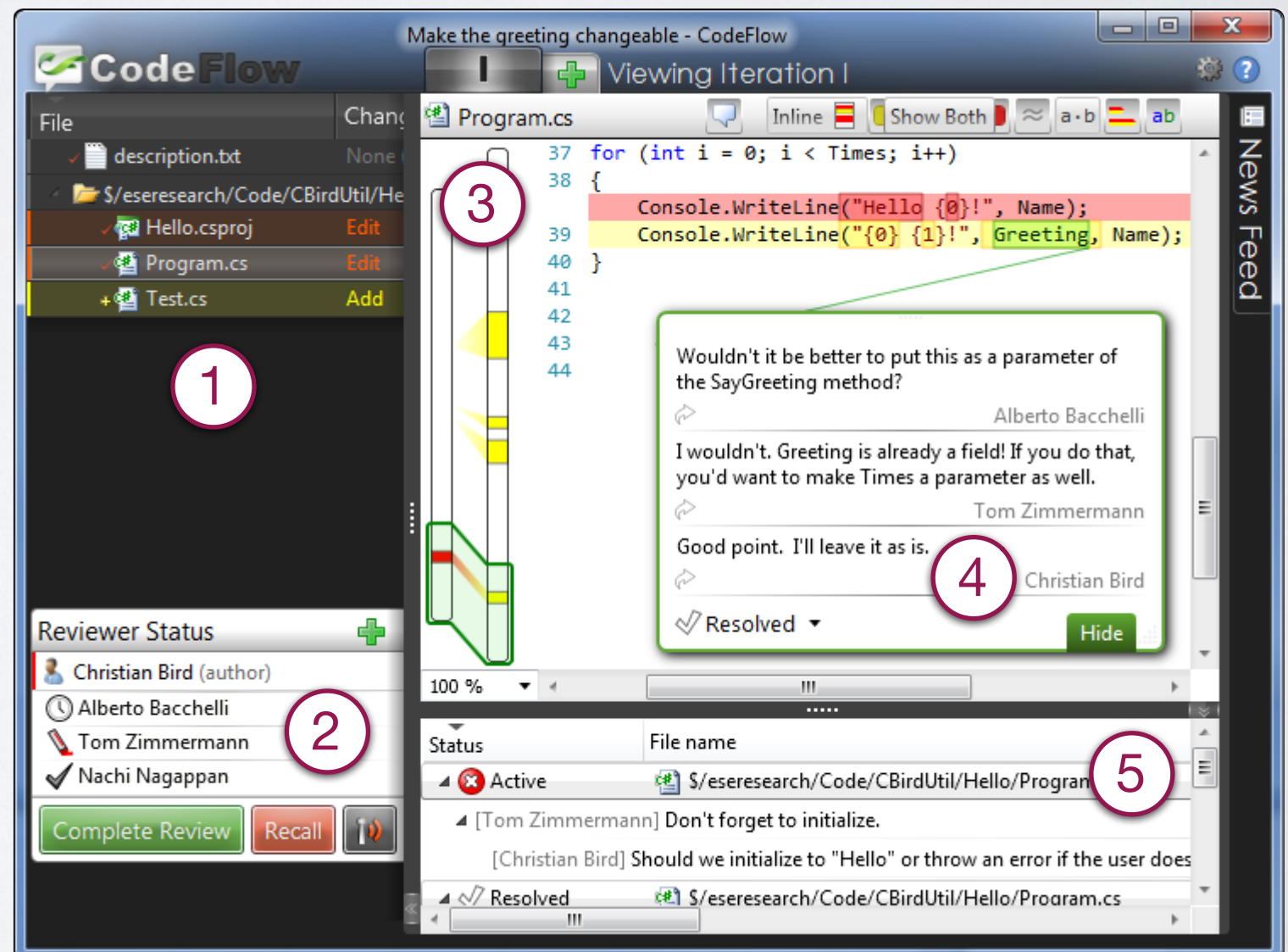


SQL Server

...

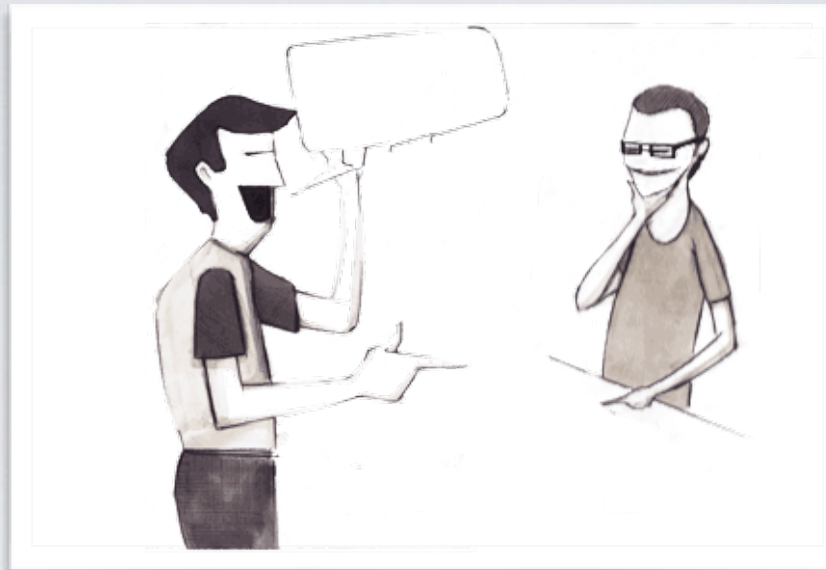
Same code review tool

Used across all Microsoft product teams
by more than 70,000 developers, so far.





observations



interviews



**18 interviews with observations
~40 minutes long
developers, testers
different roles
signed off at least 50 reviews**



TOYOTA

SIENNA LE
AWD

Shuttle Connect

Microsoft

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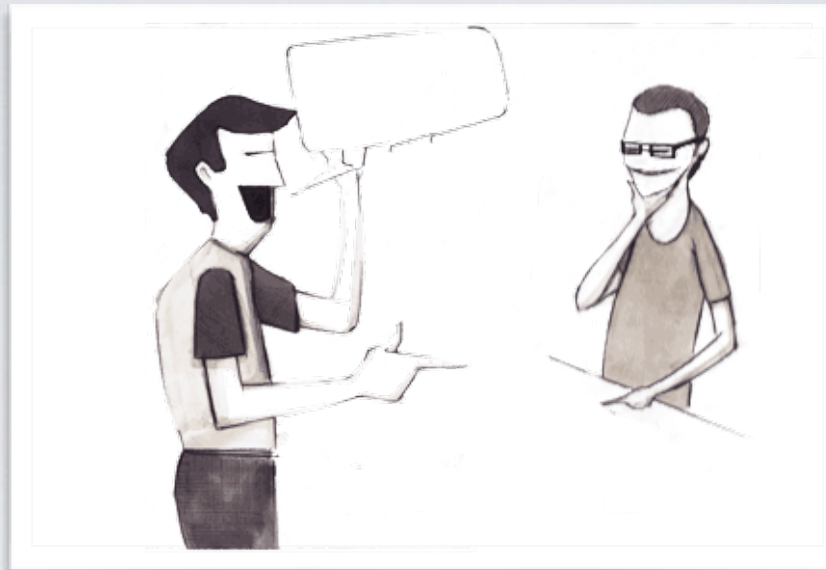
Shuttle
Connect

363

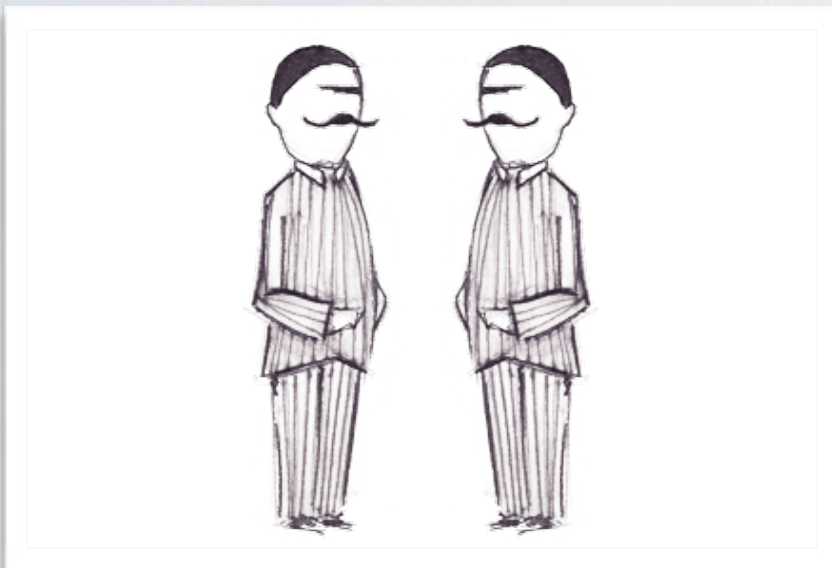
103-



observations



interviews



survey to 165 managers

Why do programmers do code reviews?

motivation

Why do programmers do code reviews? — List of Motivations

**Alternative
Solutions**

**Avoid Build
Breaks**

**Code
Improvement**

**Team
Assessment**

**Share Code
Ownership**

**Team
Awareness**

**Knowledge
Transfer**

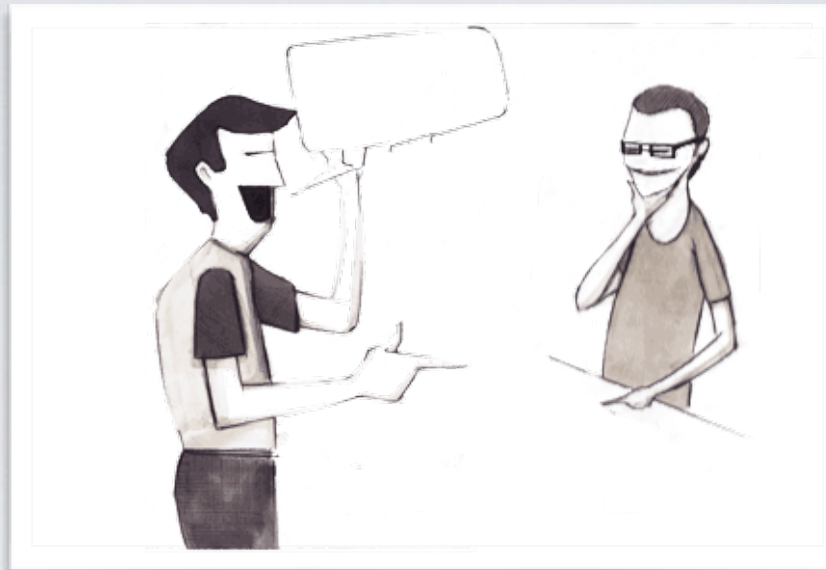
**Improve
Dev. Process**

**Track
Rationale**

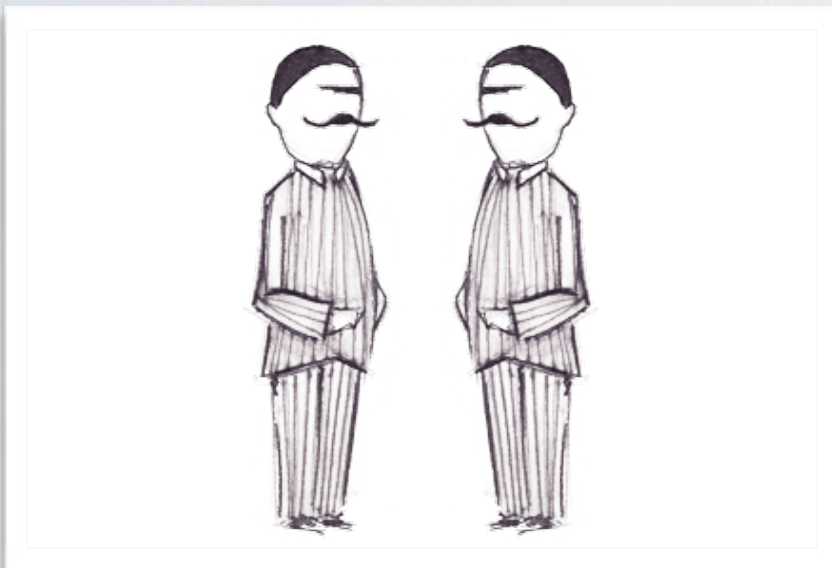
**Finding
Defects**



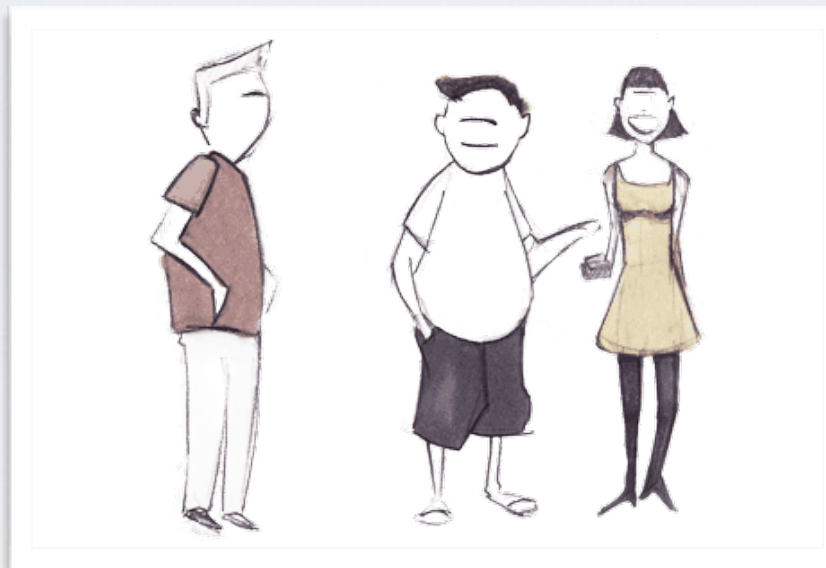
observations



interviews

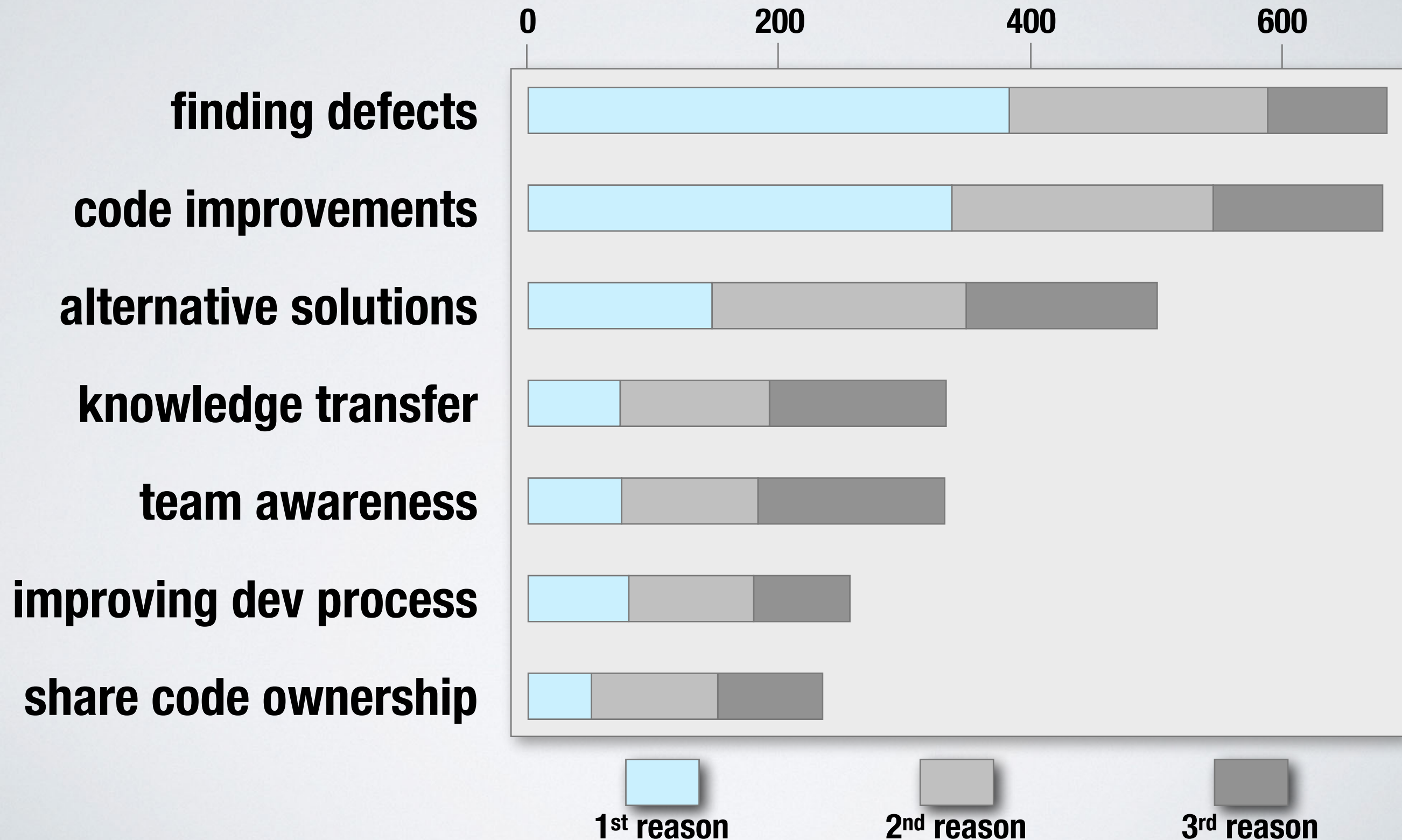


survey to 165 managers



survey to 873 developers

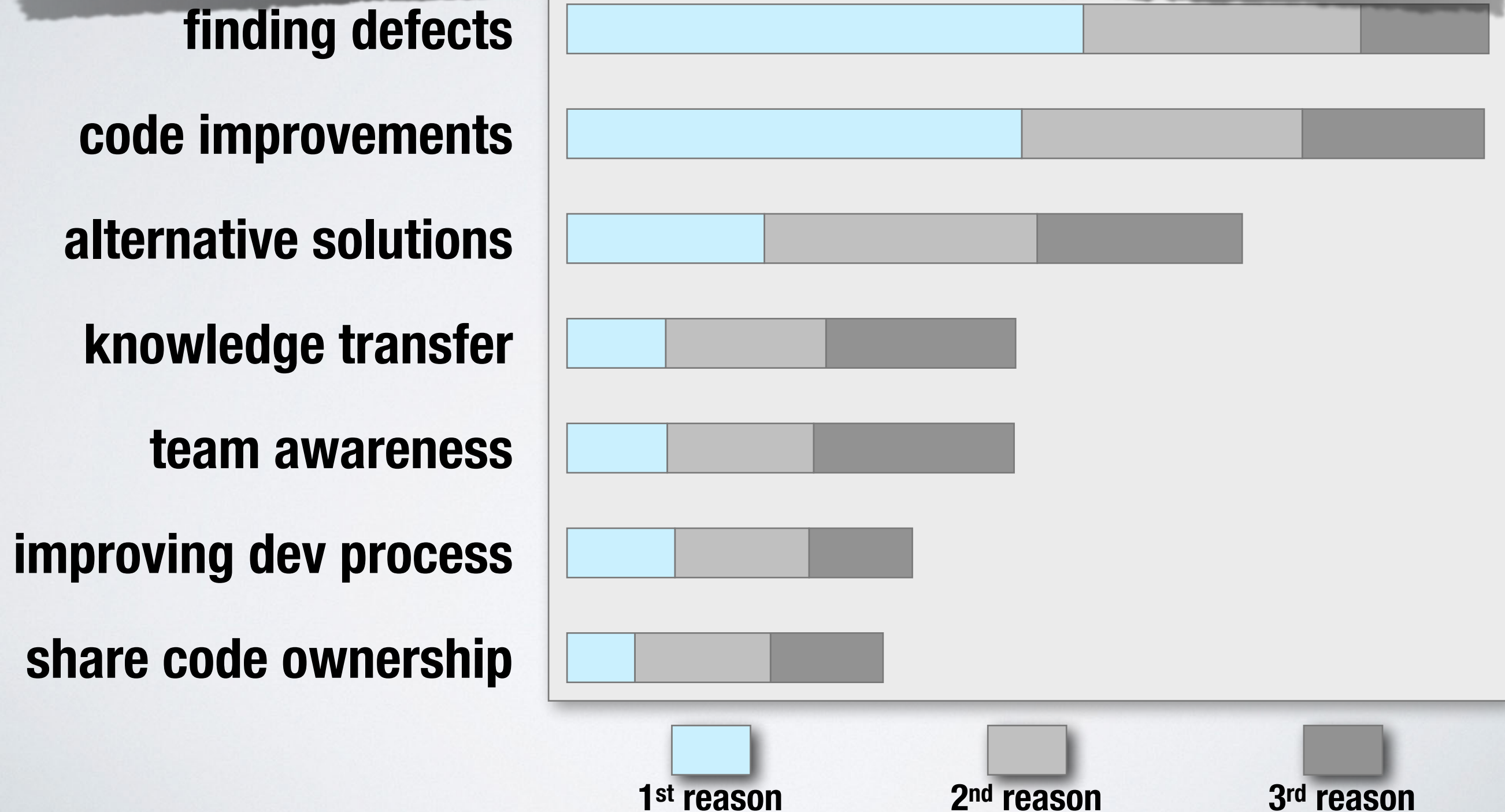
Why do programmers do code reviews? — Motivations' ranking



Why do programmers do code reviews? — Motivations' ranking

“Finding defects is the main reason for doing code review.”

72 managers and 384 developers @ Microsoft



What is the outcome of code reviews?

outcome

What is the outcome of code reviews?

The screenshot displays the CodeFlow application window titled "Make the greeting changeable - CodeFlow". The interface includes a sidebar on the left with a file explorer showing "description.txt", "Hello.csproj", "Program.cs", and "Test.cs". Below the file explorer is a "Reviewer Status" section listing participants: Christian Bird (author), Alberto Bacchelli, Tom Zimmermann, and Nachi Nagappan, with buttons for "Complete Review" and "Recall". The main area shows "Program.cs" with a code snippet:

```
37 for (int i = 0; i < Times; i++)
38 {
39     Console.WriteLine("Hello {0}!", Name);
40     Console.WriteLine("{0} {1}!", Greeting, Name);
41 }
42
43
44
```

A review comment is displayed over the code, asking: "Wouldn't it be better to put this as a parameter of the SayGreeting method?". The comment thread includes responses from Alberto Bacchelli, Tom Zimmermann, and Christian Bird, with a "Resolved" status and a "Hide" button.

At the bottom, a table lists the review items:

Status	File name
Active	\$/esereseach/Code/CBirdUtil/Hello/Program.cs
[Tom Zimmermann] Don't forget to initialize.	
[Christian Bird] Should we initialize to "Hello" or throw an error if the user does	
Resolved	\$/esereseach/Code/CBirdUtil/Hello/Program.cs

Recorded code review comments

CodeFlow

File

✓ description.txt

None

✓ S/esereseach/Code/CBirdUtil/He

✓ Hello.csproj

Edit

✓ Program.cs

Edit

+ Test.cs

Add

Reviewer Status

Christian Bird (author)

Alberto Bacchelli

Tom Zimmermann

✓ Nachi Nagappan

Complete Review

Recall

Make the greeting changeable - CodeFlow

Viewing Iteration 1

Program.cs

Inline Show Both a·b ab

37 for (int i = 0; i < Times; i++)

38 {

39 Console.WriteLine("Hello {0}!", Name);

40 Console.WriteLine("{0} {1}!", Greeting, Name);

41 }

42

43

44

Wouldn't it be better to put this as a parameter of the SayGreeting method?

Alberto Bacchelli

I wouldn't. Greeting is already a field! If you do that, you'd want to make Times a parameter as well.

Tom Zimmermann

Good point. I'll leave it as is.

Christian Bird

Resolved

Hide

100 %

III

Status

File name

Active

S/esereseach/Code/CBirdUtil/Hello/Program.cs

[Tom Zimmermann] Don't forget to initialize.

[Christian Bird] Should we initialize to "Hello" or throw an error if the user does

Resolved

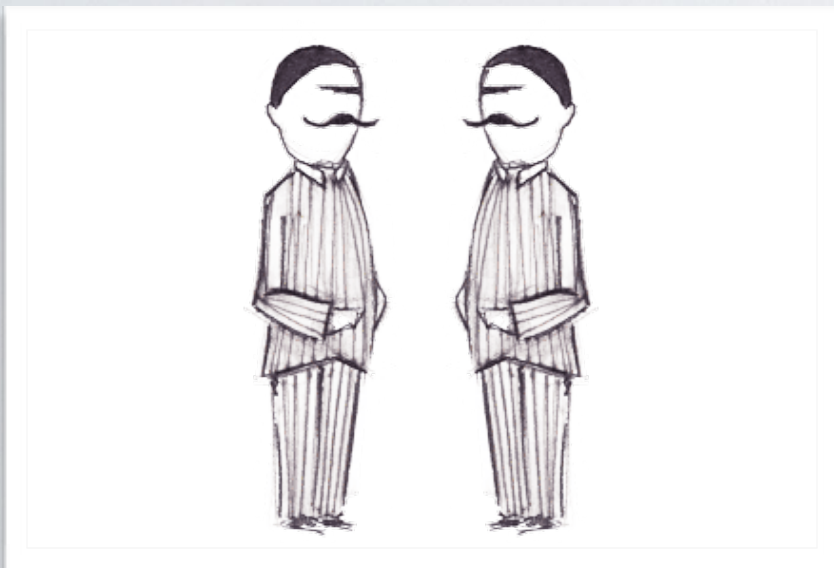
S/esereseach/Code/CBirdUtil/Hello/Program.cs



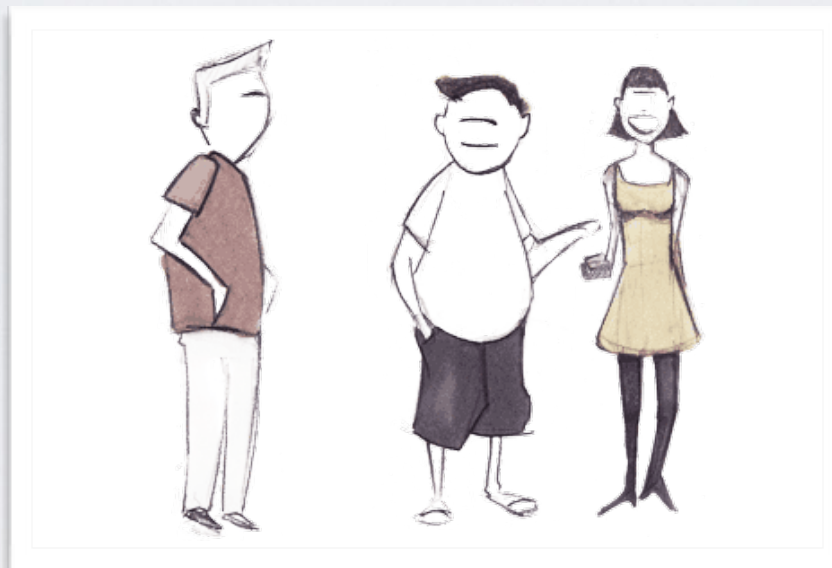
observations



interviews



survey to 165 managers

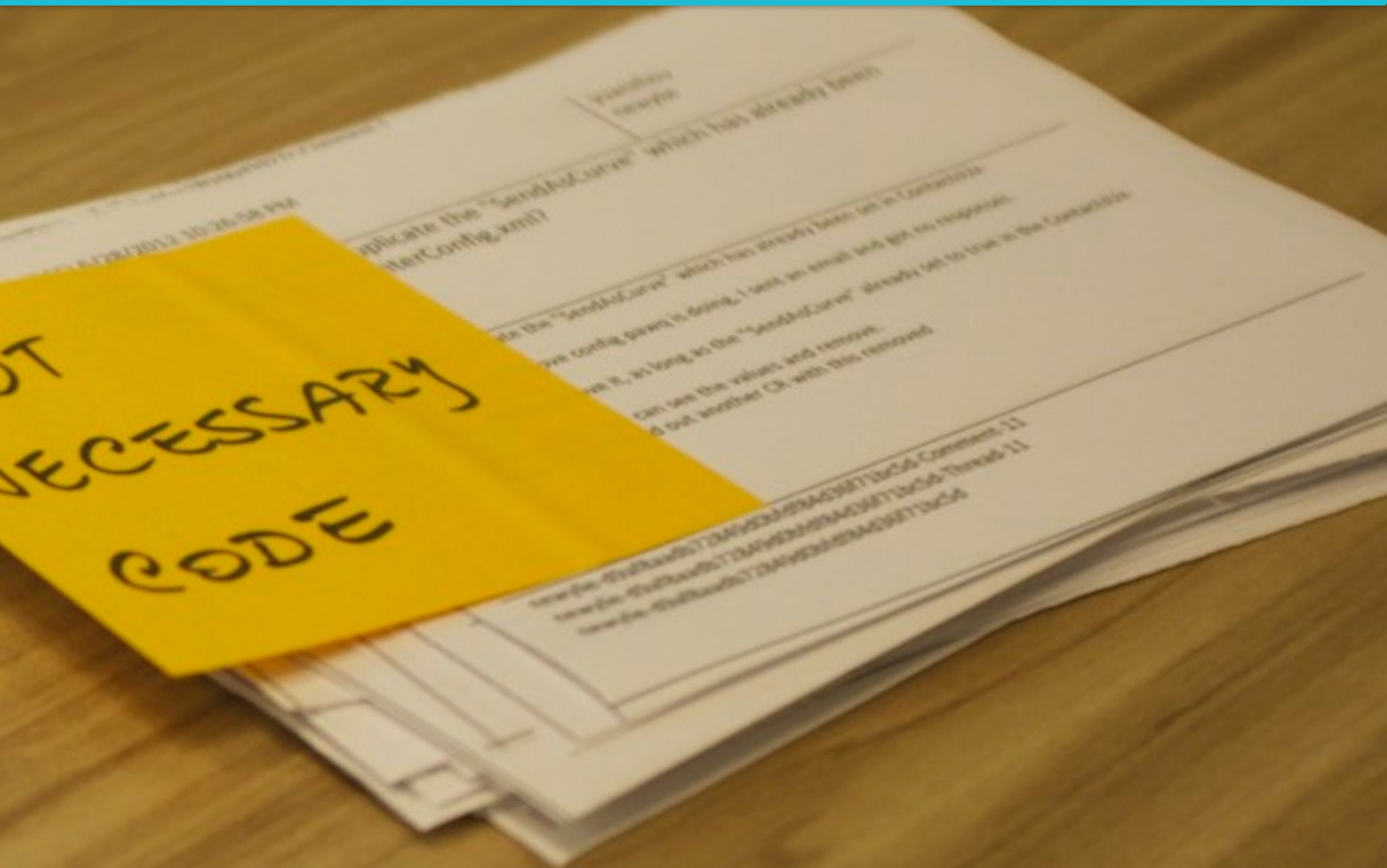


survey to 873 developers

**classification of
570 review comments**



Example stack of cards

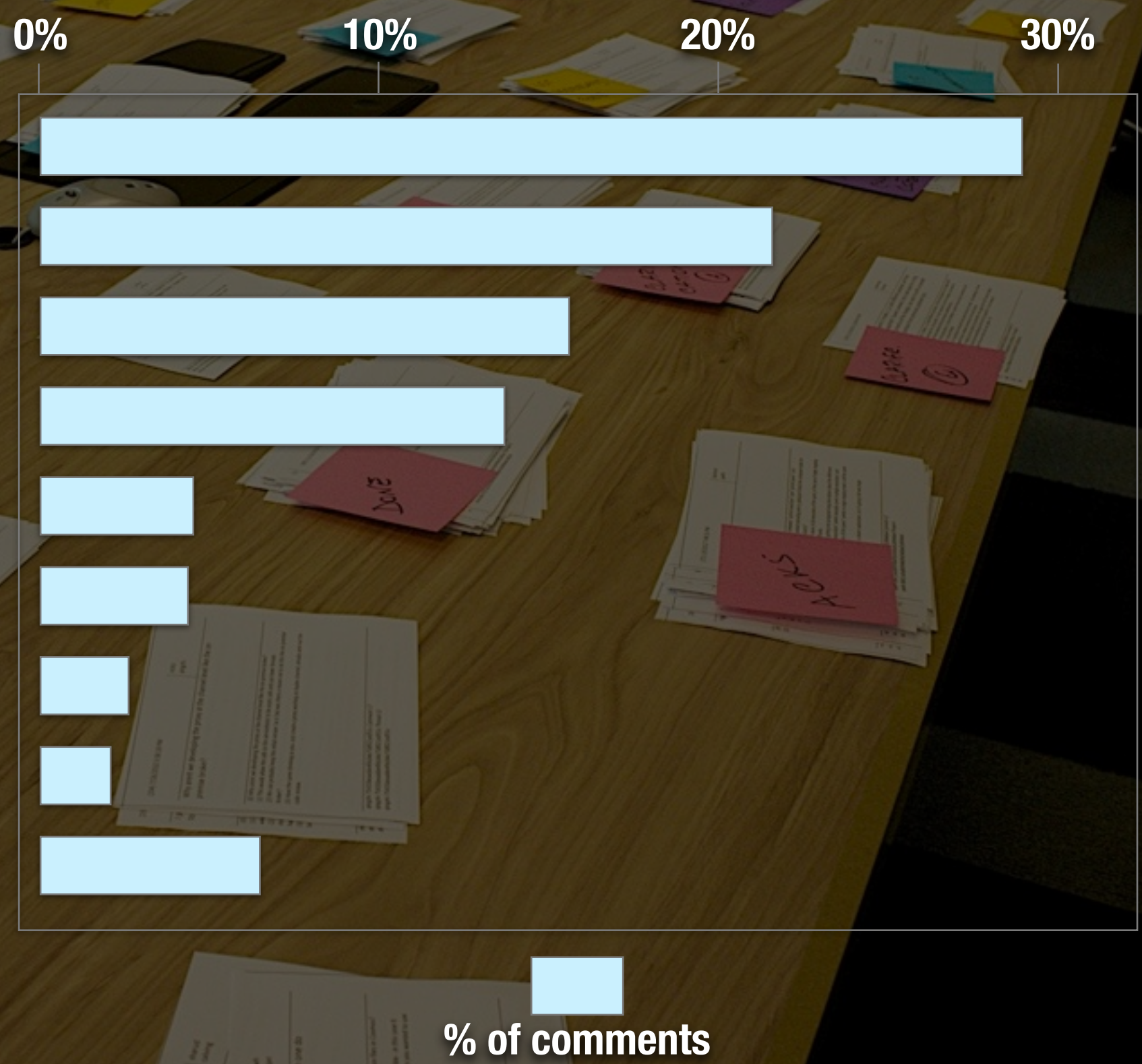


Card sort almost completed

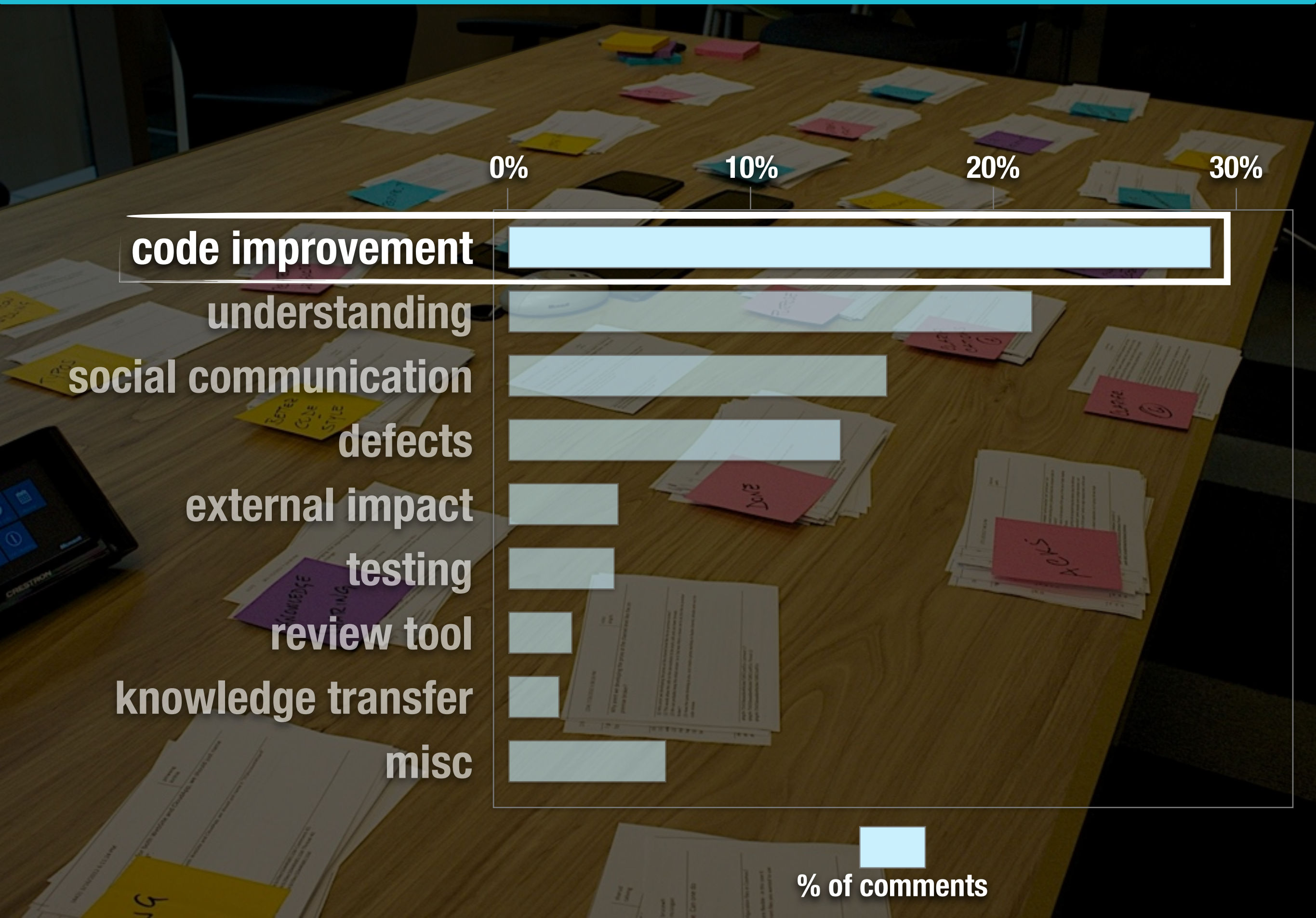


Card sort results

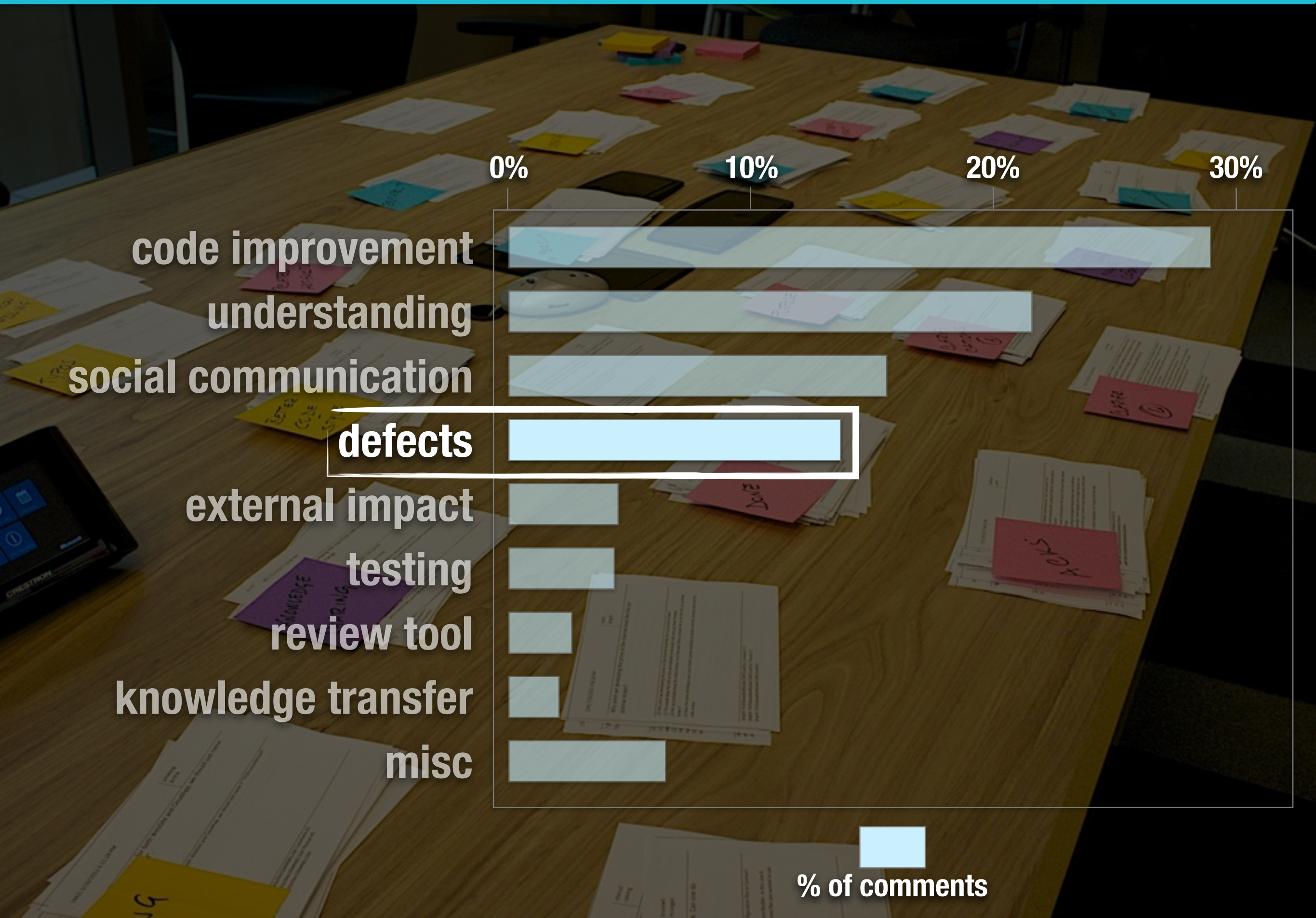
code improvement
understanding
social communication
defects
external impact
testing
review tool
knowledge transfer
misc



Card sort results



Card sort results



Card sort results defects

“what if they are all used?”

“is it possible that this statement never match?”

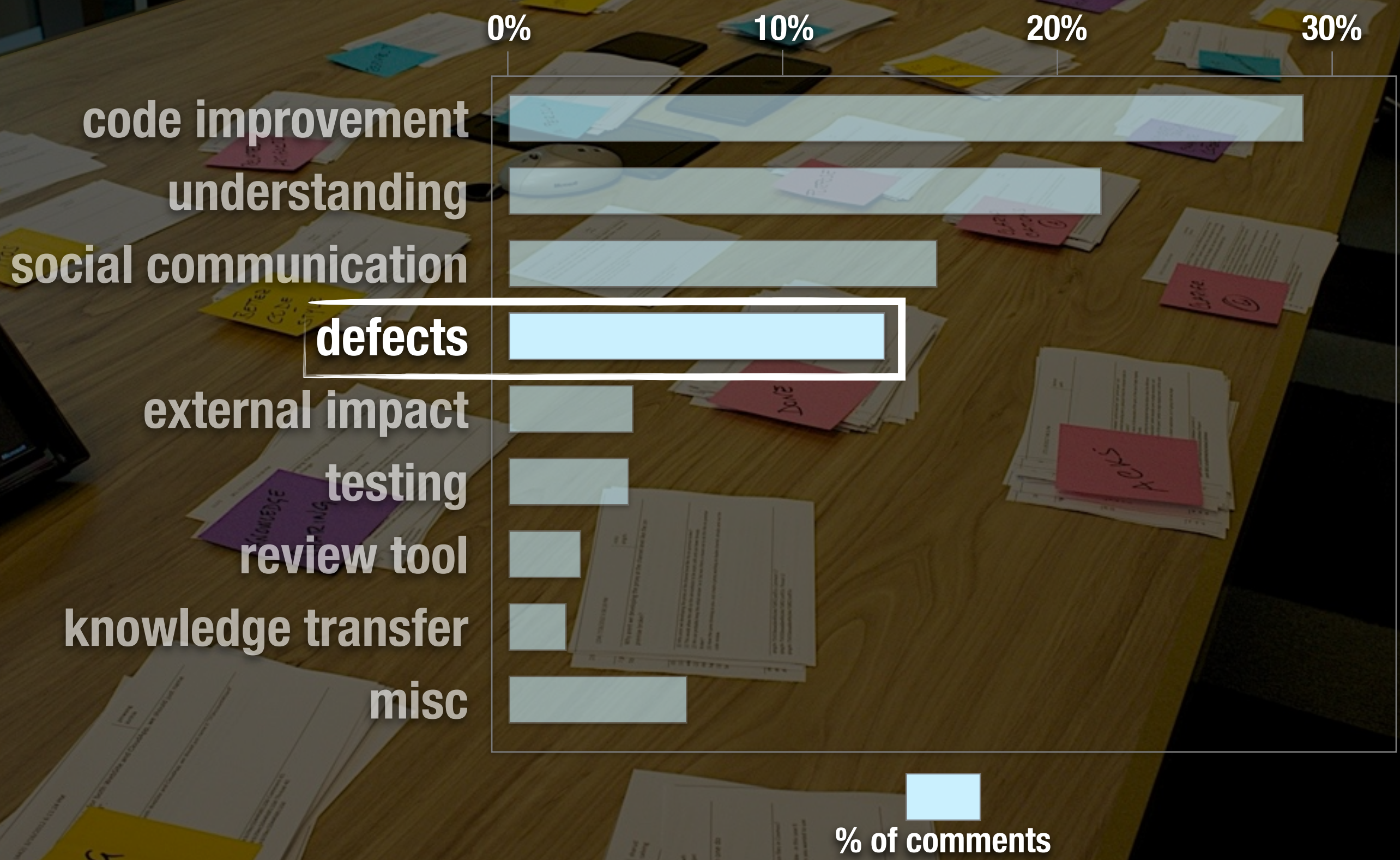
“should this end date be current date?”

“does it work if you put 0 here?”

“any doubt about the precedence here?”

“should be &&?”

Card sort results

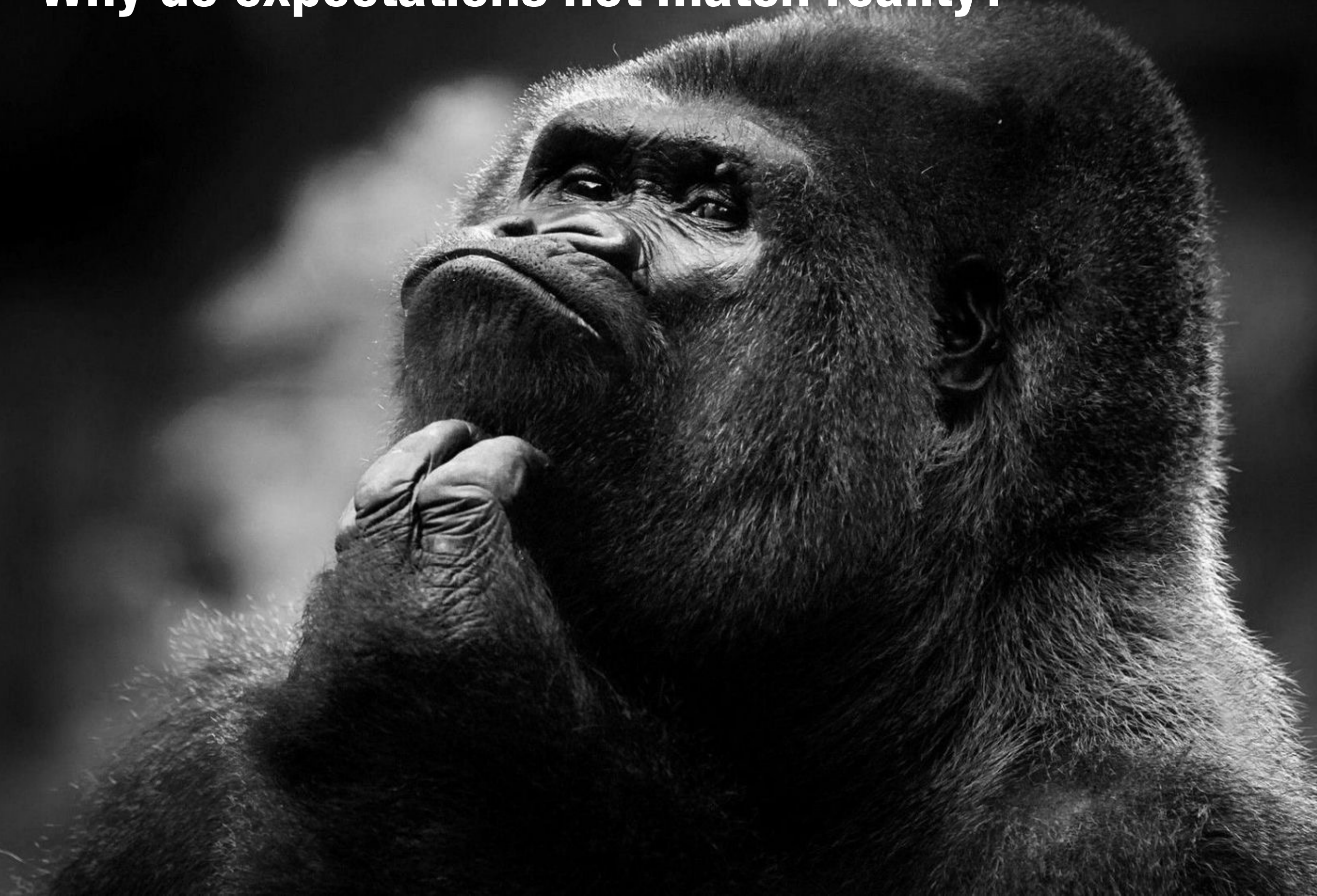


What is the outcome of code reviews? Reality \neq expectations

hot chocolate



Why do expectations not match reality?



Code reviews

... “[if] executed properly, [they] find bugs faster and more effectively than testing or other known debugging techniques”

— Jason Cohen, 2011



Code reviews

... “[if] executed properly, [they] find bugs faster and more effectively than testing or other known debugging techniques—but when done inefficiently they can quickly become unproductive. ”

— Jason Cohen, 2011



**Code review
is (still) a
fully manual task**



Tools only supports logistics of code review

The screenshot shows the CodeFlow application window titled "Make the greeting changeable - CodeFlow". The interface includes a sidebar on the left with a file explorer (1) showing files like `description.txt`, `Hello.csproj`, `Program.cs`, and `Test.cs`. Below the file explorer is a "Reviewer Status" section (2) listing participants: Christian Bird (author), Alberto Bacchelli, Tom Zimmermann, and Nachi Nagappan, with buttons for "Complete Review" and "Recall". The main area displays the code in `Program.cs` (3), showing a loop that writes to the console. A comment box (4) is open over the code, containing a discussion about parameters. At the bottom, a table (5) lists review items with their status and file names.

Code Snippet:

```
37 for (int i = 0; i < Times; i++)
38 {
39     Console.WriteLine("Hello {0}!", Name);
40     Console.WriteLine("{0} {1}!", Greeting, Name);
41 }
42
43
44
```

Comment Box (4):

Wouldn't it be better to put this as a parameter of the SayGreeting method?
Alberto Bacchelli

I wouldn't. Greeting is already a field! If you do that, you'd want to make Times a parameter as well.
Tom Zimmermann

Good point. I'll leave it as is.
Christian Bird

Resolved

Review Table (5):

Status	File name
Active	<code>\$/esereseach/Code/CBirdUtil/Hello/Program</code>
[Tom Zimmermann] Don't forget to initialize.	
[Christian Bird] Should we initialize to "Hello" or throw an error if the user does	
Resolved	<code>\$/esereseach/Code/CBirdUtil/Hello/Program.cs</code>

Code review “best practices”

Two examples

11 PROVEN PRACTICES FOR MORE EFFECTIVE, EFFICIENT CODE REVIEW

- Review **fewer than 200–400 lines** of code at a time
- Aim for an inspection rate of fewer than 200–500 LOC per hour
- Take enough time to read the code
- Be sure to read the code **thoroughly**
- Establish a **code review process**
- Use checklists
- **Verify** the code meets the requirements
- Foster a **collaborative** environment
- Beware of **groupthink**
- **Review** the code **before** it is merged
- **Adopt** a **code review** process

NOT ENOUGH EVIDENCE!!!

7 WAYS

- **Prioritize** code reviews
- **Run** the code review
- Visualize the code review
- Do code reviews as soon as you see the request
- **Imagine** how you would make this change before you read it
- Read the change in a **realistic development environment**
- **Always give approval**, unless you can prove that there is a bug

Call to Arms — Evidence-based modern code review

Research vision

**Transform code review into an engineering process,
to tap into its potential to develop high-quality software.**

What is an engineering process?

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What is an engineering process?

“Engineering enables ordinary people to do things
that formerly required virtuosos.”

Mary Shaw (US National Medal of Technology and Innovation) — 2015

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“It creates cost-effective solutions...
...to practical problems...
...by applying scientific knowledge...
...building things...
...in the service of mankind.”

Mary Shaw (US National Medal of Technology and Innovation) — 2015

Call to Arms — Evidence-based modern code review

Research vision

Transform code review into an engineering process, to tap into its potential to develop high-quality software.

Problem statement

There is no science of modern code review.

There are insufficient tools and evidence to answer the most fundamental questions and make it an engineering process.

Key goal for the next years

Make the first fundamental steps in establishing evidence-based modern code review, to make it a science.

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Code review — What do we (really) know so far?

We still know only a little, but we are making important steps:

CONVERGENT CONTEMPORARY SOFTWARE PEER REVIEW PRACTICES

[Rigby and Bird — FSE 2013]

- Contemporary peer review follows a lightweight, flexible process
- Reviews happen early (before a change is committed), quickly, and frequently
- Change sizes are small
- Two reviewers find an optimal number of defects
- Review has changed from a defect finding activity to a group problem solving activity

THE IMPACT OF MODER CODE REVIEW ON SOFTWARE QUALITY

[McIntosh, Kamei, Adams, Hassan — EMSE 2016]

CODE OWNERSHIP IN THE SCOPE OF MODERN CODE REVIEW

[Thongtanunam, McIntosh, Hassan, Iida — ICSE 2016]

TECHNICAL AND NON-TECHNICAL FACTORS IN MODERN CODE REVIEW

[Baysal, Kononenko, Holmes, Godfrey — EMSE 2016]

CODE REVIEW QUALITY: HOW DEVELOPERS SEE IT

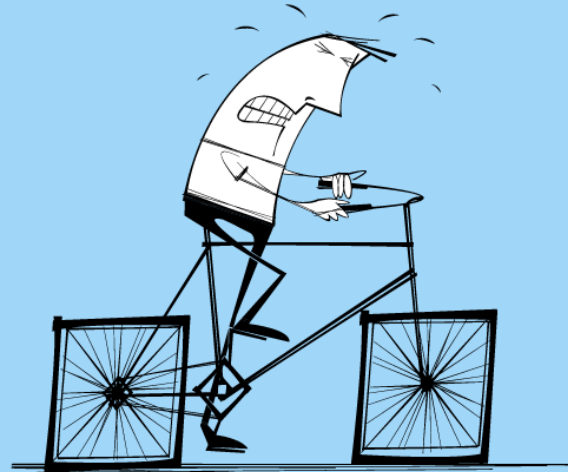
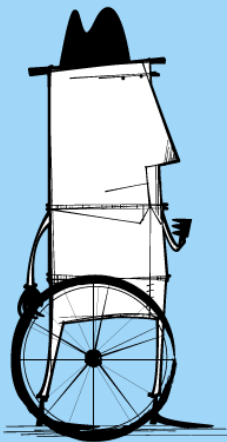
[Kononenko, Baysal, Godfrey — ICSE 2016]


...

Call to Arms — Evidence-based modern code review

ERRR...

CAN'T STOP.
TOO BUSY!!





THE ORIGINAL CURE ALL

RELIEVES INSTANTANEOUSLY

And Cures: Headaches, Neuralgia, Cough, Cold, Sneezing, Hiccups, Croup, Gonorrhea, Dyptheria, Damp lung, Mumps, Measles, Whooping cough, Tuberculosis, And even Bowden's Malady.

MITCHELL'S SNAKE OIL 101 PROOF CURE ALL AND LINAMENT

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Providing the Finest in do-it-yourself health care since 2366

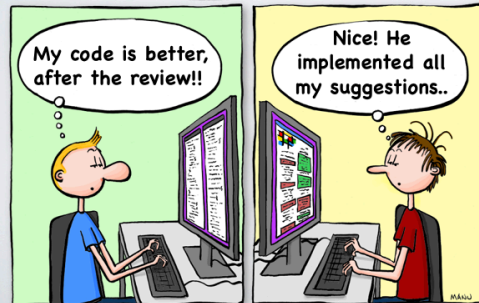
FOR BLINDNESS TRY OUR RATTLESNAKE OIL!

Alberto Bacchelli

University of Zurich,
Switzerland

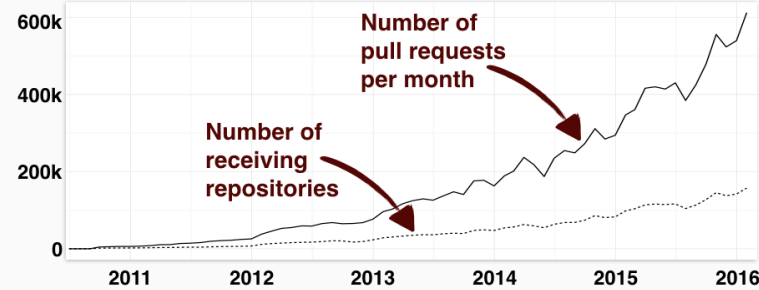
Delft University of Technology,
The Netherlands

Evidence-based Code Review



How popular is it?

Monthly growth of pull request usage on GitHub (OSS)



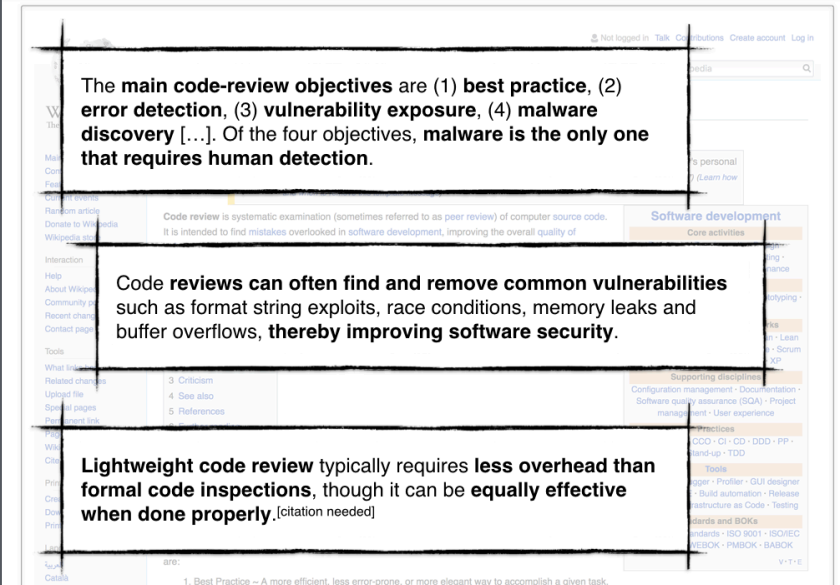
Popularity in industrial setting

Code review tool is used by more than 70,000 developers at Microsoft
[Czerwona, Greiler, Tilford — ICSE 2016]

Each code change in the main repository at Google is reviewed
[Potvin, Levenberg — Communications of the ACM, 2016]

Most other companies have similar policies and big players then to develop their own review tools (e.g., Facebook)

Wikipedia page on code review — an embarrassing stub



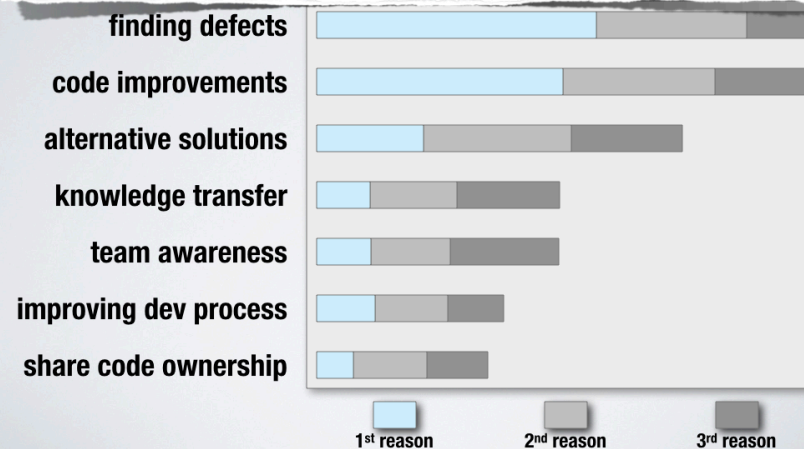
In-field study on modern code review at Microsoft



Why do programmers do code reviews? — Motivations' ranking

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72 managers and 384 developers @ Microsoft



What is the outcome of code reviews? Reality ≠ expectations



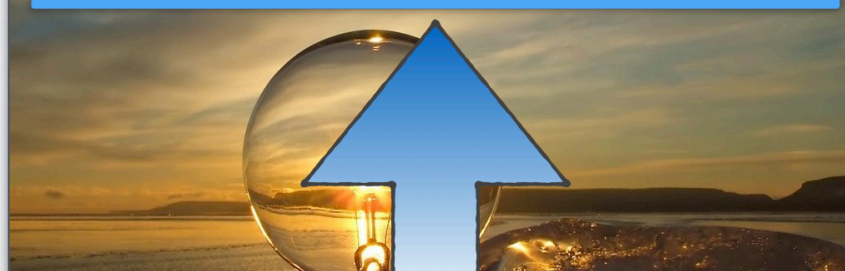
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And we are always looking for great students to work on fantastic Master theses!

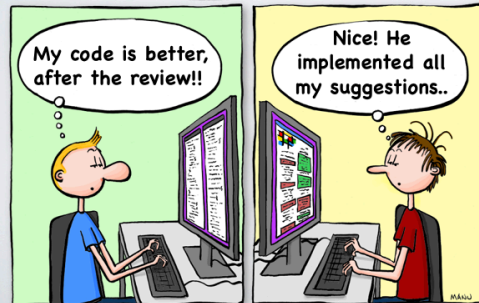
**Find me at the end of the talk,
at bacchelli@ifi.uzh.ch ,
or at @sback_**

Alberto Bacchelli

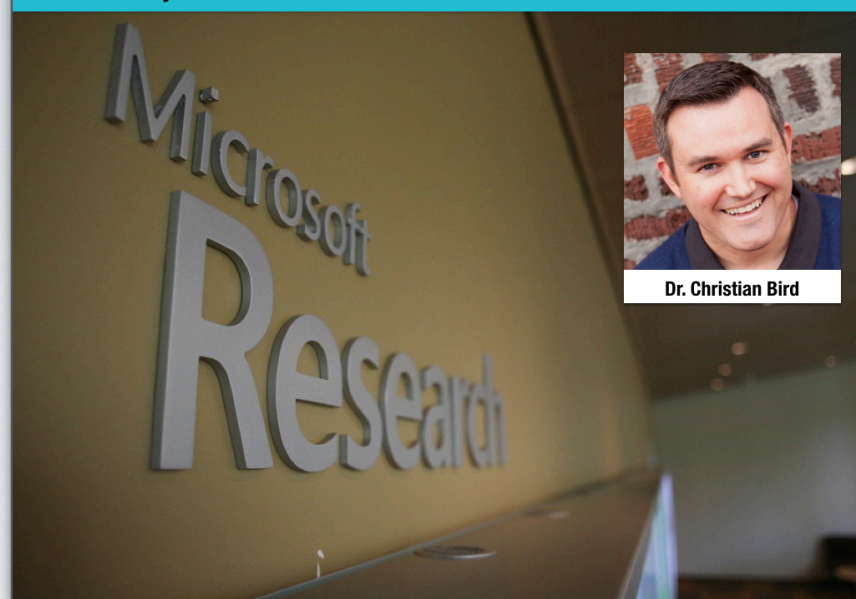
University of Zurich,
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Evidence-based Code Review



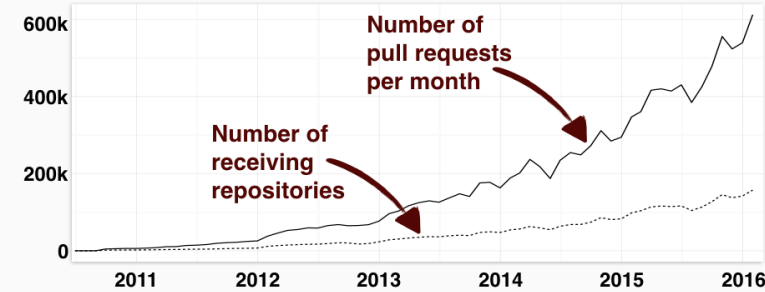
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Dr. Christian Bird

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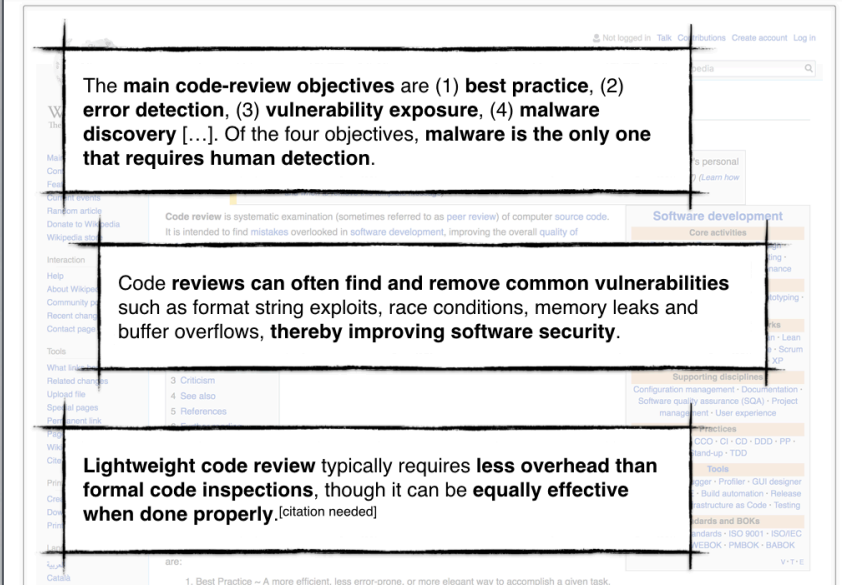
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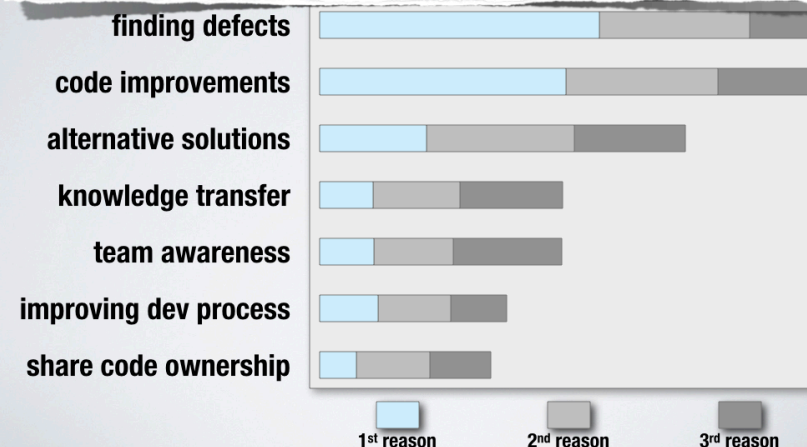
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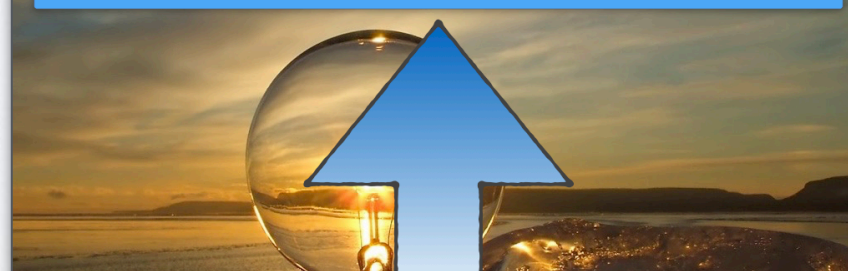
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