What Do Code Reviews at Microsoft and in Open Source Projects Have in Common?

Alberto Bacchelli
Delft University of Technology
The Netherlands
Modern code review

My code is better, after the review!!

Nice! He implemented all my suggestions..

informal  tool-based  asynchronous
Modern code review

My code is better, after the review!!

Nice! He implemented all my suggestions..

informal        tool-based        asynchronous
Code review tools: Gerrit
Code review tools: GitHub pull requests

Sending a pull request #248

cameronmcefee commented 2 years ago

I made some changes. Please review.

cameronmcefee added a commit 2 years ago

Made some changes for a pull request

octocat commented 2 years ago

Awesome, thanks!

cameronmcefee commented 2 years ago

Why yes, of course.

cameronmcefee closed the pull request 2 years ago
Code review tools: Atlassian Crucible
Code review tools: Microsoft CodeFlow
Code review, an interactive online survey!

http://sback.it/fosdem.html

http://goo.gl/forms/hknZvi1YUo
Why research on modern code review?
Code inspections

Code “inspection is a method of static testing to verify that software meets its requirements.”

“It engages developers and others in a formal process [...] that usually detects more defects in the product than does machine testing.”
Code inspections

Can you trust these results apply to modern code review?

“It engages developers and others in a formal process [...] that usually detects more defects in the product than does machine testing.”
Modern Code Review @ Microsoft
Modern Code Review @ Microsoft

Excel

Windows Phone

XBox

SQL Server
The CodeFlow review tool

Used across all Microsoft product teams by more than 70,000 developers, so far.
18 interviews with observations
~40 minutes long
developers, testers
different roles
signed off at least 50 reviews
observations

interviews

survey to 165 managers
List of motivations for doing code review

- Alternative Solutions
- Team Assessment
- Knowledge Transfer
- Avoid Build Breaks
- Share Code Ownership
- Improve Dev. Process
- Code Improvement
- Team Awareness
- Track Rationale
- Finding Defects
observations

interviews

survey to 165 managers

survey to 873 developers
Why do Microsoft developers do code reviews?

1st reason:
- Finding defects
- Code improvements
- Alternative solutions

2nd reason:
- Knowledge transfer
- Team awareness
- Improving dev process

3rd reason:
- Share code ownership
Why do Microsoft developers do code reviews?

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

72 managers and 384 developers @ Microsoft

- finding defects
- code improvements
- alternative solutions
- knowledge transfer
- team awareness
- improving dev process
- share code ownership

1st reason
2nd reason
3rd reason
Let’s look at the survey’s answers!
What is the outcome of code review at Microsoft?
What is the outcome of code review at Microsoft?
Recorded code review comments

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
observations

interviews

survey to 165 managers

survey to 873 developers

classification of 570 review comments
Card sort almost completed
Card sort results

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

% of comments
Card sort results

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

0% 10% 20% 30%

% of comments
Card sort results

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

% of comments
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

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

% of comments:
- 0%
- 10%
- 20%
- 30%
Code review at Microsoft: Expectations vs. Reality

hot chocolate

expectation

reality
What is the outcome of code review in OSS?
What is the outcome of code review in OSS?

We manually analyzed 1,400 review-induced changes.
What is the outcome of code review in OSS?
What is the outcome of code review in OSS?
What is the outcome of code review in OSS?

<table>
<thead>
<tr>
<th></th>
<th>Evolvability Changes</th>
<th>Functional Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ConQAT</td>
<td>78%</td>
<td>22%</td>
</tr>
<tr>
<td>GROMACS</td>
<td>69%</td>
<td>31%</td>
</tr>
</tbody>
</table>
What is the outcome of code review?

- **ConQAT**
  - Evolvability changes: 78%
  - Functional changes: 22%

- **GROMACS**
  - Evolvability changes: 69%
  - Functional changes: 31%

- **Microsoft**
  - Evolvability changes: 81%
  - Functional changes: 19%
What is the outcome of code review?

<table>
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<td>23%</td>
</tr>
<tr>
<td>Students review</td>
<td>85%</td>
<td>15%</td>
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What Do Code Reviews at Microsoft and in Open Source Projects Have in Common?
What Do Code Reviews at Microsoft and in Open Source Projects Have in Common?

The outcome
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
… “[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.
Let’s look at the survey’s answers!
What are the challenges of code review at MSFT?
What are the challenges of code review at MSFT?

“understanding the code takes most of the reviewing time.”
Understanding needs, by outcome

Level of Understanding Needed

- None
- Low
- High
- Complete

Responses

finding defects: Complete
alternative solutions: Complete
share code ownership: Complete
knowledge transfer: Complete
team assessment: Complete
code improvements: Complete
improving dev process: Complete
team awareness: Complete
track rationale: Complete
avoid build breaks: Complete
Understanding needs, by outcome

Level of Understanding Needed

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Responses

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alternative solutions

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Responses
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Responses

- finding defects
- alternative solutions
- share code ownership
- knowledge transfer
- team assessment
- code improvements
- improving dev process
- team awareness
- track rationale
- avoid build breaks

Responses
Effect of code ownership on reviews

Does it take longer to review files that you are not familiar with (or files that are new)?

"YES"
798 developers (91%)

Is there a difference in comments/feedback you receive when a reviewer is very familiar with or the owner of the files you changed in a code review?

"YES"
716 developers (82%)
Effect of code ownership on reviews

Is there a difference in comments/feedback you receive when a reviewer is very familiar with or the owner of the files you changed in a code review?

“YES”
716 developers (82%)

“Comments reflect their deeper understanding – more likely to find subtle defects, feedback is more conceptual (better ideas, approaches) instead of superficial (naming, mechanical style, etc.)”
Code review needs the right data and the right tools
Software analytics

… “is analytics on software data for managers and software engineers with the aim of empowering software development individuals and teams to gain and share insight from their data to make better decisions.”

— Menzies and Zimmermann, 2013

IN THIS SPECIAL issue of IEEE Software, we invited submissions that reflected the benefits (and drawbacks) of software analytics. The response was overwhelming. Software analytics is an area of explosive growth, and we had so many excellent submissions that we had to split this special issue into two volumes—you’ll see even more content in the September/October issue. We divided the articles on conceptual grounds, so both volumes will feature equally excellent work.

To better frame these articles, we offer some definitions and historical perspectives on software analytics. Specifically, we describe where the field was, where it is, and where it might be going.

What Is Software Analytics?
Thanks to the Internet and open source, there’s now so much data about software projects that it’s impossible to manually browse through it all:

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Software analytics

… “is analytics on software data for managers and software engineers with the aim of empowering software development individuals and teams to gain and share insight from their data to make better decisions.”

— Menzies and Zimmermann, 2013
Software analytics’ workflow

software engineering tasks helped

programming debugging maintenance testing

data mining and software analysis techniques

classification patterns clustering

software data

source code versioning system issue tracking system
Software analytics for code reviews

Software engineering tasks helped

Data mining and software analysis techniques

Classification
Patterns
Clustering

Software data

Source code
Versioning system
Issue tracking system
Review data
My research: Data-supported code review

- recommender for reviewers
- change untangler
- automatic risk detection
My research: Data-supported code review

recommender for reviewers

change untangler

automatic risk detection
Who should review my code changes?

recommend for reviewers

most appropriate reviewer #1

most appropriate reviewer #2

most appropriate reviewer #3

versioning system

code review data

changes to review
My research: Data-supported code review

- recommender for reviewers
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How should I split my code for easier review?

changes to review

change untangler

versioning system

self-contained change
My research: Data-supported code review

- recommender for reviewers
- change untangler
- automatic risk detection
Which changes should I review more carefully?

Octopull

automatic risk detection

issue tracking system

versioning system

changes to review
My research: Data-supported code review

- recommender for reviewers
- change untangler
- automatic risk detection
Add code review analytics support to GitHub
Software analytics for code reviews

Software engineering tasks helped

Code review

Data mining and software analysis techniques

Classification
Patterns
Clustering

Software data

Source code
Versioning system
Issue tracking system
Review data
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Modern Code Review @ Microsoft

Code review at Microsoft: Expectations vs. Reality

hot chocolate

expectation

reality

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The outcome

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recommend for reviewers
change untangler
automatic risk detection

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Would you like to work on these topics (with me)?

We have 3 fully funded 4-year PhD (or postdoc) positions!

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

Find me at the end of the talk, at a.bacchelli@tudelft.nl, or at @sback_
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hot chocolate
expectation
reality

Moritz Beller
TUDelft

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