

Modern Code Reviews in Open-Source Projects: Which Problems Do They Fix?



Delft University of Technology

Moritz Beller

Delft University of Technology



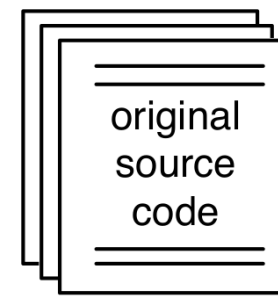
Alberto Bacchelli, Andy Zaidman



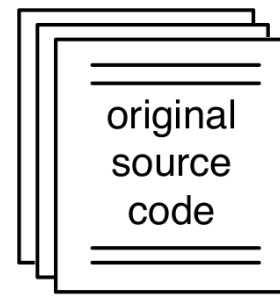
Elmar Juergens,
CQSE GmbH

Modern Code Review Workflow

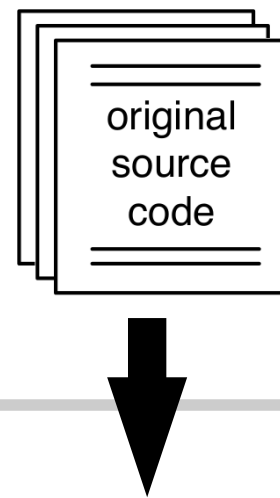
Modern Code Review Workflow



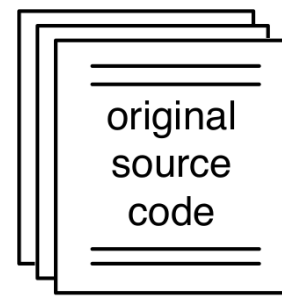
Modern Code Review Workflow



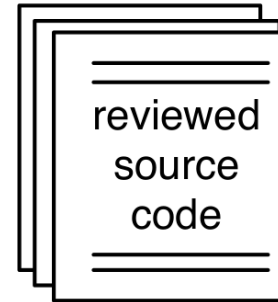
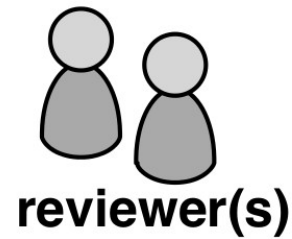
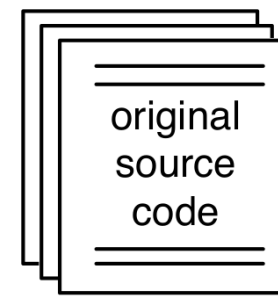
Modern Code Review Workflow



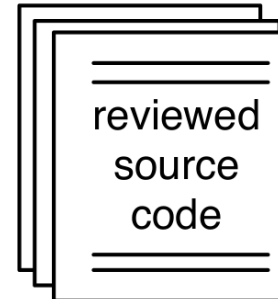
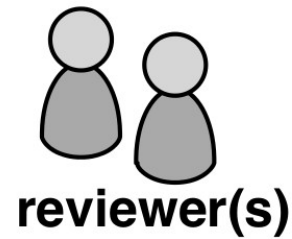
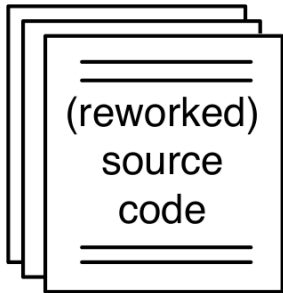
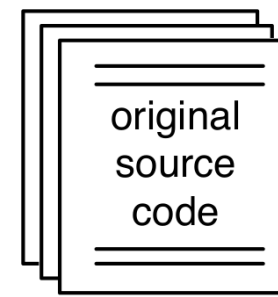
Modern Code Review Workflow



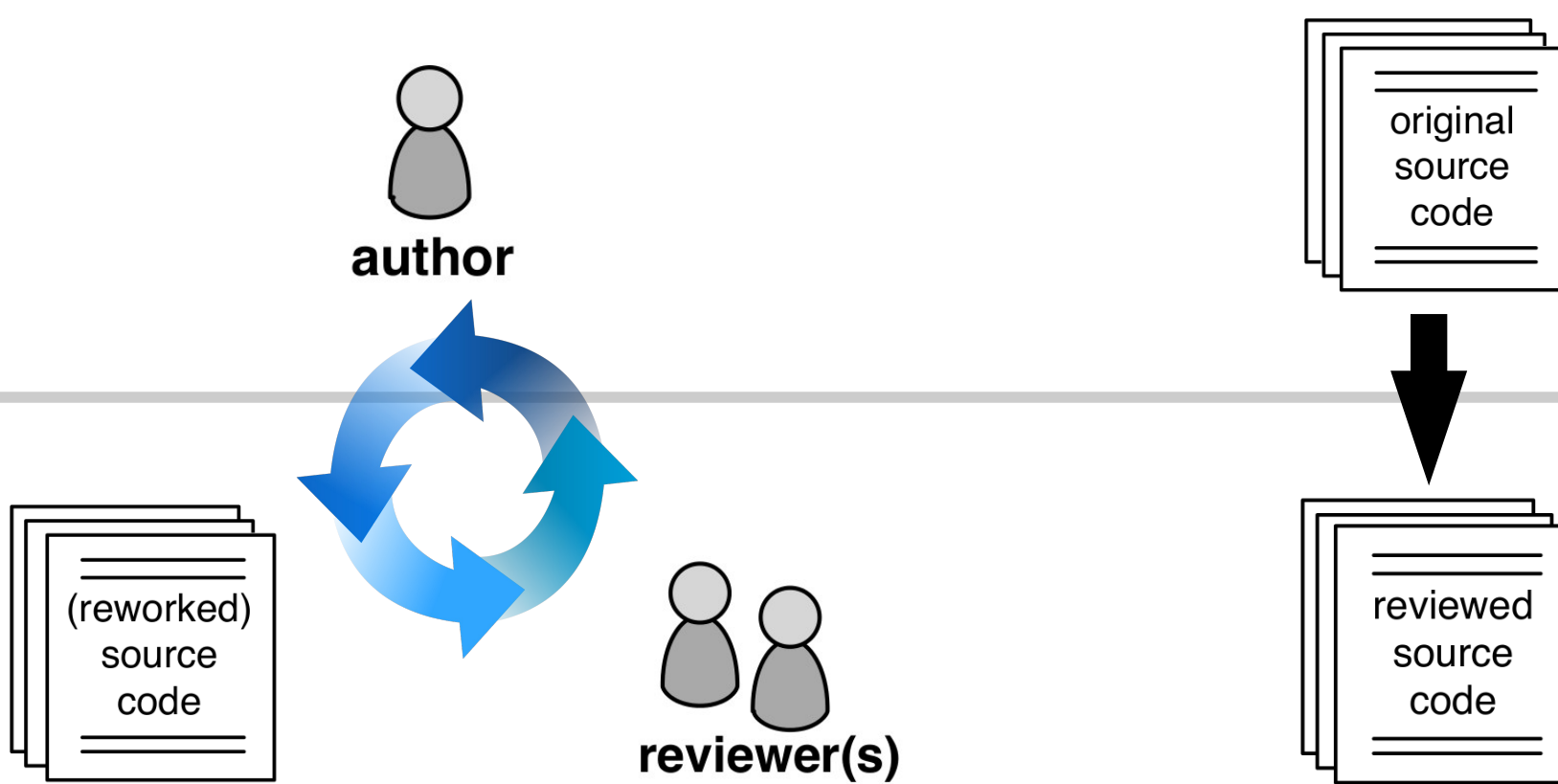
Modern Code Review Workflow



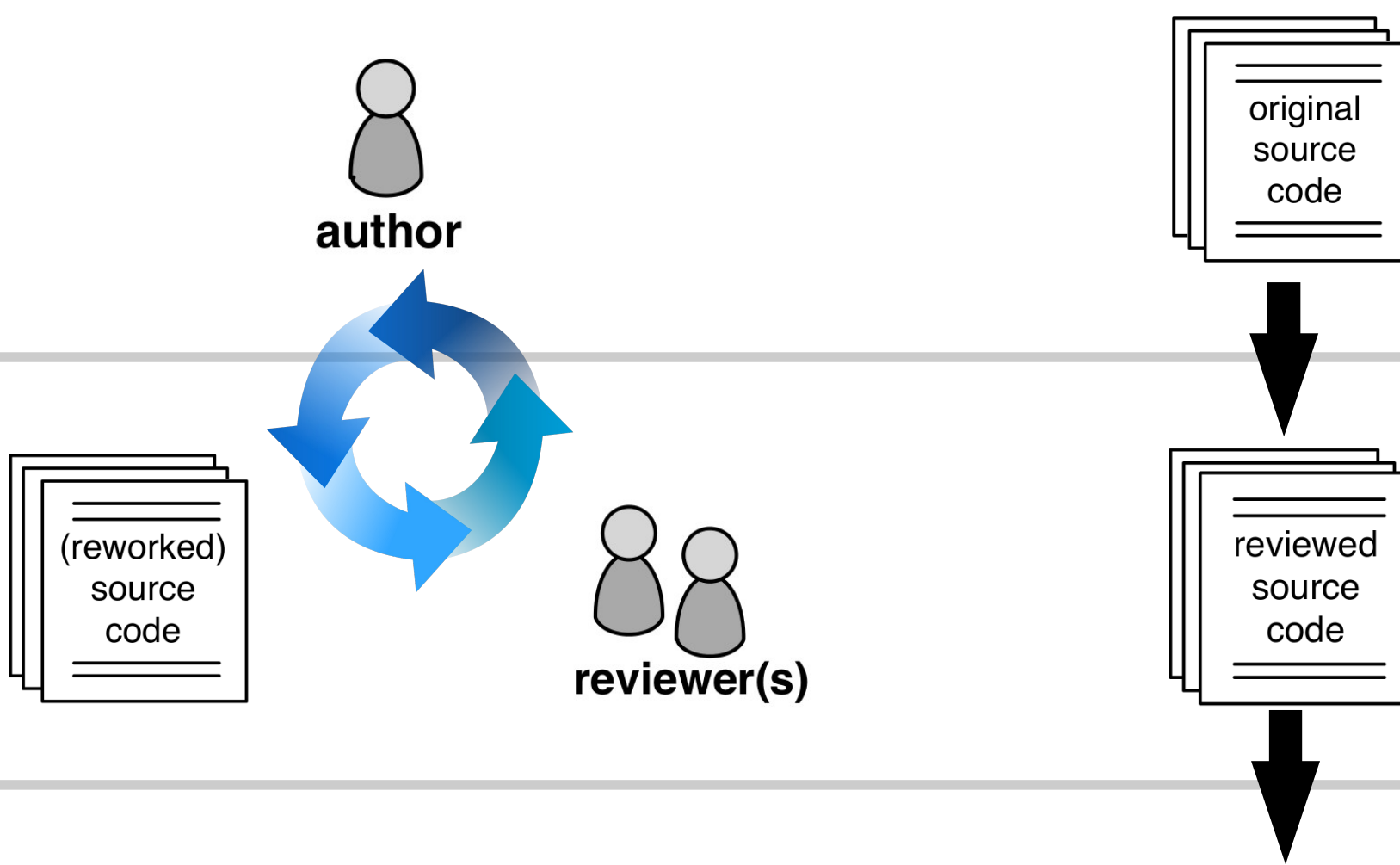
Modern Code Review Workflow



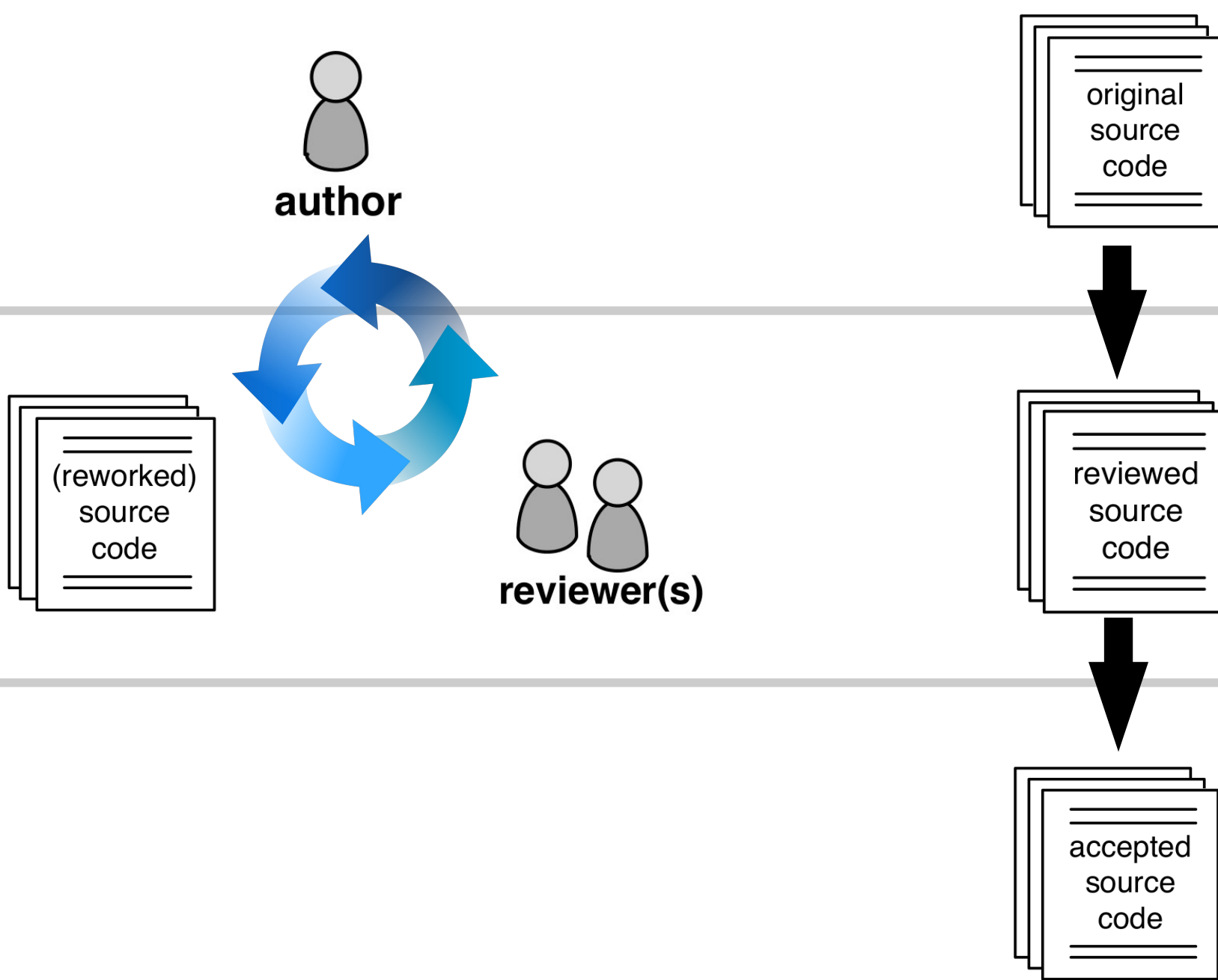
Modern Code Review Workflow



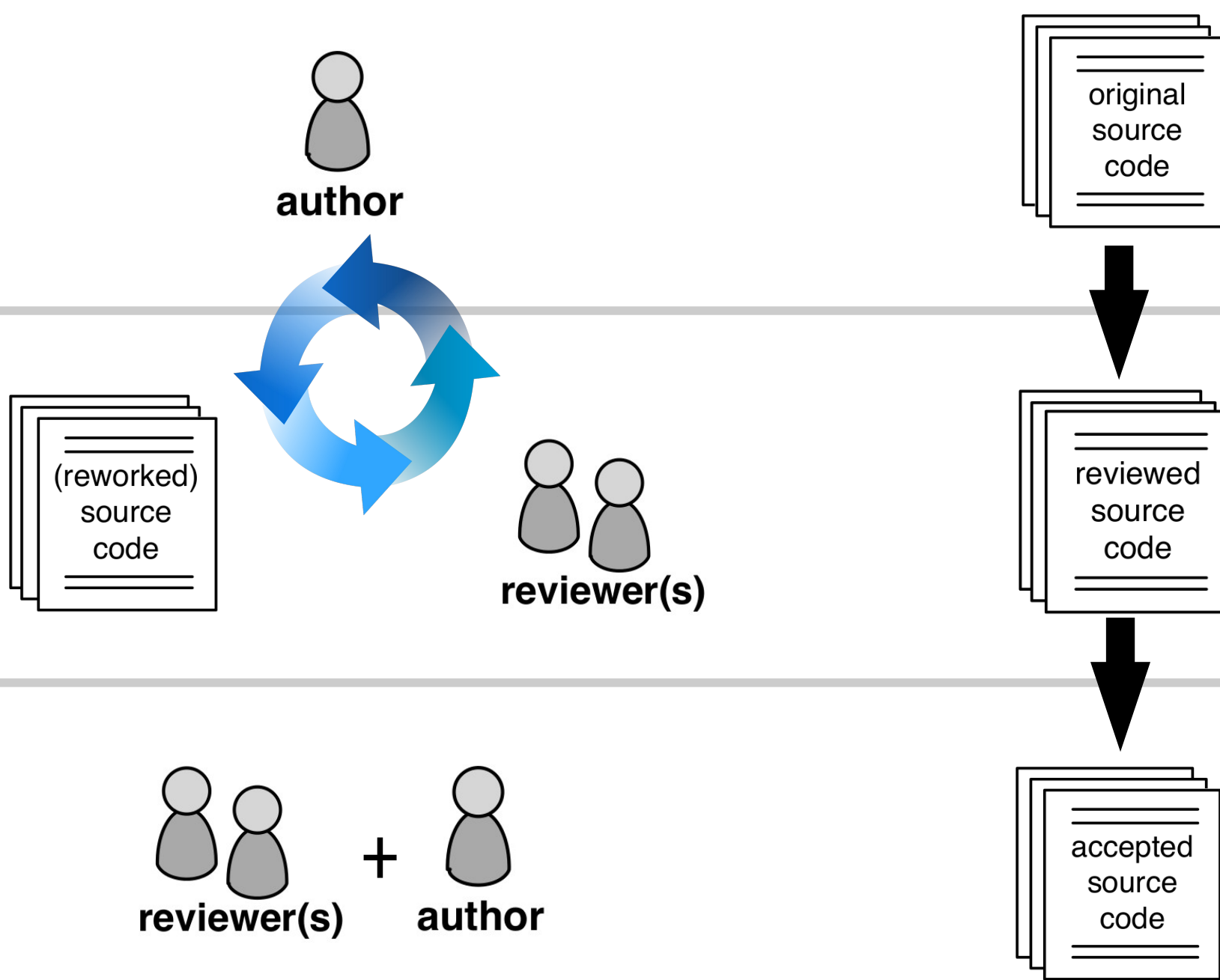
Modern Code Review Workflow



Modern Code Review Workflow



Modern Code Review Workflow



Modern Code Review Workflow



```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```



```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```



```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```




The diagram illustrates a sequence of code changes. It features two horizontal lines with large downward-pointing arrows between them. Above the first arrow is a stack of document icons labeled 'original'. Below the second arrow is a stack of document icons labeled 'reviewed source code'. The code is presented in two blocks, one above and one below the arrows, showing a modification to a Java code snippet.

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

The diagram illustrates the process of code review and acceptance. It consists of three horizontal sections, each representing a different stage of the code's development. The first section shows the 'original' code. A large black arrow points down to the second section, which shows the 'reviewed' code. Another large black arrow points down to the third section, which shows the 'accepted' code. The background features a large, light gray 'L' shape on the left side.

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDogUiThread = new  
StartupUIThread();
```

The diagram illustrates the evolution of a code snippet through three stages, represented by a stack of document icons labeled 'original', 'reviewed source code', and 'accepted code'. The first stage shows the initial code. A large black arrow points down to the second stage, which adds a TODO comment. Another large black arrow points down to the third stage, which renames the variable. Horizontal lines separate the code blocks.

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDogUiThread = new  
StartupUIThread();
```



```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

The diagram illustrates a sequence of three code snippets, each representing a different state of a code review. The snippets are connected by downward-pointing arrows, indicating a progression from the original code to a reviewed version, and finally to an accepted version. The background features a large, light gray '1' on the left side.

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDogUiThread = new  
StartupUIThread();
```

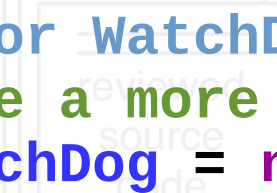
Review-triggered Change



```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```



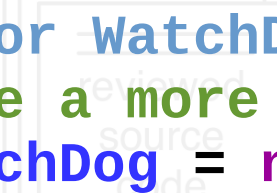
```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```






```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```





```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```





The diagram illustrates the evolution of a code snippet through three stages, separated by horizontal lines and downward arrows. The background features a large, light blue stylized number '2' on the left. Each stage is represented by a document icon with a label: 'original' for the first, 'reviewed source code' for the second, and 'accepted source code' for the third.

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
private Runnable watchDogUiThread = new  
StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
private Runnable watchDogUiThread = new  
StartupUIThread();
```




The diagram illustrates a sequence of code changes. It features three code snippets arranged vertically, connected by large black downward-pointing arrows. The first snippet is labeled 'original' and shows a public Runnable named 'watchDog'. The second snippet is labeled 'reviewed source code' and adds a TODO comment. The third snippet is labeled 'accepted code' and changes the variable name to 'watchDogUiThread' and its access modifier to 'private'. A large blue number '2' is on the left, and a blue bar is at the bottom.

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
private Runnable watchDogUiThread = new  
StartupUIThread();
```

Self-motivated + Review-triggered Change



```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```



```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```


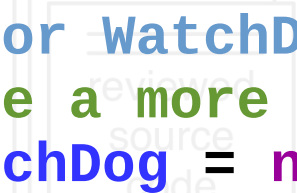




```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```



```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```


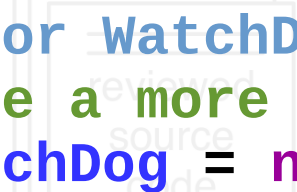





```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```



```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```



```
/**  
 * The ui thread for WatchDog registration. From  
 * this thread, the WatchDog program is started.  
 */  
public Runnable watchDog = new StartupUIThread();
```


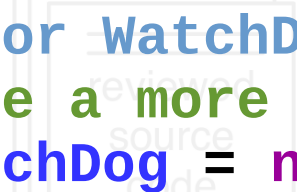





```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```



```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```



```
/**  
 * The ui thread for WatchDog registration. From  
 * this thread, the WatchDog program is started.  
 */  
public Runnable watchDog = new StartupUIThread();
```





```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```



original



```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

reviewed
source code



```
/**  
 * The ui thread for WatchDog registration. From  
 * this thread, the WatchDog program is started.  
 */  
public Runnable watchDog = new StartupUIThread();
```

accepted
source code

Self-motivated Change



```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```



```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```


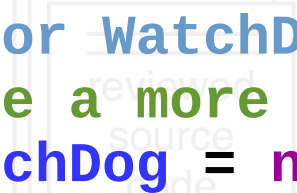




```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```



```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```






```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```



```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```



```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```






```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```



```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```



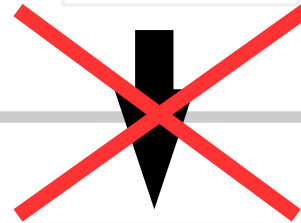
```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```



No Change



```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```



```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```



```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

No Change



```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

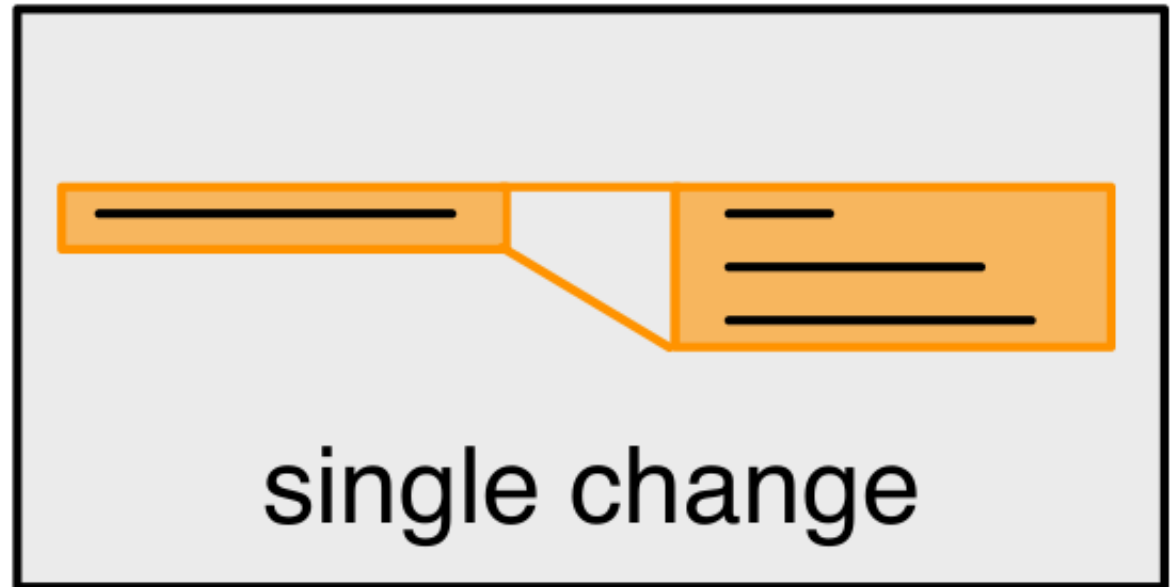
No Change

Does it matter?

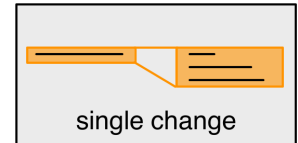
>1,400 changes
>245 tasks

GROMACS FAST.
FLEXIBLE.
FREE.

conQAT
CQSE



Motivation for Change



1

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

2

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

3

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDogUiThread = new  
StartupUIThread();
```

Review-triggered Change

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
private Runnable watchDogUiThread = new  
StartupUIThread();
```

Self-motivated + Review-triggered Change

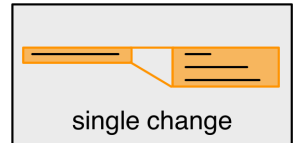
```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

```
/**  
 * The ui thread for WatchDog registration. From  
 * this thread, the whole WatchDog program is run.  
 */  
private Runnable watchDogUiThread = new  
StartupUIThread();
```

Self-motivated + Review-triggered Change

Motivation for Change



1

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

2

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

3

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDogUiThread = new  
StartupUIThread();
```

Review-triggered Change

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
private Runnable watchDogUiThread = new  
StartupUIThread();
```

Self-motivated + Review-triggered Change

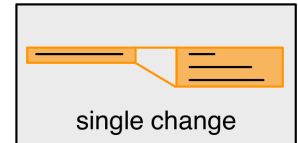
```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

```
/**  
 * The ui thread for WatchDog registration. From  
 * this thread, the whole WatchDog program is run.  
 */  
private Runnable watchDogUiThread = new  
StartupUIThread();
```

Self-motivated + Review-triggered Change

Motivation for Change



1

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

2

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

78-90%

3

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDogUiThread = new  
StartupUIThread();
```

Review-triggered Change

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
private Runnable watchDogUiThread = new  
StartupUIThread();
```

Self-motivated + Review-triggered Change

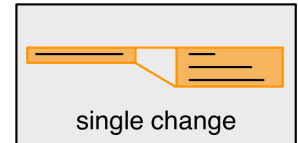
```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

```
/**  
 * The ui thread for WatchDog registration. From  
 * this thread, the whole WatchDog program is run.  
 */  
private Runnable watchDogUiThread = new  
StartupUIThread();
```

Self-motivated + Review-triggered Change

Motivation for Change



1

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

2

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

78-90%

3

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDogUiThread = new  
StartupUIThread();
```

Review-triggered Change

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
private Runnable watchDogUiThread = new  
StartupUIThread();
```

Self-motivated + Review-triggered Change

22-10%

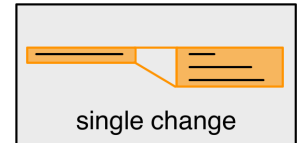
```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

```
/**  
 * The ui thread for WatchDog registration. From  
 * this thread, the whole WatchDog program is run.  
 */  
private Runnable watchDogUiThread = new  
StartupUIThread();
```

Self-motivated + Review-triggered Change

Motivation for Change



1

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

2

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

78-90%

3

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDogUiThread = new  
StartupUIThread();
```

Review-triggered Change

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
private Runnable watchDogUiThread = new  
StartupUIThread();
```

Self-motivated + Review-triggered Change

22-10%

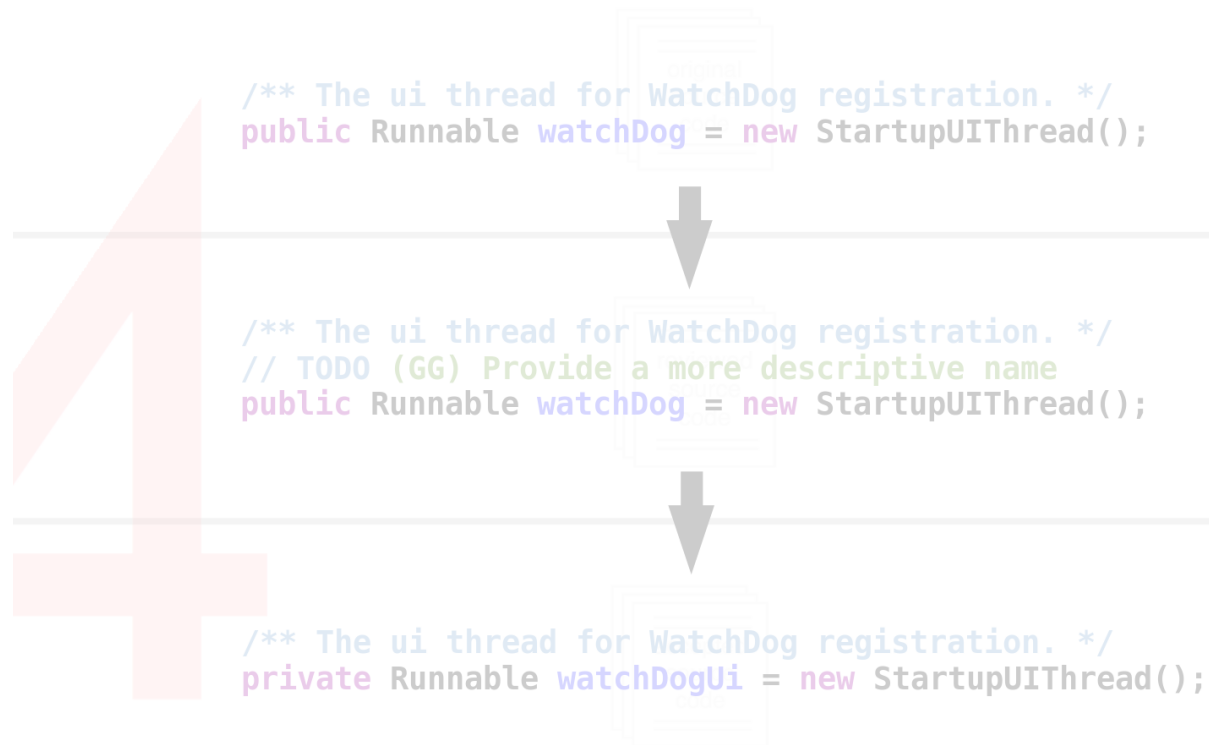
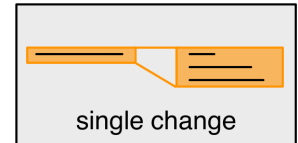
```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```

```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```

```
/**  
 * The ui thread for WatchDog registration. From  
 * this thread, the whole WatchDog program is run.  
 */  
private Runnable watchDogUiThread = new  
StartupUIThread();
```

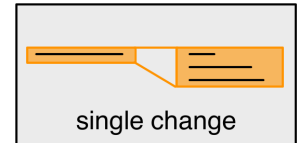
Self-motivated + Review-triggered Change

Motivation for No Change



No Change

Motivation for No Change



original

```
/** The ui thread for WatchDog registration. */  
public Runnable watchDog = new StartupUIThread();
```



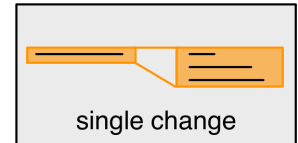
```
/** The ui thread for WatchDog registration. */  
// TODO (GG) Provide a more descriptive name  
public Runnable watchDog = new StartupUIThread();
```



```
/** The ui thread for WatchDog registration. */  
private Runnable watchDogUi = new StartupUIThread();
```

No Change

Motivation for No Change



original
/** The ui thread for WatchDog registration. */
public Runnable watchDog = new StartupUIThread();



/** The ui thread for WatchDog registration. */
// TODO (GG) Provide a more descriptive name
public Runnable watchDog = new StartupUIThread();

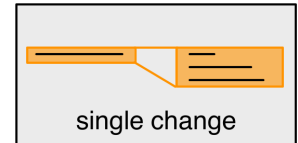
7-35%



/** The ui thread for WatchDog registration. */
private Runnable watchDogUi = new StartupUIThread();

No Change

Motivation for No Change



original
/** The ui thread for WatchDog registration. */
public Runnable watchDog = new StartupUIThread();



/** The ui thread for WatchDog registration. */
// TODO (GG) Provide a more descriptive name
public Runnable watchDog = new StartupUIThread();

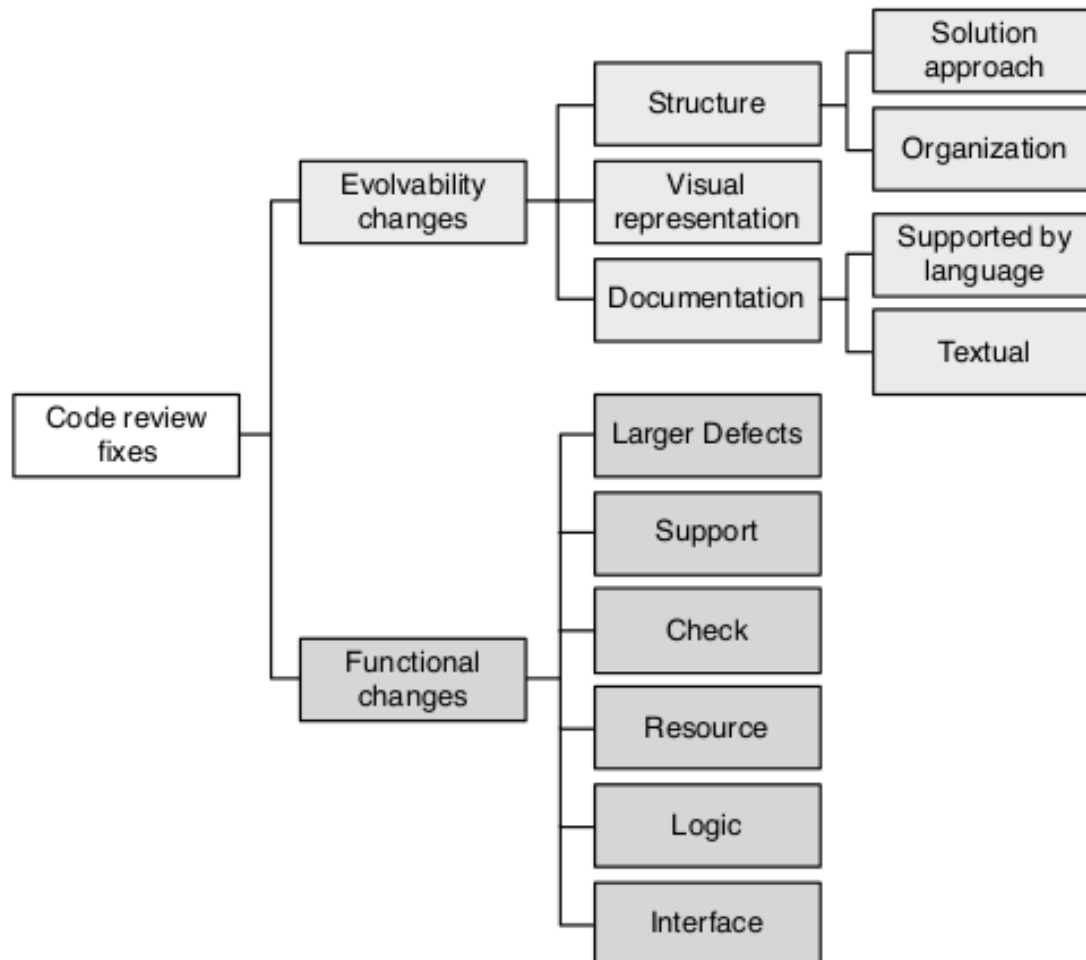
7-35%



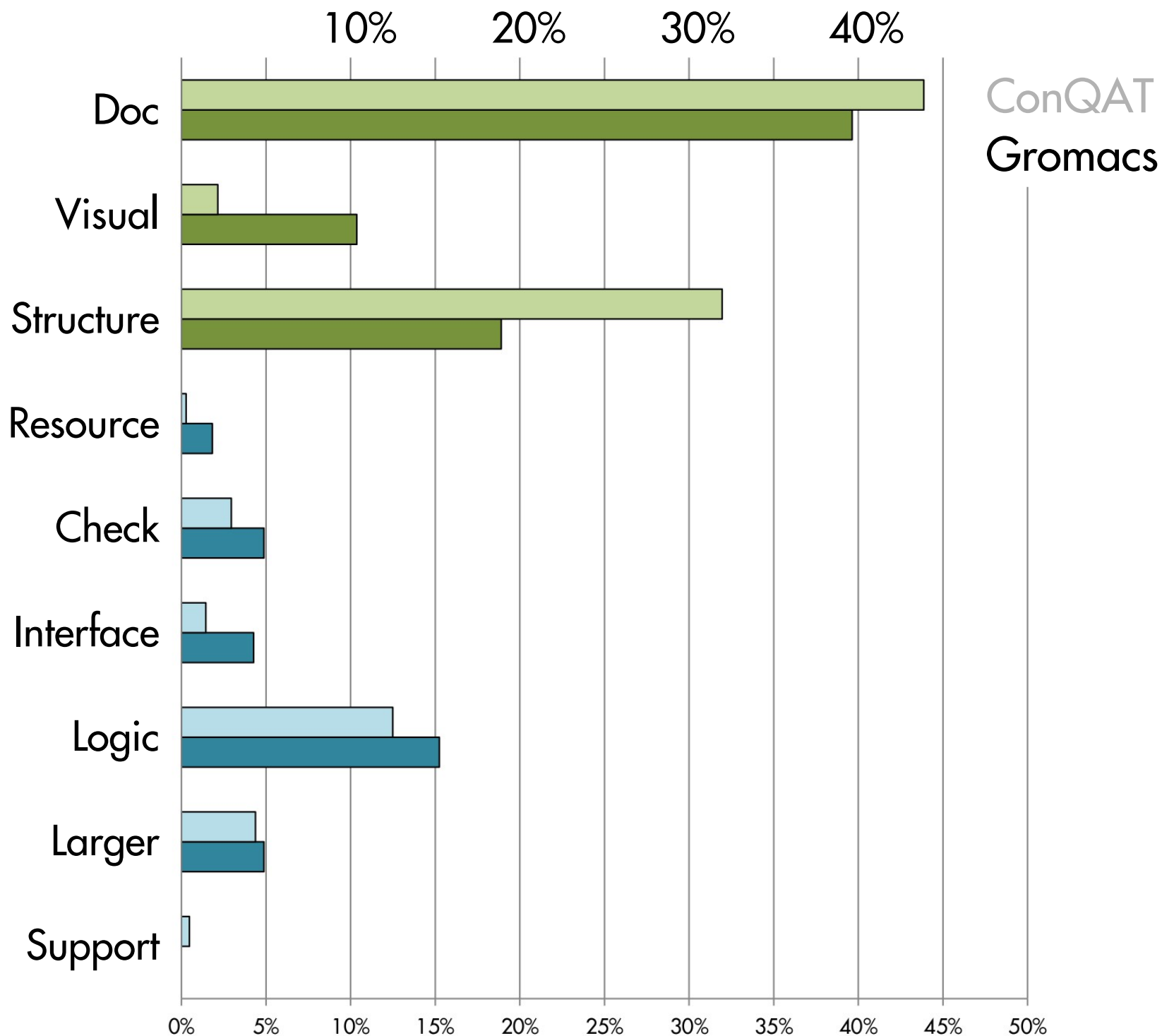
/** The ui thread for WatchDog registration. */
private Runnable watchDogUi = new StartupUIThread();

No Change

Type of Change



manual change classification

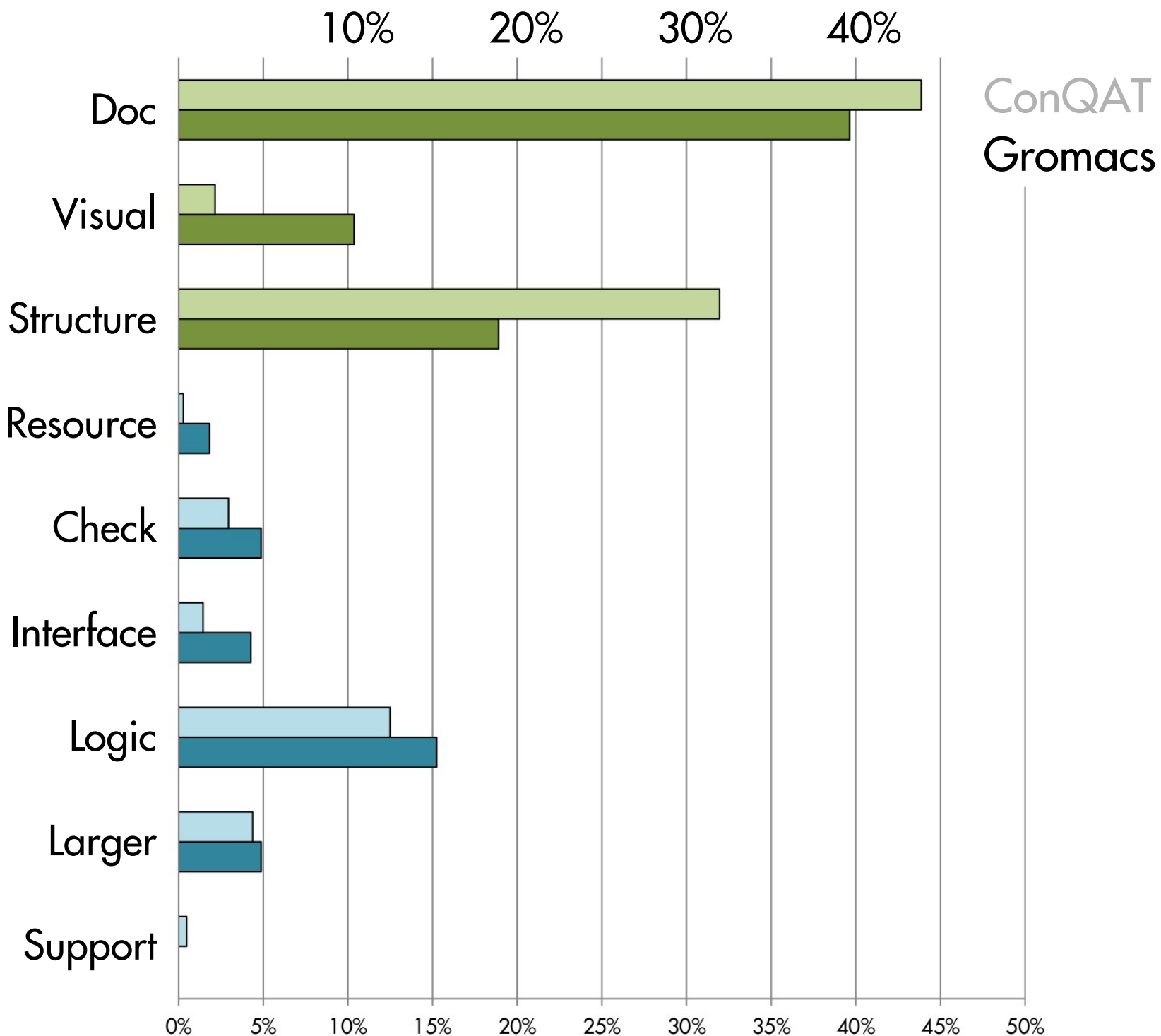


75

•

•

25

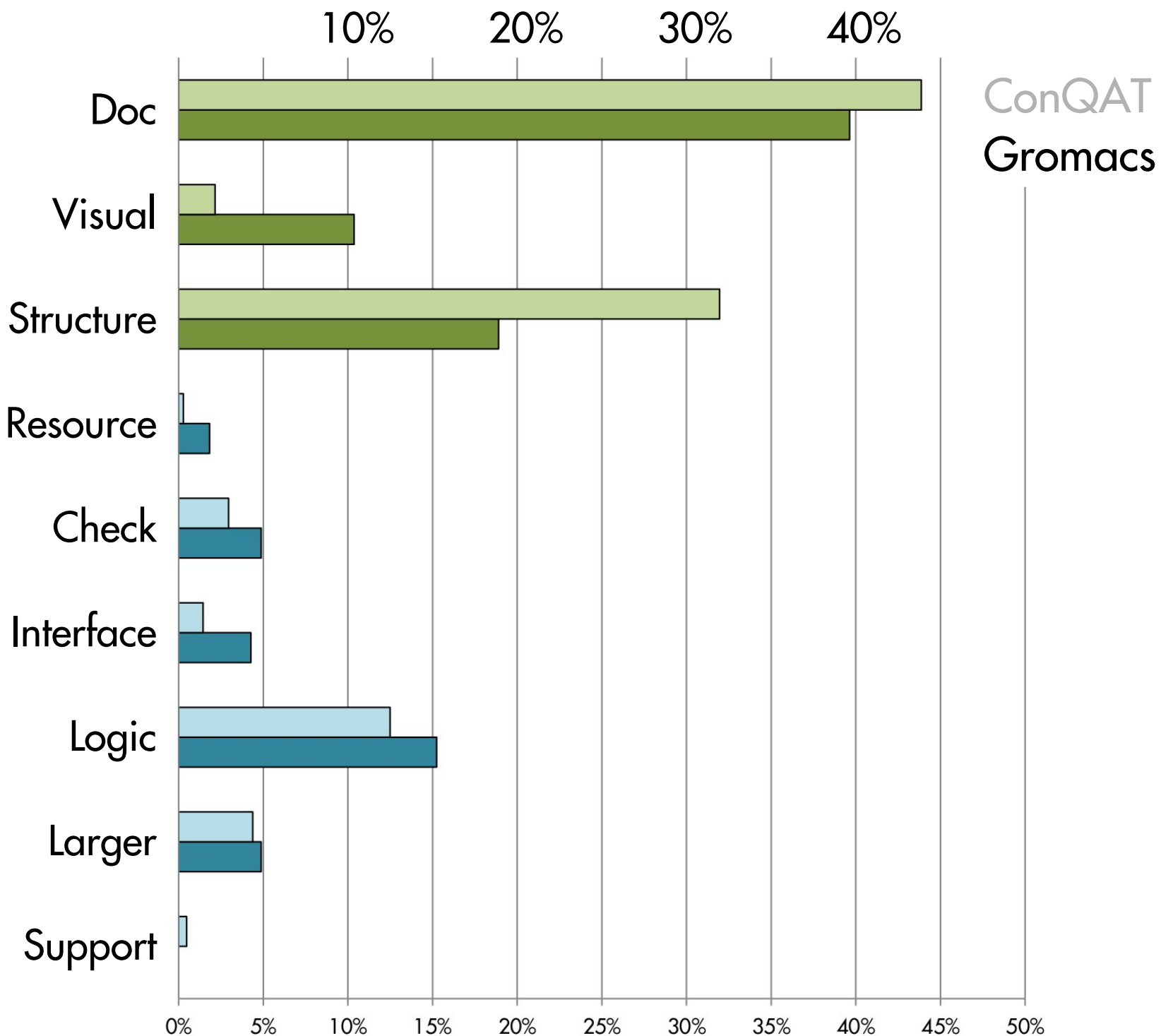


75

•

•

25

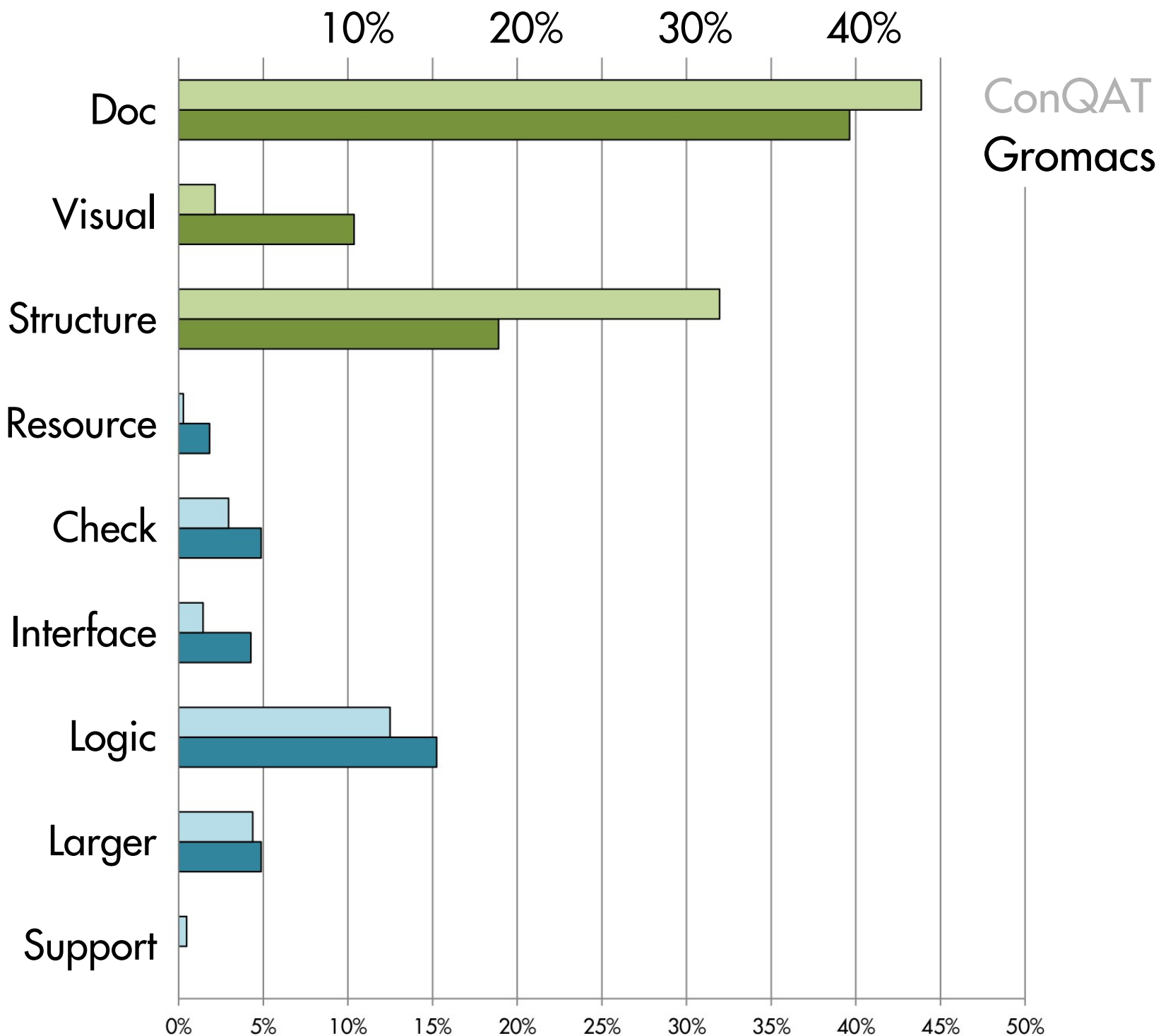


75

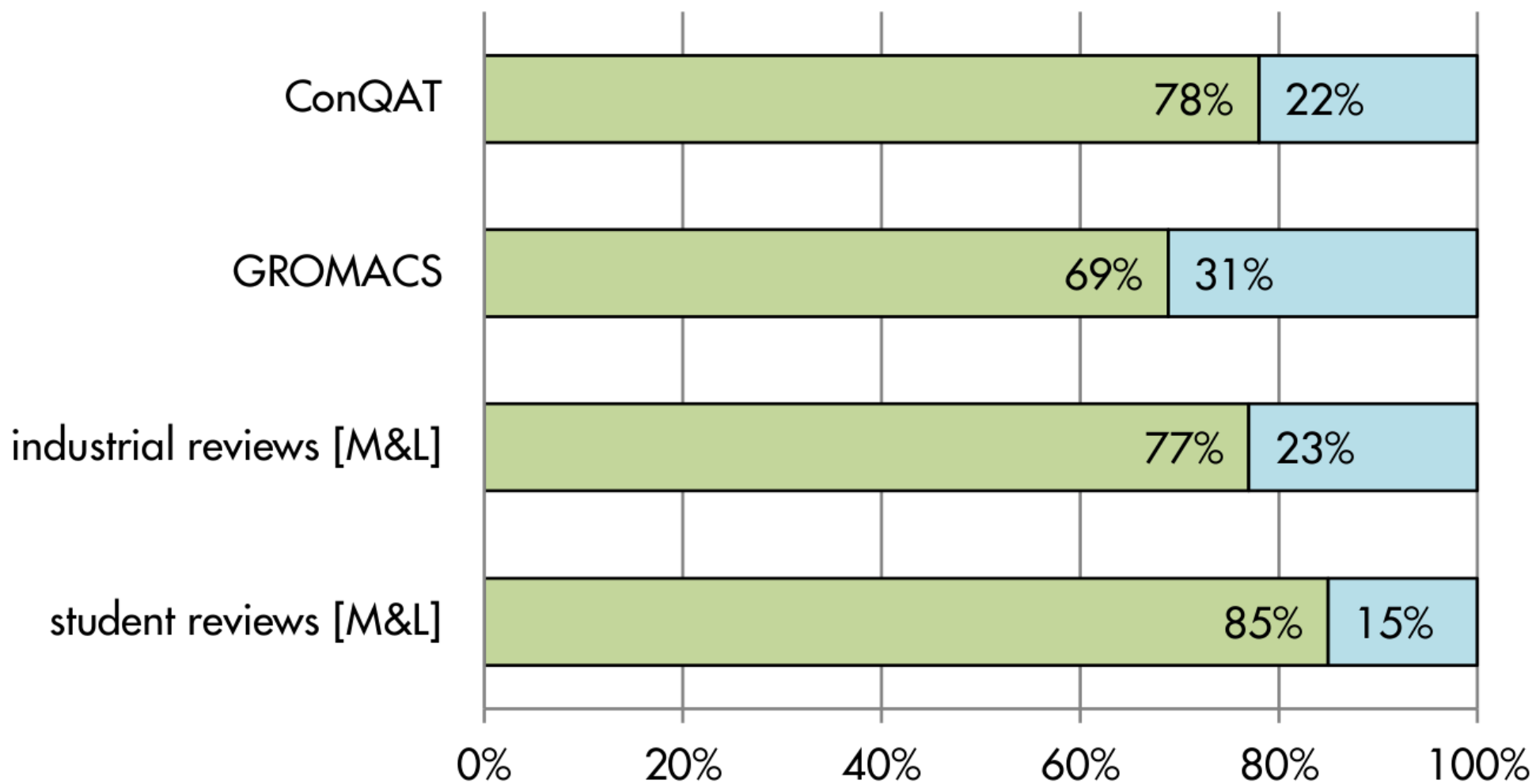
•

•

25

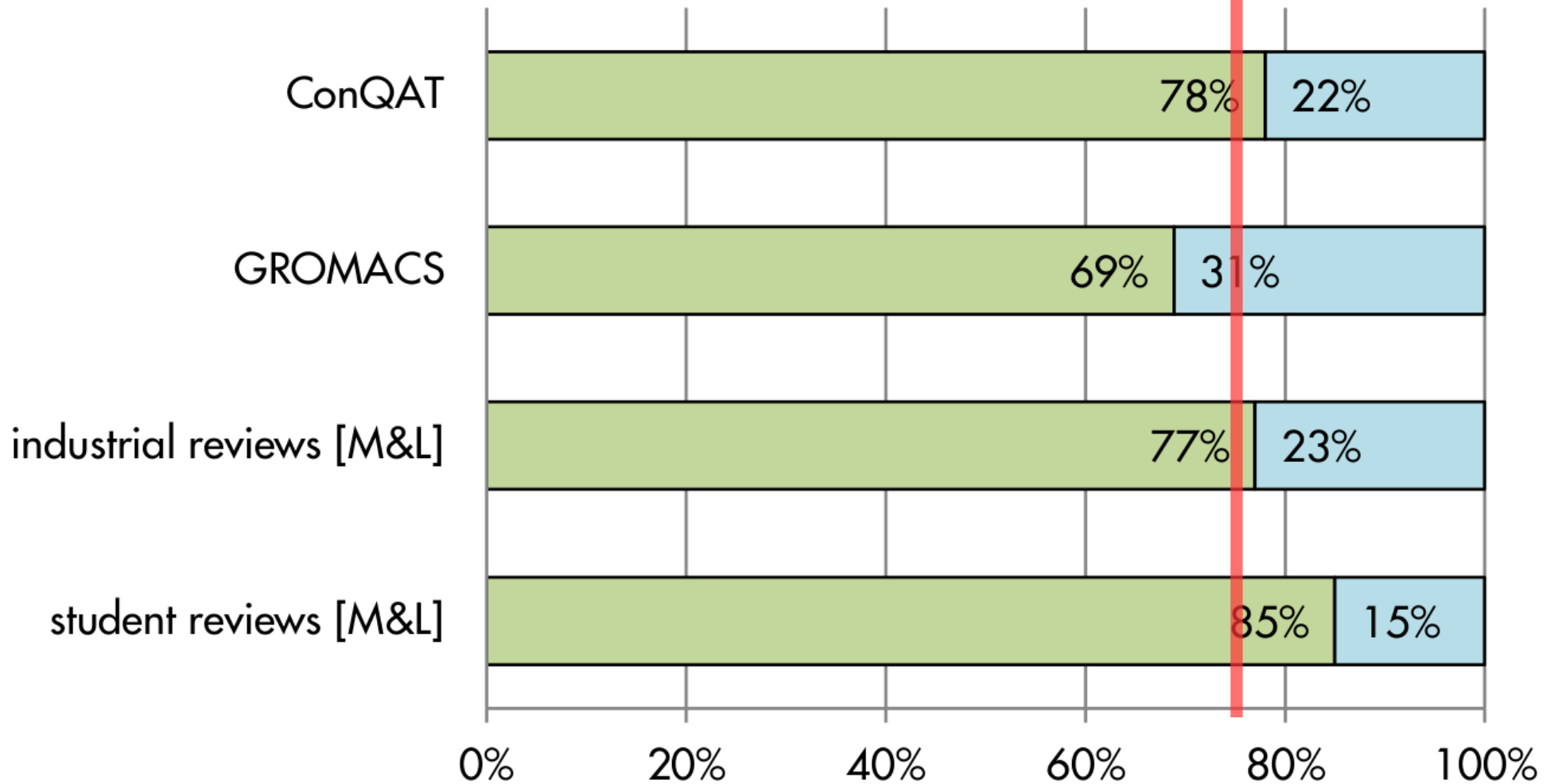


■ evolvability changes ■ functional changes



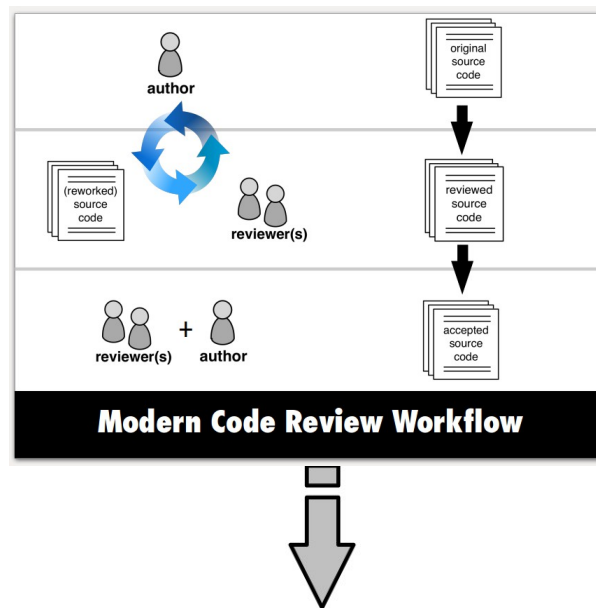
75 : 25

■ evolvability changes ■ functional changes

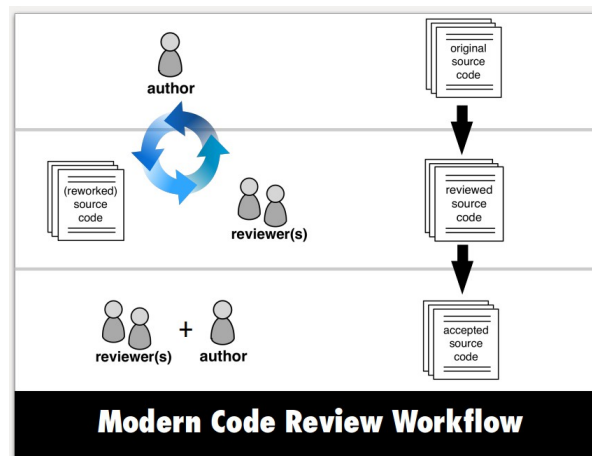


What Influences Code Review?

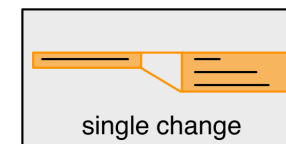
What Influences Code Review?



What Influences Code Review?



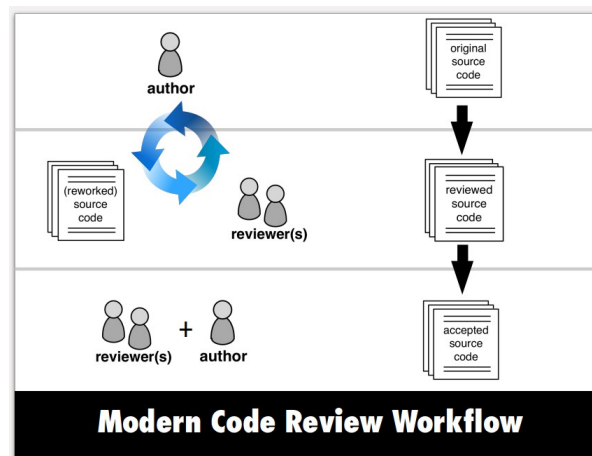
number of changes
in code under review



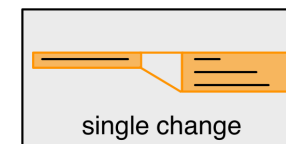
What Influences Code Review?

conQAT

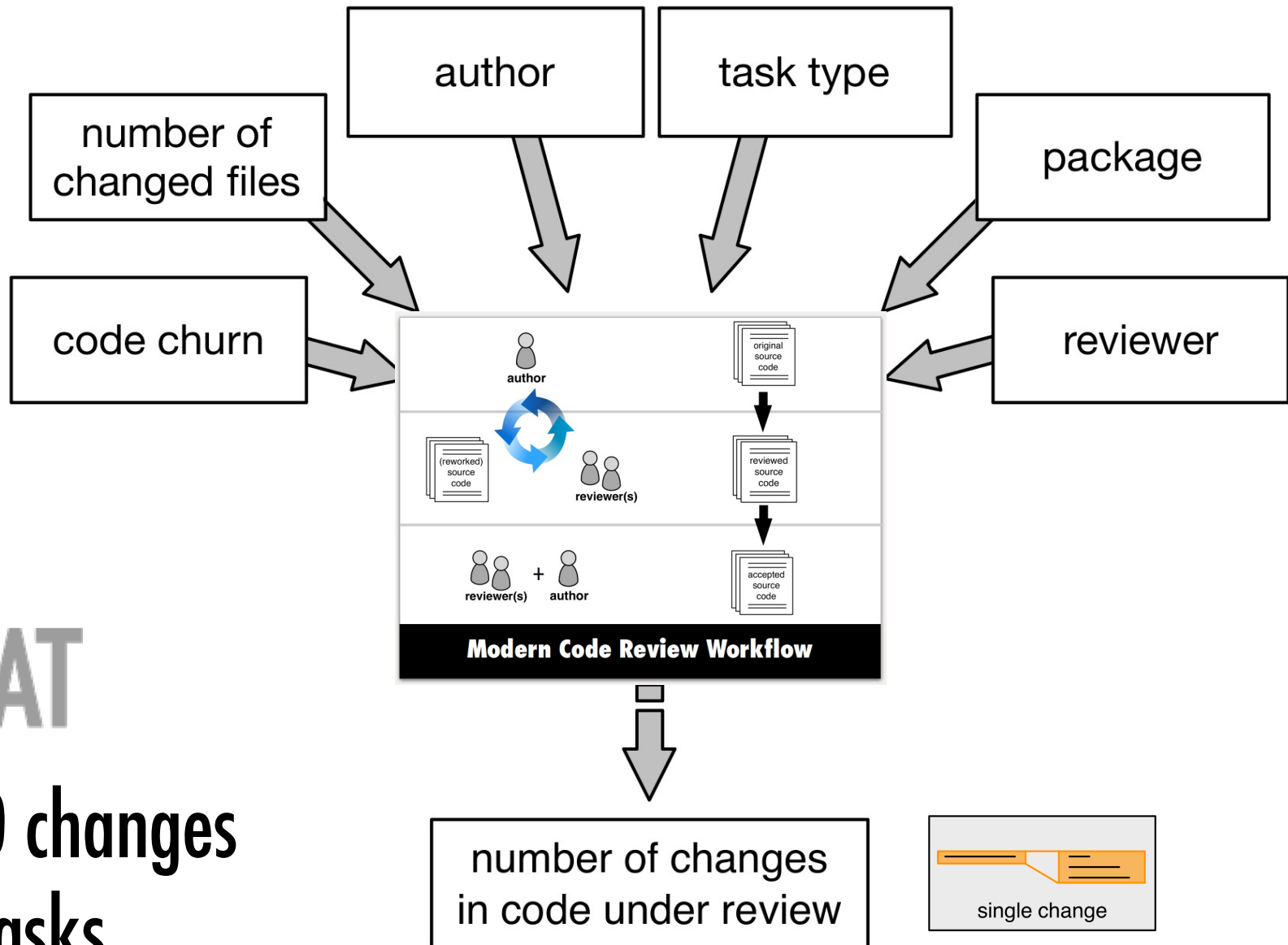
> 2,800 changes
> 970 tasks



number of changes
in code under review



What Influences Code Review?

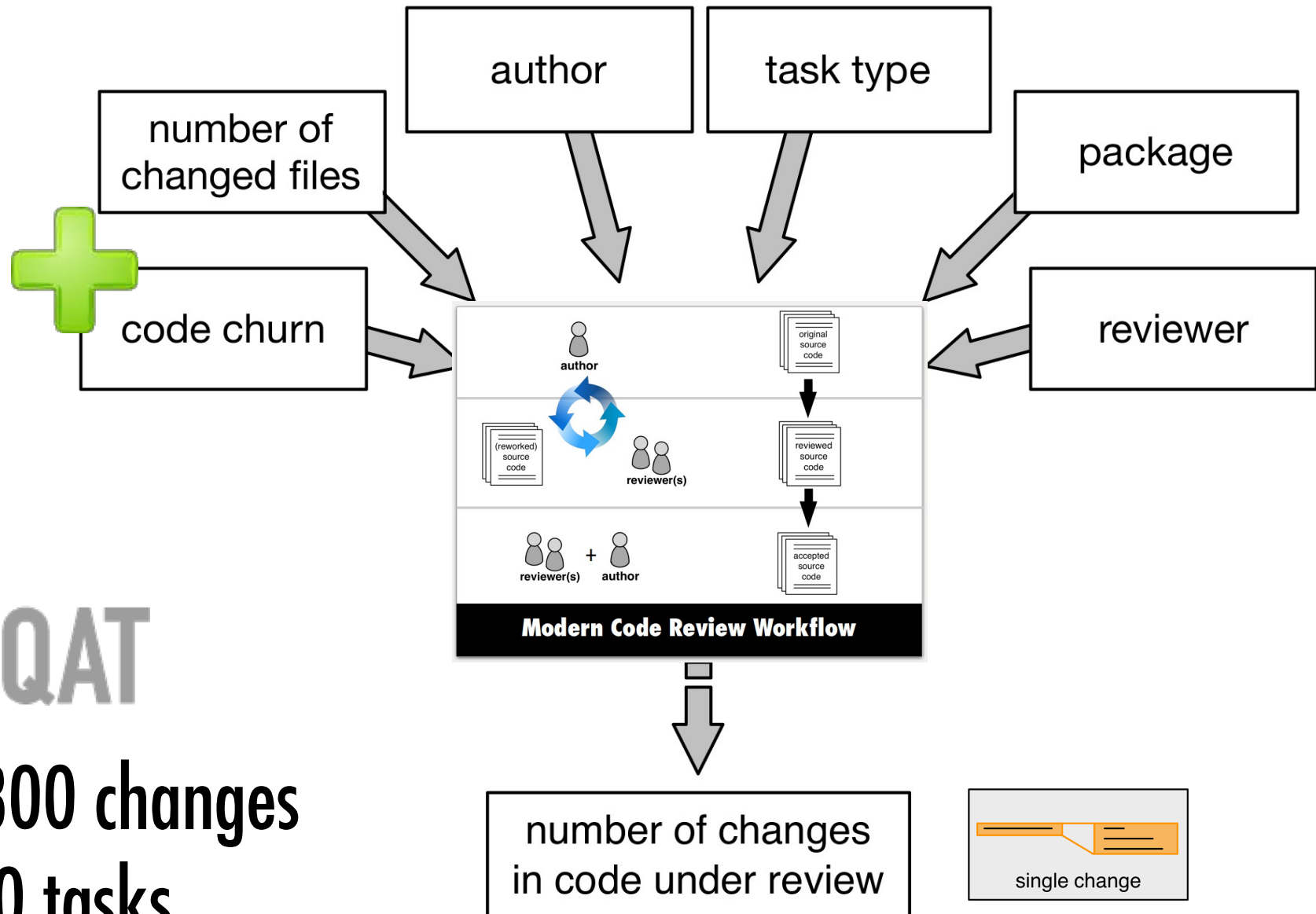


conQAT

> 2,800 changes

> 970 tasks

What Influences Code Review?

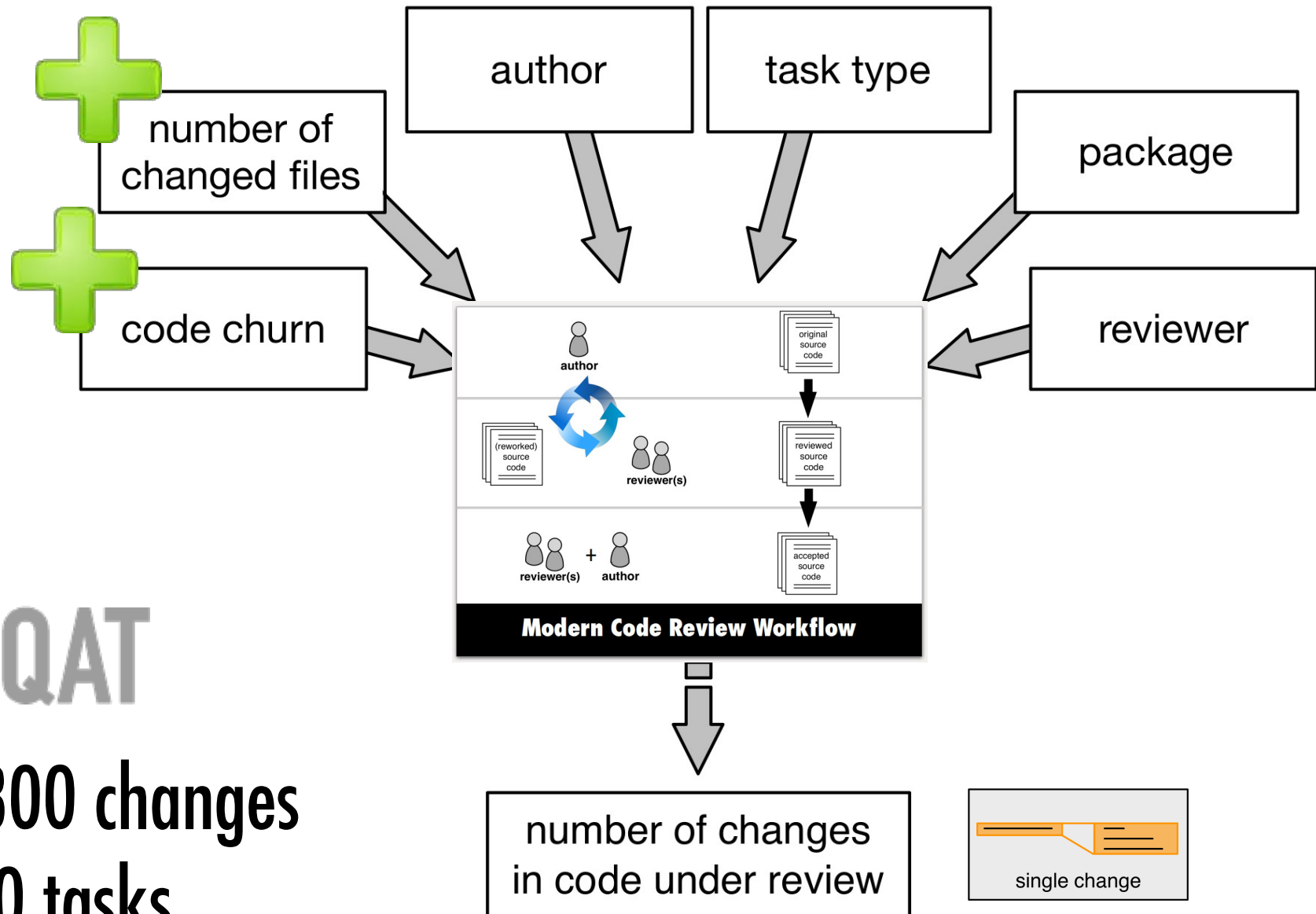


conQAT

> 2,800 changes

> 970 tasks

What Influences Code Review?

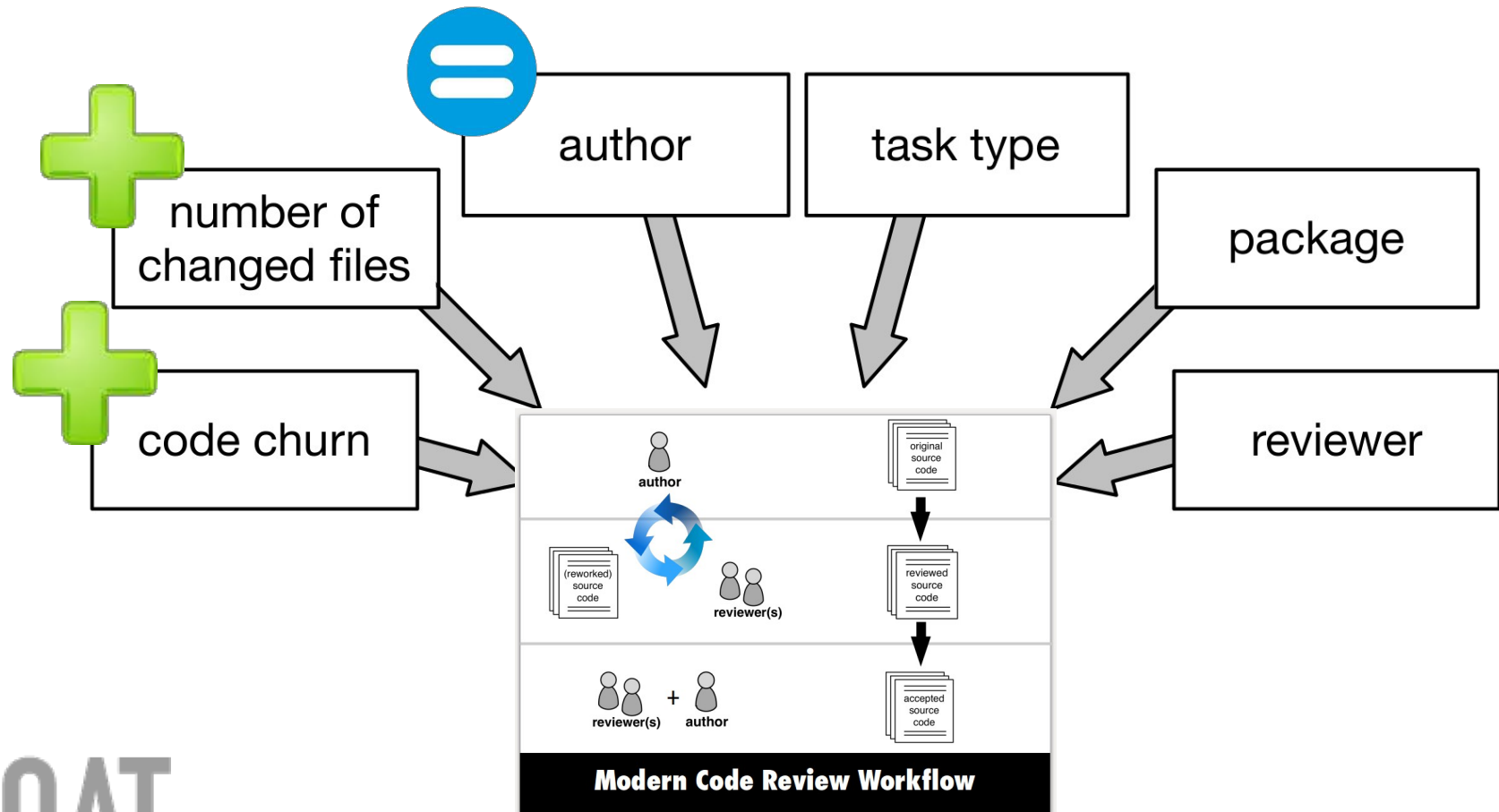


conQAT

> 2,800 changes

> 970 tasks

What Influences Code Review?

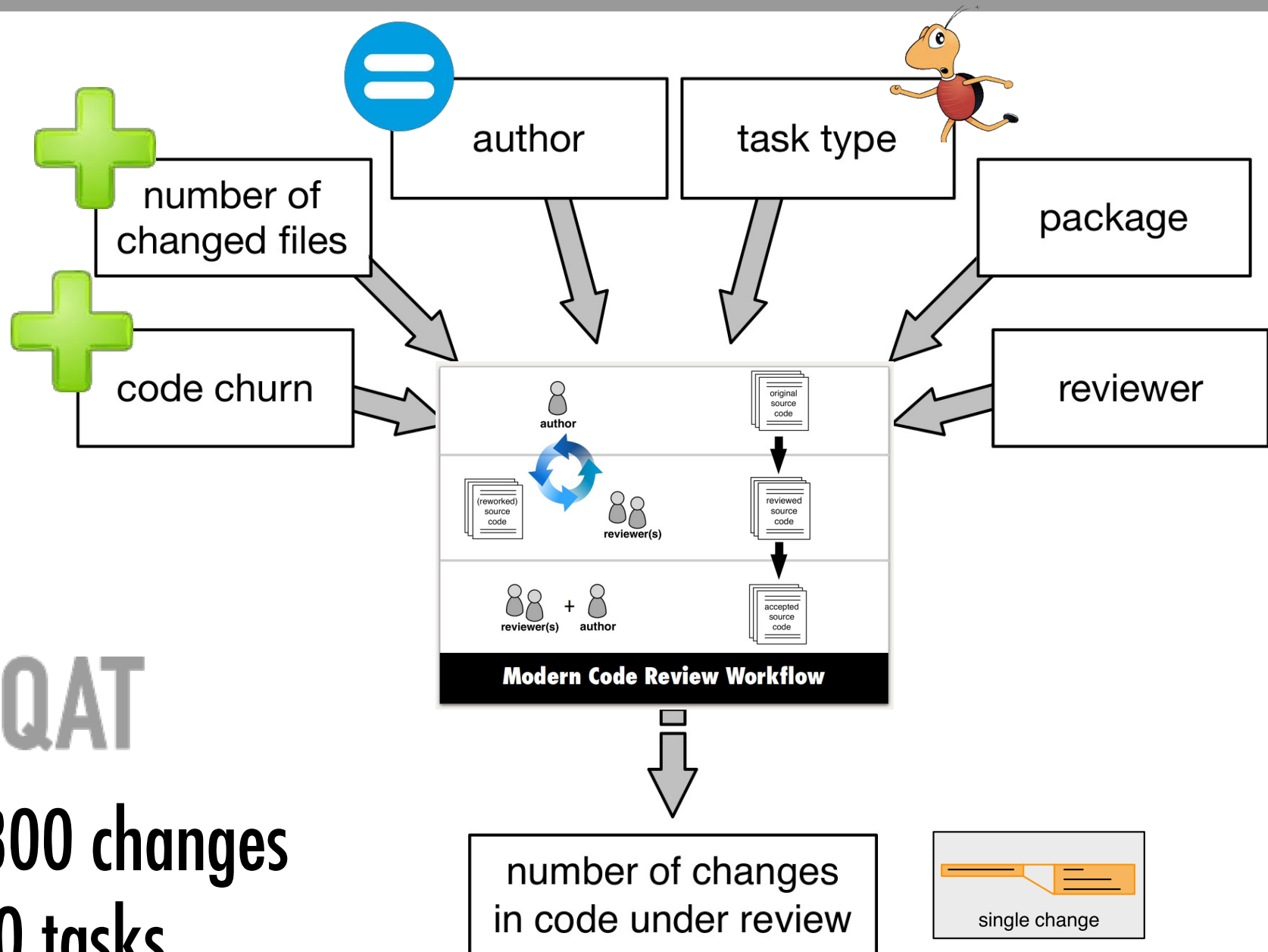


conQAT

> 2,800 changes

> 970 tasks

What Influences Code Review?

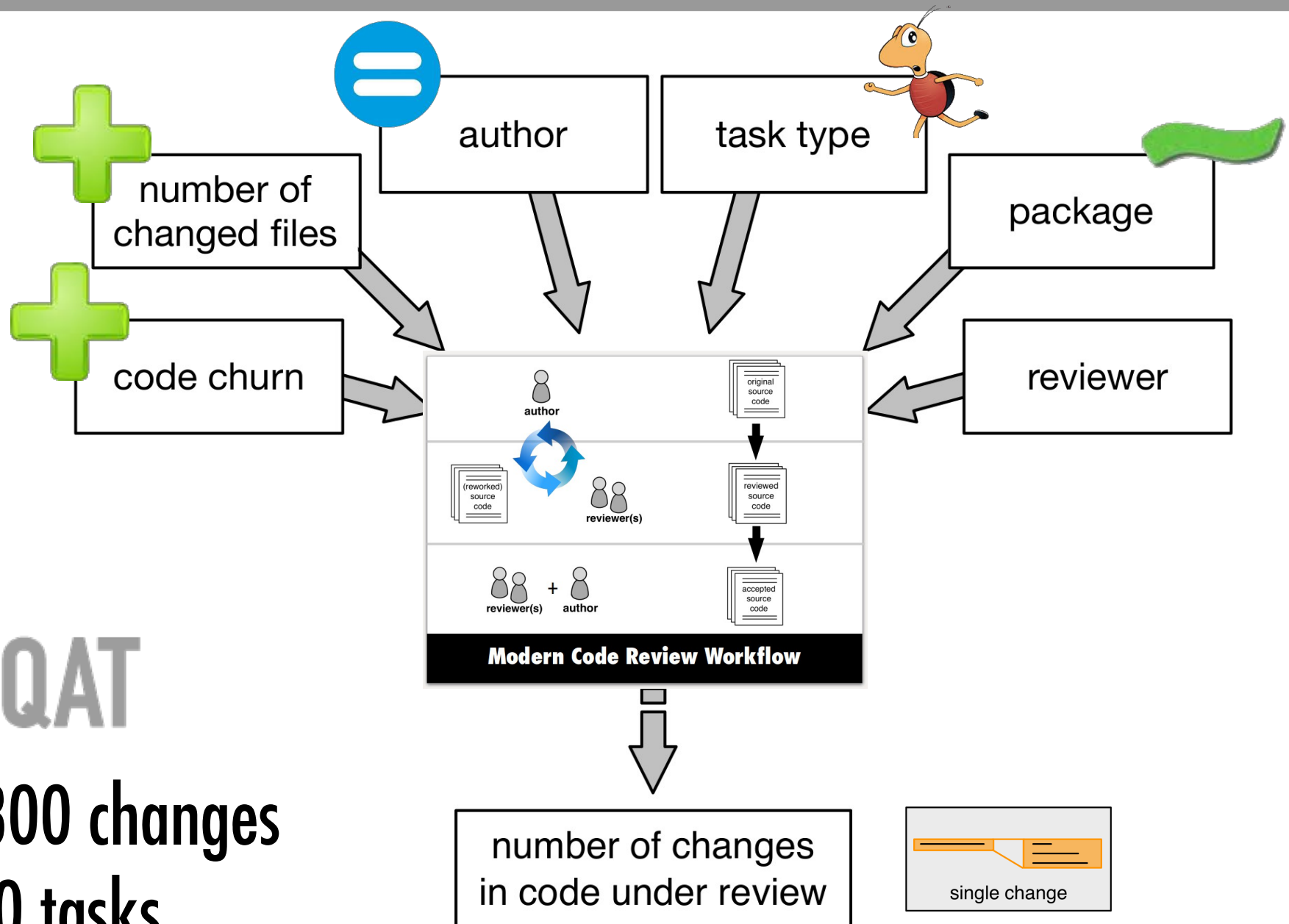


conQAT

> 2,800 changes

> 970 tasks

What Influences Code Review?

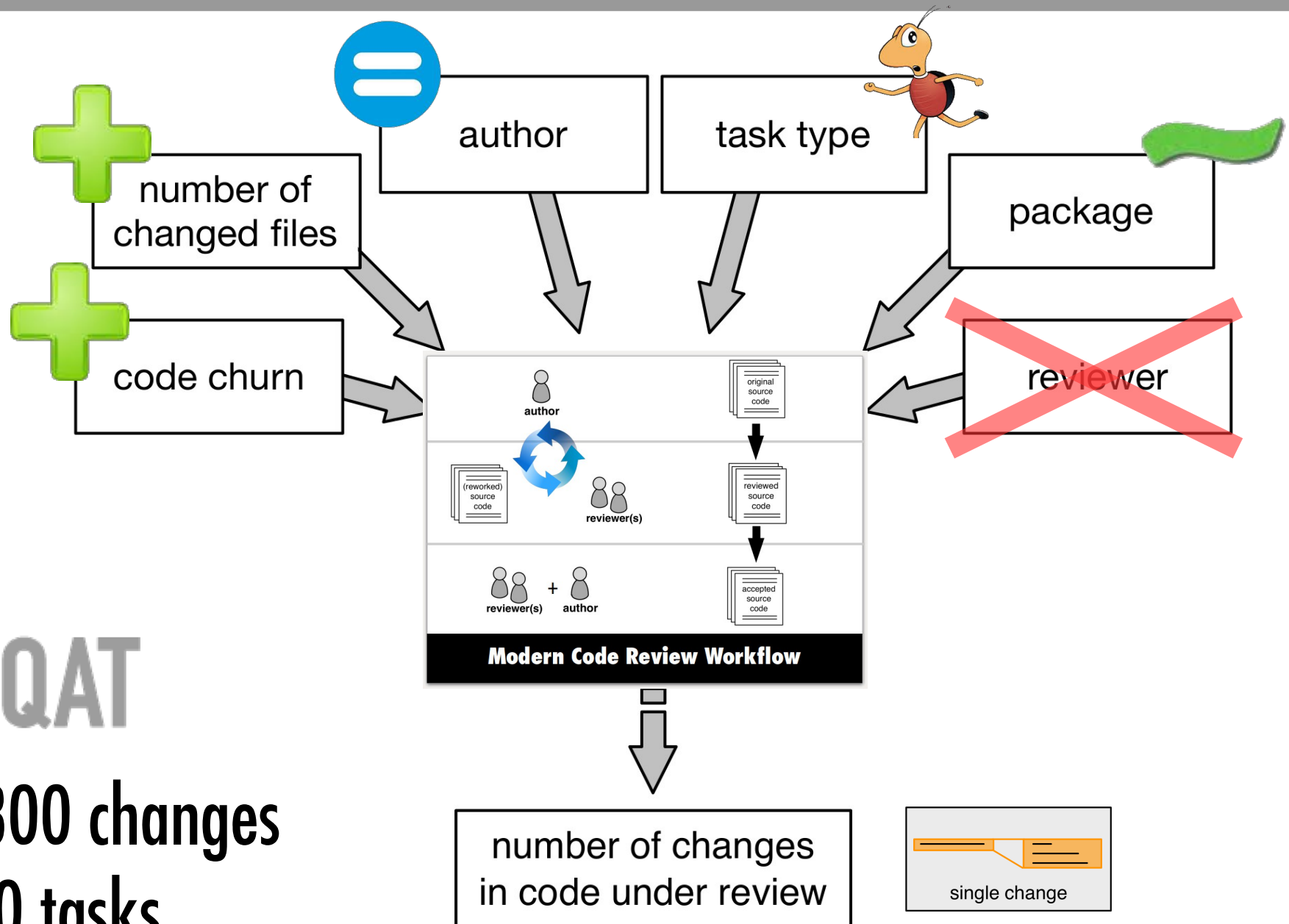


conQAT

> 2,800 changes

> 970 tasks

What Influences Code Review?



conQAT

> 2,800 changes

> 970 tasks

Modern Code Reviews in Open-Source Projects: Which Problems Do They Fix?



@Inventitech

Moritz Beller, TU Delft

Modern Code Reviews in Open-Source Projects: Which Problems Do They Fix?

Does it matter?

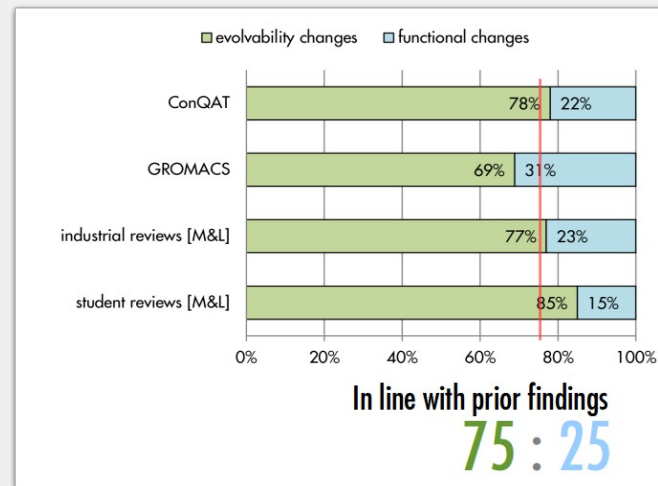


@Inventitech

Moritz Beller, TU Delft

Modern Code Reviews in Open-Source Projects: Which Problems Do They Fix?

Does it matter?



@Inventitech

Moritz Beller, TU Delft

Modern Code Reviews in Open-Source Projects: Which Problems Do They Fix?

Does it matter?

