

An Empirical Study of Delays In The Integration of Addressed Issues

Daniel A. Costa



Surafel L. Abebe



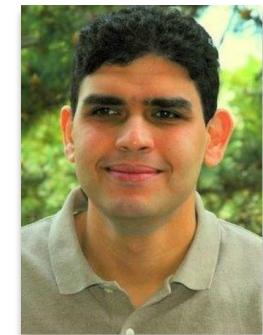
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The term *issue* can refer to a *bug fix*, a *new feature* or an *enhancement*



Bug fix

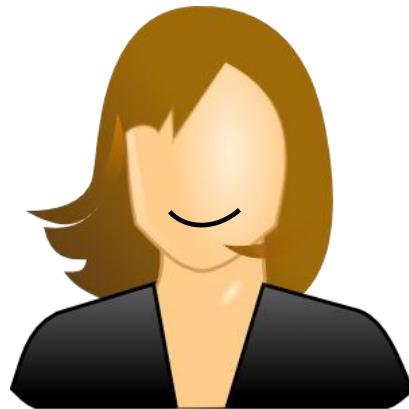


Enhancement

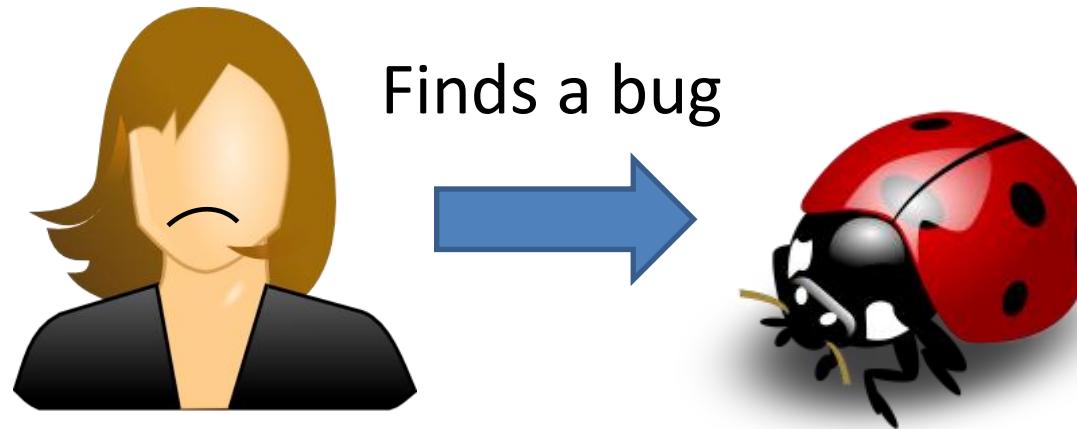


New feature

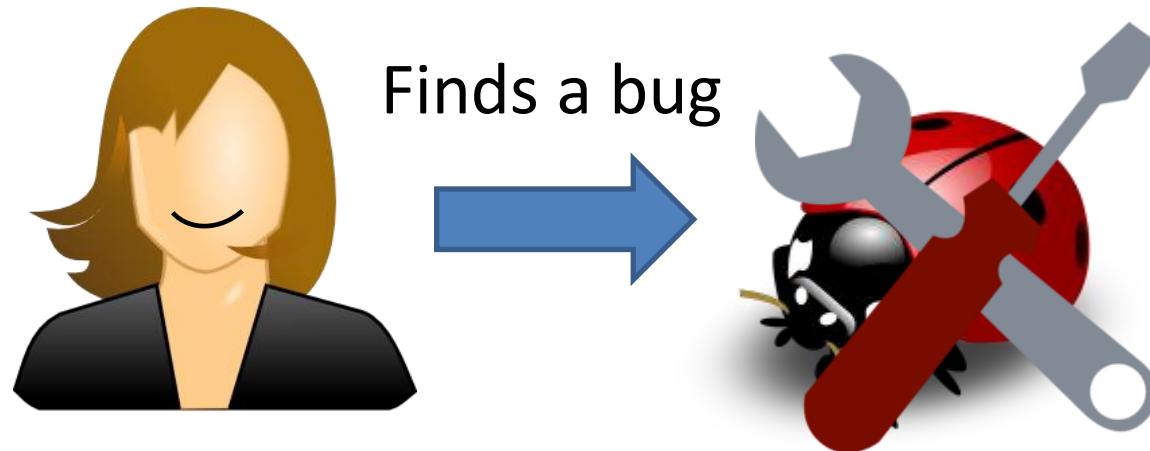
We may think that to address an issue
is enough to satisfy an user



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**Previous research has focused on the
time to fix a bug**



Opened

Previous research has focused on the time to fix a bug



Opened



Resolved-Fixed

Previous research has focused on the time to fix a bug



Opened



Resolved-Fixed

How much time?

Techniques and approaches were invented

Techniques and approaches were invented

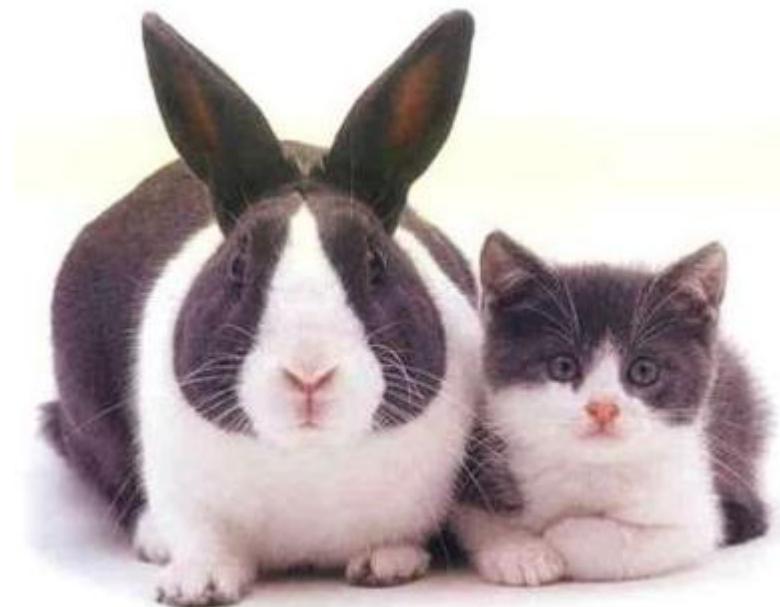


Prediction Models

Techniques and approaches were invented



Prediction Models



Bug Repots Similarty

But an addressed issue may take some time to be integrated into a release



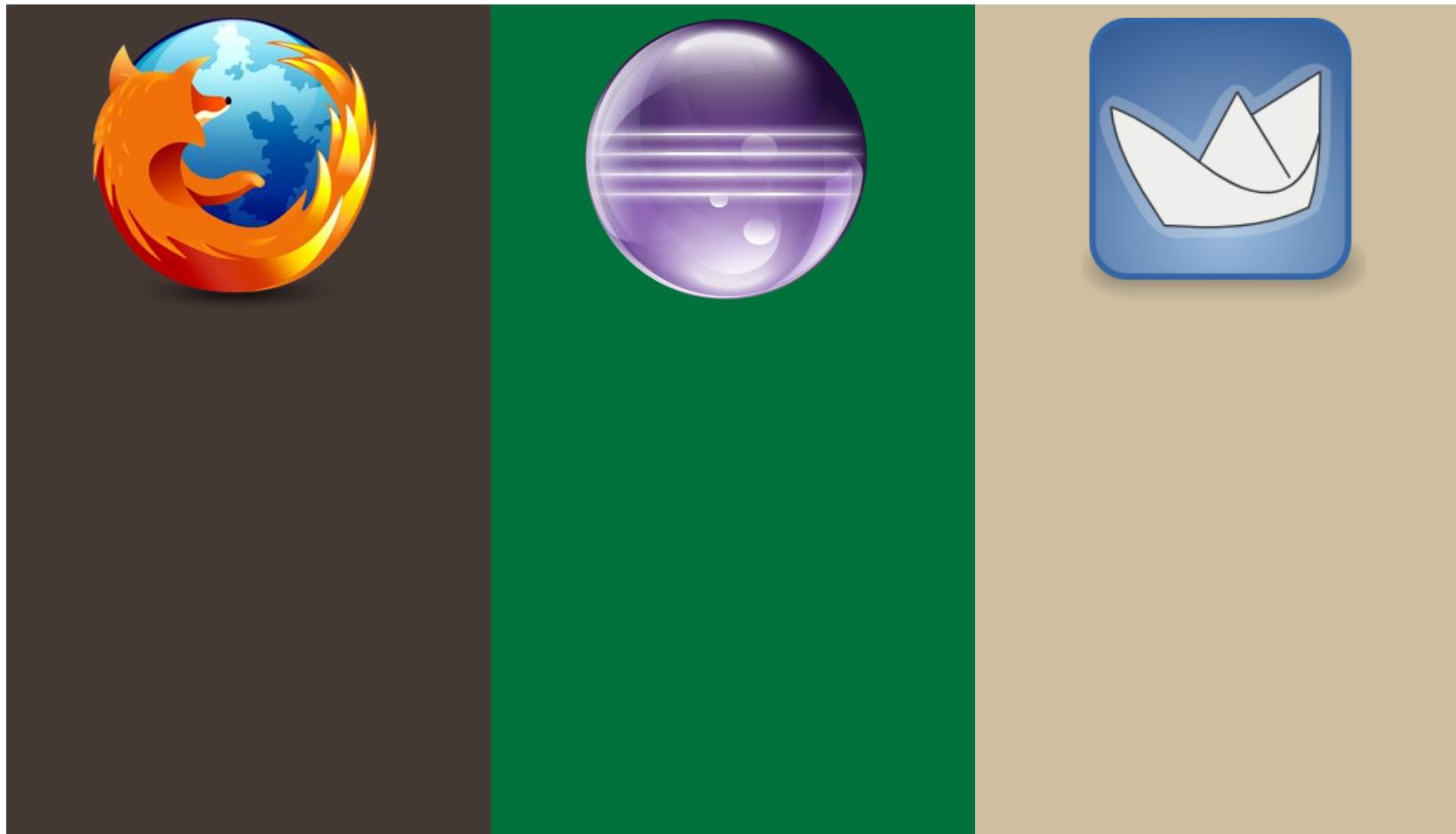
But an addressed issue may take some time to be integrated into a release



So when does this stuff get added? Will it be applied to the next FF23 beta? A 22.01 release? Otherwise?



An empirical study to analyze the integration delay



An empirical study to analyze the integration delay



14,530 issues
15 releases



3,344 issues
(JDT)
11 releases



3,121 issues
17 releases

An empirical study to analyze the integration delay



14,530 issues
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3,121 issues
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20,995 issues

An empirical study to analyze the integration delay



14,530 issues
15 releases

Rapid



3,344 issues
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11 releases

Traditional



3,121 issues
17 releases

Traditional

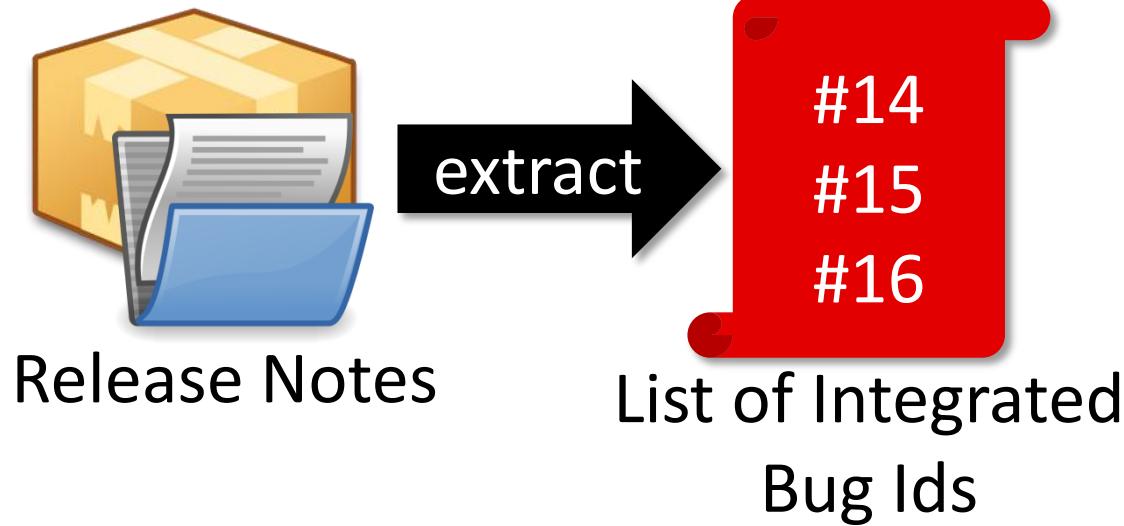
20,995 issues

We collected data from release notes
and issue tracking systems

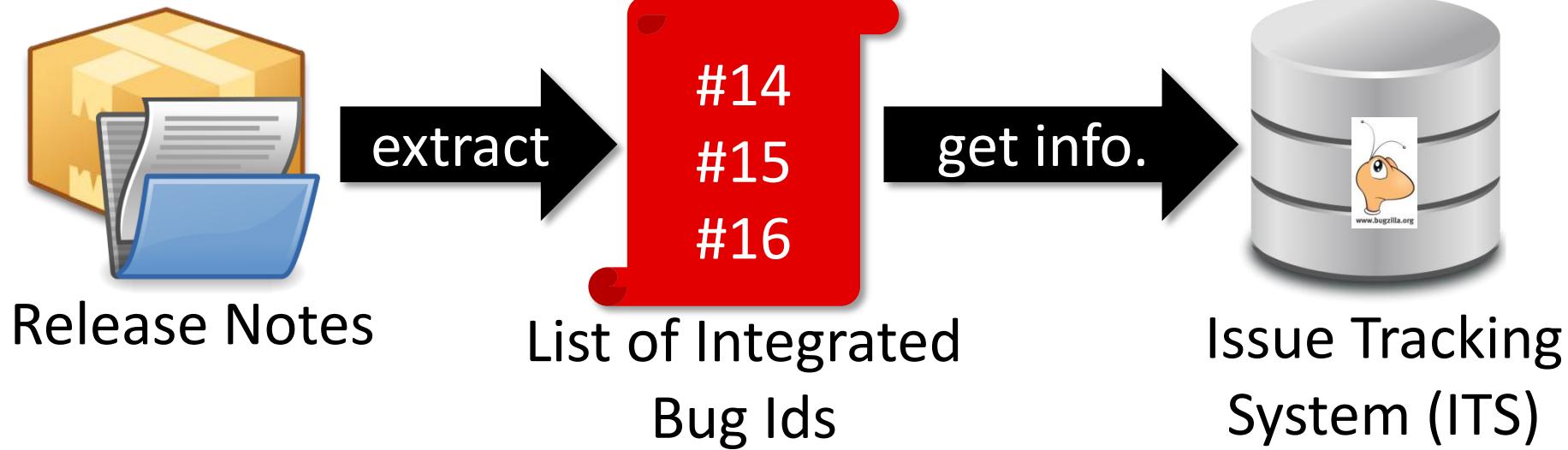


Release Notes

We collected data from release notes and issue tracking systems

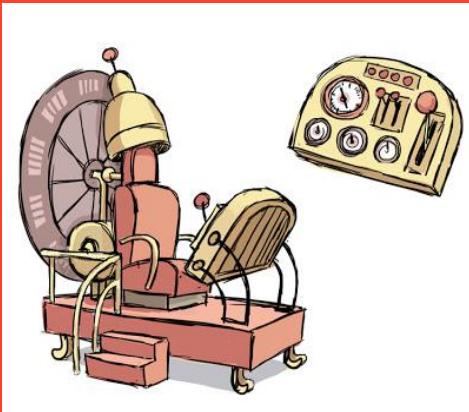


We collected data from release notes and issue tracking systems





Integration
delay



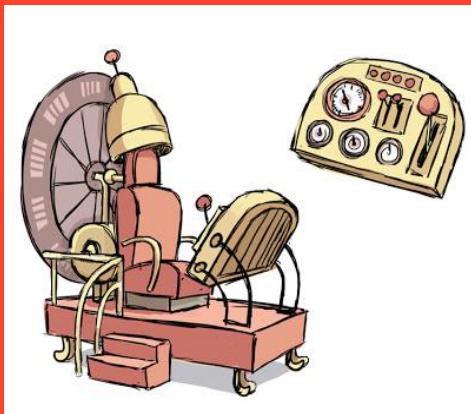
Prediction
models



Influential
variables



Integration
delay



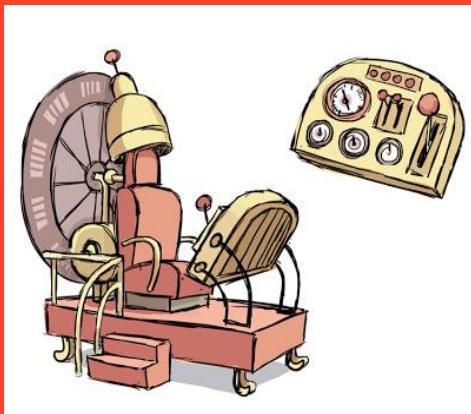
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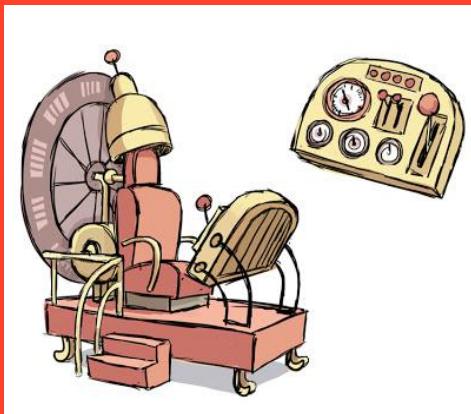
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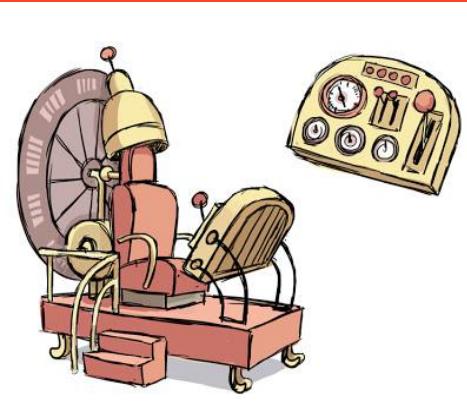
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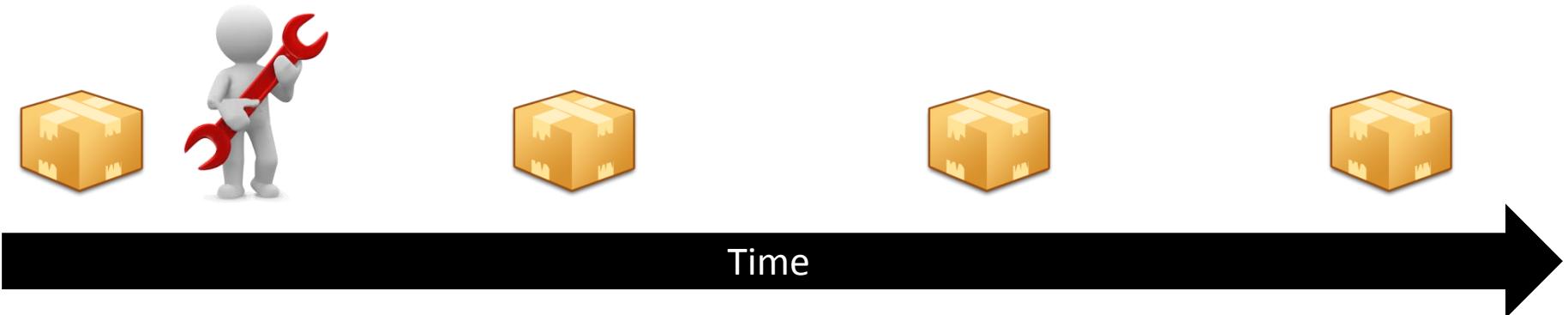


Influential
variables

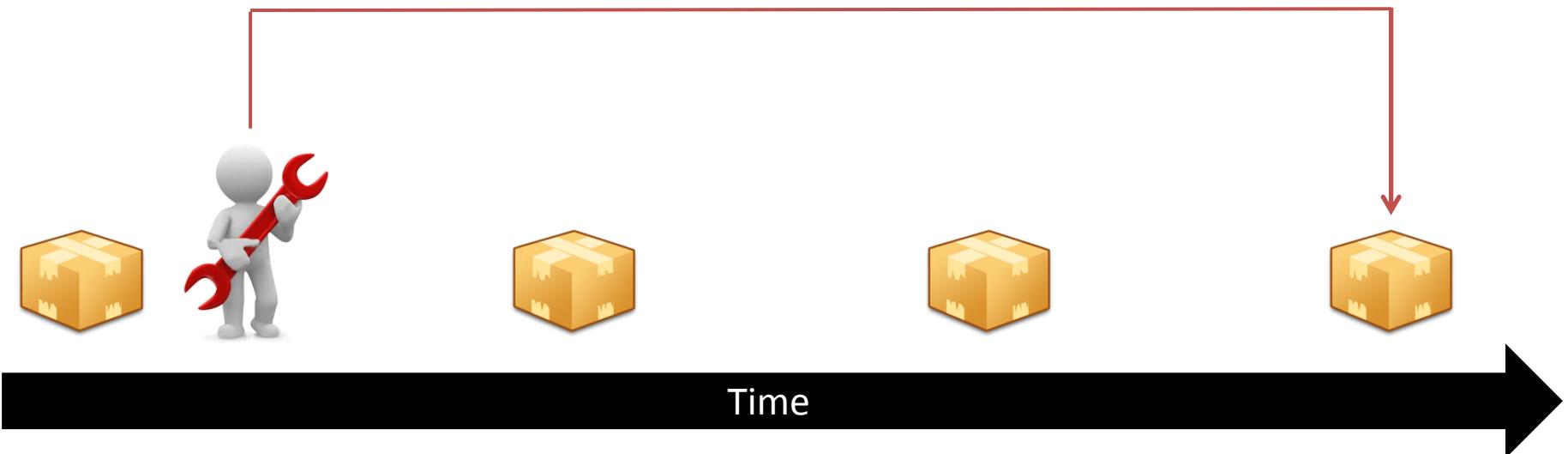
Measuring integration delay



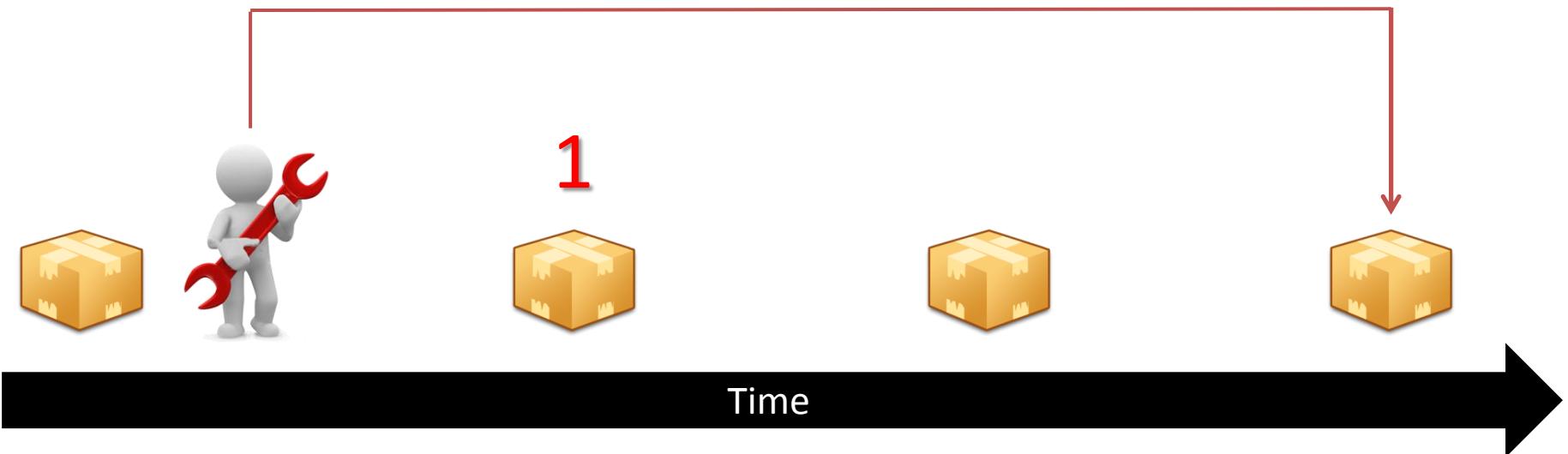
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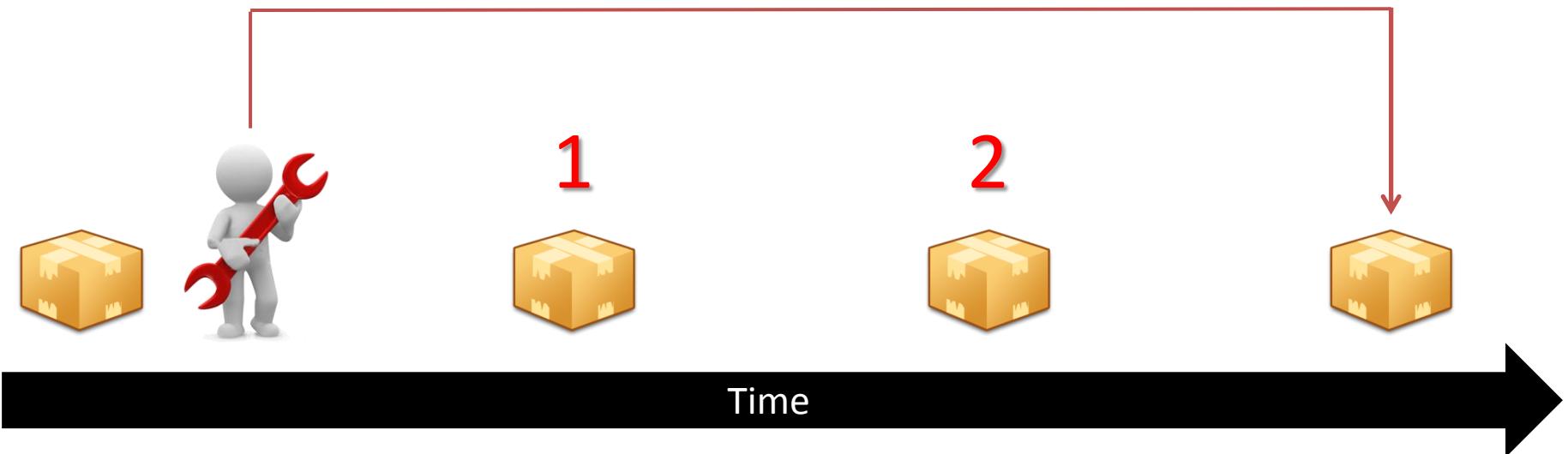
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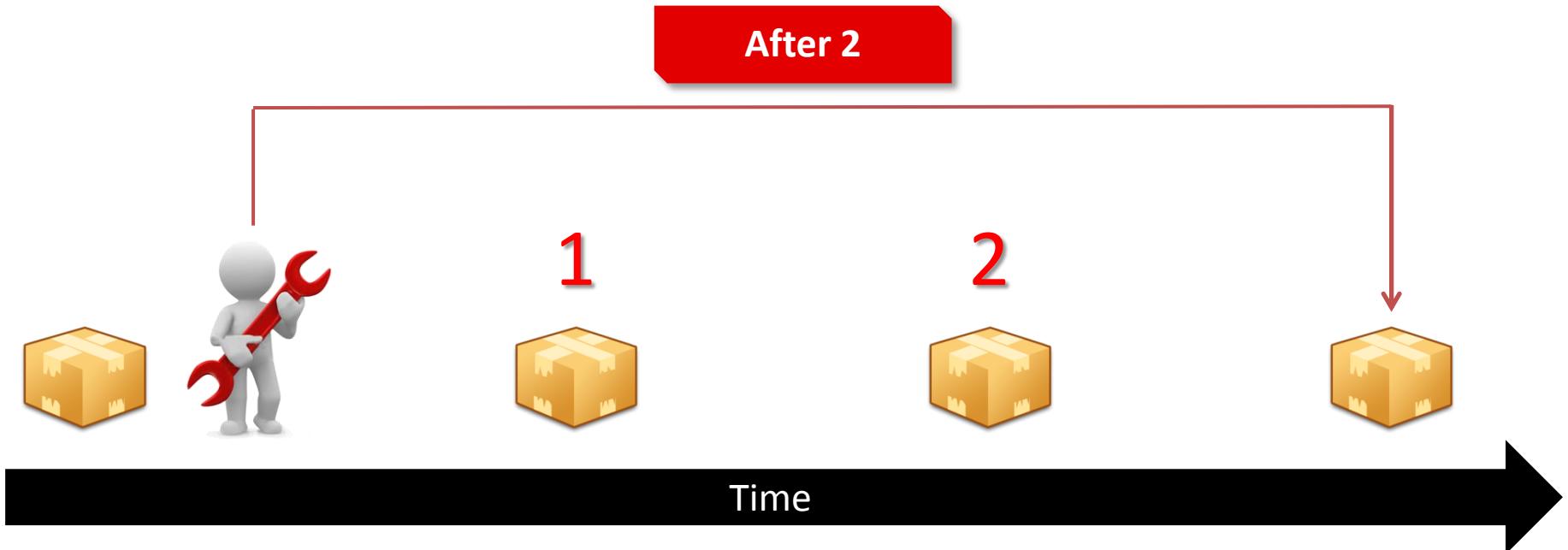
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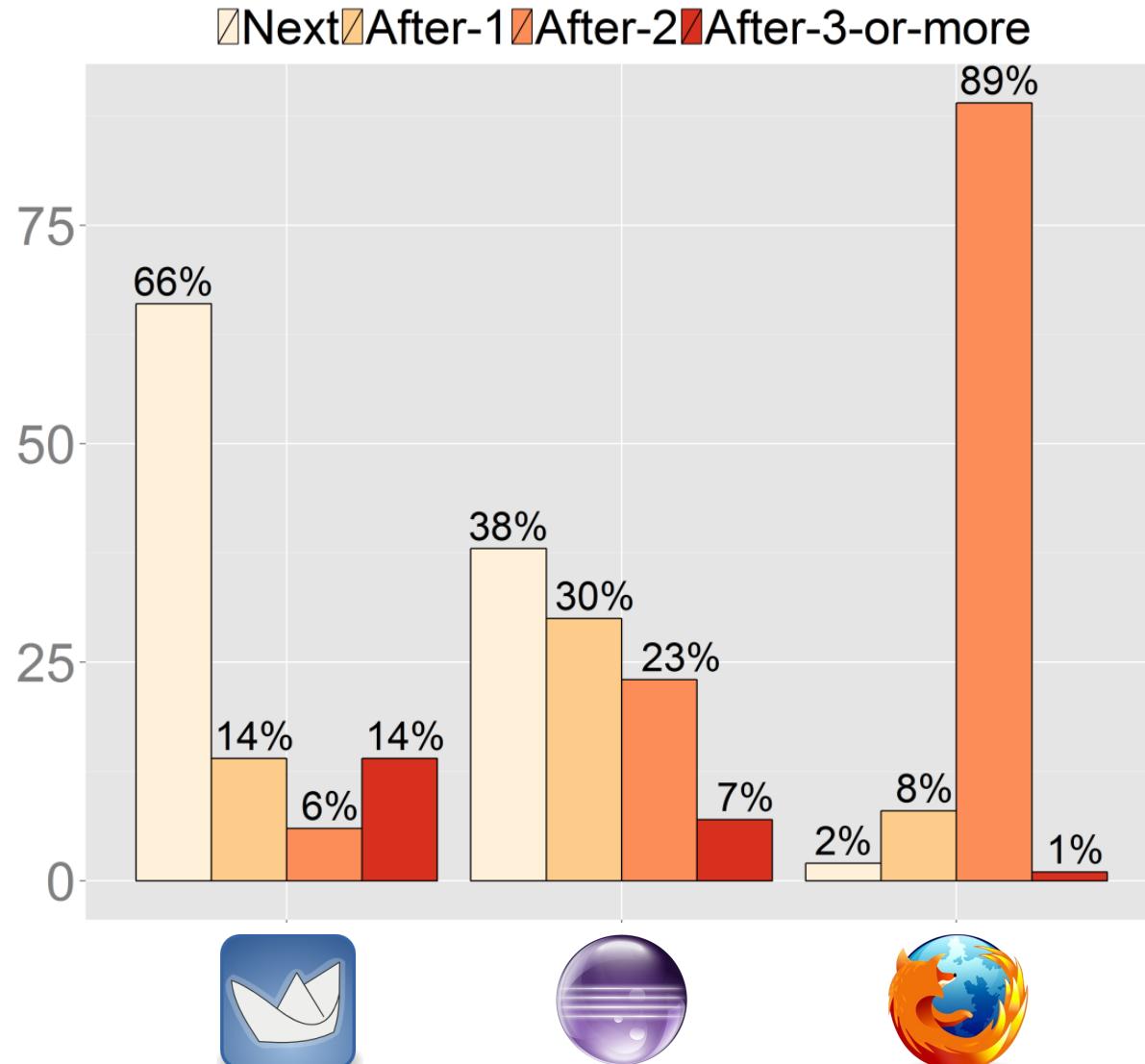
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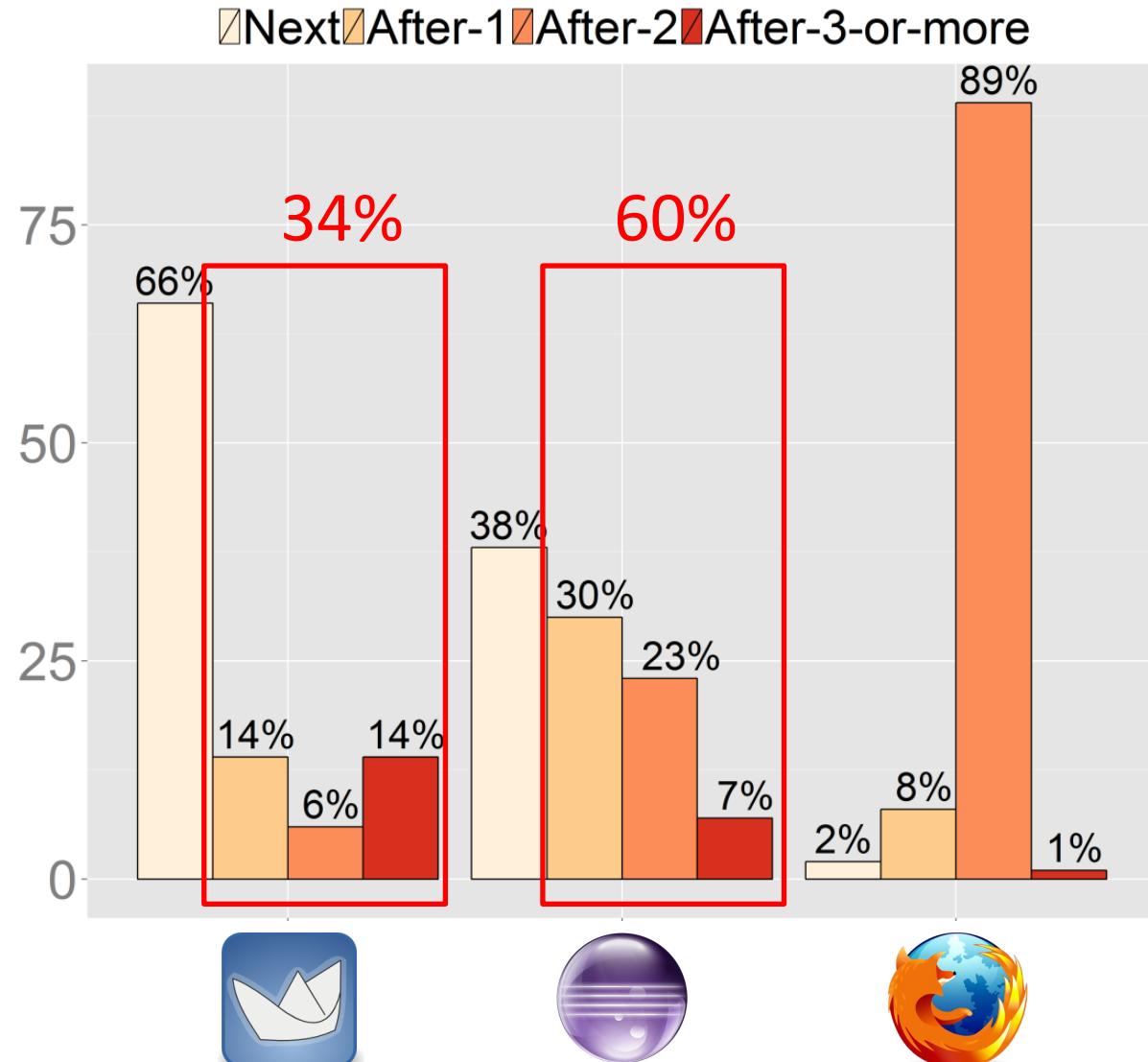
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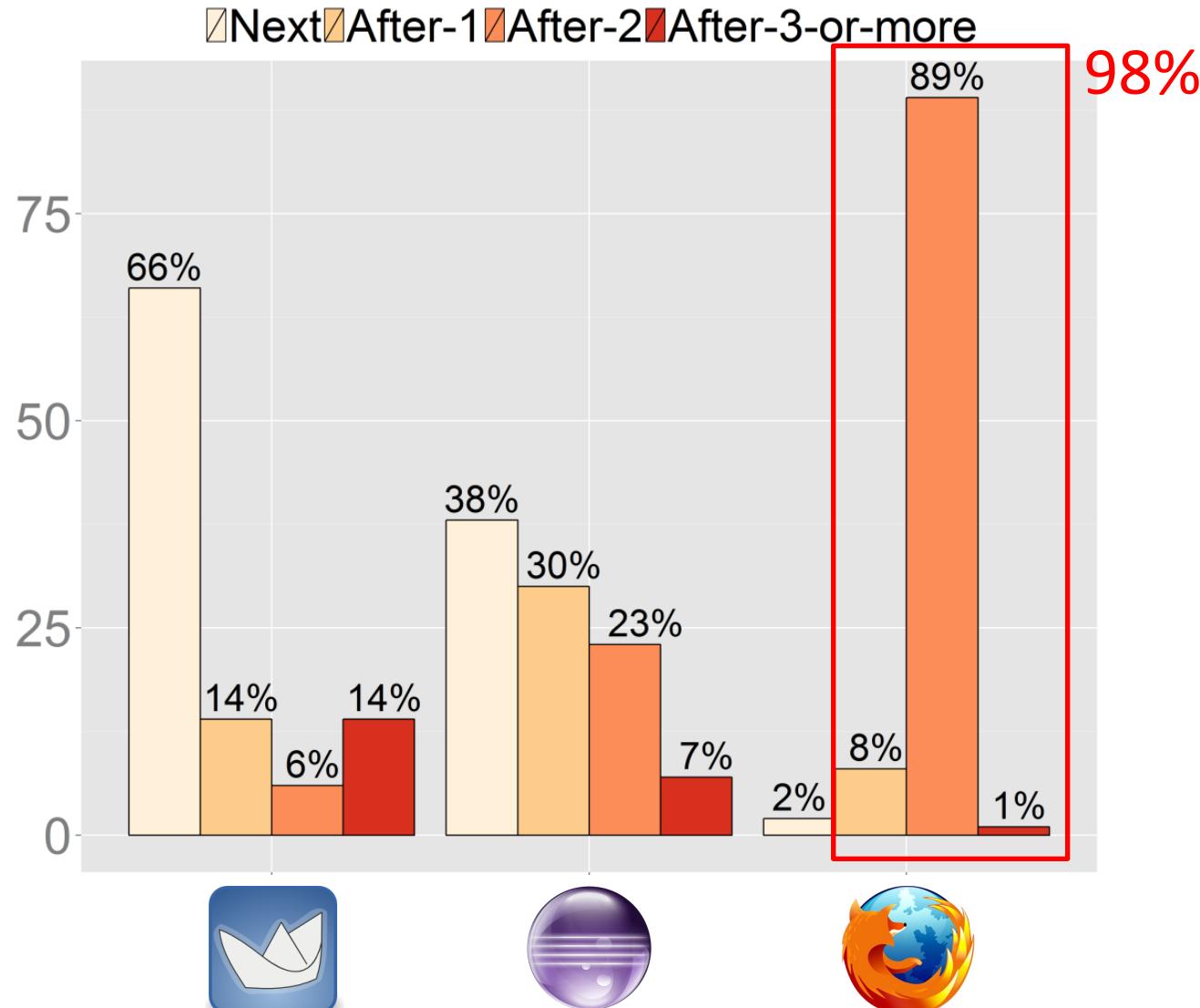
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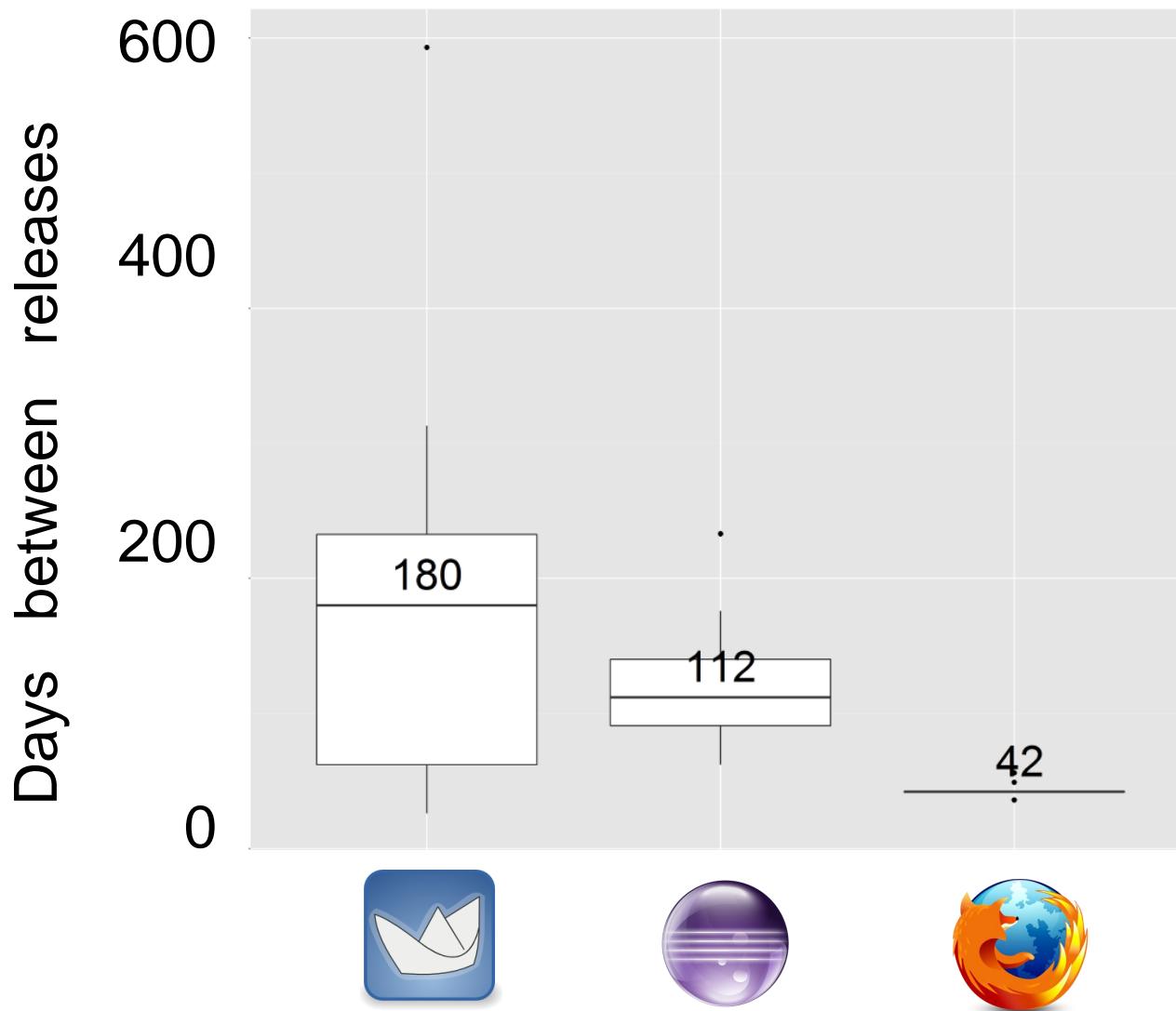
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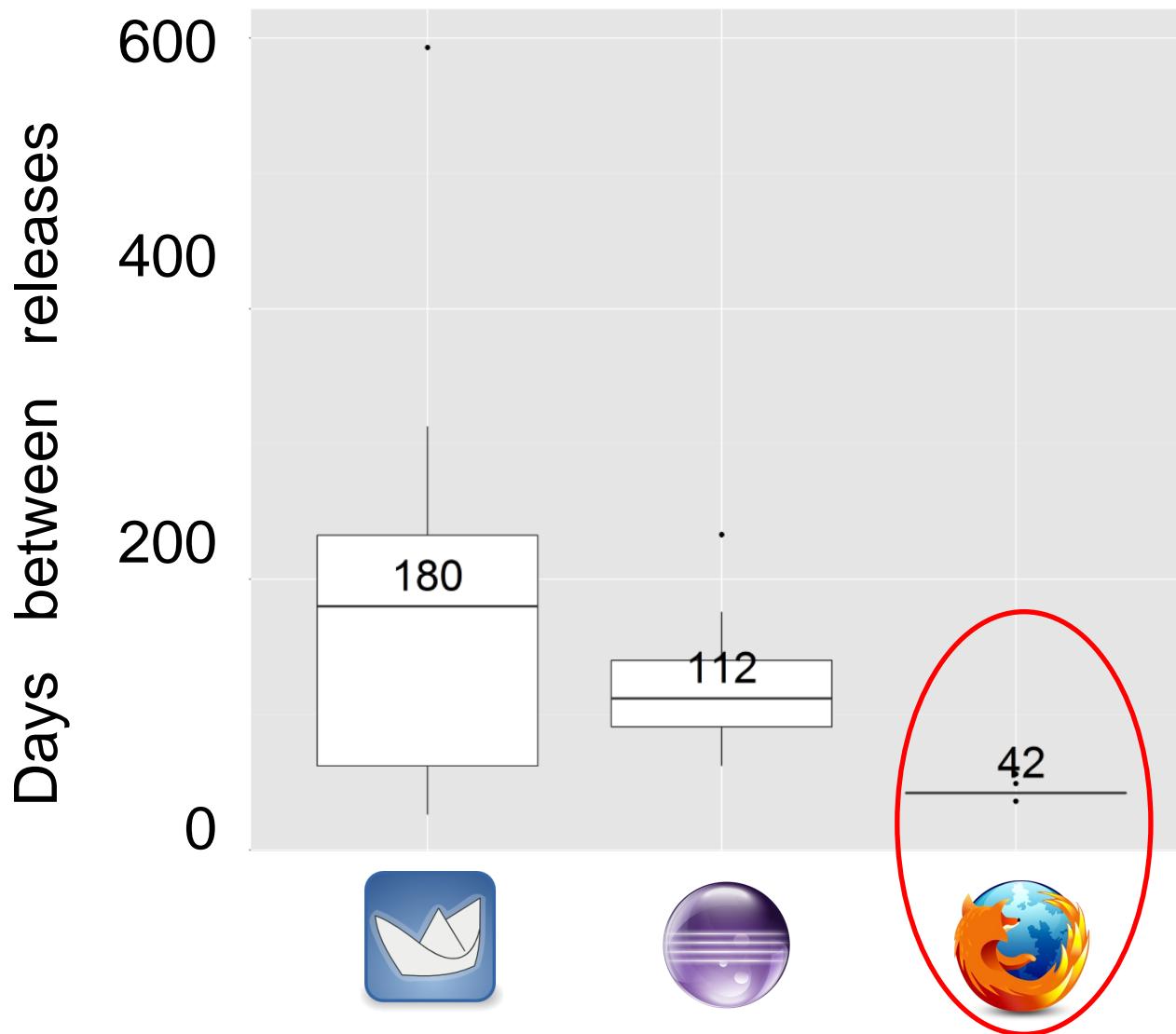
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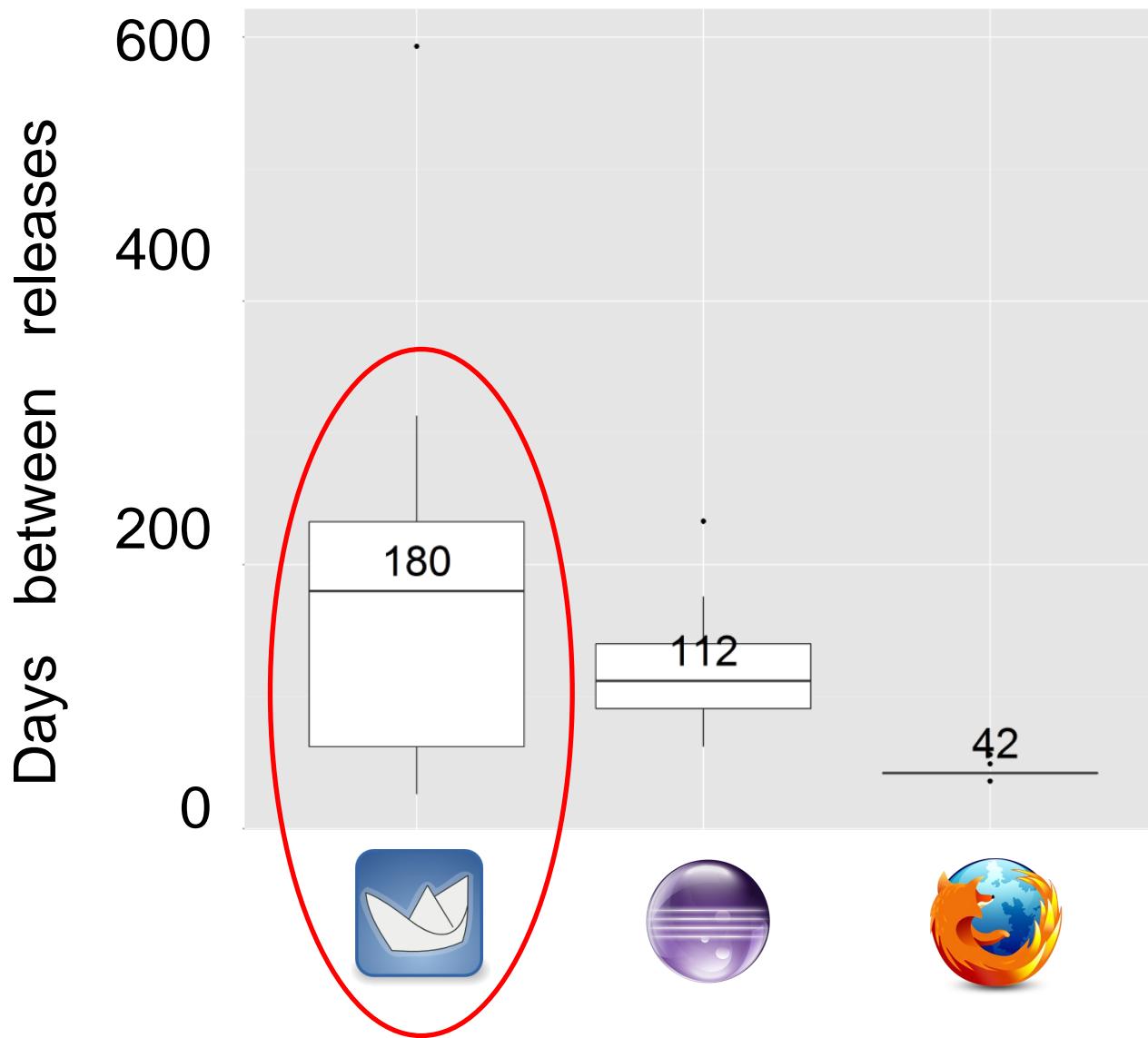
Measuring the release frequency



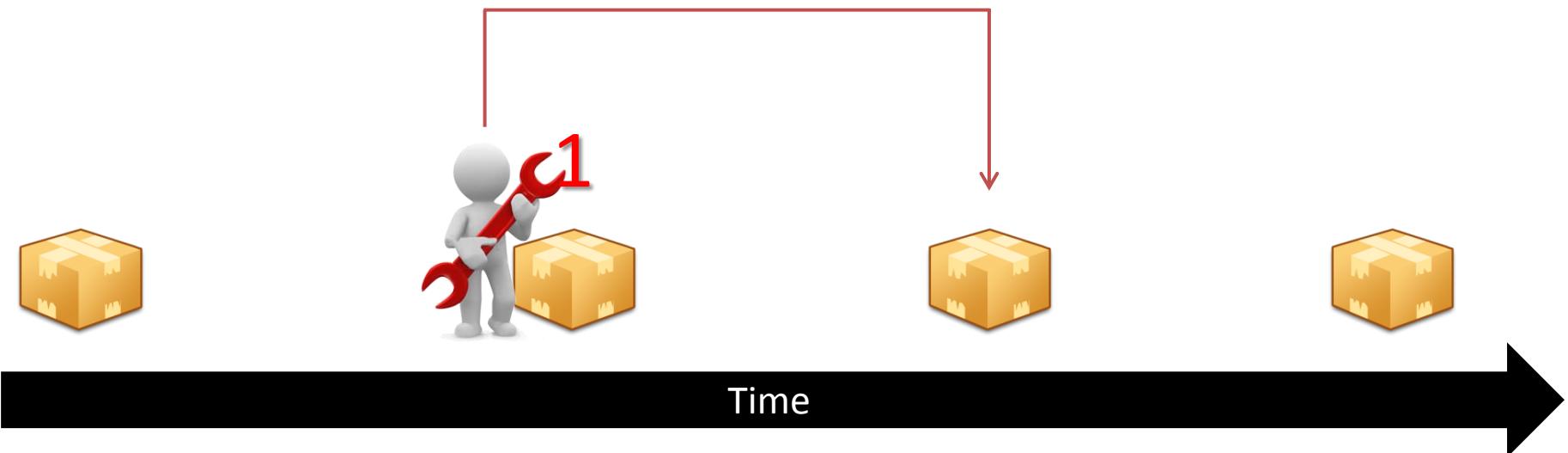
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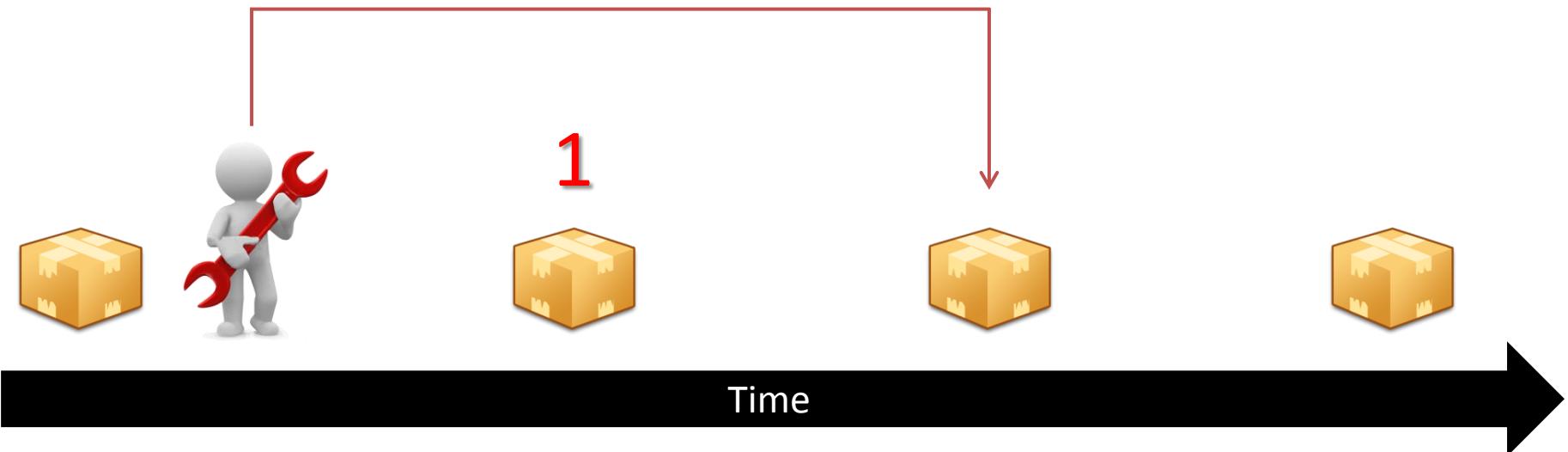
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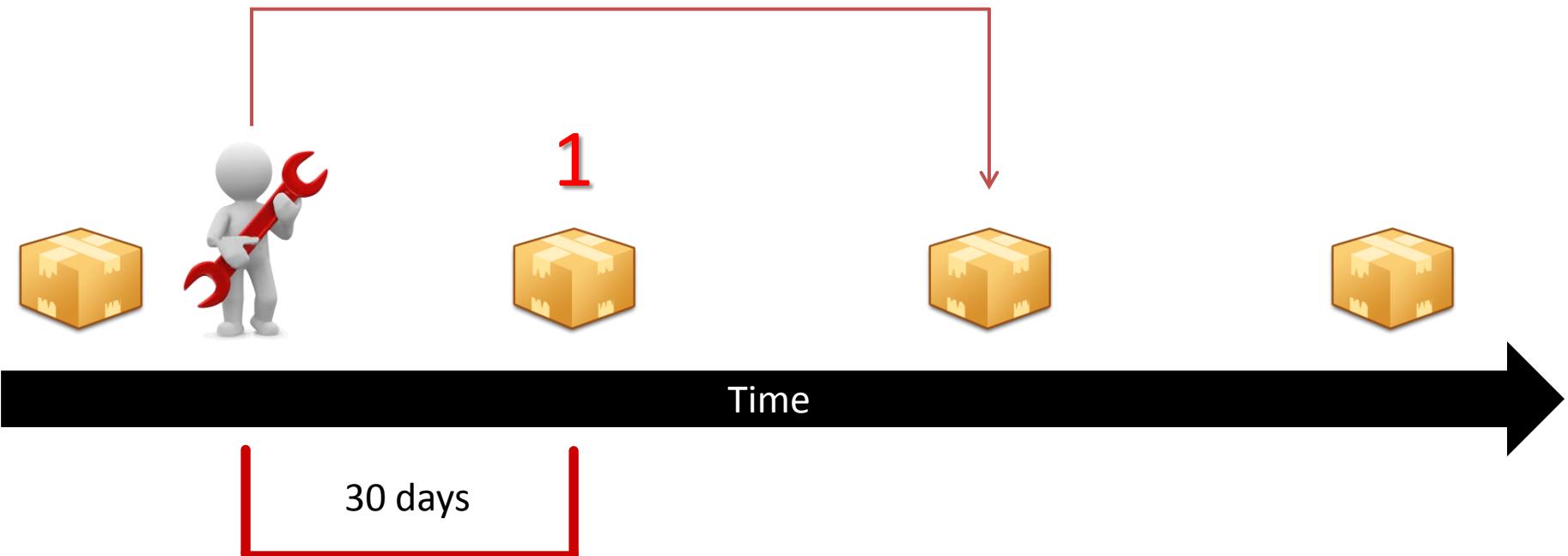
How long an issue was addressed before a release?



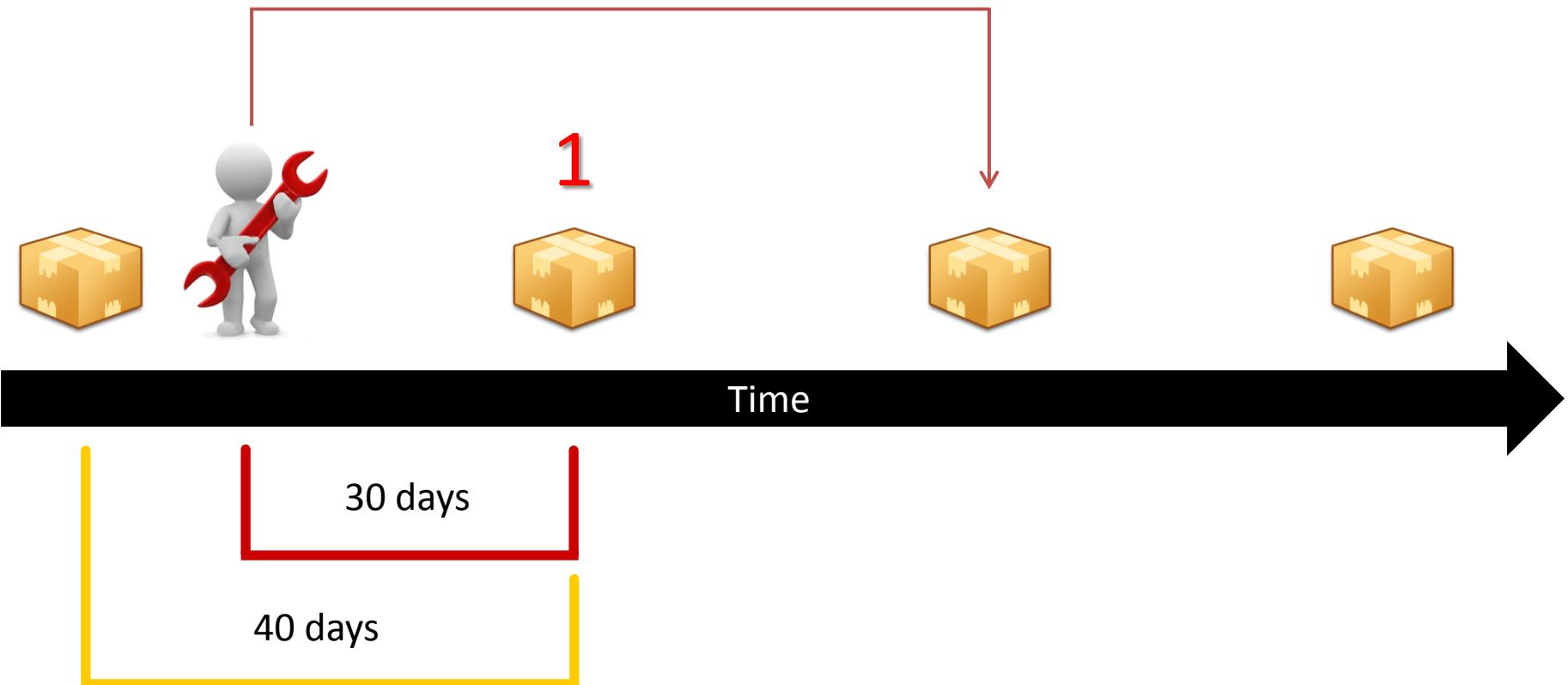
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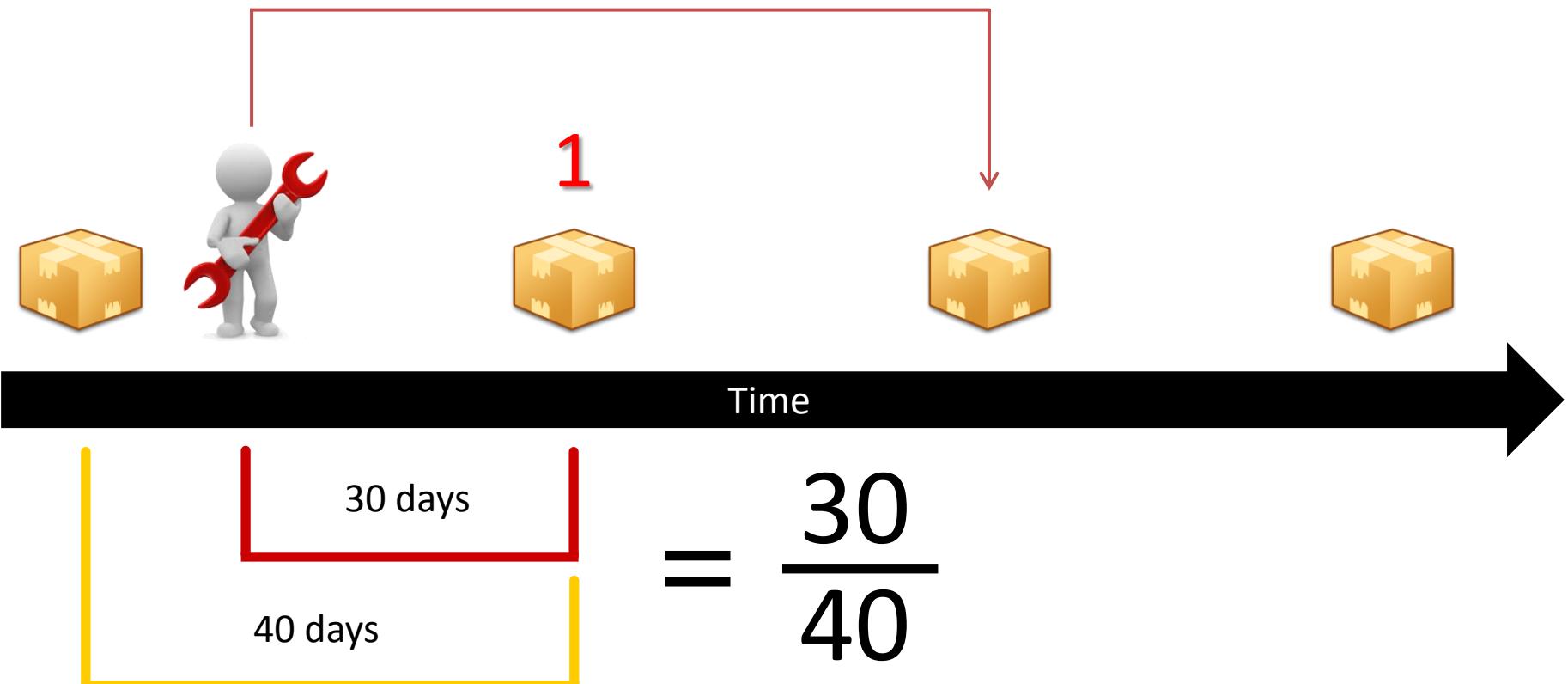
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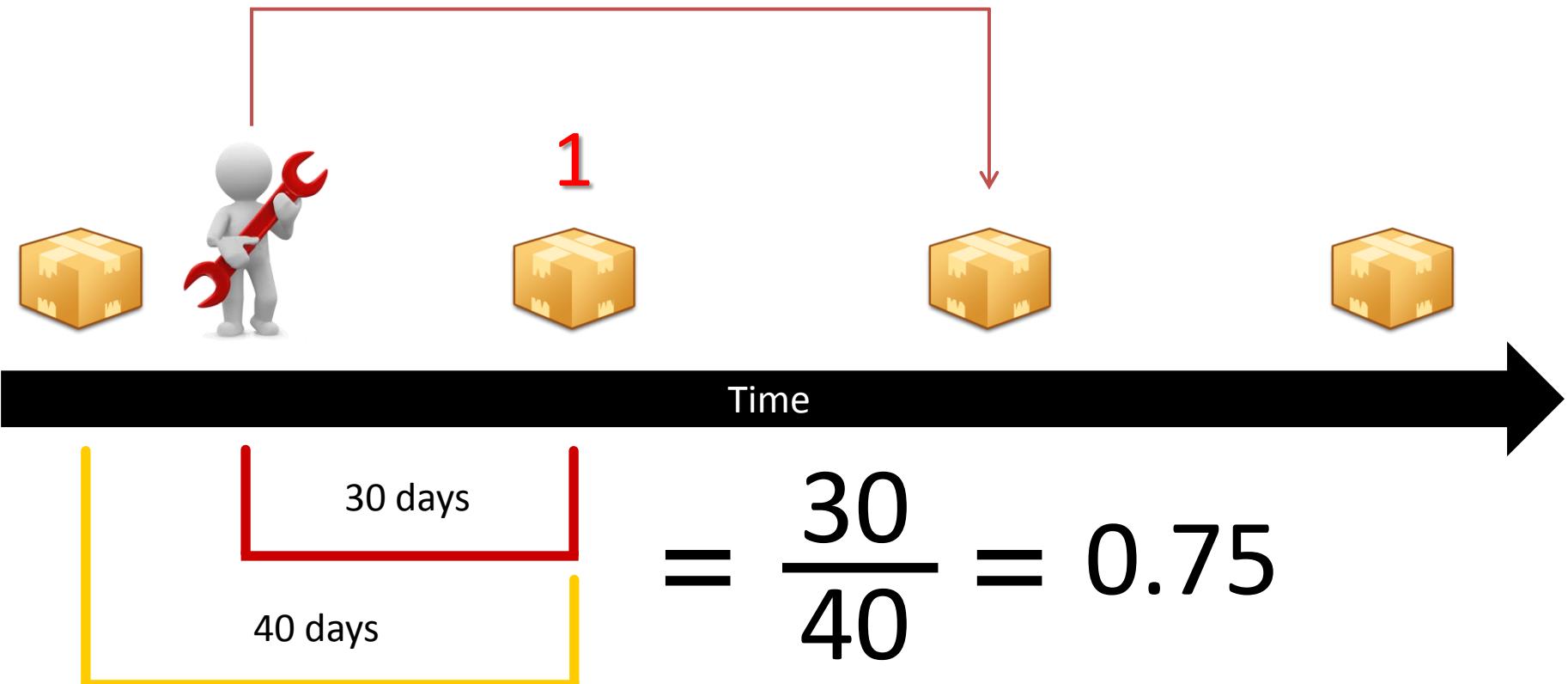
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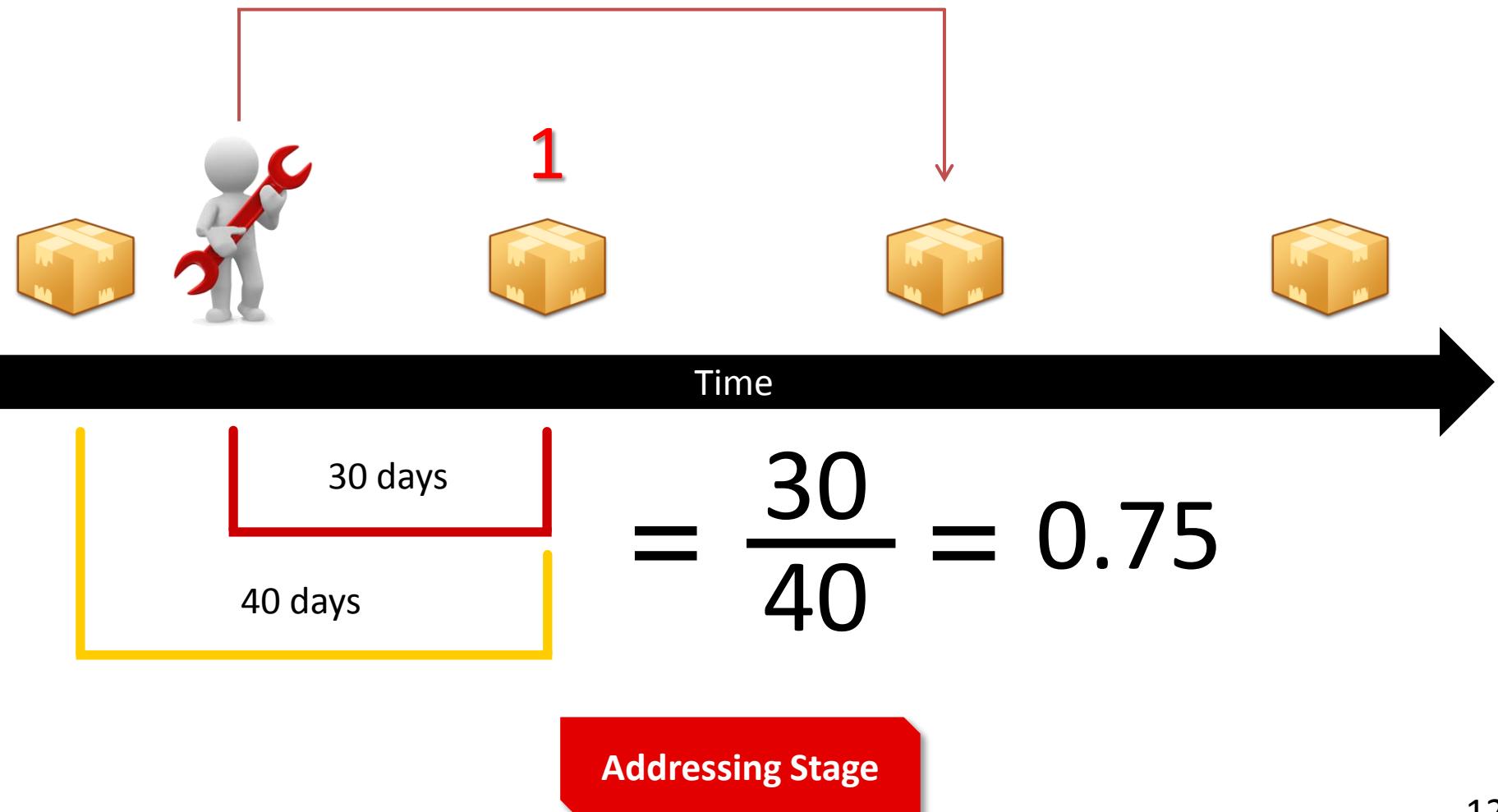
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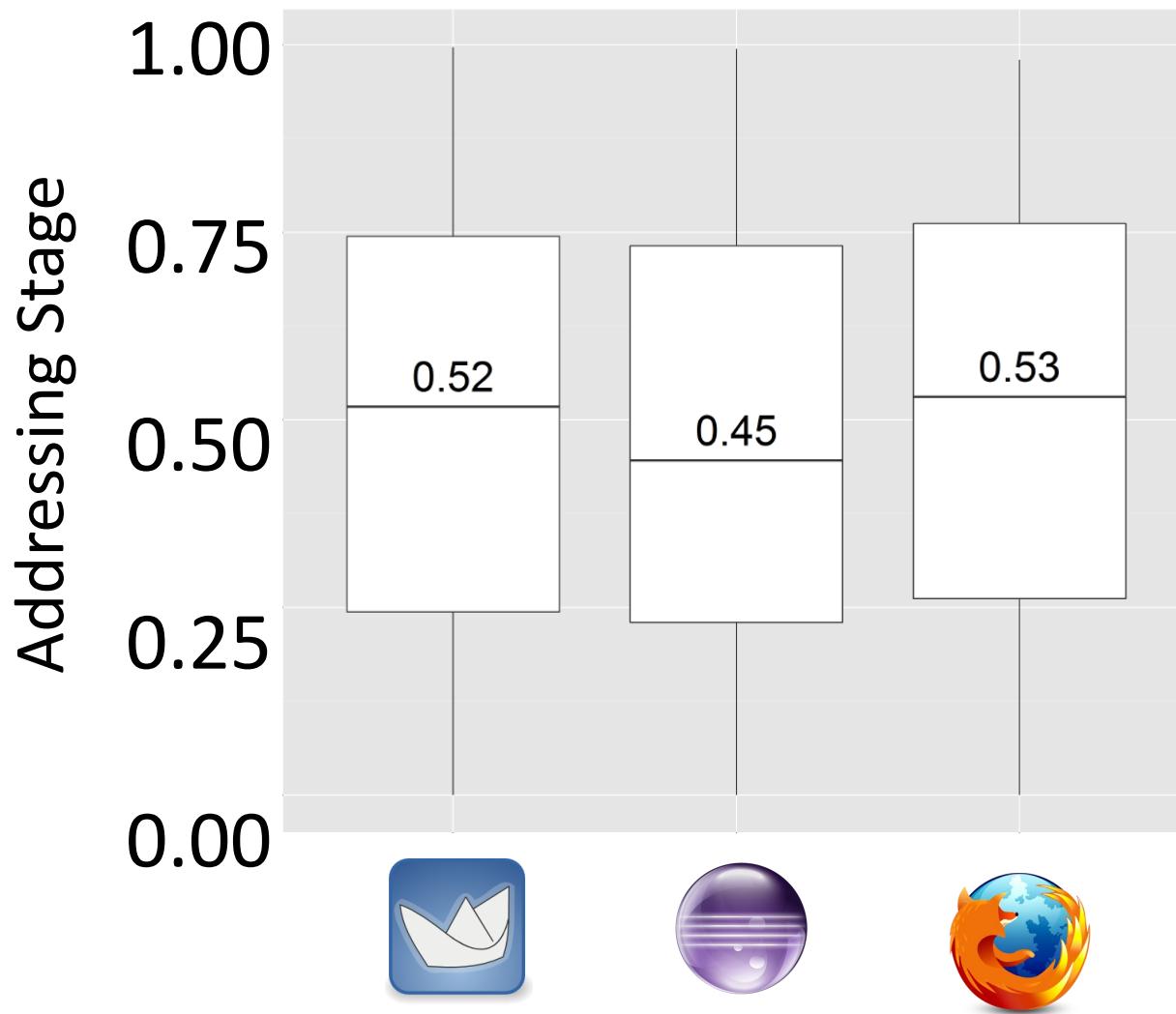
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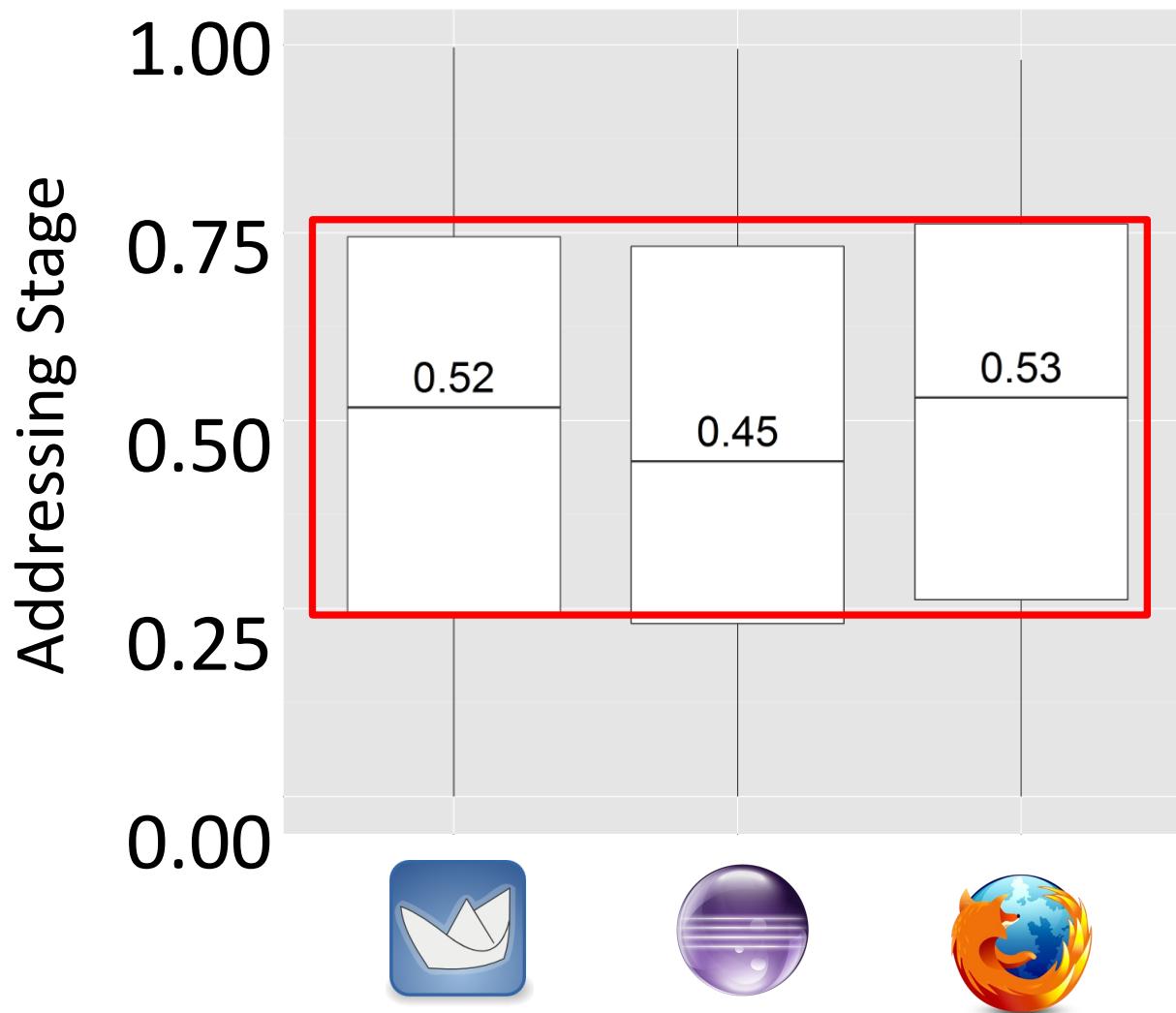
How long an issue was addressed before a release?



Delayed issues were addressed well before the next release

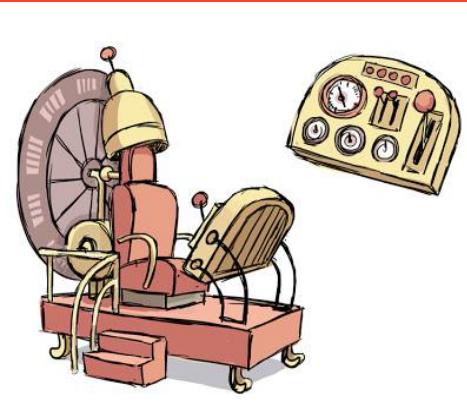


Delayed issues were addressed well before the next release





Integration
delay



Prediction
models

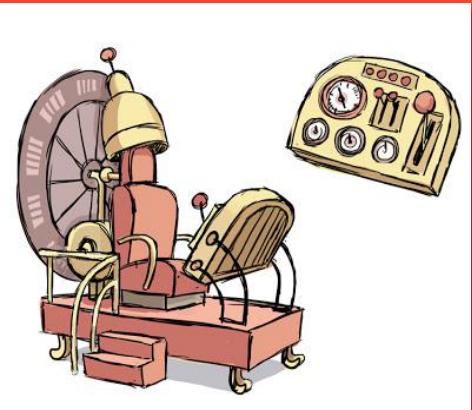


Influential
variables



Integration delay

Issues are usually delayed in rapid releasing cycle



Prediction models



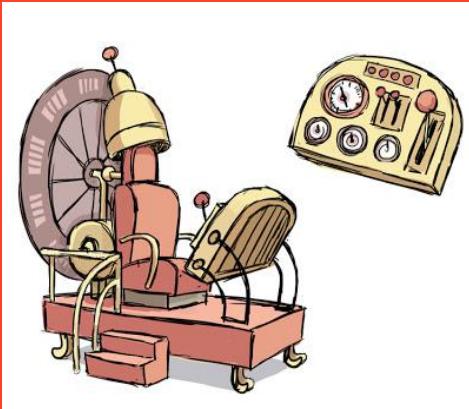
Influential variables



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Prediction models



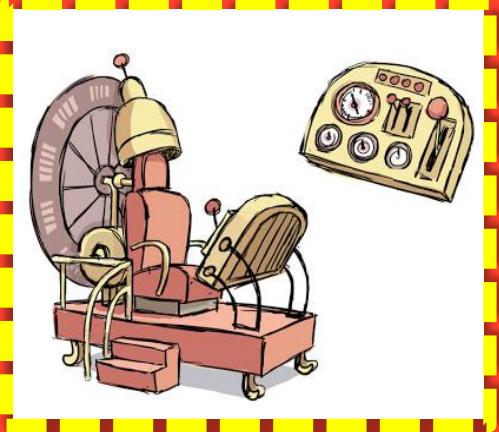
Influential variables



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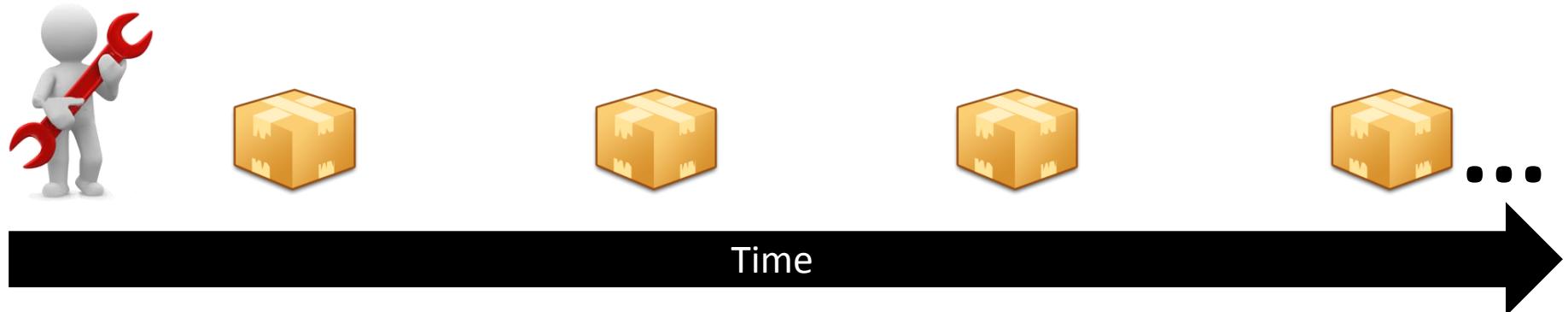


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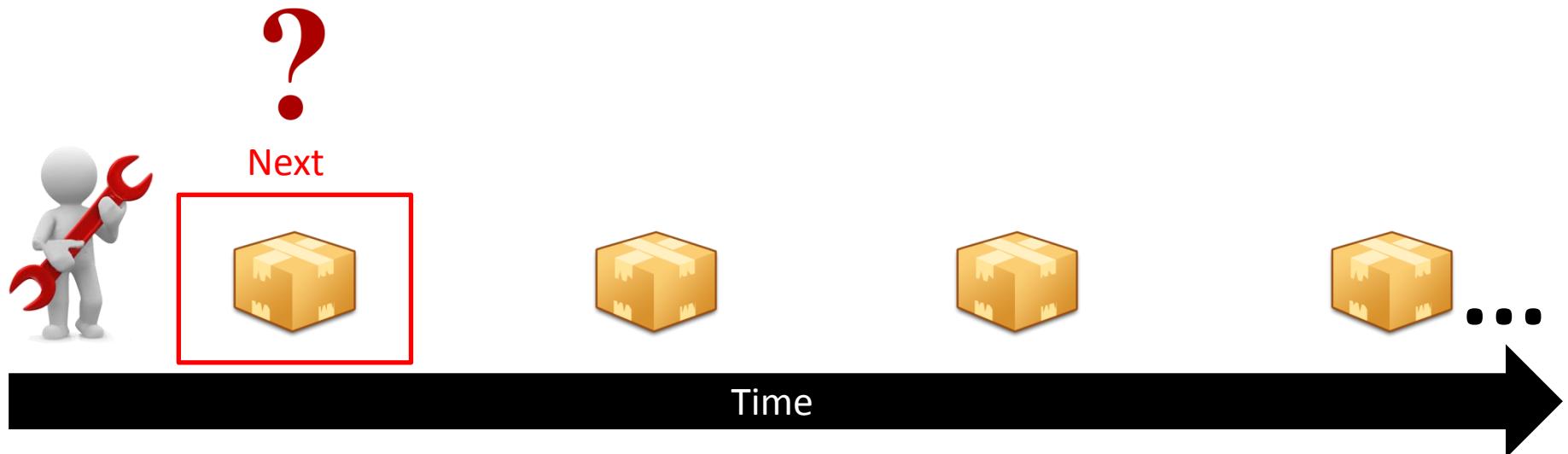


Influential variables

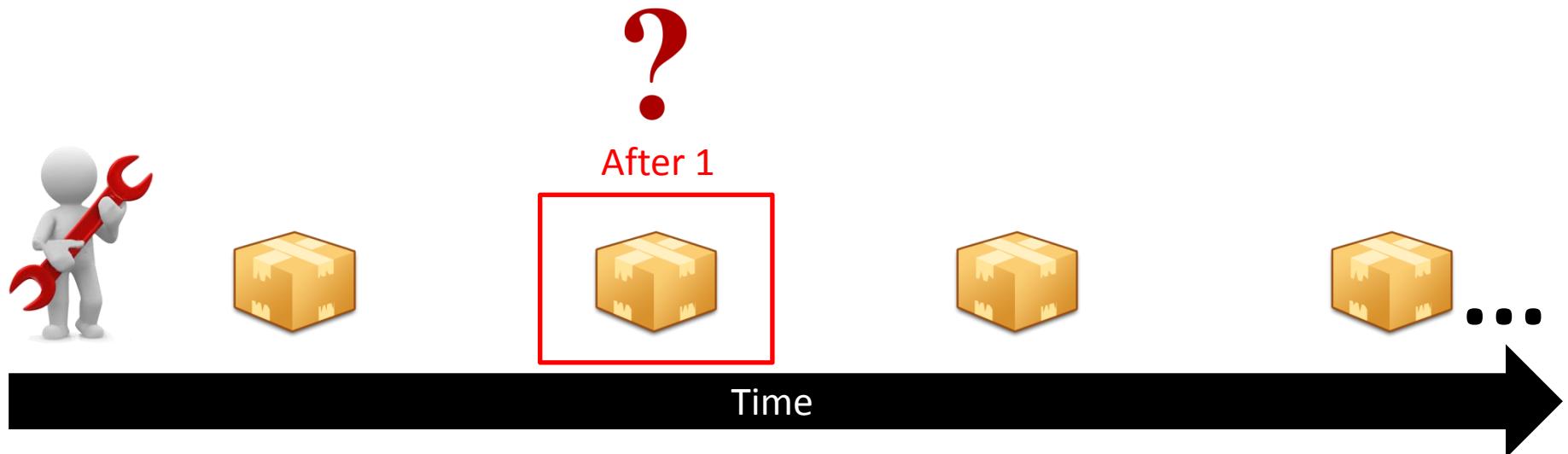
When will an addressed issue be integrated?



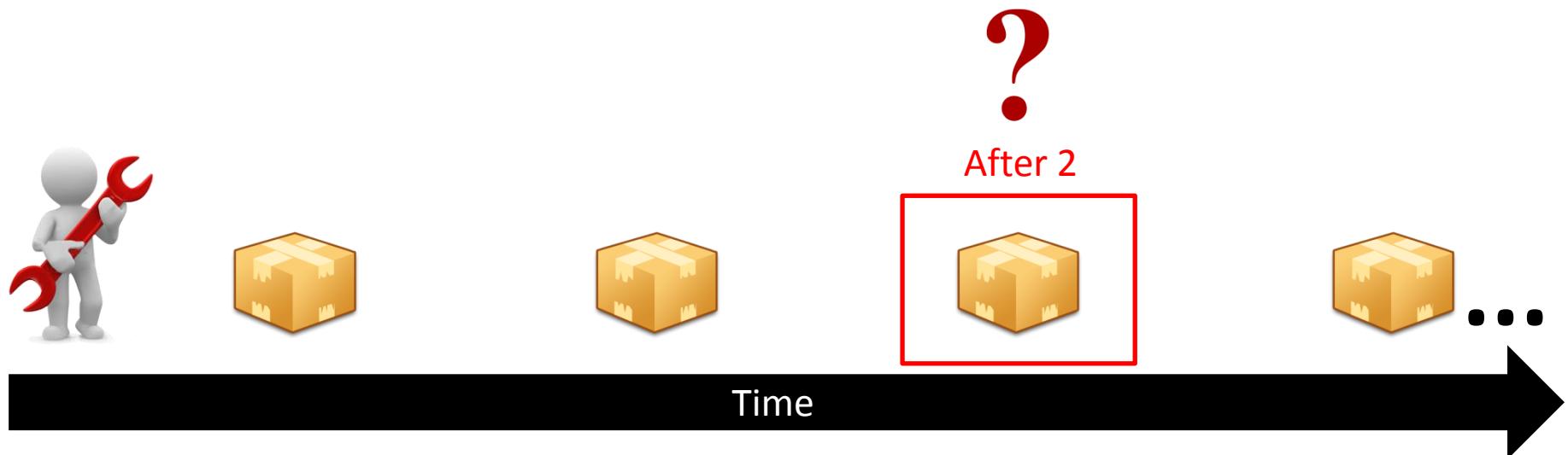
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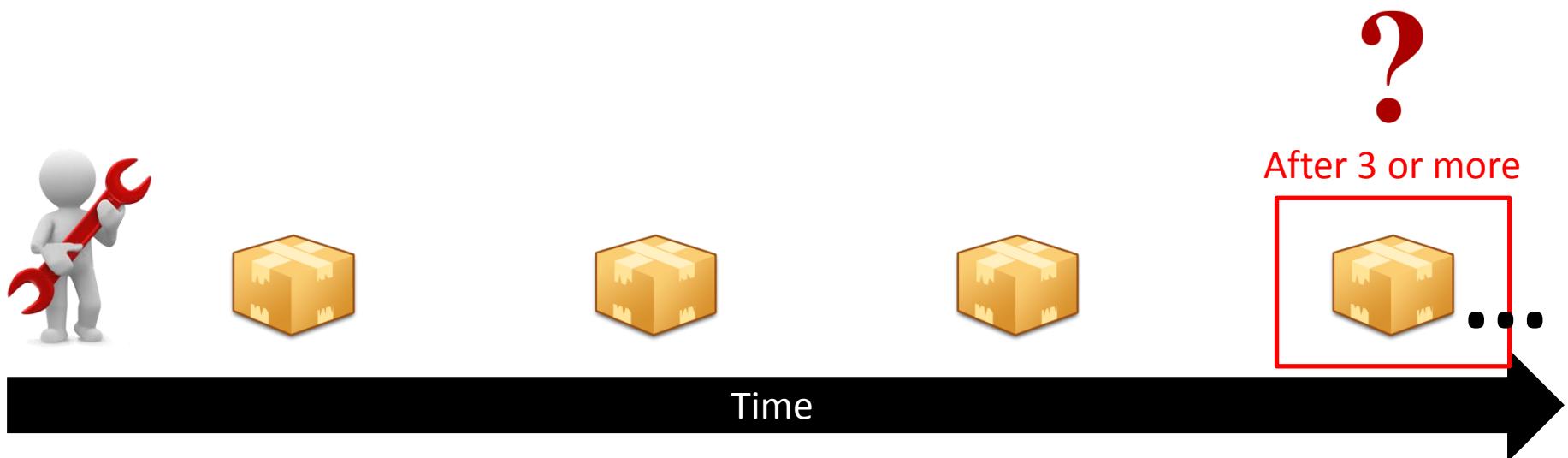
When will an addressed issue be integrated?



When will an addressed issue be integrated?



When will an addressed issue be integrated?



We built our prediction model using
random forests

We built our prediction model using random forests



It is robust to
noisy data

We built our prediction model using random forests



It is robust to
noisy data

It deals with
several types
of attributes



We evaluated our models using
***precision**, **recall** and **ROC** areas*



Precision



Recall



ROC Areas

We evaluated our models using
precision, ***recall*** and ***ROC*** areas



Precision



Recall



ROC Areas

We evaluated our models using
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Precision



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ROC Areas

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Precision



Recall



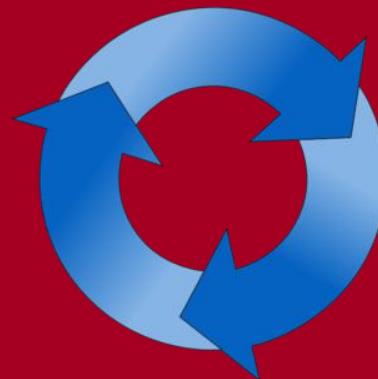
ROC Areas

Studied metrics

Reporter metrics



Issue metrics



Process metrics



Project metrics

Studied metrics

Reporter metrics

Reporter
Experience



Issue metrics

Issue
priority



Number of
comments



Process metrics

Project metrics



Integration
workload

Studied metrics

Reporter metrics

Reporter
Experience

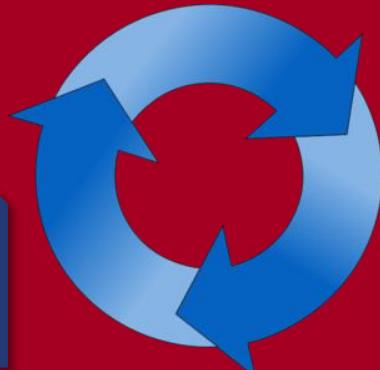


Issue metrics

Issue
priority



Number of
comments



Process metrics

Project metrics



Integration
workload

Measuring the integration workload of a given addressed issue



Time

Measuring the integration workload of a given addressed issue



Time

Measuring the integration workload of a given addressed issue



Time



= 500 ?

We are still waiting as well!

Our models perform better than random guessing



Precision



Recall



ROC Areas

Our models perform better than random guessing



Precision
0.59 to 0.88



Recall
0.62 to 0.88



ROC Areas
All above 0.74

Our models perform better than random guessing



Precision
0.59 to 0.88



Recall
0.62 to 0.88

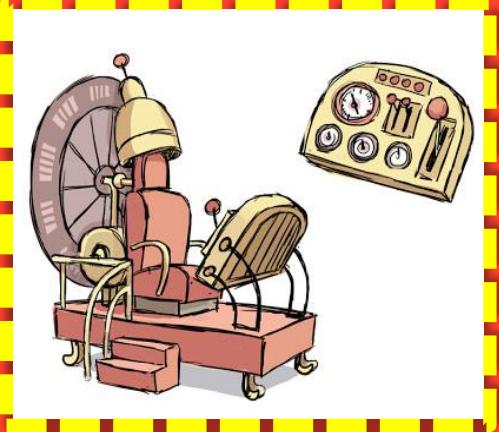




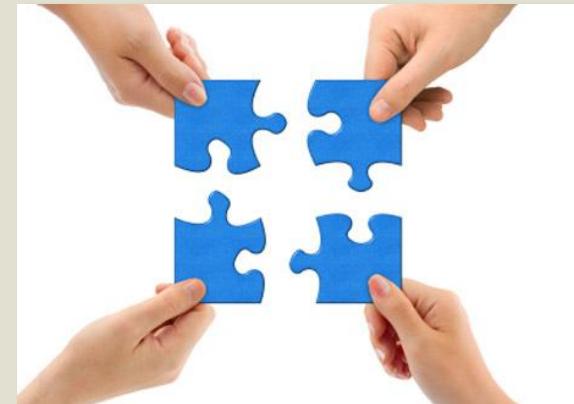
Integration delay

Issues are usually delayed in rapid releasing cycle

Issues are addressed well before a release



Prediction models



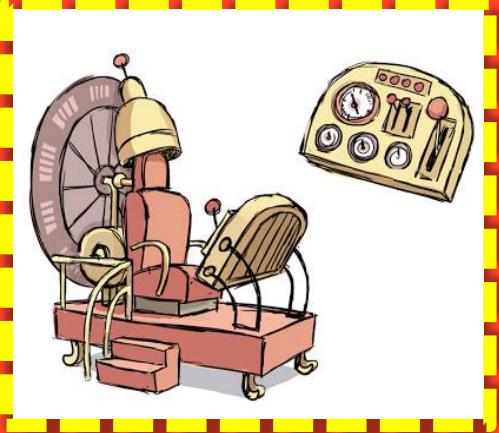
Influential variables



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Prediction models

Our models perform better than random prediction



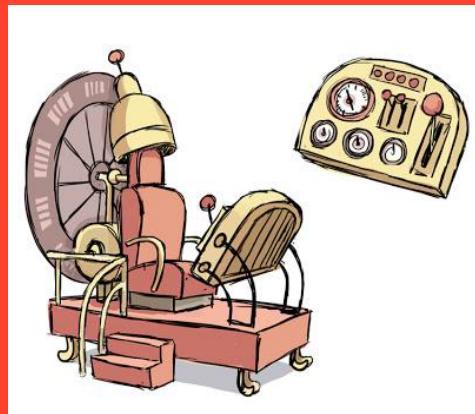
Influential variables



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Prediction models

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Influential variables

We computed the variable importance of our methods

Experience	Workload	#Comments
55	340	30
66	100	70
78	540	22

Accuracy: 0.8

We computed the variable importance of our methods



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Accuracy: 0.79

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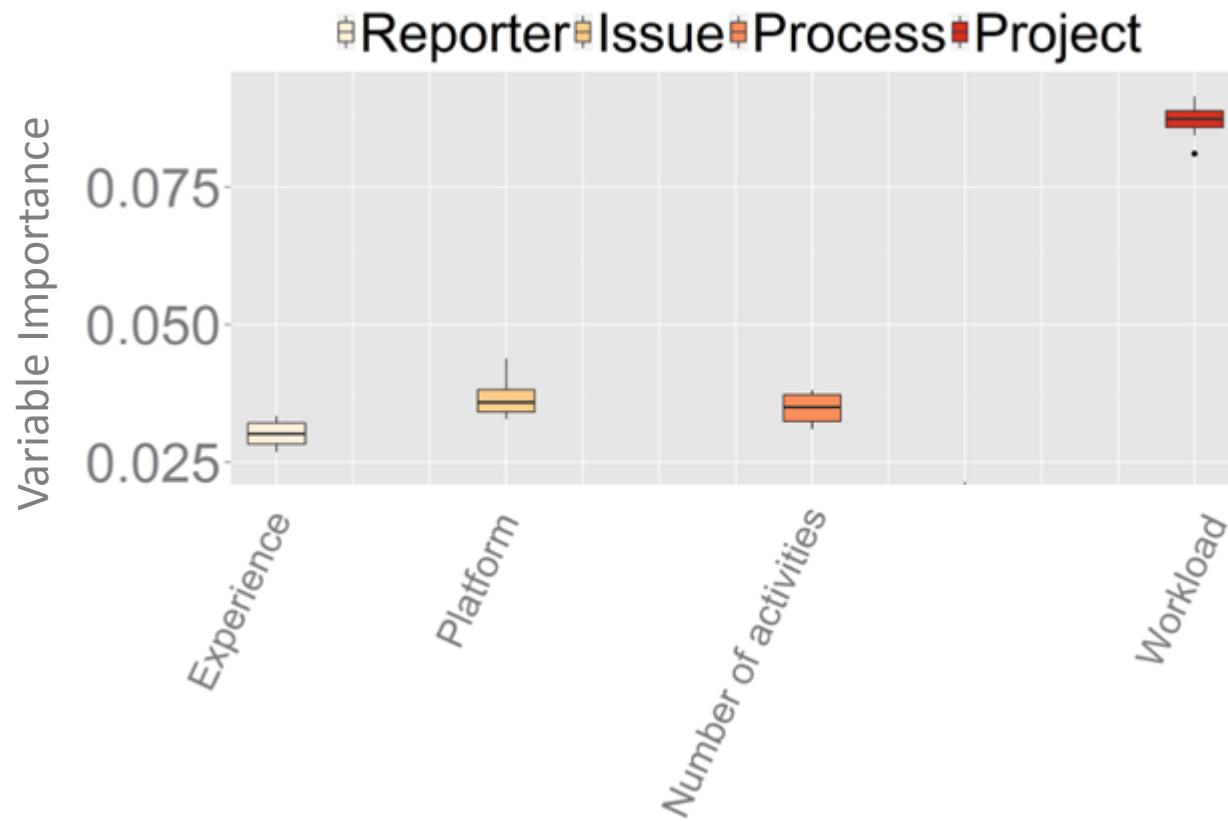
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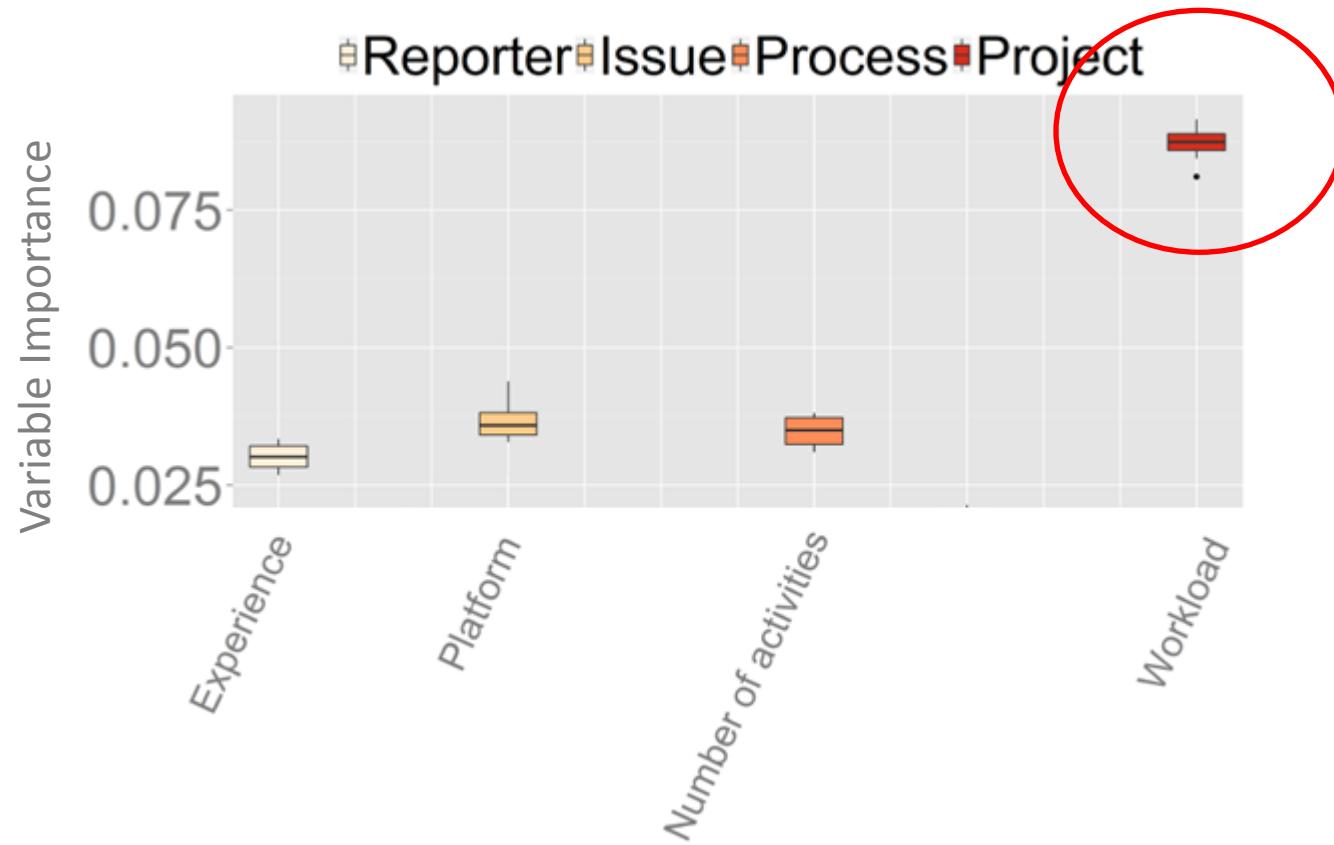
Experience	Workload	#Comments
55	100	30
66	340	70
78	540	22

Accuracy: 0.3

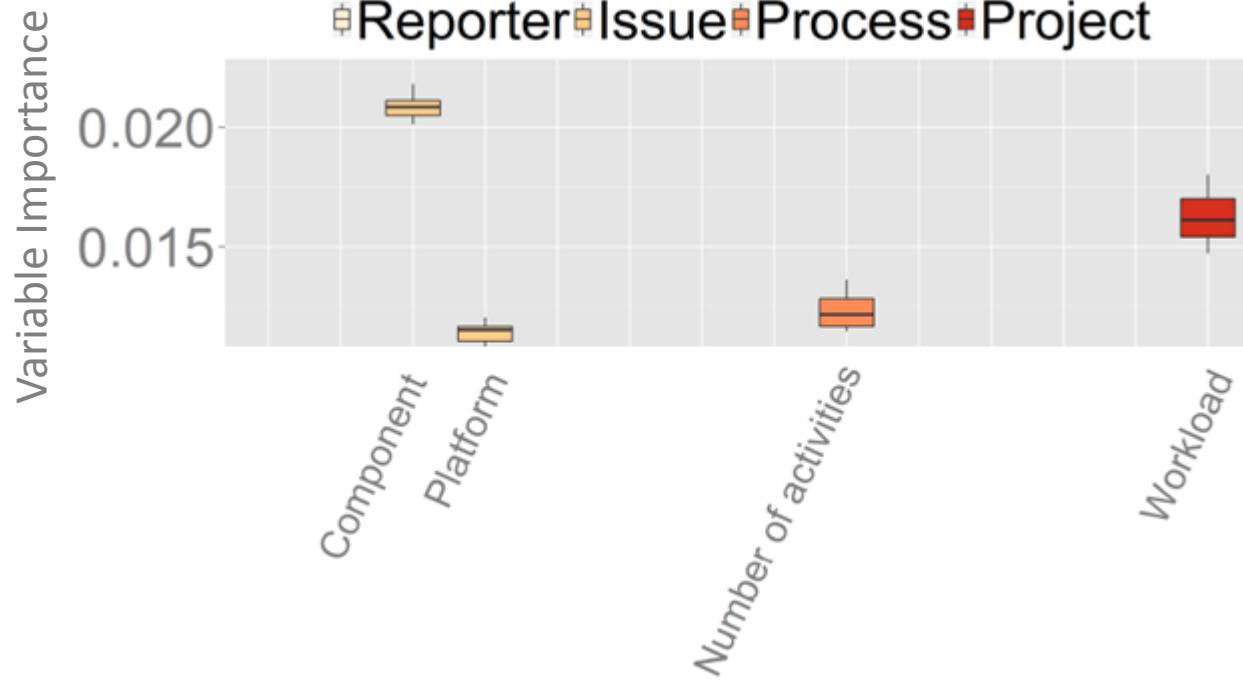
The integration workload has a bigger influence in our models



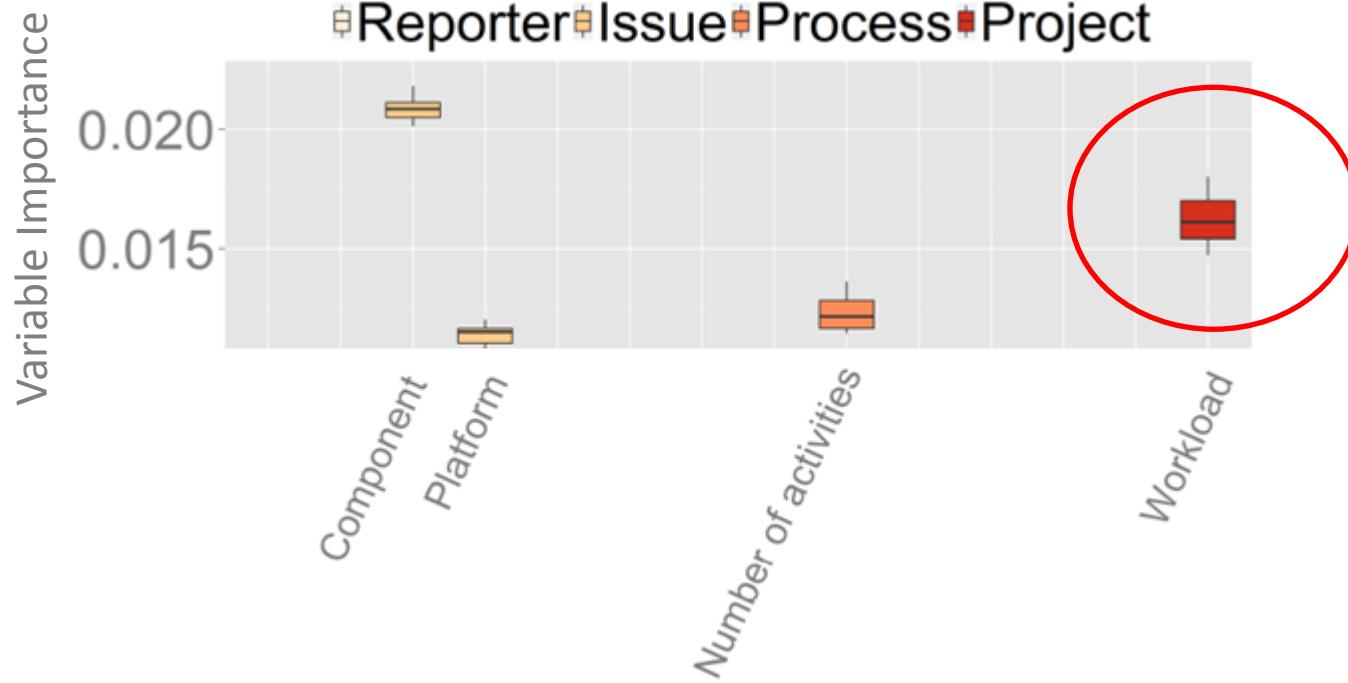
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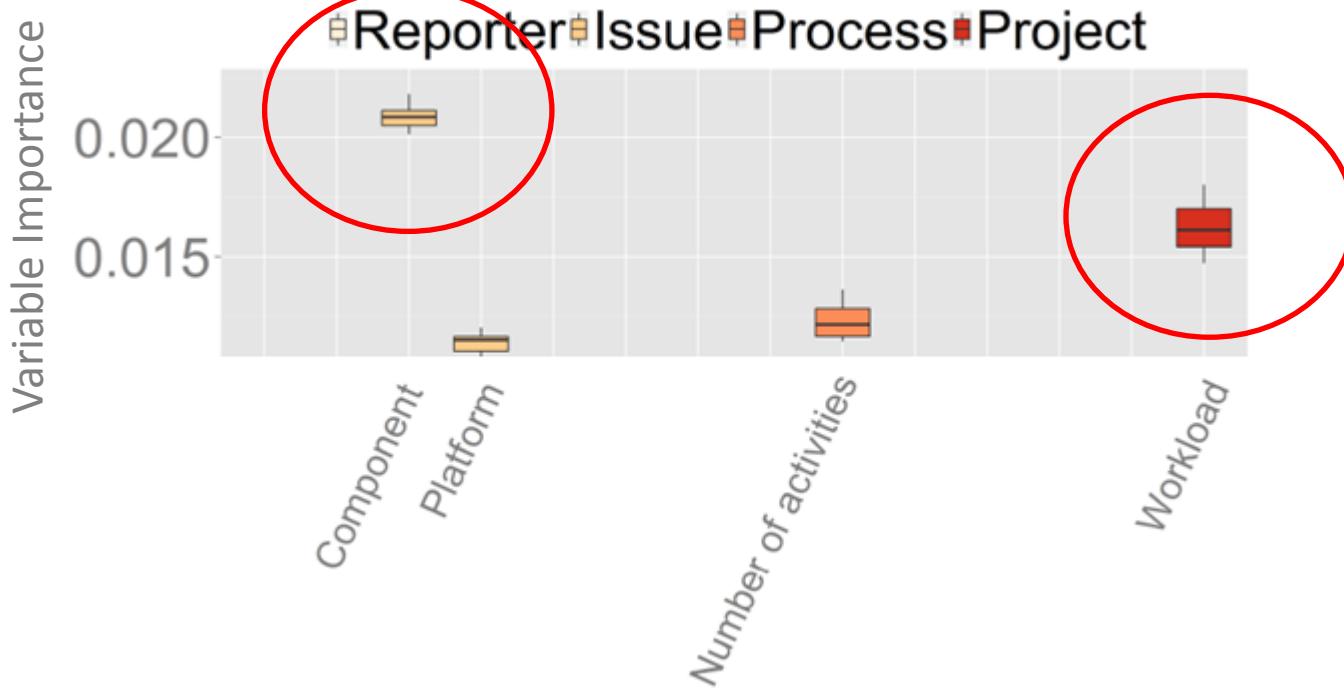
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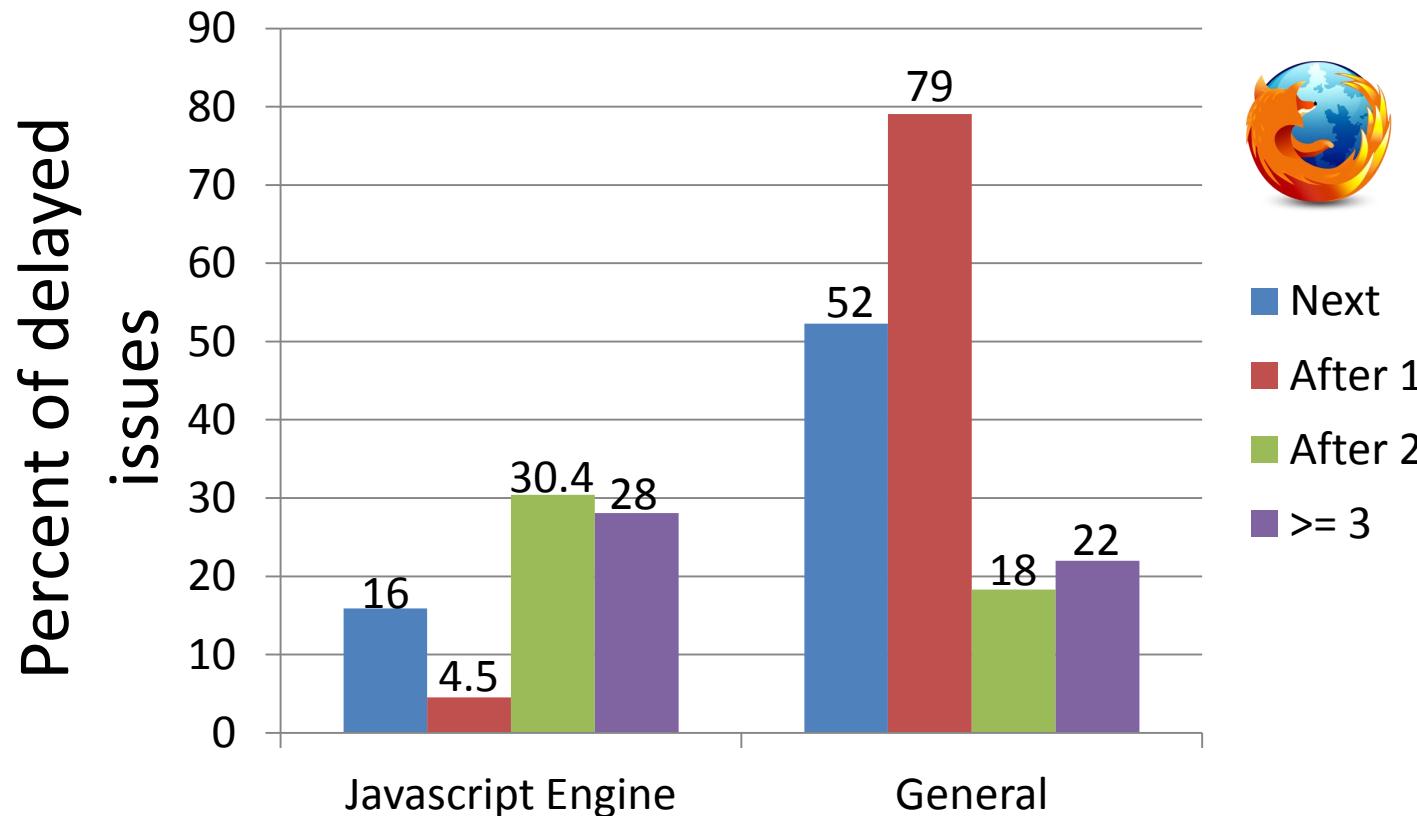
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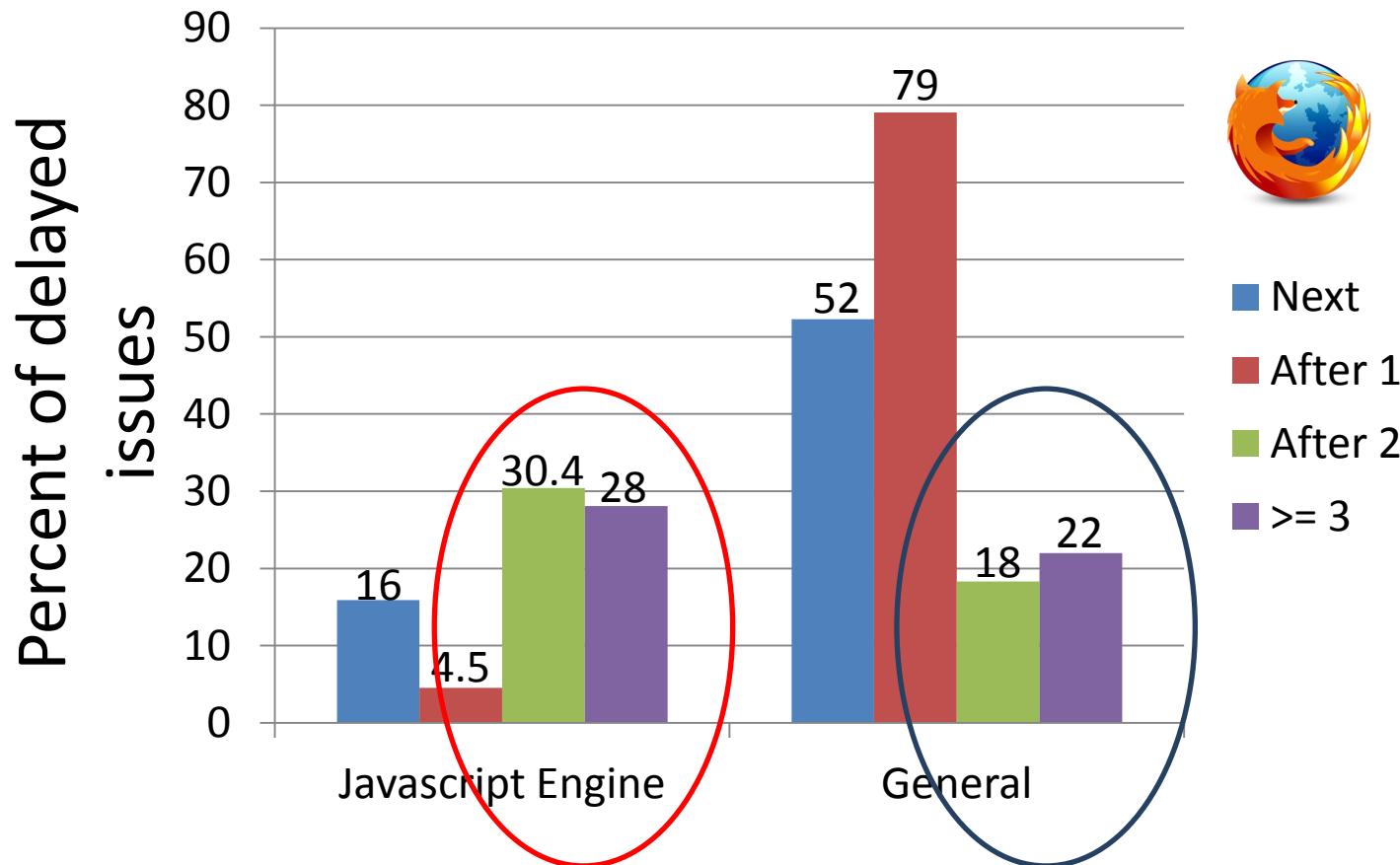
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Javascript Engine is the component with the most delayed issues in firefox

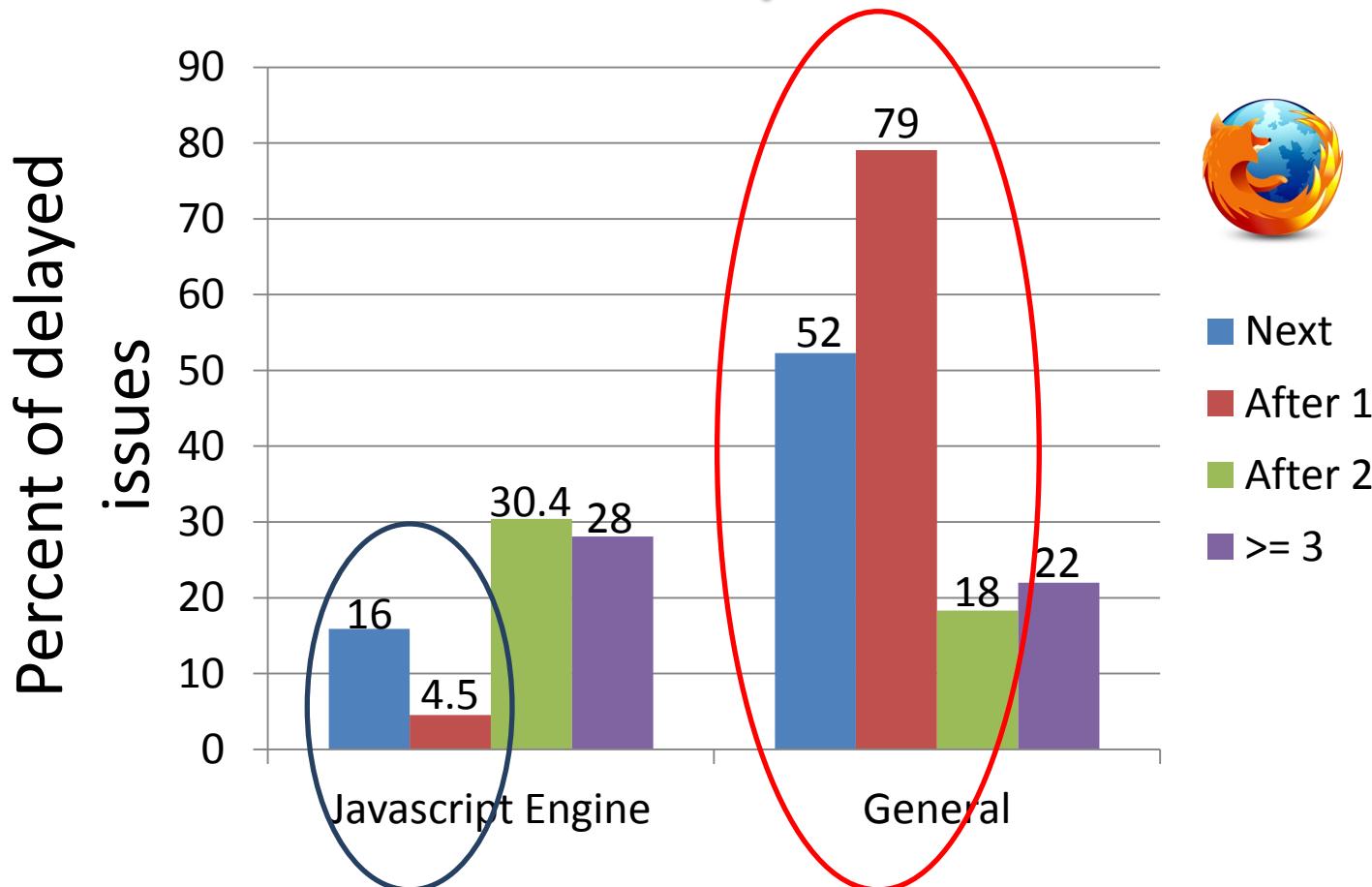


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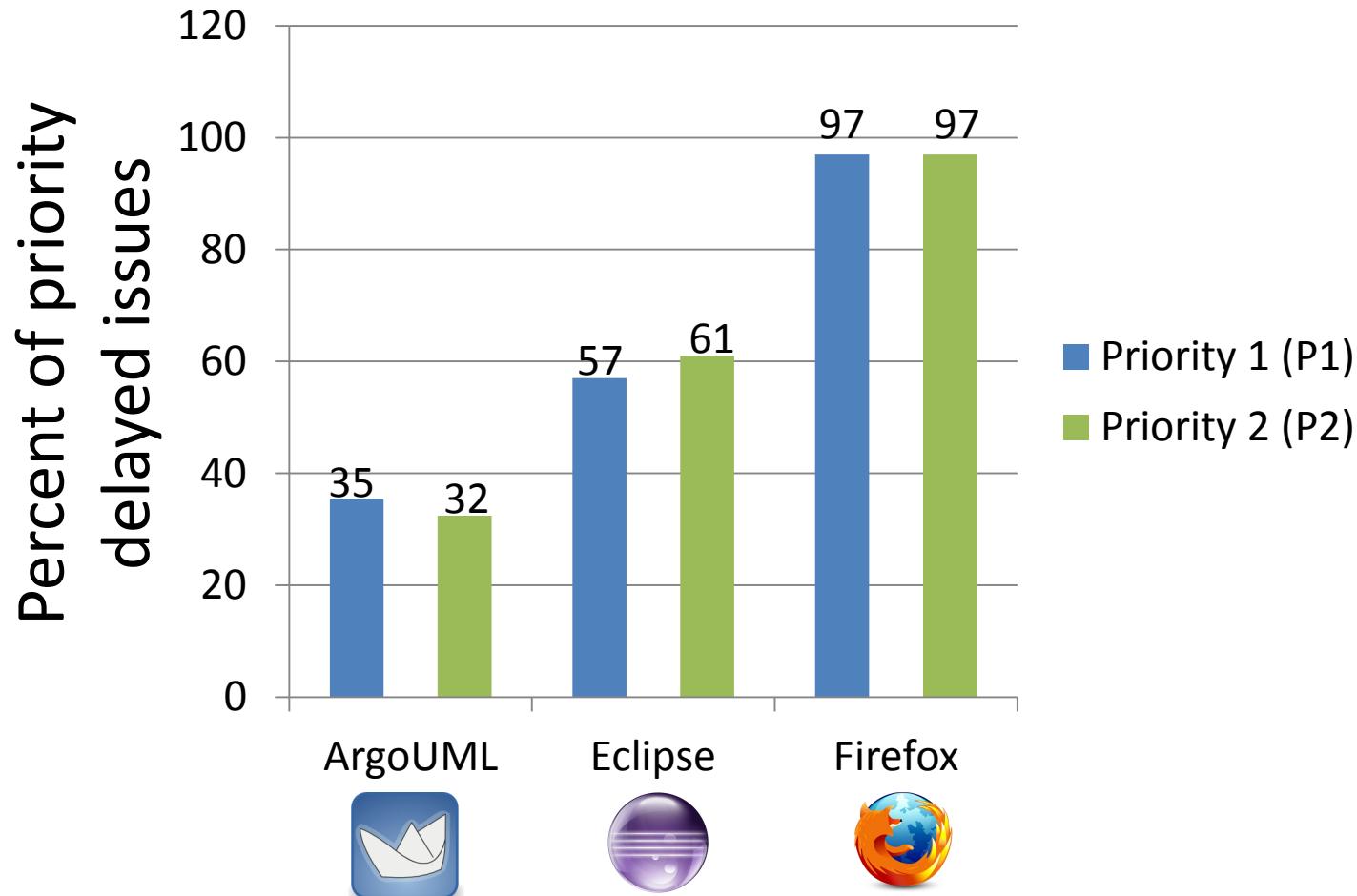


- Next
- After 1
- After 2
- ≥ 3

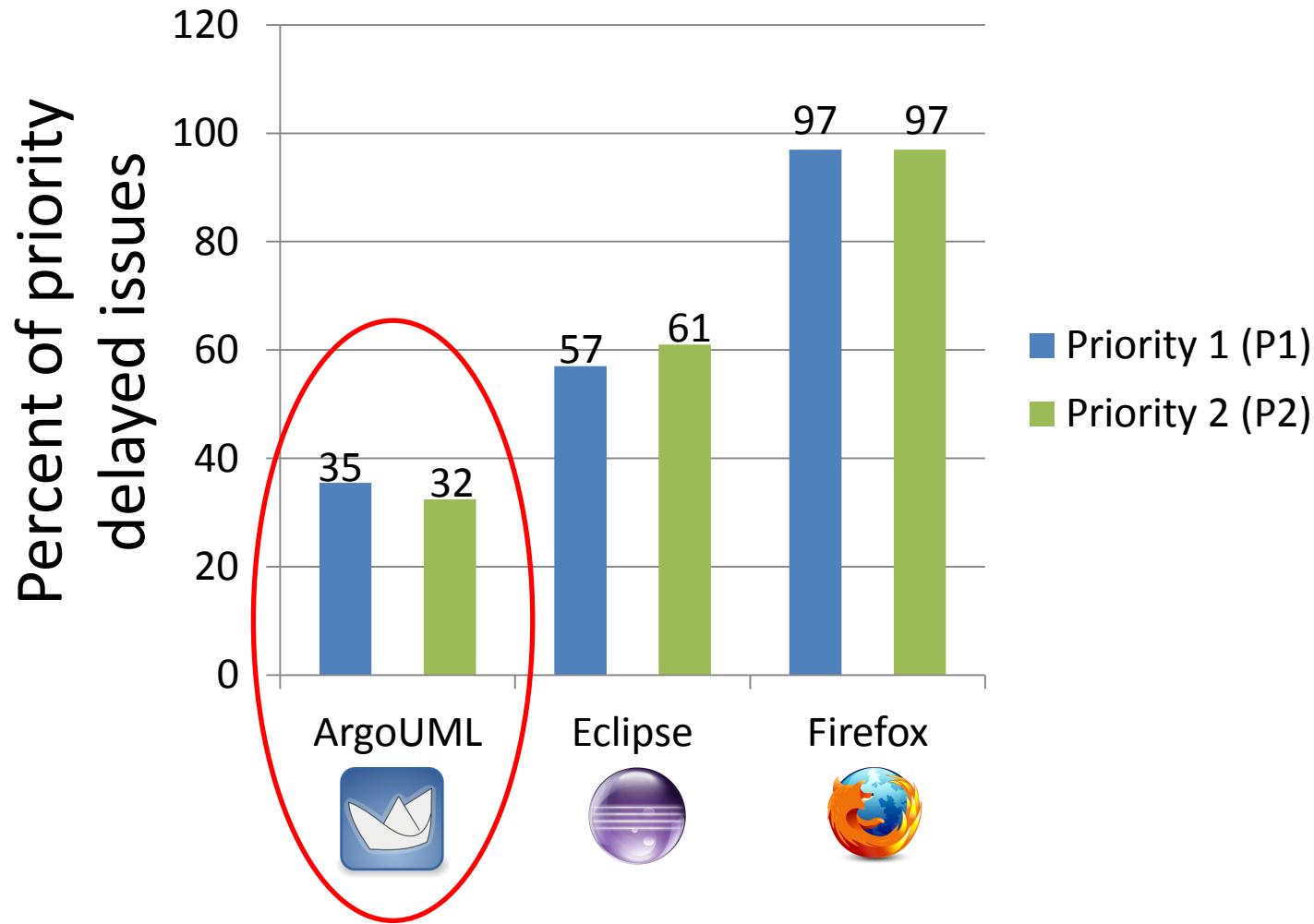
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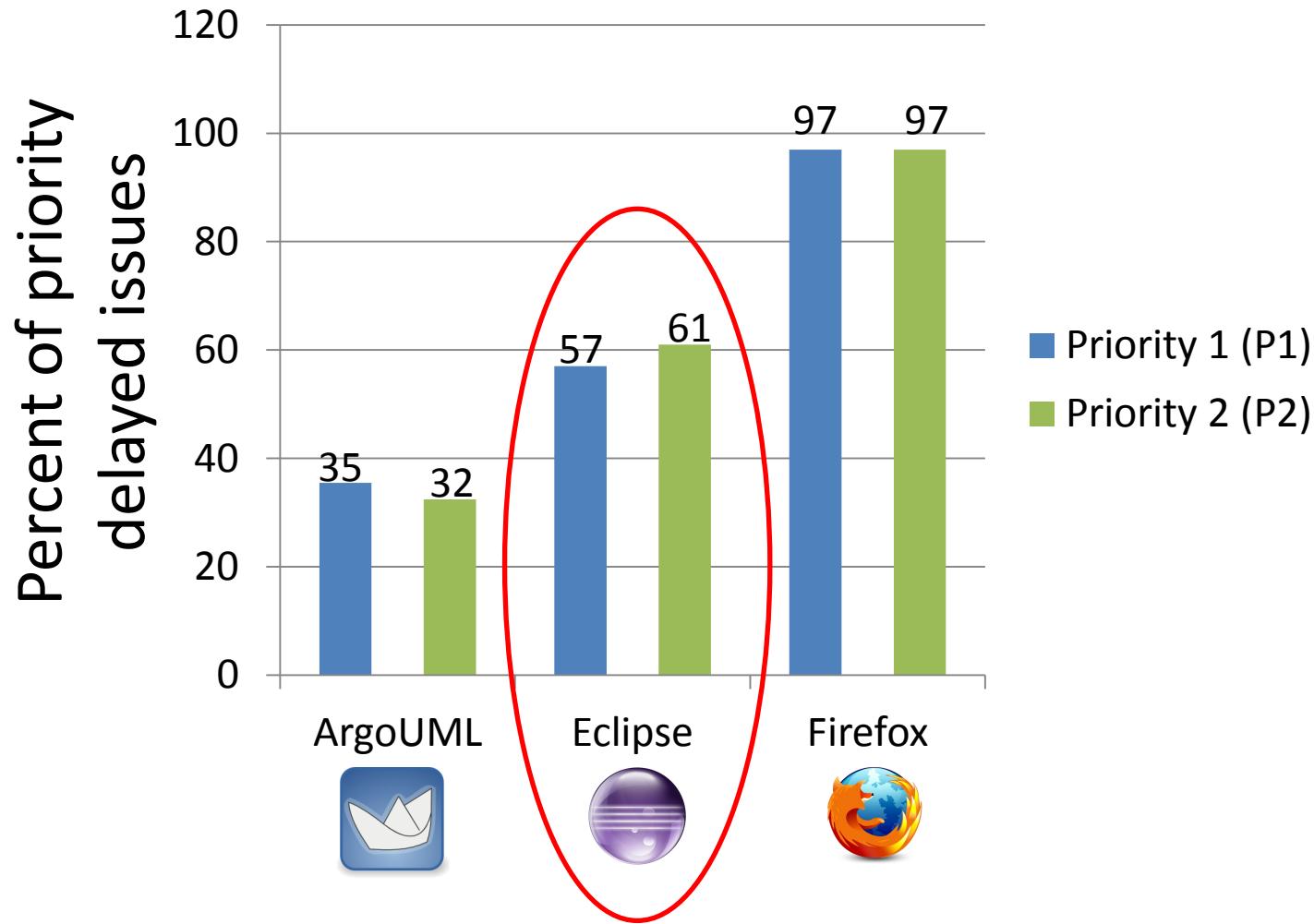
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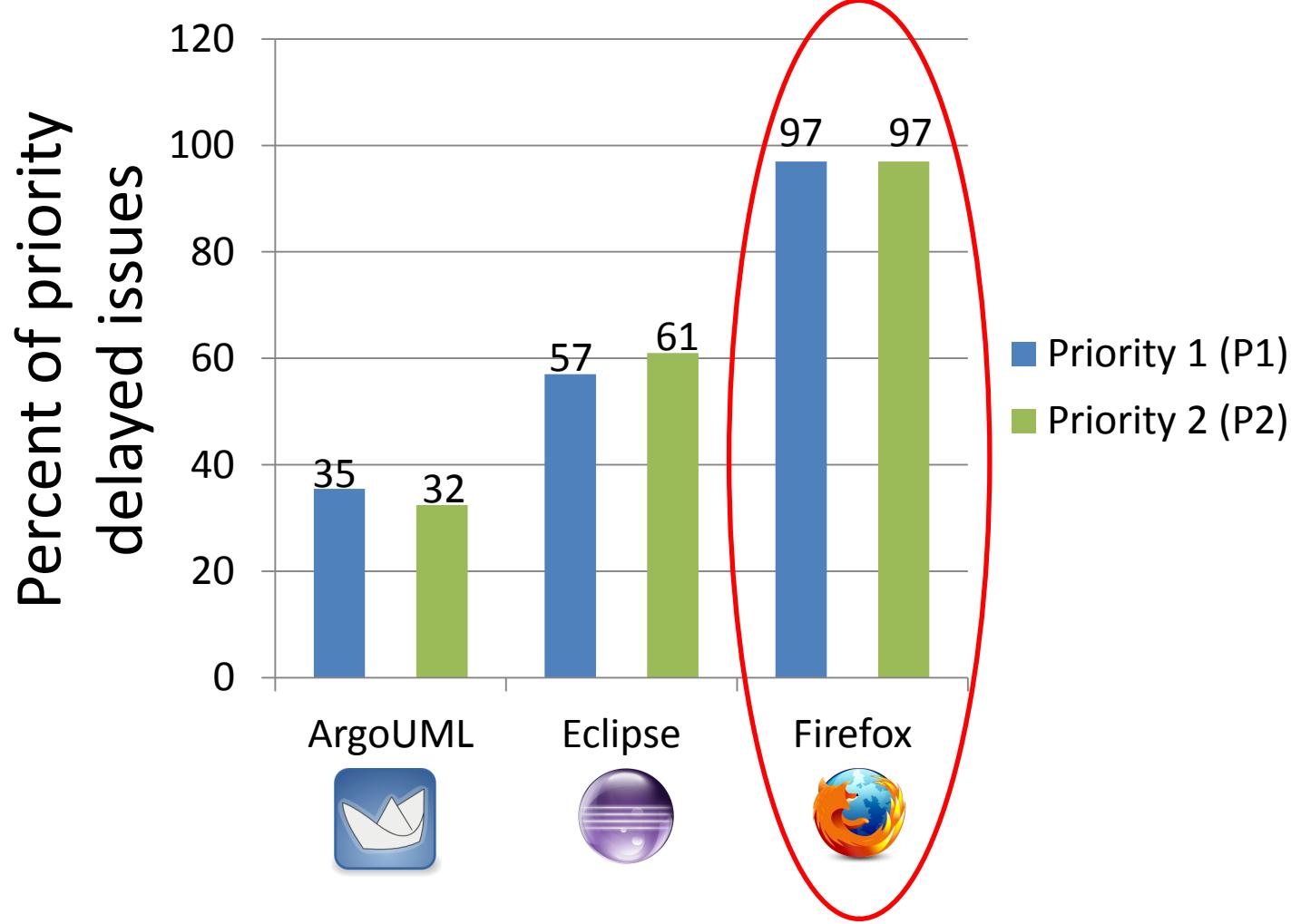
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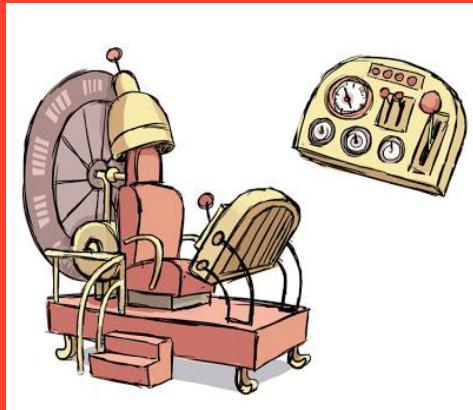




Integration delay

Issues are usually delayed in rapid releasing cycle

Issues are addressed well before a release



Prediction models

Our models perform better than random prediction



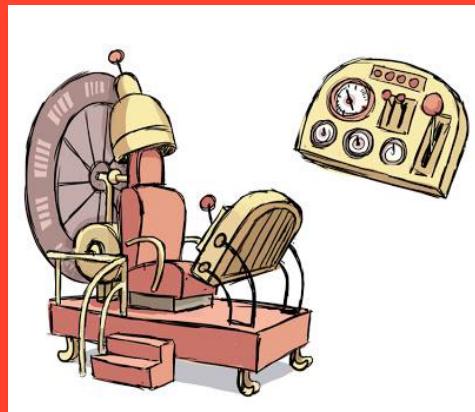
Influential variables



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Influential variables

Integration Workload is the most influential variable in our models

Summary

But an addressed issue may take some time to be integrated into a release



So when does this stuff get added? Will it be applied to the next FF23 beta? A 22.01 release? Otherwise?



But an addressed issue may take some time to be integrated into a release



#883554

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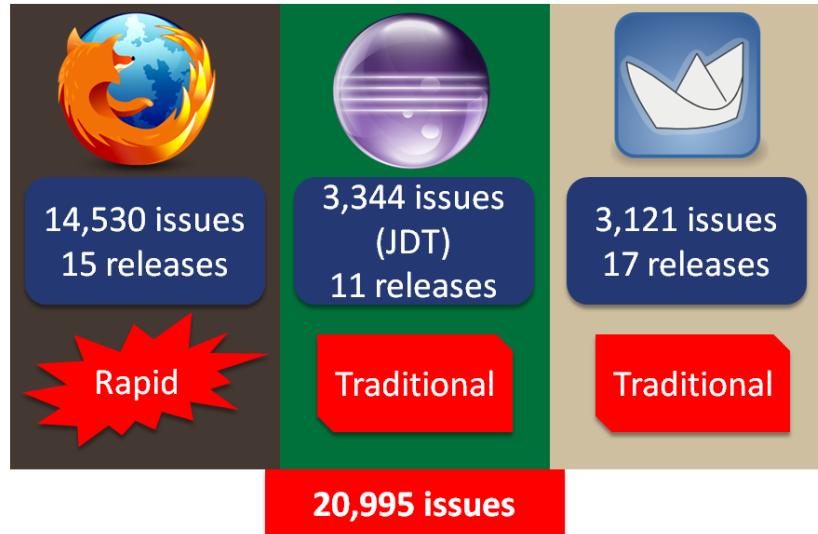
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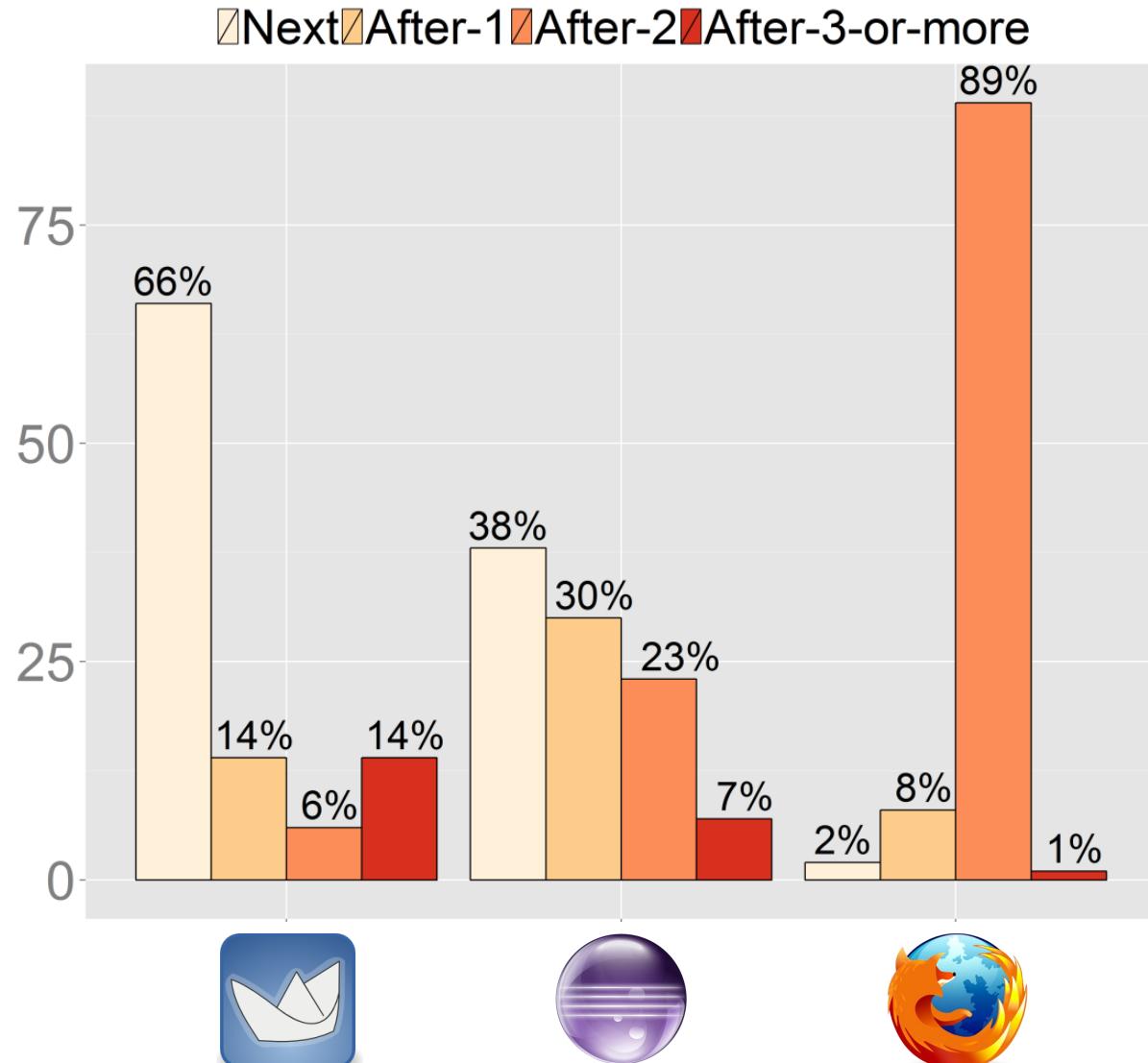
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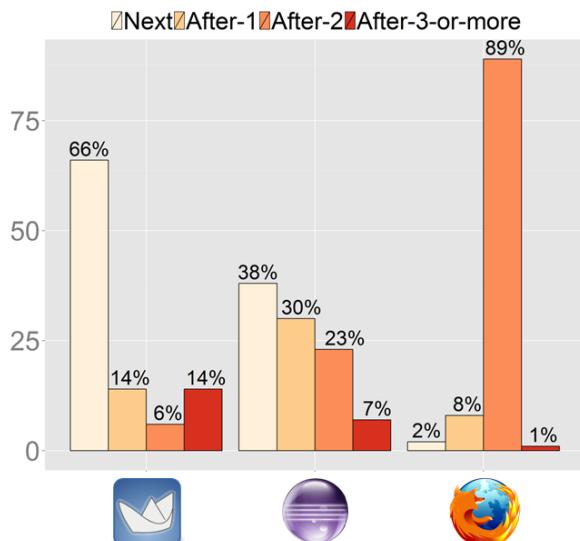
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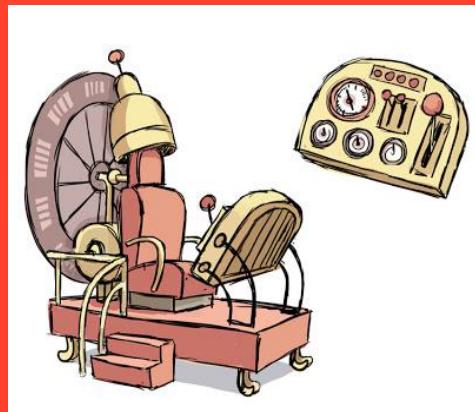




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Influential variables

Integration Workload is the most influential variable in our models

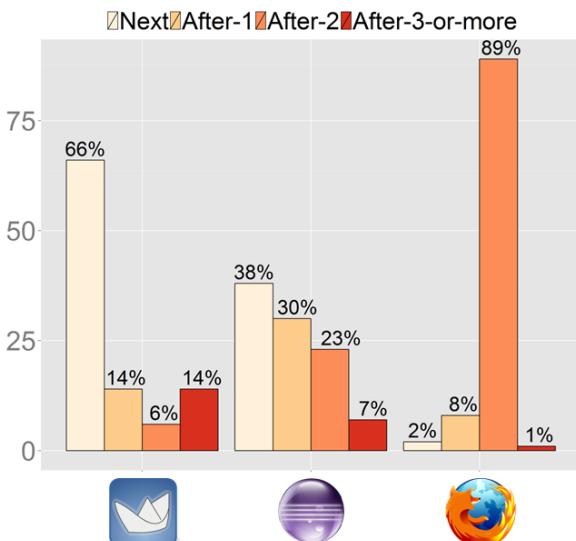
But an addressed issue may take some time to be integrated into a release



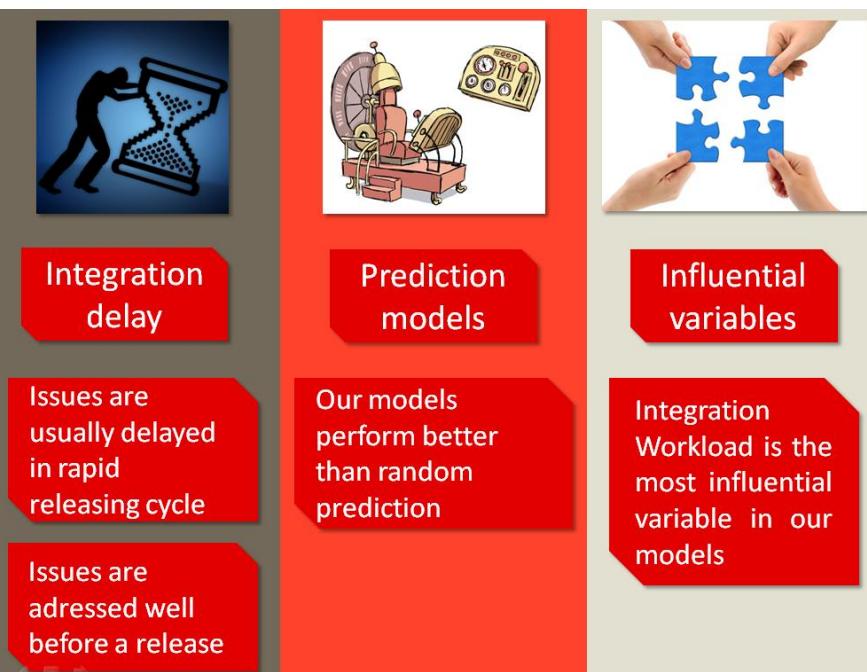
So when does this stuff get added? Will it be applied to the next FF23 beta? A 22.01 release? Otherwise?



34% to 60% of addressed issues in traditional release cycle were delayed



An empirical study to analyze the integration delay



An Empirical Study of Delays In The Integration of Addressed Issues

Daniel A. Costa



Surafel L. Abebe



Shane McIntosh



Uirá Kulesza

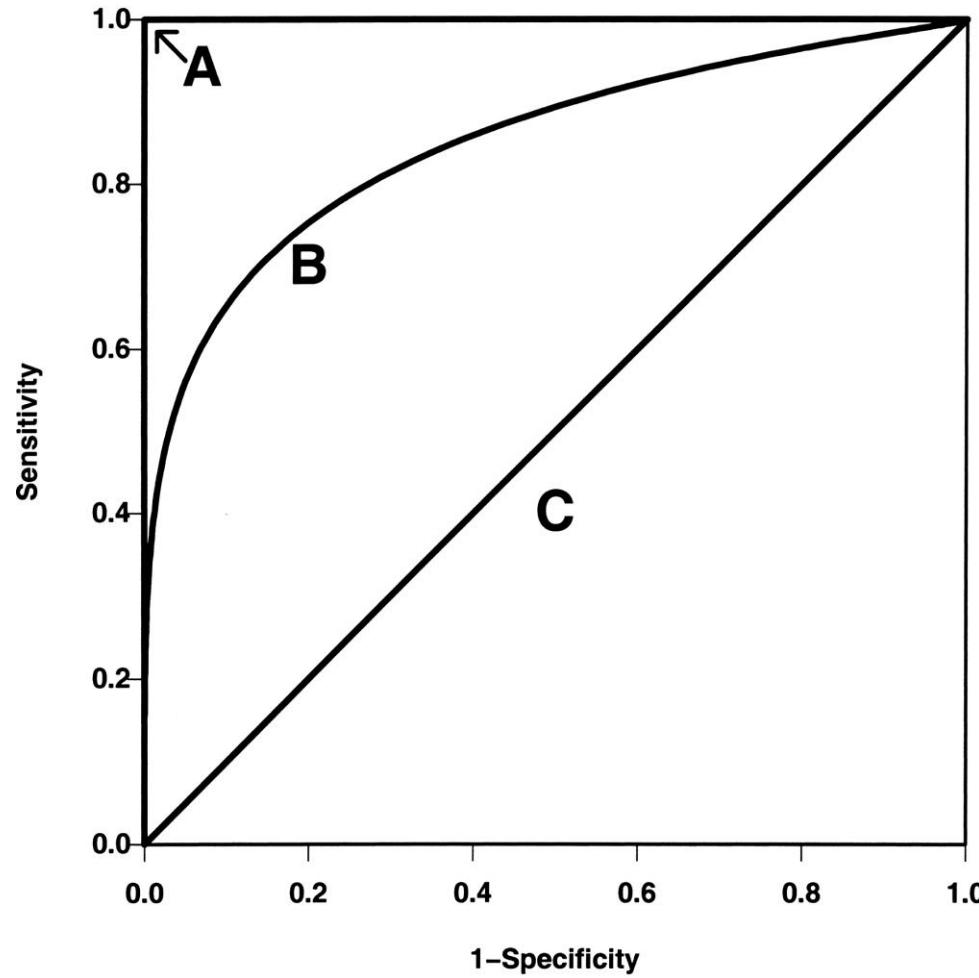


Ahmed E. Hassan

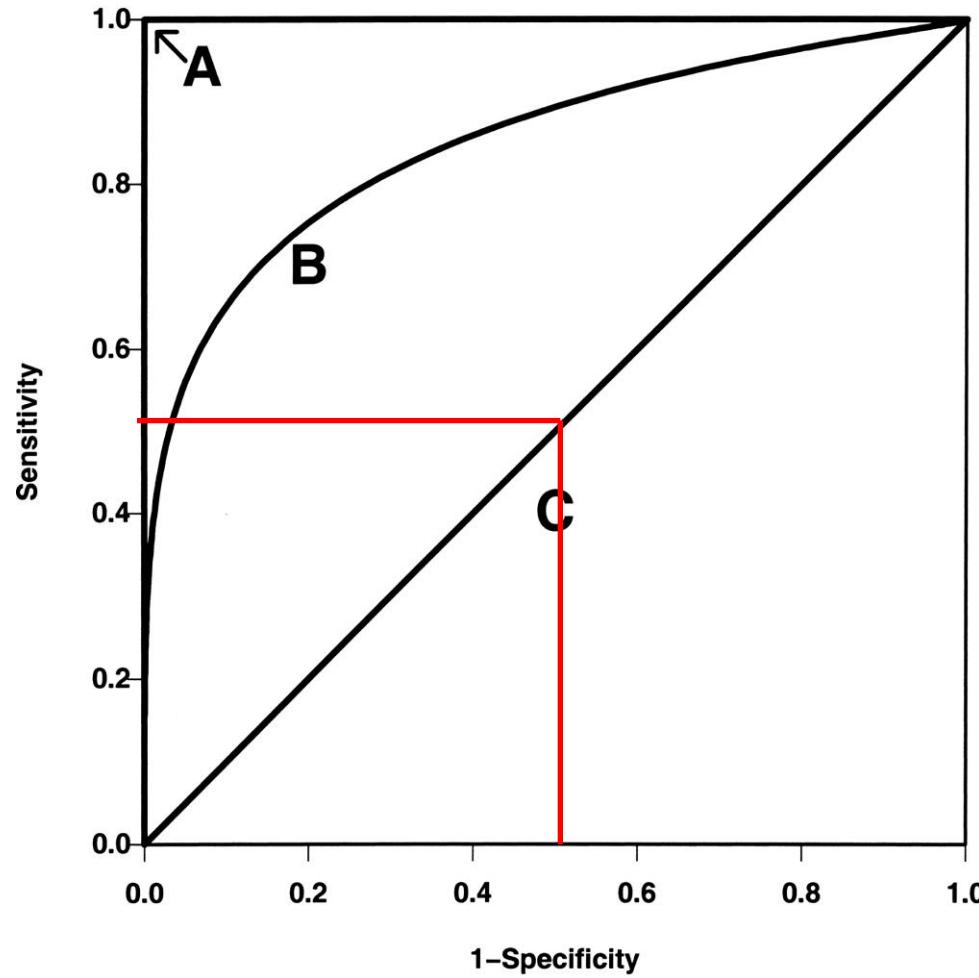


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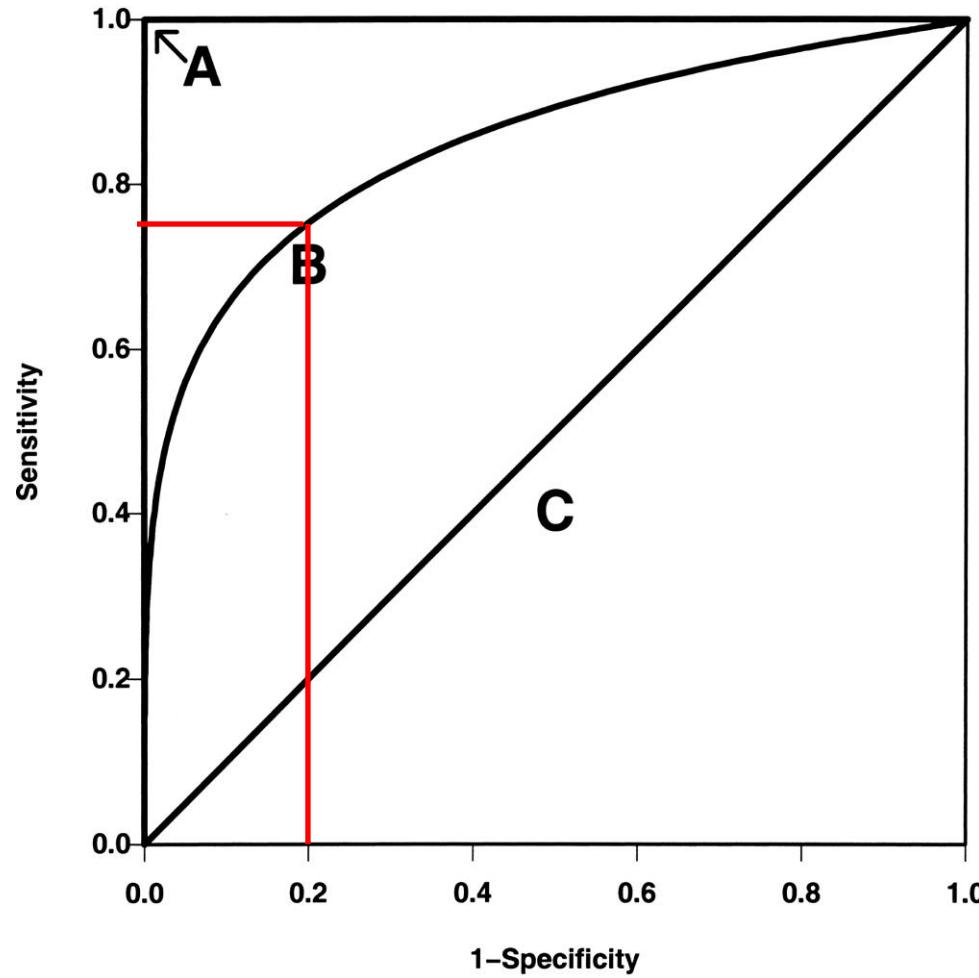
How ROC should be interpreted?



How ROC should be interpreted?



How ROC should be interpreted?



We calculated the ROC areas in a pair basis

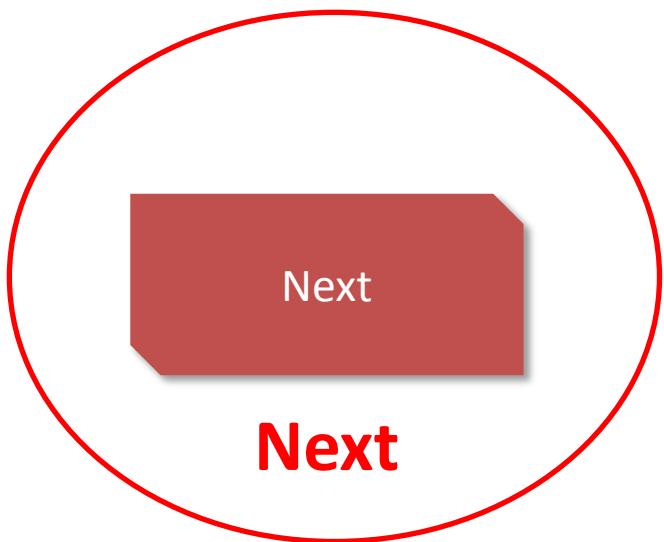
After 1

Next

After 2

After 3

We calculated the ROC areas in a pair basis

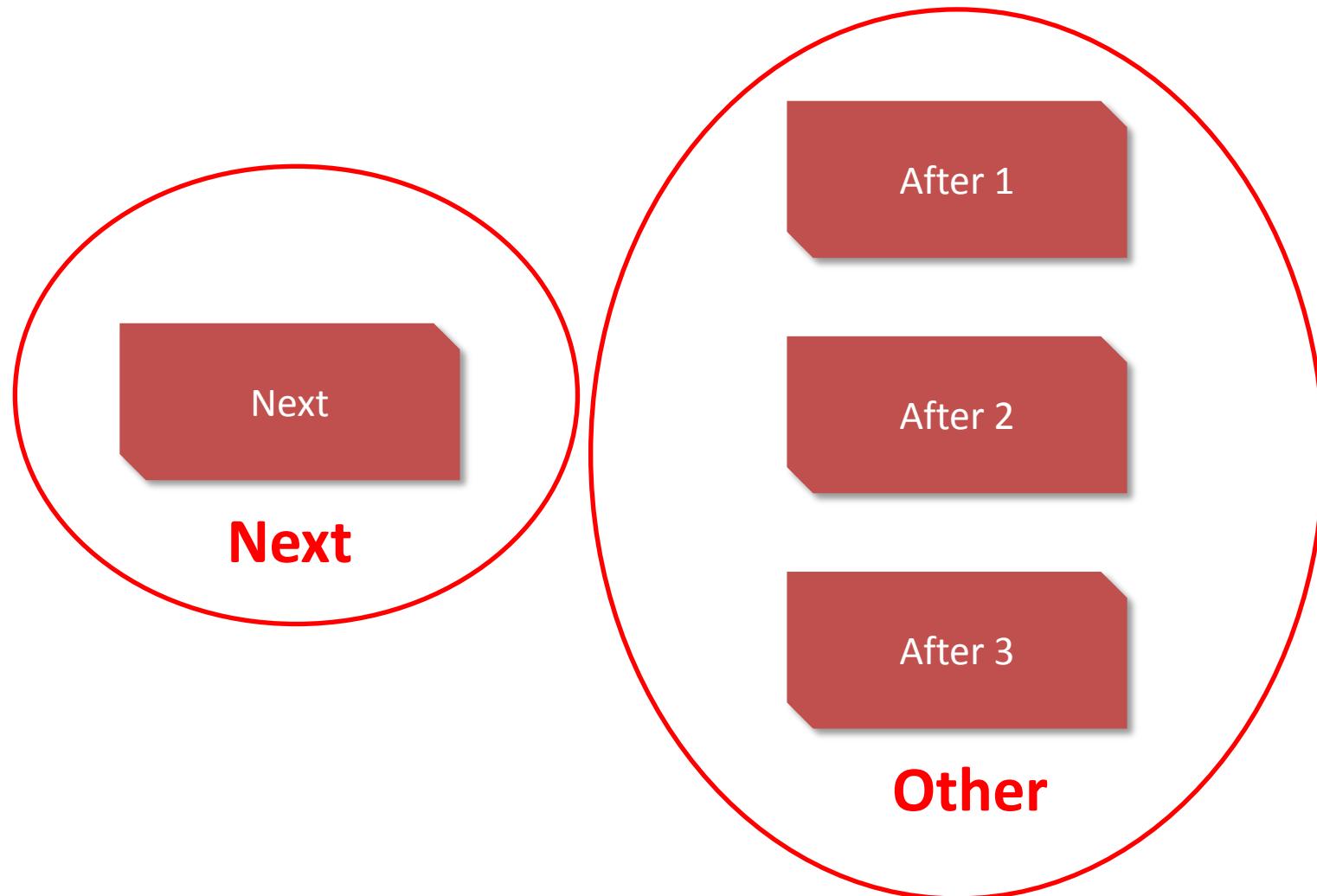


After 1

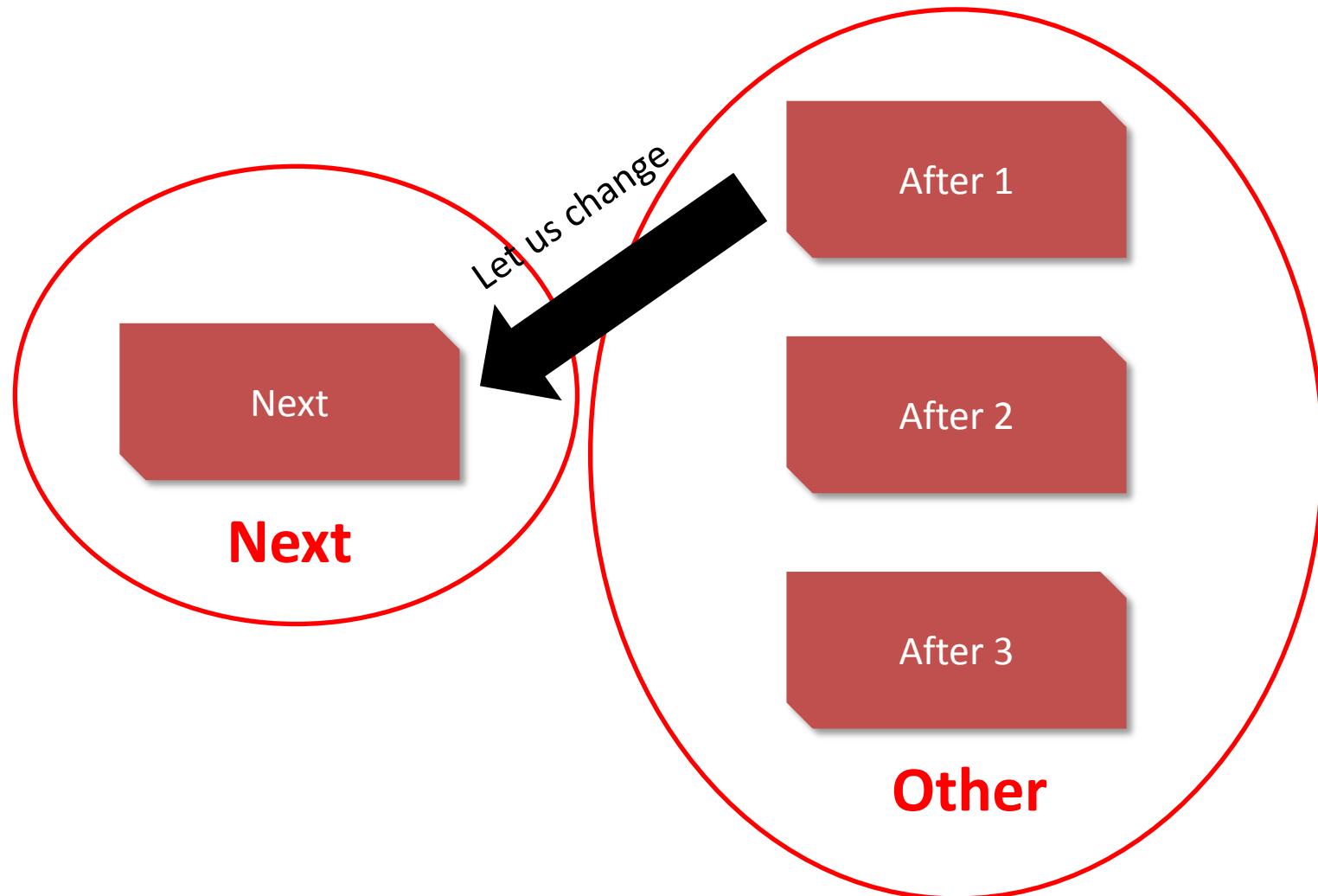
After 2

After 3

We calculated the ROC areas in a pair basis



We calculated the ROC areas in a pair basis



We calculated the ROC areas in a pair basis

