Universiteit Antwerpen

Vrije Universiteit Brussel

CHA-Q

Change-centric quality Assurance

February 2015

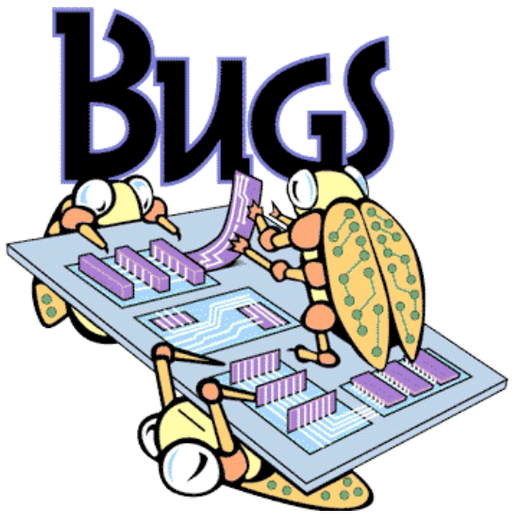
WHY ?

Changes
Past
annotations
recurring
program
misclassified
Analyzing
Present
Software
change-aware
reports
mining
Repeating
bug
links
re
long
transformations
traceability
meta
Change-Centric
Future
logging
meta-data
model
active
fix
evolution
API
process
distilling
monitor
bug-fixes
Development
Tracing
test

Reliability vs. Agility

Software is vital to our society ⇒ Software must be reliable

Traditional Software Engineering
Reliable = Software without bugs

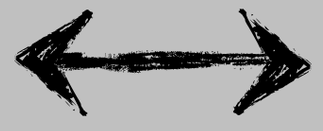


Today's Software Engineering
Reliable = Easy to Adapt

On the Origin of Species

Striving for RELIABILITY

(Optimise for *perfection*)



Striving for AGILITY

(Optimise for *development speed*)

Software Repositories & Archives

Version Control

- CVS, Subversion, …
- Rational ClearCase
- Perforce,
- Visual Source Safe
- …

Automate the Build

- make
- Ant, Maven
- MSBuild
- OpenMake
- Build Forge
- …

Issue Tracking

- Bugzilla
- BugTracker.NET
- ClearQuest
- JIRA
- Mant
- Visual Studio Team Foundation Server
- …

Automated Testing

- HP QuickTest Professional
- IBM Rational Functional Tester
- Maveryx
- Selenium
- TestComplete
- Visual Studio Test Professional Microsoft 2010
- …

… mailing archives, newsgroups, chat-boxes, facebook, twitter, …

Software Repositories & Archives

Version Control

- CVS, Subversion, …
- Rational ClearCase
- Perforce,
- Visual Source Safe
- …

Automate the Bui

- make
- Ant, Maven
- MSBuild
- OpenMake
- Build Forge

All of a sudden empirical research has what any empirical science needs: a large corpus of objects to analyze.

[Bertrand Meyer's technology blog]

Issue Tracking

- Bugzilla
- BugTracker.NET
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- Visual Studio Team Foundation Server
- …

Automated Testing

- HP QuickTest Professional
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- …

… mailing archives, newsgroups, chat-boxes, facebook, twitter, …

Mining Software Repositories

The Mining Software Repositories (MSR) field analyzes the rich data available in software repositories to uncover interesting and actionable information about software systems and projects.

Conferences

- 2015—12th edition, Florence, Italy
- 2014—11th edition, Hyderabad, India
- 2013—10th edition, San Francisco, CA, USA
- 2012—9th edition, Zürich, CH
- 2011—8th edition, Honolulu, HI, USA
- 2010—7th edition, Cape Town, ZAF
- 2009—6th edition, Vancouver, CAN
- 2008—5th edition, Leipzig, DEU
- 2007—4th edition, Minneapolis, MN, USA
- 2006—3rd edition, Shanghai, CHN
- 2005—2nd edition, Saint Luis, MO, USA
- 2004—1st edition, Edinburgh, UK

Hall of Fame—Mining Challenge Winners

- 2015 — StackOverflow

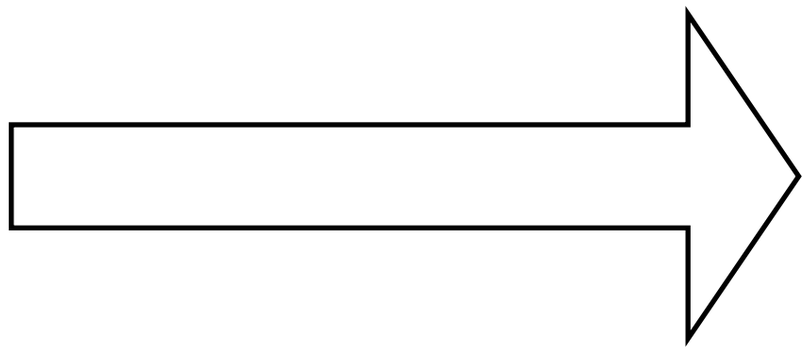
- 2014—Sentiment Analysis of Commit Messages in *GitHub*: An Empirical Study
- 2013—Encouraging User Behaviour with Achievements: An Empirical Study [*StackOverflow*]
- 2012—Do the Stars Align? Multidimensional Analysis of *Android's* Layered Architecture
- 2011—Apples Vs. Oranges? An exploration of the challenges of comparing the source code of two software systems [Netbeans+Eclipse]
- 2010—Cloning and Copying between *GNOME* Projects
- 2009—On the use of Internet Relay Chat (IRC) meeting by developers of the *GNOME* GTK+ project
- 2008—A newbie's guide to *Eclipse* APIs
- 2007—Mining *Eclipse* Developer Contributions via Author-Topic Models
- 2006—A study of the contributors of *PostgreSQL*

Space

P. Dourish and V. Bellotti. **Awareness and Coordination in Shared Workspaces.** Proceedings of the ACM Conference on Computer-Supported Cooperative Work (CSCW'92).

© Margaret-Anne (Peggy) Storey; Keynote for MSR 2012, Zurich, Switzerland

Space



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Space → Place

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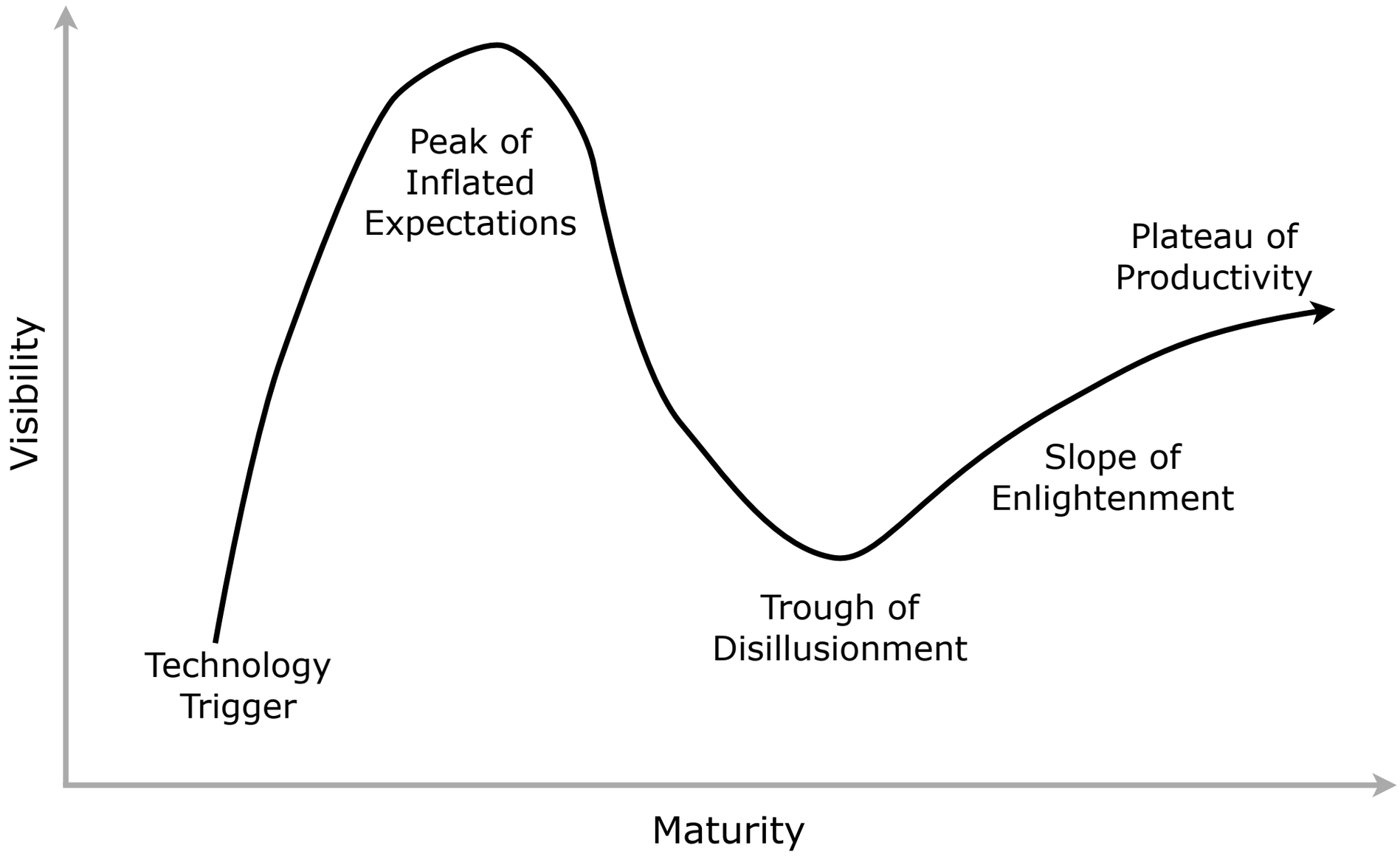
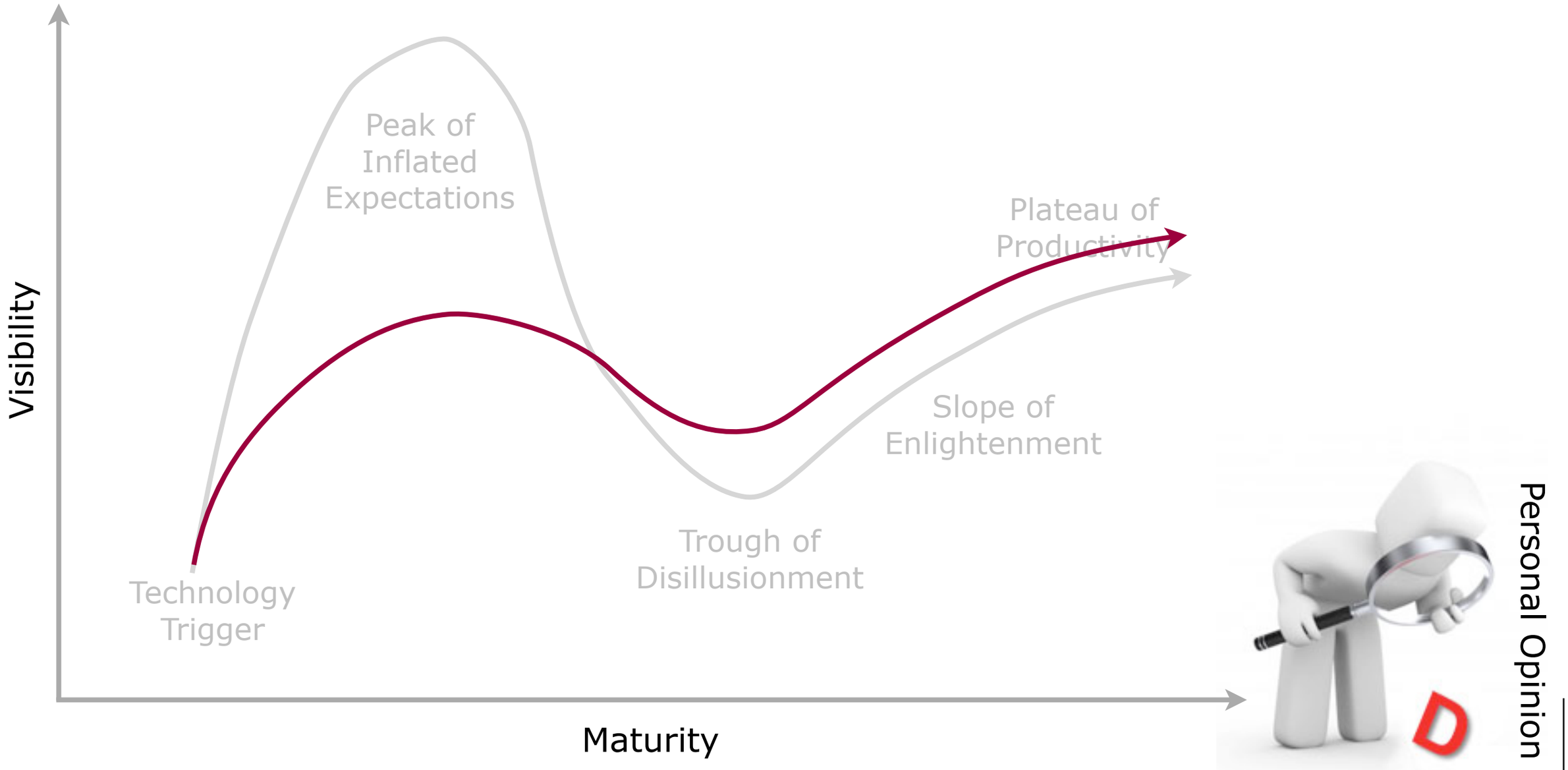
Hype Cycle



Hype Cycle © Gartner

The Future ?



Hype Cycle © Gartner

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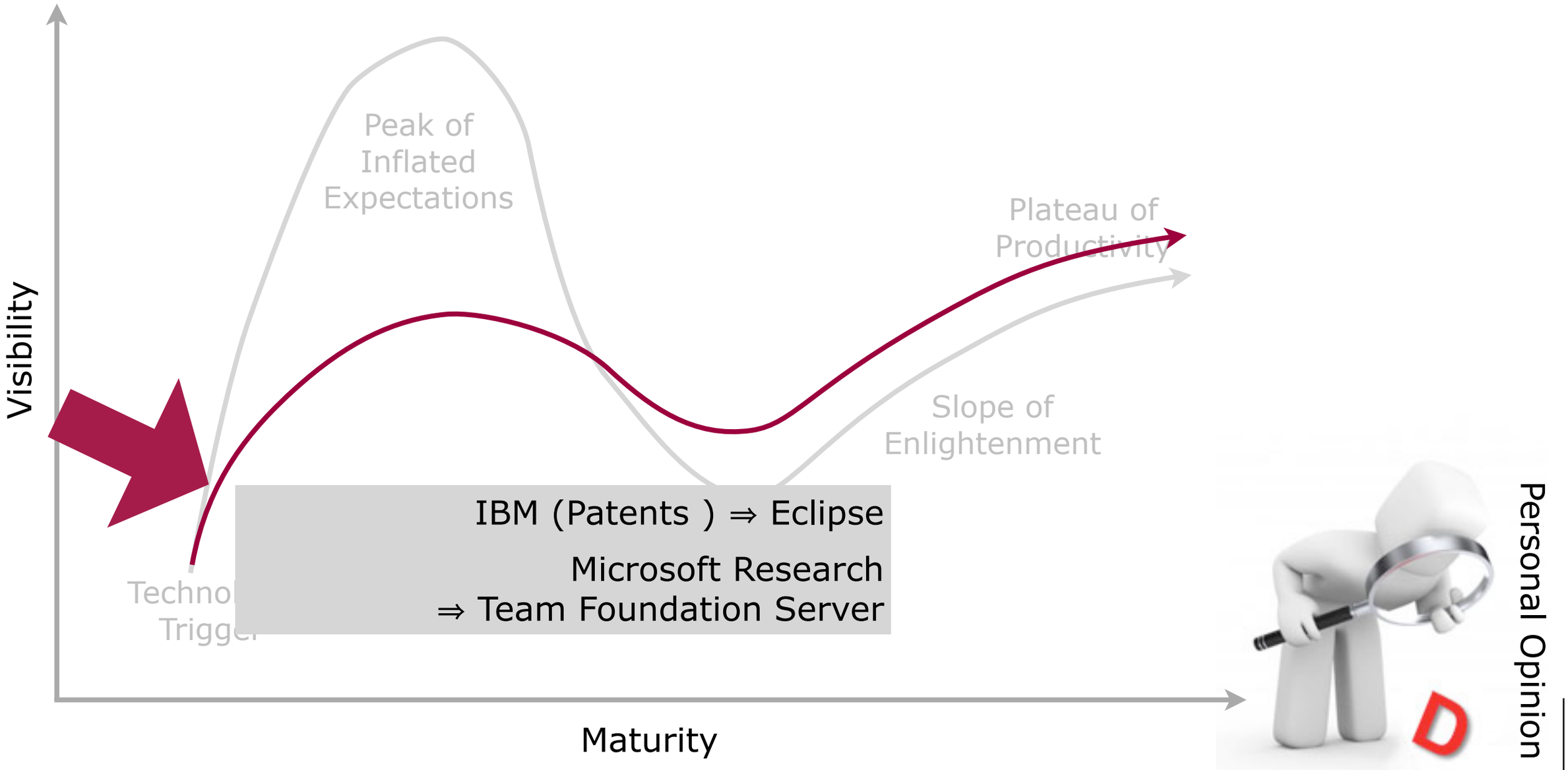


Hype Cycle © Gartner

HOW ?

Changes
Past
annotations
recurring
program
misclassified
Analyzing
Present
Software
change-aware
reports
mining
Repeating
bug
links
re
long
transformations
traceability
meta
Change-Centric
Future
logging
meta-data
model
active
fix
evolution
API
process
distilling
monitor
bug-fixes
Development
Tracing
test

Project Overview

[RT1] Analysing Changes
- meta model
- distilling & logging

[RT2] Repeating Changes
- program transformations
- change-aware transformations

[RT3] Tracing Changes
- mining traceability links
- active meta-data (annotations)

Change-Centric Software Development

Past Changes
[UC1] monitor test process
[UC2] misclassified bug reports

Present Changes
[UC3] API evolution
[UC4] recurring bug-fixes

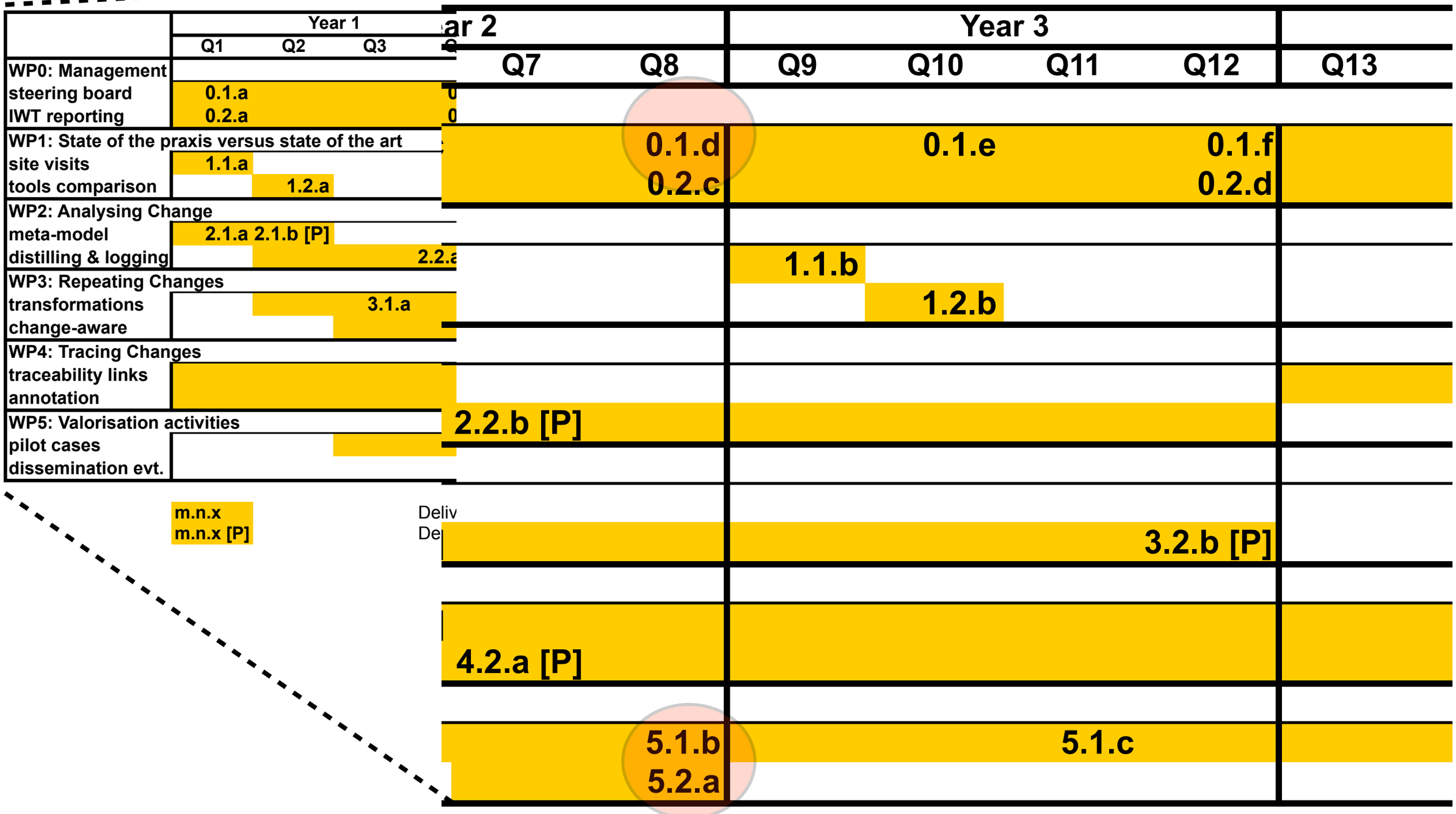
Future Changes
[UC5] who should fix ?
how long to fix ?
[UC6] what to (re)test ?

Deliverables

	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
WP0: Management																
steering board	0.1.a			0.1.b		0.1.c		0.1.d		0.1.e		0.1.f		0.1.g		0.1.h
IWT reporting	0.2.a			0.2.b				0.2.c				0.2.d				0.2.e
WP1: State of the praxis versus state of the art																
site visits	1.1.a								1.1.b							
tools comparison		1.2.a								1.2.b						
WP2: Analysing Change																
meta-model	2.1.a	2.1.b [P]												2.1.c		2.2.c
distilling & logging				2.2.a [P]		2.2.b [P]										2.2.c
WP3: Repeating Changes																
transformations			3.1.a		3.1.b [P]											
change-aware						3.2.a [P]						3.2.b [P]				3.2.c
WP4: Tracing Changes																
traceability links						4.1.a [P]										4.1.b
annotation							4.2.a [P]									4.2.b
WP5: Valorisation activities																
pilot cases					5.1.a			5.1.b		5.1.c			5.1.d			5.1.e
dissemination evt.								5.2.a								5.2.b

m.n.x	Deliverable m.n.x is due at end of quarter. m = work-package; n = activity; x = sequence number
m.n.x [P]	Deliverable m.n.x includes a prototype tool

Deliverables



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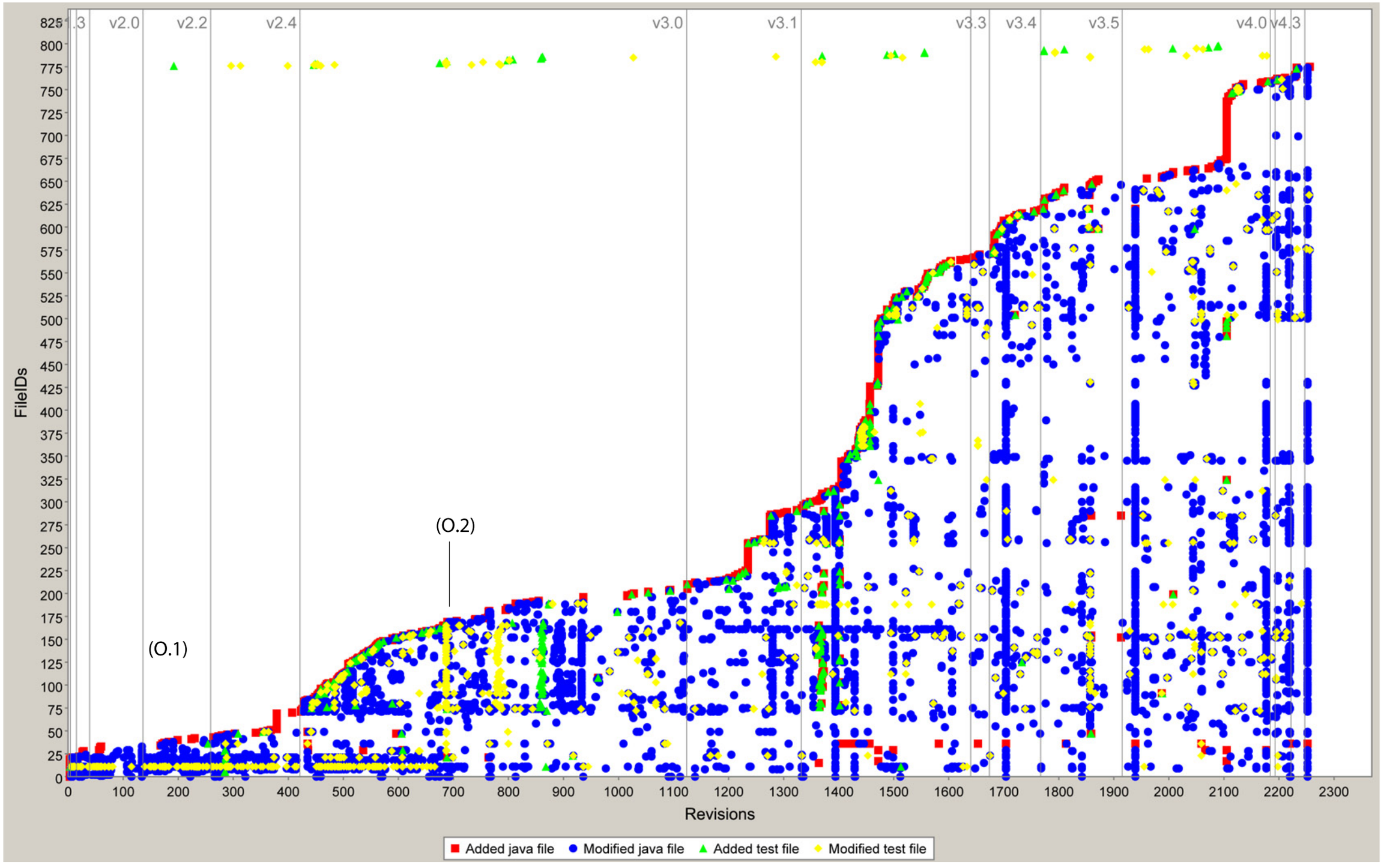
rototype tool

[UC1] Monitor Test Process

http://swerl.tudelft.nl/bin/view/Main/TestHistory

Case = Checkstyle



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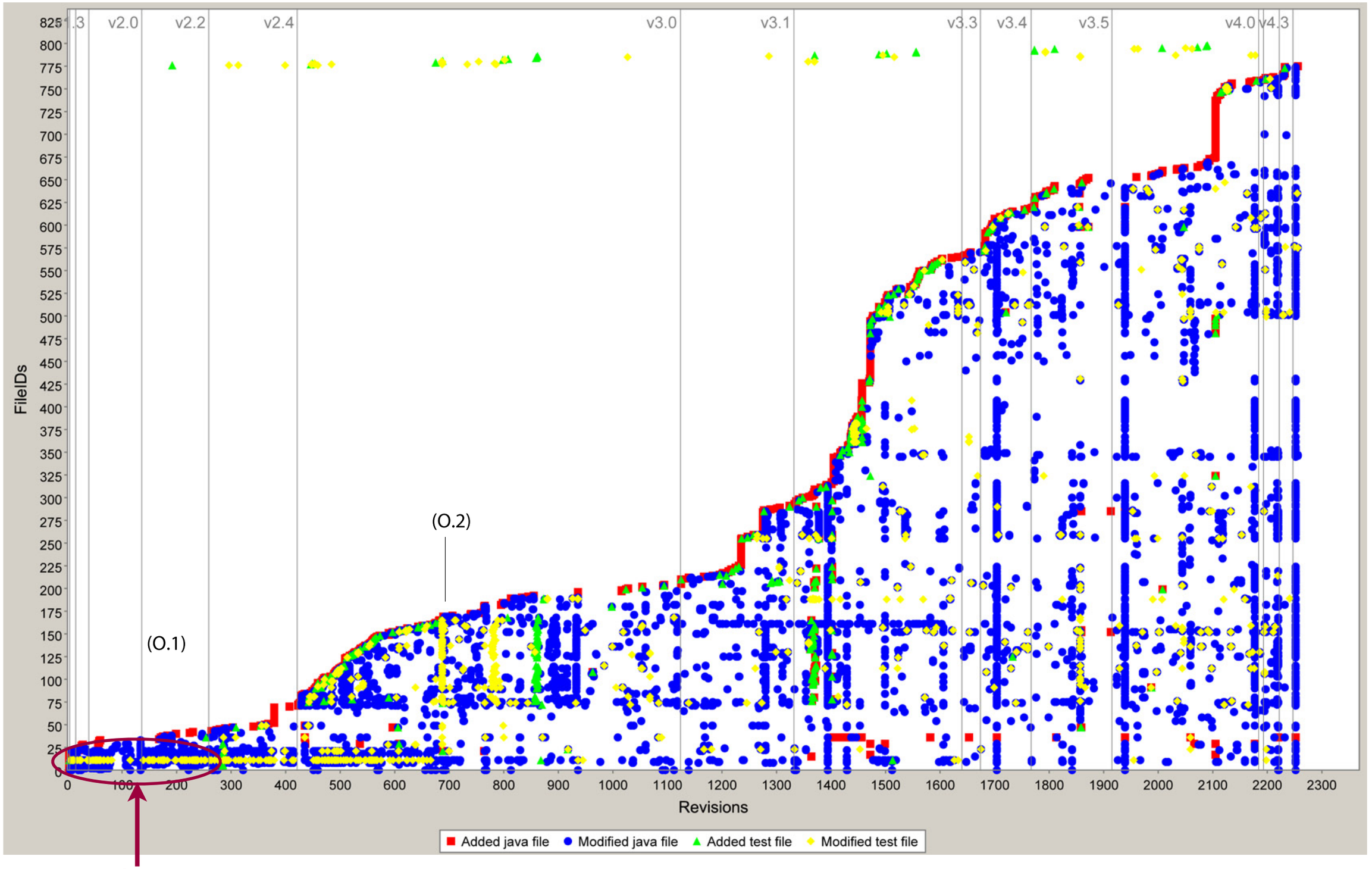

Single Test

[UC1] Monitor Test Process

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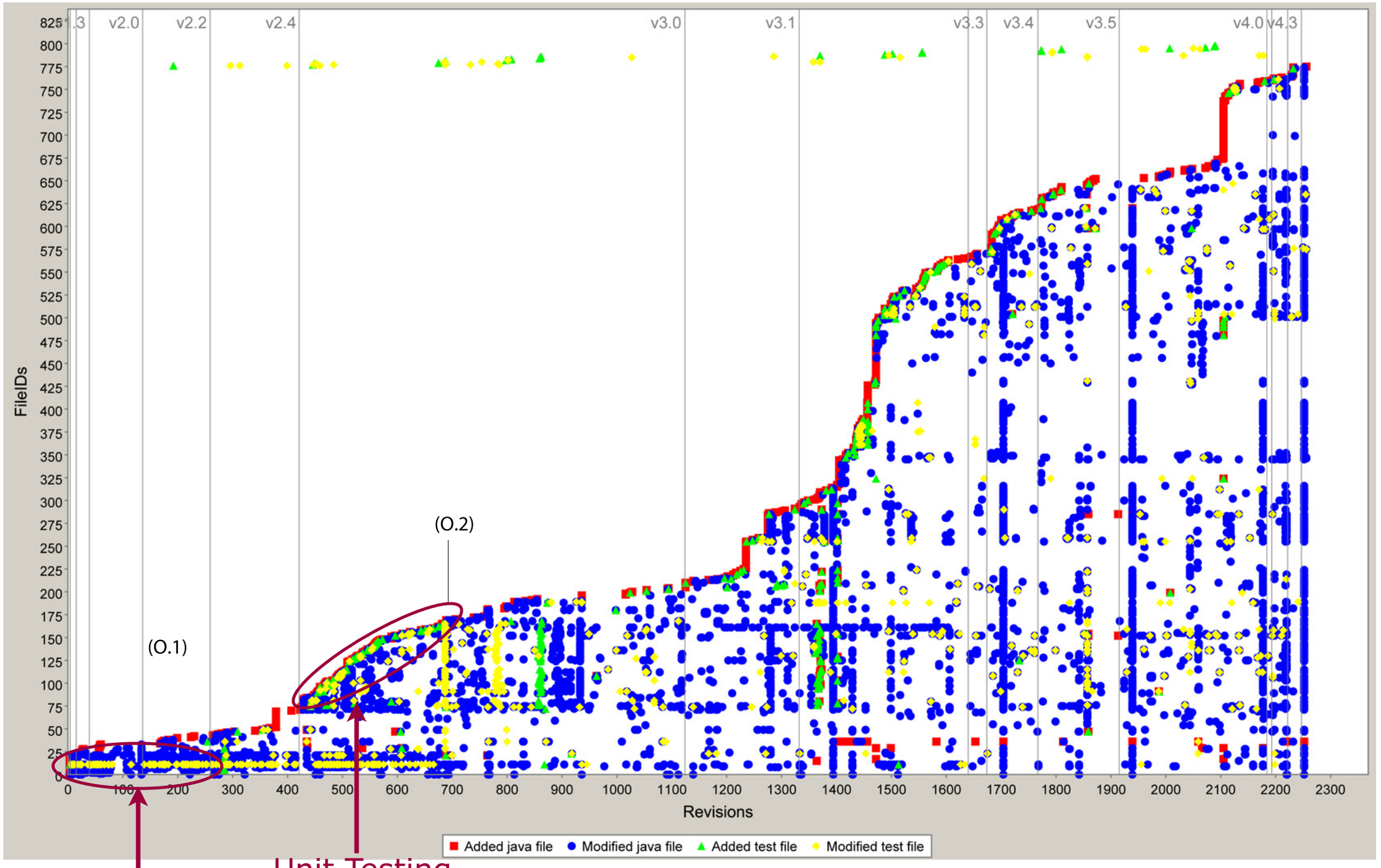
Case = Checkstyle



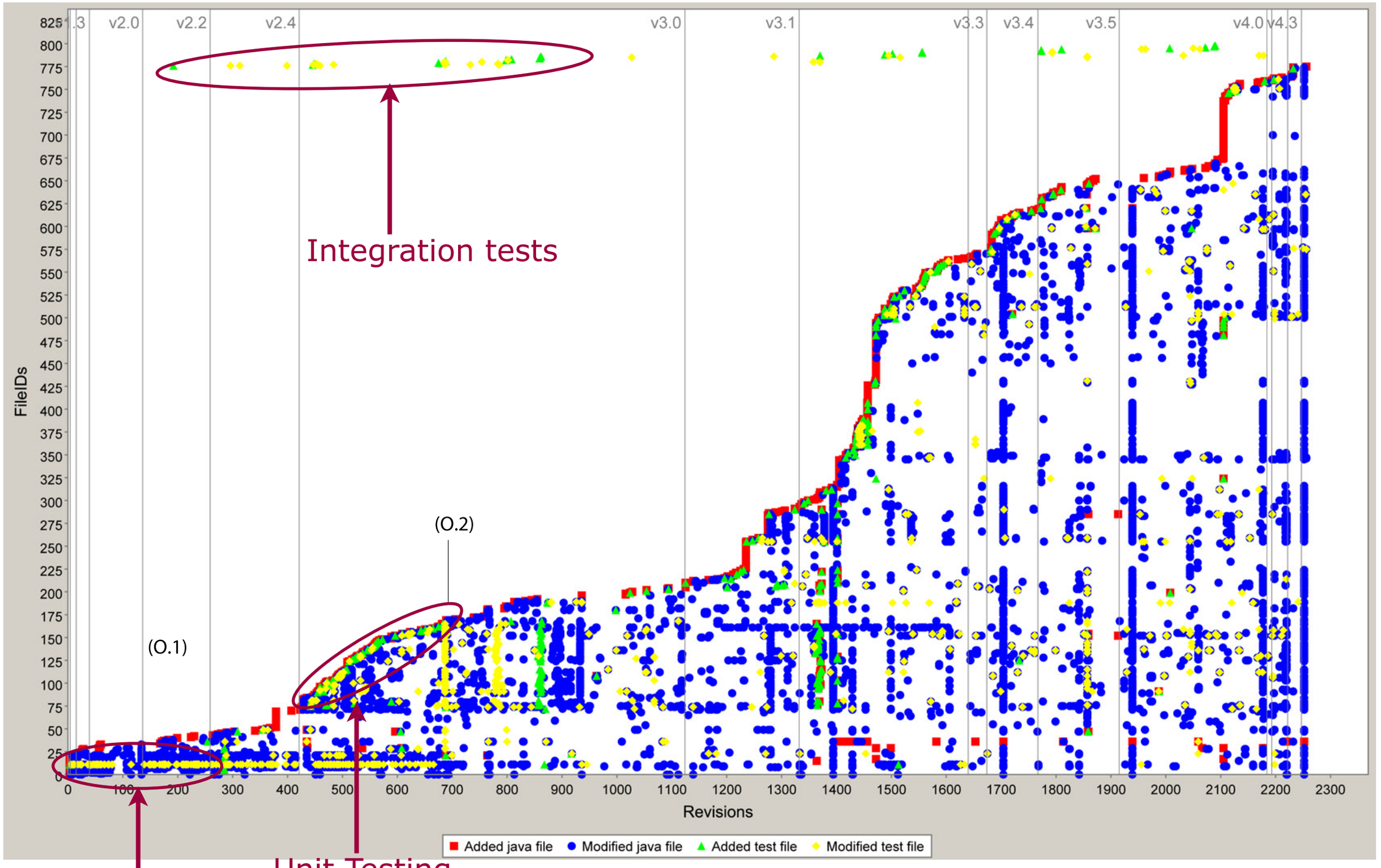
Single Test

Unit Testing

[UC1] Monitor Test Process

http://swerl.tudelft.nl/bin/view/Main/TestHistory

Case = Checkstyle



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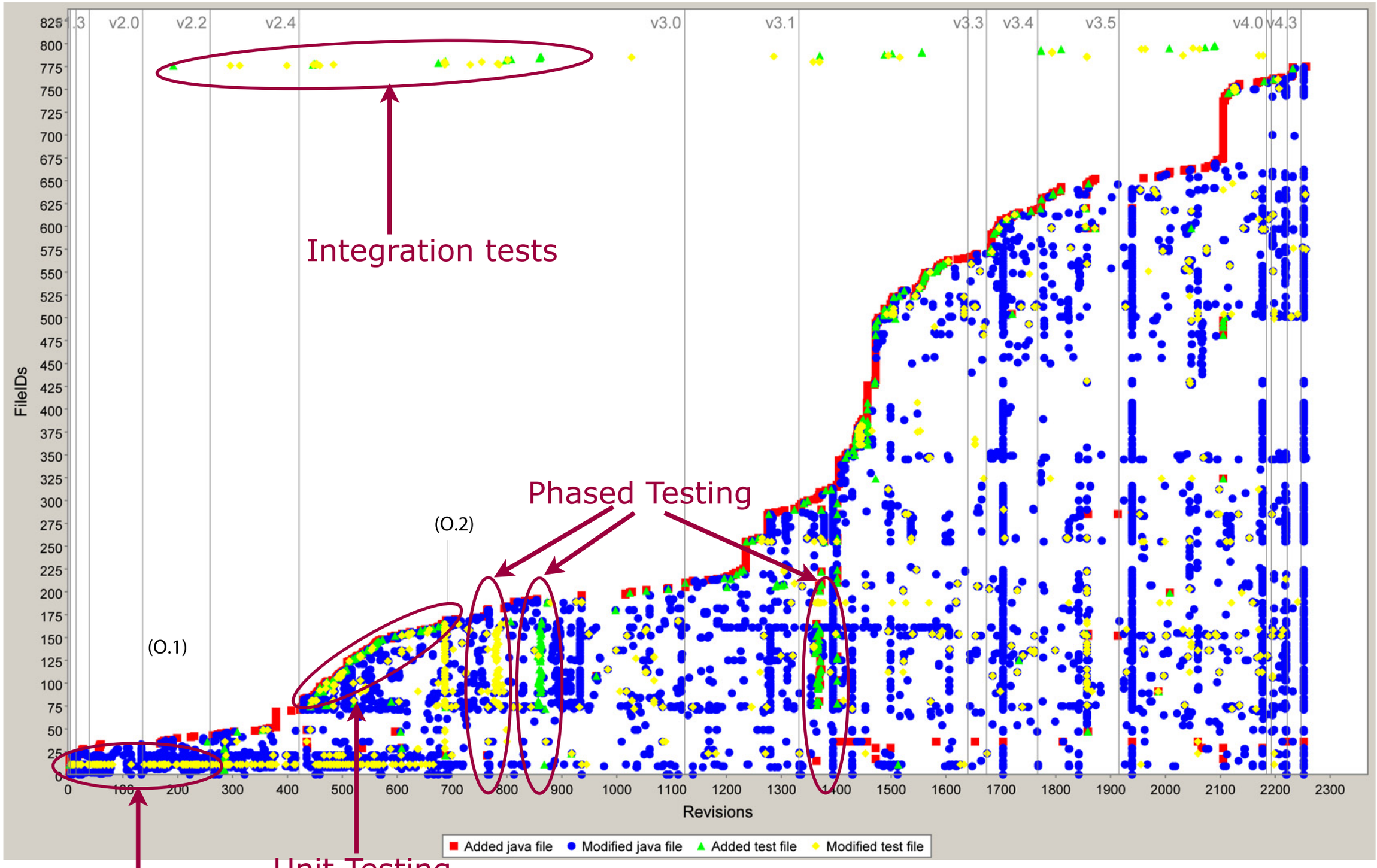


[UC3] API evolution

Type of change	E	E*	M	S	S*	L	JHD
Moved Method	16	13	-	11	28	9	-
Moved Field	-	45	-	18	2	5	-
Deleted Method	2	2	-	24	32	-	2
ChangedArgumentType	5	-	4	18	4	11	-
Changed Return Type	2	-	1	2	-	2	31
Replaced Method Call	1	20	-	8	4	-	1
Renamed Method	4	-	-	16	5	8	-
New Hook Method	4	2	2	7	-	-	5
Extra Argument	3	2	2	1	1	-	2
Deleted Class	-	-	-	9	-	-	1
Extracted Interface	-	-	-	-	-	-	7
Renamed Field	-	-	-	6	1	-	-
Renamed Class	-	1	-	2	-	2	2
Method Object	3	-	-	-	-	-	-
Pushed Down Method	3	-	-	-	-	-	-
Moved Class	-	2	-	-	-	-	1
Pulled Up Method	-	-	-	1	-	-	-
Renamed Package	-	-	-	-	-	-	1
Split Package	-	-	-	-	-	-	1
Split Class	-	-	-	-	-	-	1
New Method Contract	3	12	1	8	-	1	-
Implement New Interface	1	-	1	5	-	-	3
Changed Event Order	3	-	-	-	-	-	-
New Enum Constant	1	-	-	-	-	-	-

Table II. Types of BREAKING API CHANGES and the number of these changes in Eclipse (E), Mortgage (M), Struts (S), log4j (L), and JHotDraw (JHD). Eclipse* (E*) and Struts* (S*) denote recommended changes, that is changes that will become breaking changes in future releases. Those changes in italic font (upper half of the table) are refactorings.

Component	# Breaking Changes	% Refactorings
Eclipse	51	84%
Eclipse*	99	87%
Mortgage	11	81%
Struts	136	90%
Struts*	77	100%
Log4J	38	97%
JHotDraw	58	94%

Table IV. Ratio of refactorings to all breaking API changes. Eclipse* and Struts* denote recommended changes.

	Struts	Log4J
Refactorings	123	37
All Other API Changes	325	920
Percentage of Refactorings	27.4%	3.8%
Impact of Refactorings	90%	97%

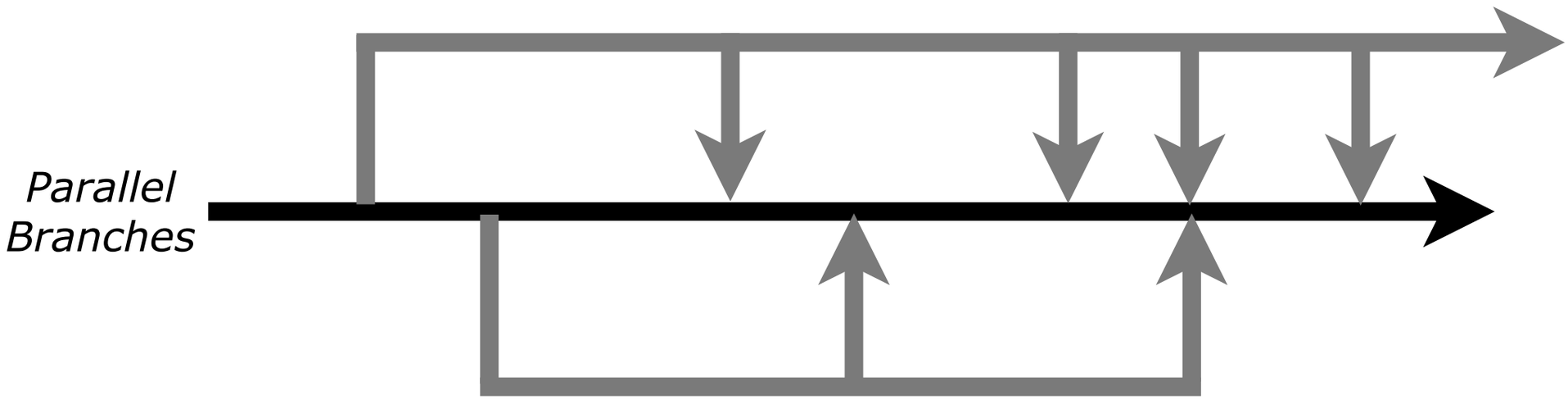
Table V. The impact of refactorings upon backwards compatibility

How do APIs evolve? A story of refactoring
Danny Dig, and Ralph Johnson (JSME 2006)

[UC5] Recurring Bug Fixes

			same revision	*different revision*	
Project	RBF	Percentage	In Space	In Time	Both
ArgoUML	390	16.8%	96.9%	17.2%	14.1%
Columba	377	45.4%	88.8%	17.7%	6.5%
ZK	188	38.4%	91.5%	13.3%	4.8%
FlashRecruit	244	24.2%	85.3%	22.1%	7.4%
gEclipse	215	19.1%	89.1%	27.7%	16.8%

Recurring Bug Fixes in Object-Oriented Programs,
Tung Thanh Nguyen, et. al. (ICSE2010)



[UC2] Misclassified Bug Reports

Enter Bug: OAW4

Bugzilla – Enter Bug: OAW4

Home | New | Search | Find | Reports | My Requests | My Votes | Preferences | Log out karsten.thoms@itemis.de

Before reporting a bug, please read the bug writing guidelines, please look at the list of most frequently reported bugs, and please search for the bug.

Reporter: karsten.thoms@itemis.de
Version: 4.2.1 / 4.3.0 / 4.3.1 / 4.3.1 RC1 / 4.3.1 RC2

Product: OAW4
Component: oAW-adapter / oAW-build / oAW-check / oAW-classic / oAW-docs

Severity: enhancement
Priority: P5

Platform: PC
OS: Mac OS

Initial State: NEW
Assign To:
Cc:
Default CC:

Estimated Hours: 0.0
Deadline: (YYYY-MM-DD)

URL: http://
Summary:
Description:

Attachment: Add an attachment
Depends on:
Blocks:

Commit | Remember values as bookmarkable template

We've made a guess at your operating system and platform. Please check them and, if we got it wrong, email karsten.thoms@itemis.de.

Actions: Home | New | Search | Find | Reports | My Requests | My Votes | Preferences | Log out karsten.thoms@itemis.de
Edit: Parameters | Default Preferences | Sanity Check | Users | Products | Flags | Custom Fields | Field Values | Groups | Keywords | Whining
Saved Searches: My Bugs

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[UC2] Misclassified Bug Reports ?

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OS: Mac OS

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Assign To:
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[UC5] Who to fix ?
How long to fix ?

Estimated Hours: 0.0
Deadline: (YYYY-MM-DD)

URL: http://
Summary:
Description:

Description ⇒ text Mining

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Depends on:
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Saved Searches: My Bugs

[UC5] Who should fix ? How long to fix ?

Question	Cases	Precision	Recall
Who should fix this bug ?	Eclipse, Firefox, gcc	eclipse: 57% firefox: 64% gcc: 6%	—
How long will it take to fix this bug ?	JBoss	depends on the component many similar reports: off by one hour few similar reports: off by 7 hours	

Promising results but …
- how much training is needed ?
- how reliable is the data ?
  (estimates, severity, assigned-to)
- does this generalize ? (on industrial scale ?)

⇒ replication is needed

[UC6] What to Retest ?

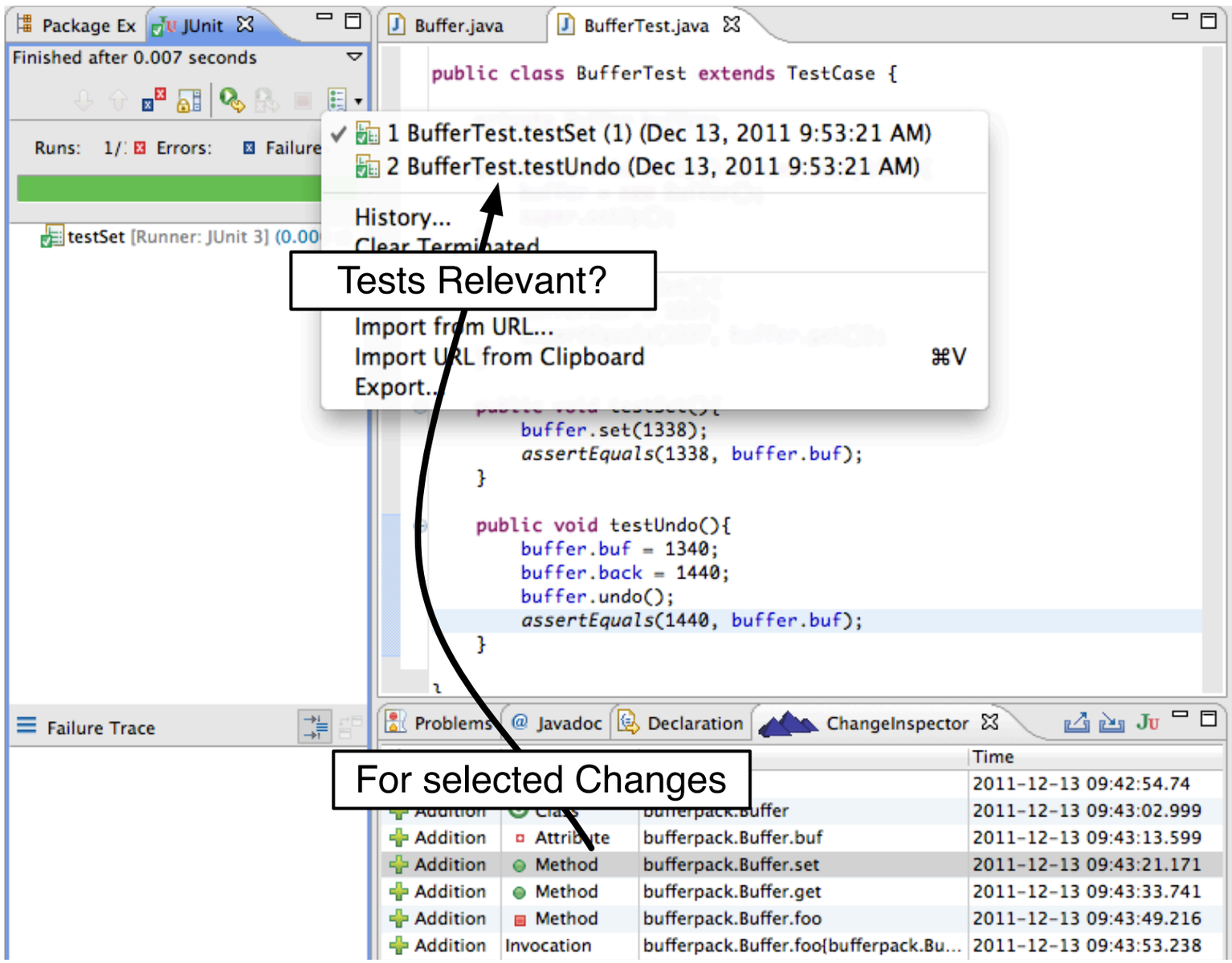
Most respondents said that running all unit tests took just seconds or minutes, but some respondents had *unit test suites that took hours to execute.*

A survey of unit testing practices. Per Runeson, IEEE Software, vol.23, no.4, pp.22,29, July-Aug. 2006

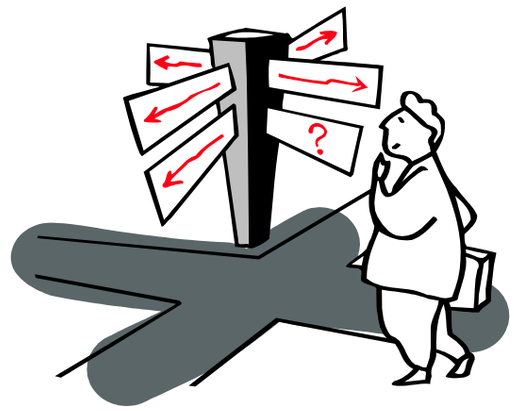
[UC6] What to Retest ?

Most respondents said that running all unit tests took just seconds or minutes, but some respondents had *unit test suites that took hours to execute.*

A survey of unit testing practices. Per Runeson, IEEE Software, vol.23, no.4, pp.22,29, July-Aug. 2006



Program



13:30 — 14:00 — [Serge] Welcome & Introduction of the project

14:00 — 10 minutes — [Tim] CHAQ tooling infrastructure
14:10 — 10 minutes — [Angela] Traceability
14:20 — 10 minutes — [Coen] Program Transformation
14:30 — 10 minutes — [Alessandro] How long to fix

14:40 — 10 minutes — Biological break

14:50 — 10 minutes — [Ali] Mutation Testing
15:00 — 10 minutes — [Quinten] What to retest
15:10 — 10 minutes — [Laurent] Maintenance of Selenium Tests
15:20 — 10 minutes — [Serge] Invitation to the steering board

15:30 — 1 hour — [Jurgen] International Guest Speaker