

Agile Requirements Tracing

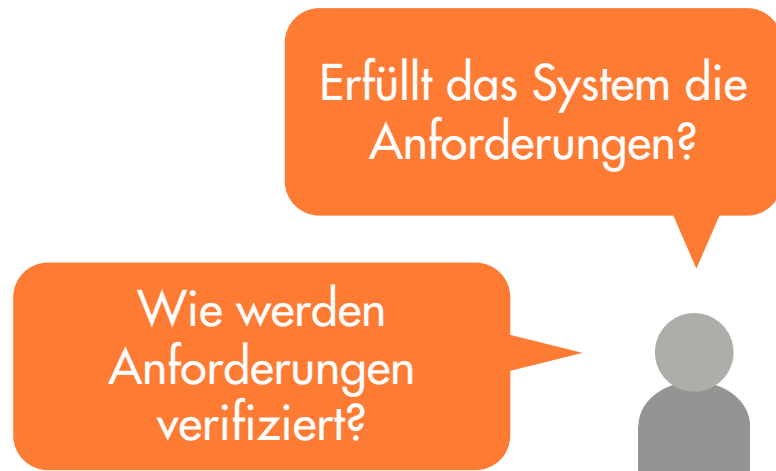
Sind Anforderungen, Code und Tests in Sync?

CQSE

Dr. Sven Amann

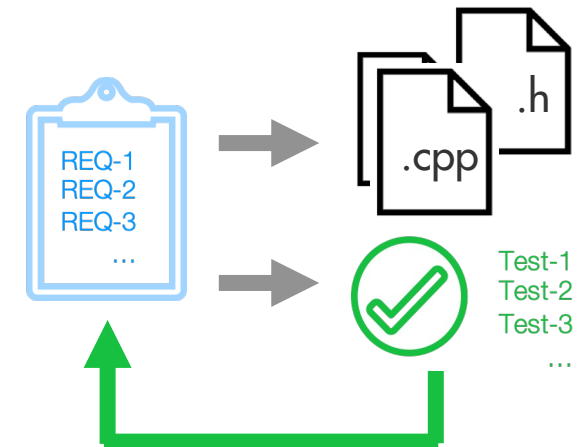
Requirements Tracing

- Herkunft: Sicherheitskritische Systeme



- Zertifizierung:

1. Anforderungen erfassen
2. Kritische Anforderungen verifizieren
3. Durch Traceability nachweisen



Standards fordern Requirements Tracing ...

- Medizin: IEC 62304, FDA GAMP, CFR 803.18
- Automobil: ISO 26262
- Luftfahrt: DO-178C/ED-12C
- ...

... und unser Anspruch an die eigene Professionalität wächst:

Sicherstellen, dass wir entwickeln, was wir entwickeln wollen!

Die Verifikationsmatrix: Sicherheit, dass Sie entwickeln, was Sie entwickeln wollen.

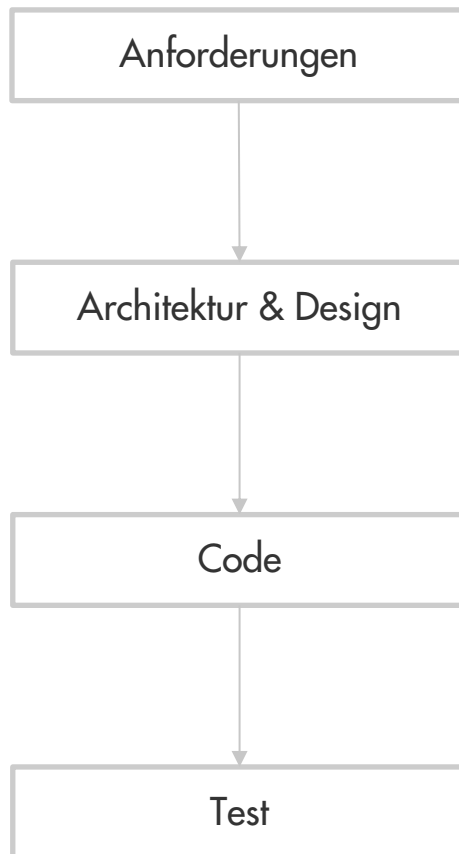
Anforderungen

Requirement Identifiers	Reqs Tested	REQ1 UC 1.1	REQ1 UC 1.2	REQ1 UC 1.3	REQ1 UC 2.1	REQ1 UC 2.2	REQ1 UC 2.3.1	REQ1 UC 2.3.2	REQ1 UC 2.3.3	REQ1 UC 2.4	REQ1 UC 3.1	REQ1 UC 3.2	REQ1 TECH 1.1	REQ1 TECH 1.2	REQ1 TECH 1.3
Test Cases	321	3	2	3	1	1	1	1	1	1	2	3	1	1	1
Tested Implicitly	77														
1.1.1	1	x													
1.1.2	2		x	x											
1.1.3	2	x													
1.1.4	1			x											
1.1.5	2	x												x	
1.1.6	1		x												
1.1.7	1			x											
1.2.1	2				x		x								
1.2.2	2					x		x							
1.2.3	2								x	x					
1.3.1	1										x				
1.3.2	1										x				
1.3.3	1											x			
1.3.4	1											x			
1.3.5	1											x			
etc....															
5.6.2	1														x

Testfälle

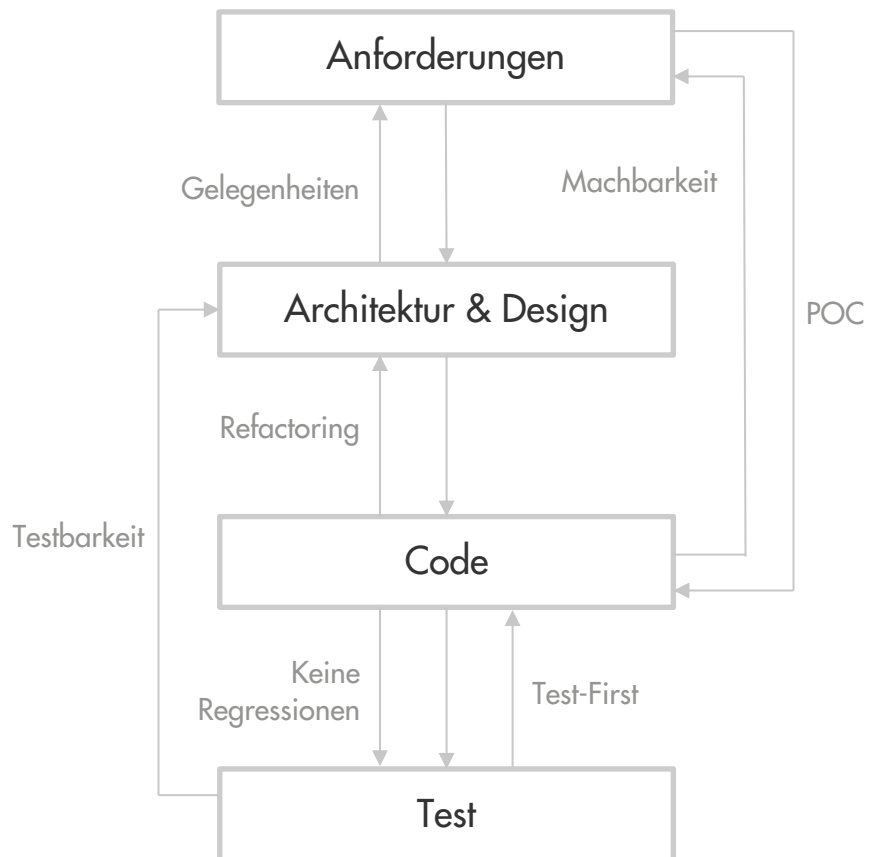
Haben wir die Anforderungen angemessen verifiziert?

Software Engineering aus Sicht der meisten Standards



Tracing-Informationen werden von Schritt zu Schritt mitgeführt.

Software Engineering in innovativen Projekten (die Realität)



Software Engineering ist ein Lernprozess!

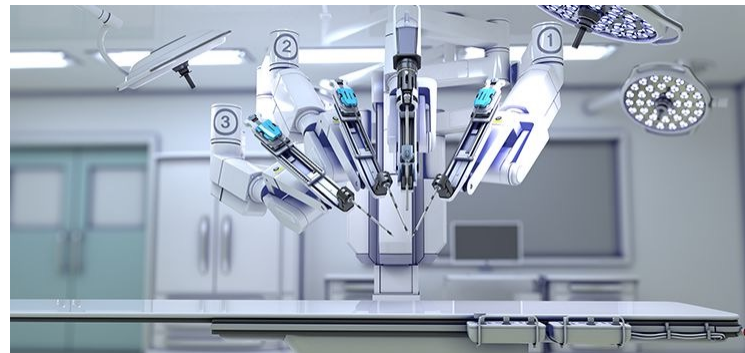


Wie gleichen wir Anforderungen, Code und Tests ab?!

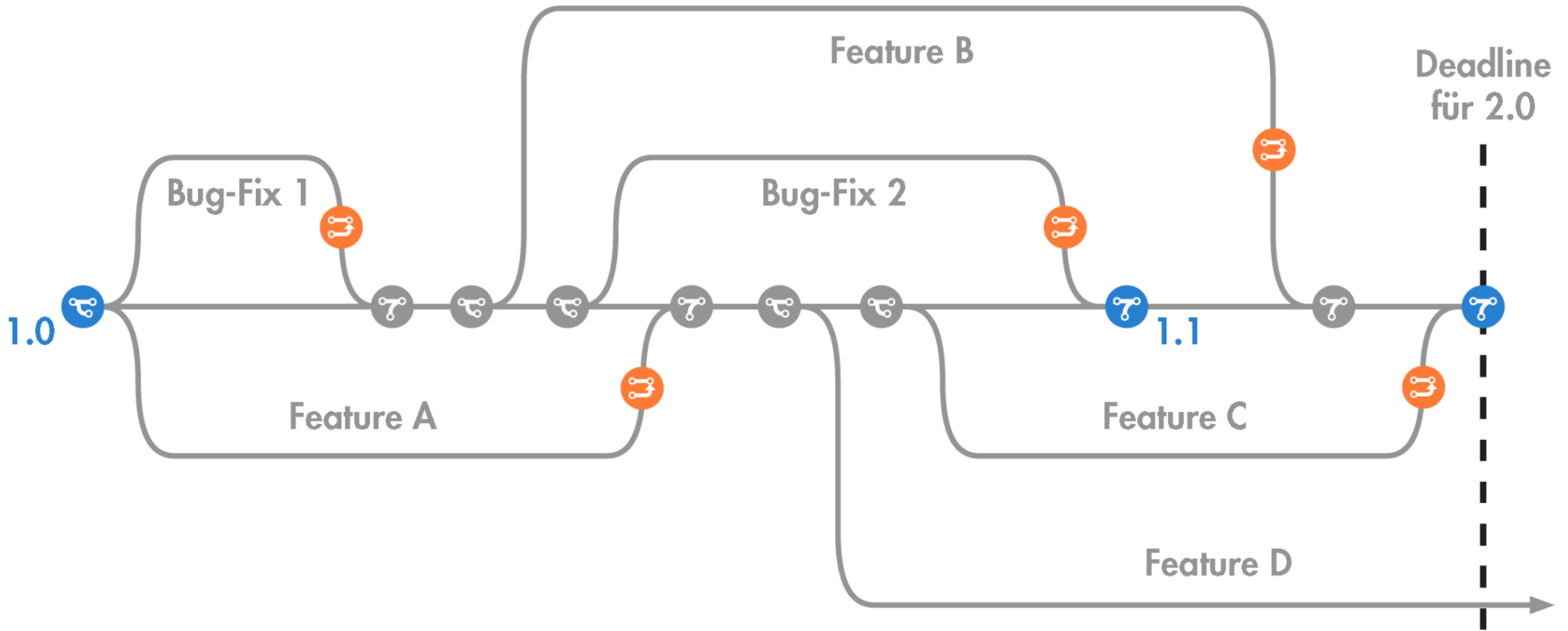
Zur schnellen Entwicklung hoch-innovativer Produkte brauchen wir Agilität!?

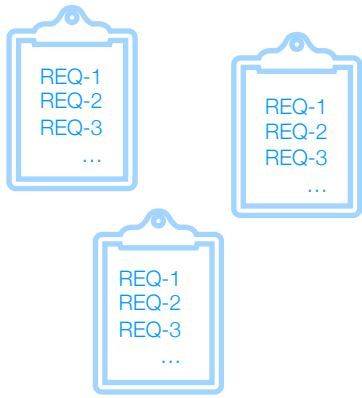
Agiles Manifest

- Individuen und Interaktionen stehen über **Prozessen** und Werkzeugen
- Funktionierende Software steht über umfassender **Dokumentation**
- Zusammenarbeit mit dem Kunden steht über **Vertragsverhandlungen**
- Eingehen auf Verändern steht über dem Befolgen eines **Plans**

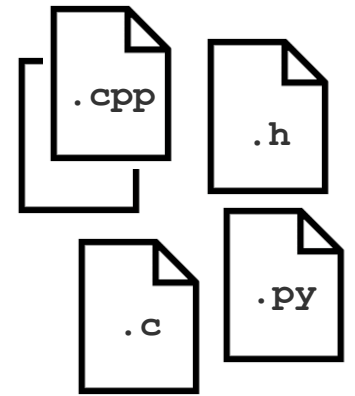
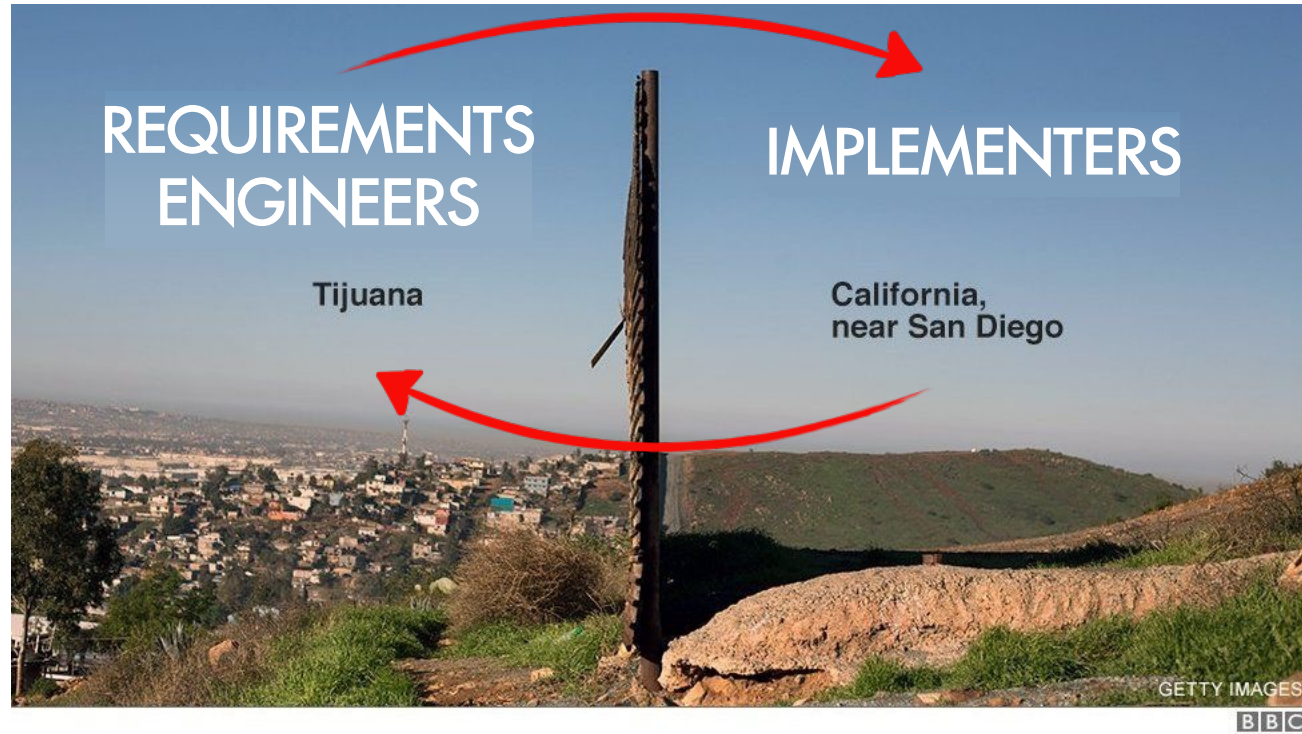








...



...



Stakeholder von Requirements Tracing

»Haben die Anforderungen Mängel?«



Requirements
Engineers

»Welche Anforderungen brauchen Tests?«



Tester

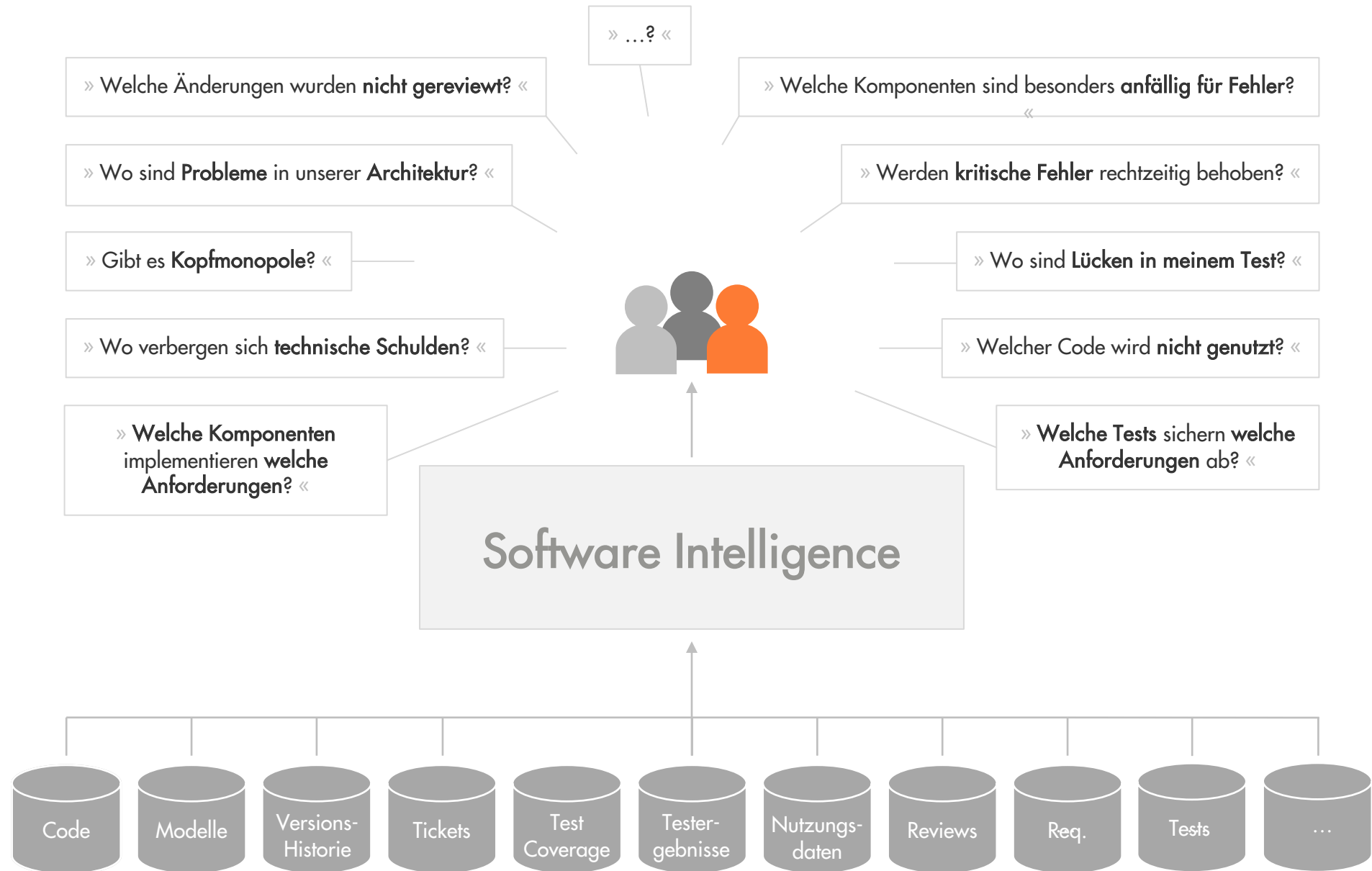
»Verifiziert dieser Test wirklich die Anforderung?«

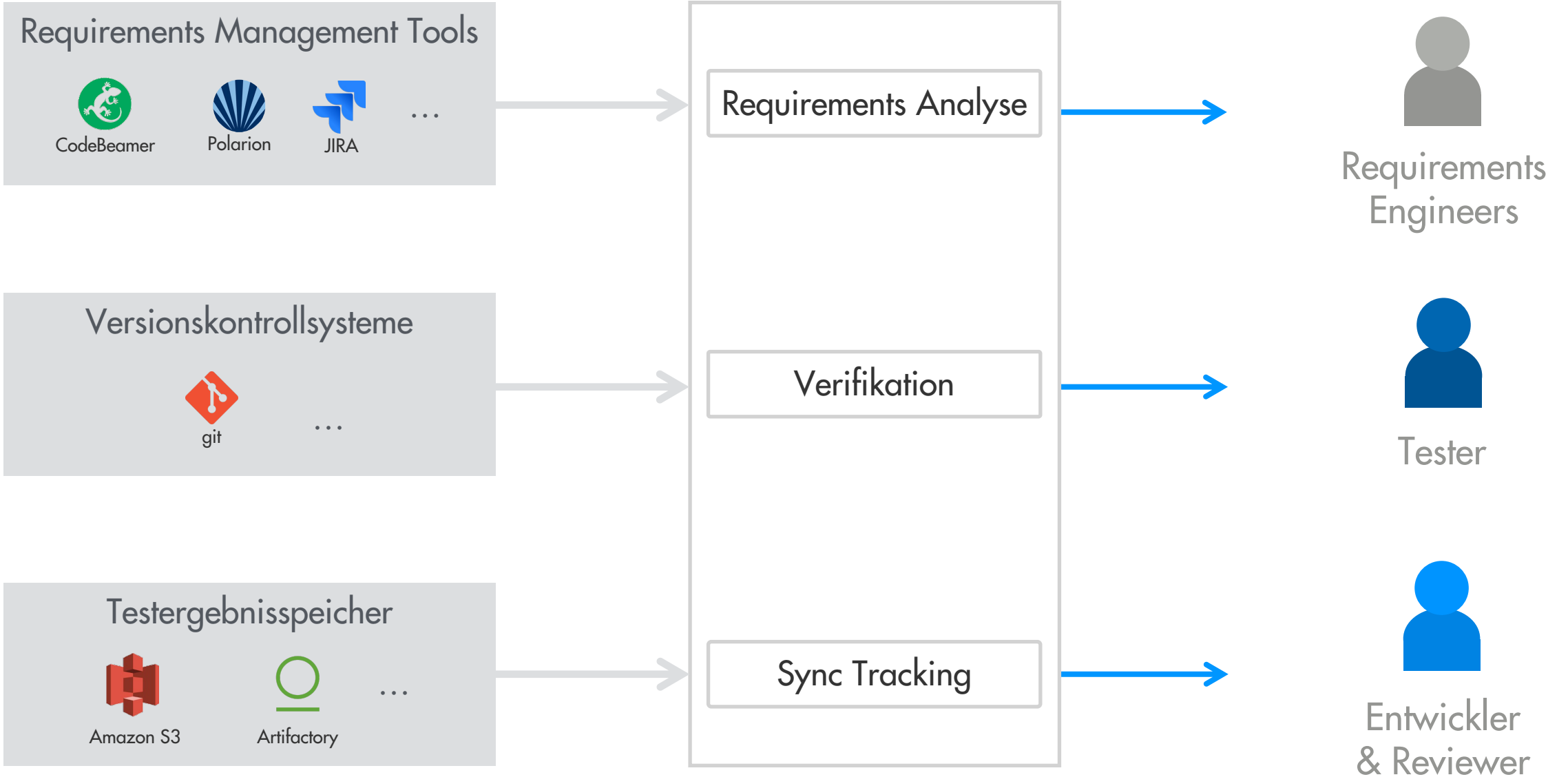


Entwickler
& Reviewer

Software Intelligence

- Hilft, Anforderungen und Code synchron zu halten
- Hilft, wichtige Fragen zu beantworten, z.B. bei der Verifikation
- Ermöglicht einen agileren Entwicklungsprozess, in dem sich Anforderungen weiterentwickeln können





Requirement Analyse

»Haben die Anforderungen
Mängel?«



Requirements
Engineers

»Haben die Anforderungen
Mängel?«



Requirements
Engineers

INTERNATIONAL
STANDARD

**ISO/IEC/
IEEE
29148**

First edition
2011-12-01

**Systems and software engineering —
Life cycle processes — Requirements
engineering**

*Ingénierie des systèmes et du logiciel — Processus du cycle de vie —
Ingénierie des exigences*



Reference number
ISO/IEC/IEEE 29148:2011(E)

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»Haben die Anforderungen
Mängel?«



Requirements
Engineers

Write well-formed requirements by **avoiding vague and general terms**: They result in requirements that are often difficult or even impossible to verify, or may allow for multiple interpretations.

Avoid the following types of unbounded or ambiguous terms:

- **superlatives** (e.g., 'best', 'most');
- **subjective** language (e.g., 'user friendly', 'easy to use', 'cost effective');
- **vague pronouns** (e.g., 'it', 'this', 'that');
- **ambiguous terms** such as adverbs and adjectives (e.g., 'almost always', 'significant', 'minimal');
- **ambiguous logical statements** (e.g., 'or', 'and/or')— consider multiple requirements in this case;
- **open-ended, non-verifiable** terms (e.g., 'provide support', 'but not limited to', 'as a minimum');
- **comparative** phrases (e.g., 'better than', 'higher quality');
- **loopholes** (e.g., 'if possible', 'as appropriate', 'as applicable');
- terms that imply **totality** (e.g., 'all', 'always', 'never', and 'every');
- **incomplete** references (not specifying the reference with its date and version number; not specifying just the applicable parts of the reference to restrict verification work).

»Haben die Anforderungen
Mängel?«



Requirements
Engineers

As a user, I want to send emails **optionally** with attachment.

Imprecise Phrase

Avoid the usage of ambiguous phrases, which can be interpreted in multiple ways by the reader.

[Details](#)

»Haben die Anforderungen
Mängel?«



Requirements
Engineers

As a client, I would like to be able to upload medical invoices online

Missing Rationale

A rationale is missing (... so that ...).

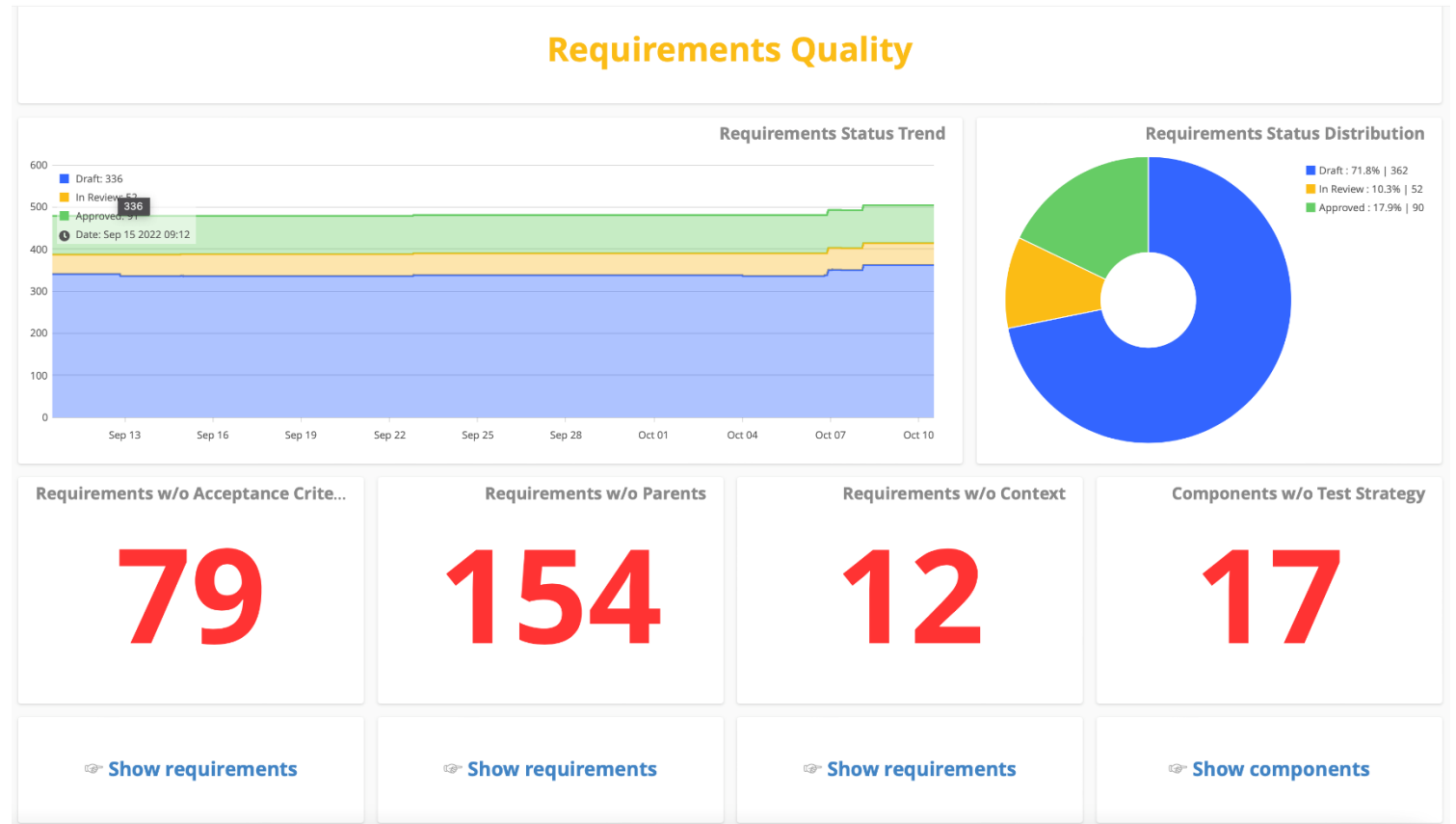
Acceptance Criteria:

- The UI of the upload system should be user-friendly and provide a button with the title 'Upload medical invoice'.
- As soon as the button is pressed, an additional window will automatically open and it is possible to browse through files.
- The system must accept all common file formats for uploading (pdf etc.).
- As soon as the user has found the desired invoice and presses the Upload button, the document is uploaded as quickly as possible and checked for the correct file format.

»Haben die Anforderungen Mängel?«




Requirements Engineers







... basierend auf den relevanten Requirements

Select from a total of 58 requirements:

✓ parent in [SW-193, SW-194, SW-186] 

Found 4 requirements matching your query "Concurrency" + Save Query As Metric

Requirements **58** Traceability Matrix

ID ▾	Subject	
SW-281	MySystem shall report to the client wether all items have...	Draft 
SW-278	MySystem shall use the instance name to configure the class name	Draft 
SW-275	MySystem shall allow the client to retrieve the number of items that was a...	Draft 
SW-274	Multiple clients shall have the ability to concurrently retrieve MySystem stat...	

Verifikation

»Welche Anforderungen
brauchen Tests?«



Tester

»Welche Anforderungen
brauchen Tests?«



Tester

Show test results from: **All**

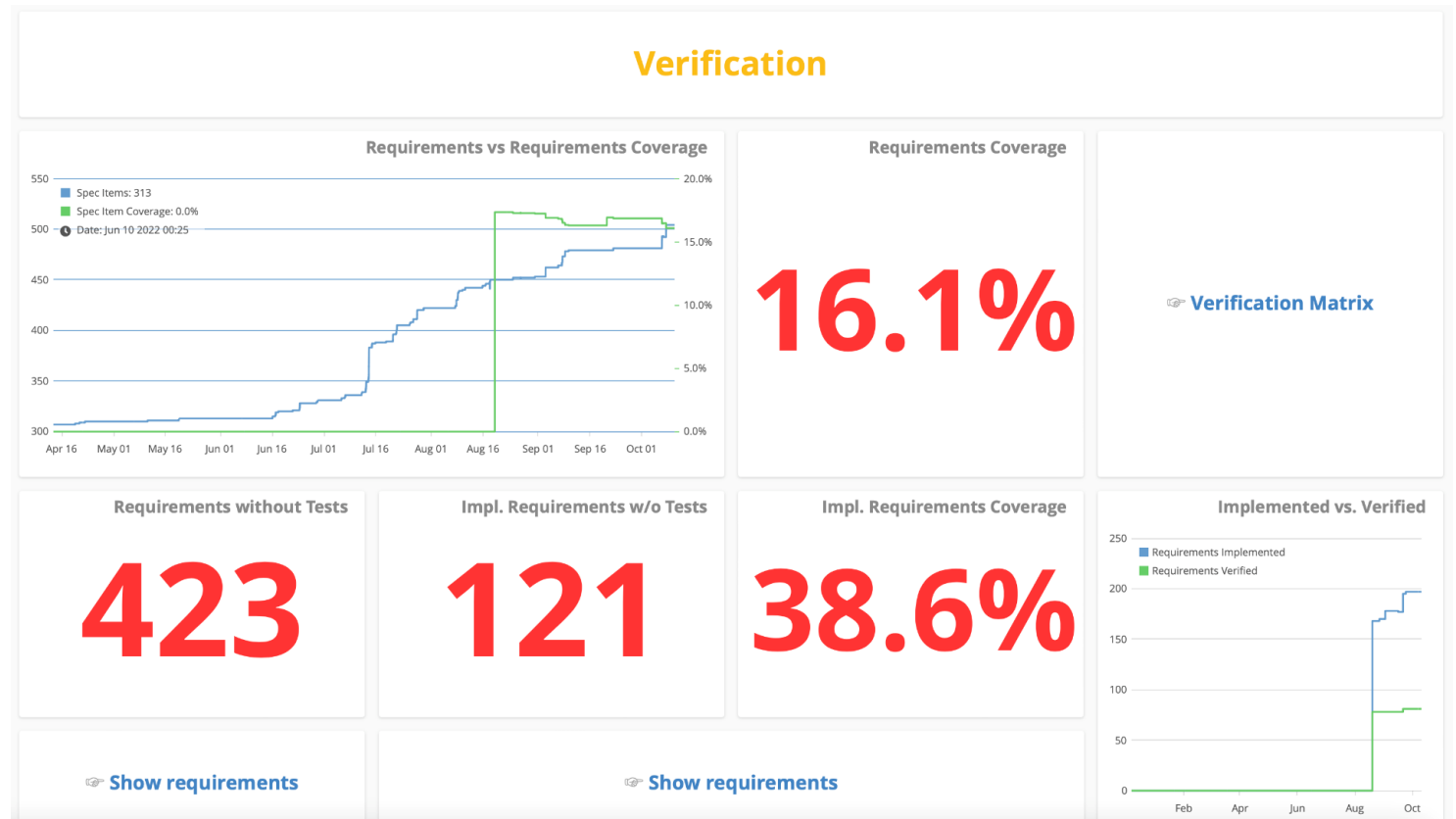
Tests	Specification Items	REQ DP-539	REQ DP-540	TST DP-547	TST DP-548
	Σ	1	0	1	1
data_structures/tests/stack_tests.c/StackTests/Push	1				
data_structures/tests/stack_tests.c/StackTests/Pop	1				
data_structures/tests/stack_tests.c/StackTests/Peek	1				

Linux SKIPPED
Windows FAILURE

»Welche Anforderungen brauchen Tests?«



Tester



... basierend auf den Tests aus dem Quellcode oder Test Management Tool

```
1  /*
2  * Stack Tests
3  */
4
5  #include <stdio.h>
6  #include <stdlib.h>
7  #include <time.h>
8  #include "stack.h"
9
10
11 // Verifies requirements DP-541 and DP-544
12 // Implements test case DP-548.
13 TEST_F(StackTests, Push) {
14     Stack *stack = getStack();
15     push(stack, 1);
16     push(stack, 2);
17     push(stack, 3);
18     ASSERT_TRUE(stack->size ==
19     free(stack);
20 }
21
22 // Implements test case DP-547.
23 TEST_F(StackTests, Pop) {
24     {
25         Stack *stack = getStack();
26         push(stack, 1);
27         push(stack, 2);
28         push(stack, 3);
29         int x = pop(stack);
30         ASSERT_TRUE(stack->size == 2);
31         // ASSERT_TRUE(x == 3);
32         free(stack);
33     }
34 }
```

Linked References 2

ID	Subject		
DP-544	REQ There shall be a stack data structure.	Approved	
DP-541	REQ The stack data structure shall allow the user to push an object onto the stack	Draft	

Sync Tracking

»Verifiziert dieser Test
wirklich die Anforderung?«



Entwickler
& Reviewer

1 Verify the stack requirements

Delta

Request to merge [verify_stack](#) into [master](#)

This change contains 6 commits and introduces 2 new findings

Test Gaps

Findings 2 2

Impacted Specification Items

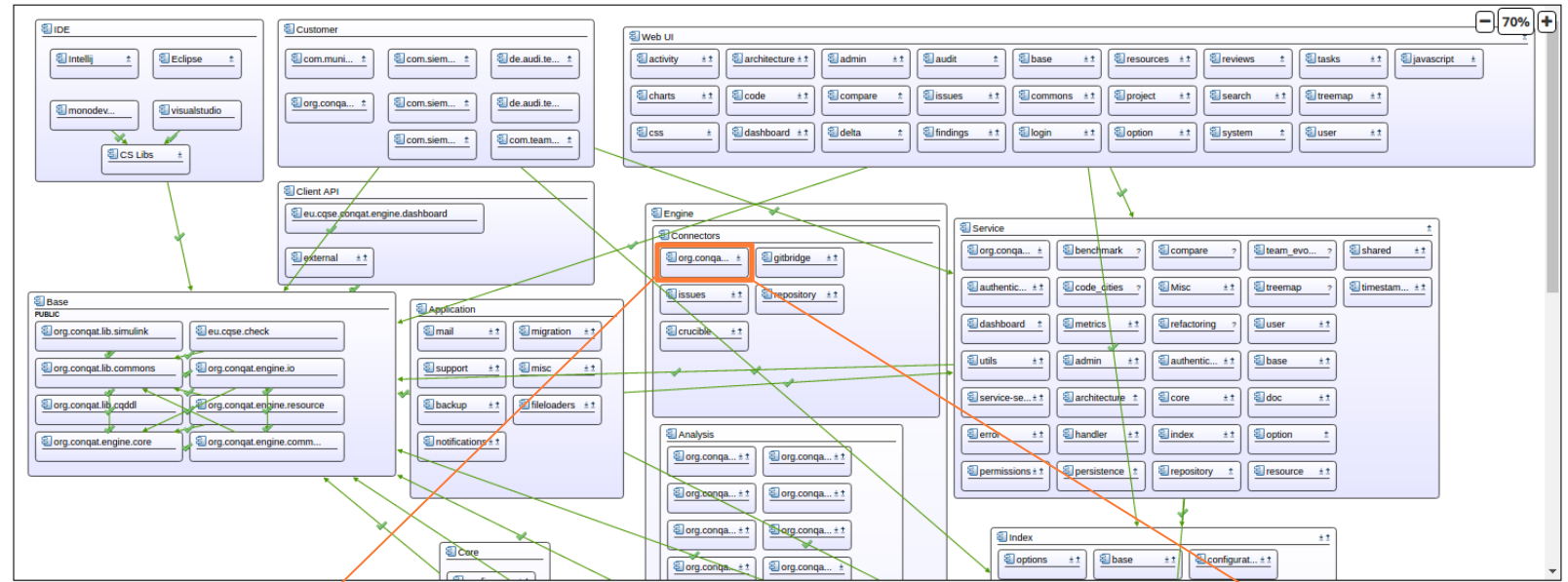
The following 4 specification items are related to the changes in this merge request. Please ensure that these specification items and the referencing code are still in line with one another.

Specification Items	Type	Change	Message	Reference location
DP-539	REQ	+	Test StackTests_Peek now references DP-539	data_structures/tests/stack_tests.c:37
DP-547	TST	⚡	Test StackTests_Pop has been modified and references DP-547	data_structures/tests/stack_tests.c:22
DP-544	REQ	🔻	Test StackTests_Push no longer references DP-544	data_structures/tests/stack_tests.c:11
DP-541	REQ	🔻	Test StackTests_Push no longer references DP-541	data_structures/tests/stack_tests.c:11

»Verifiziert dieser Test
wirklich die Anforderung?«



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Code Specification Items

Code Mappings: +

include src/* 249

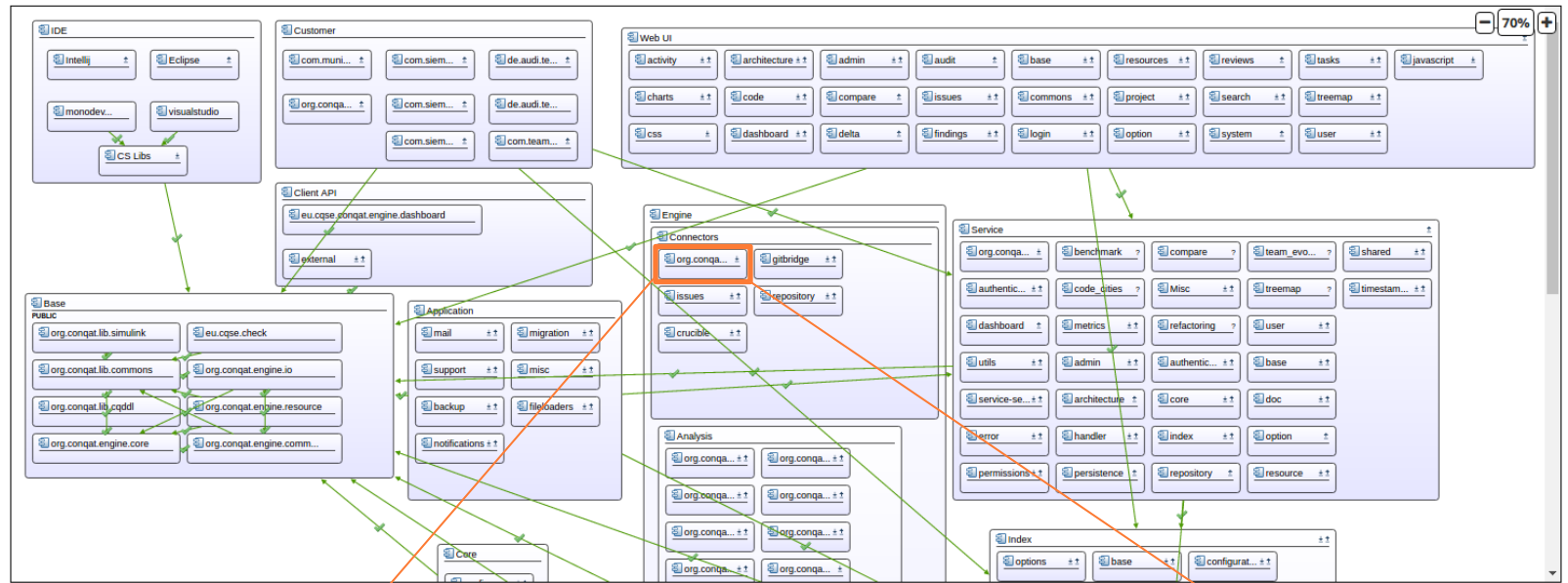
Matched Types: 249

- src/GvimExt/gvimext.cpp
- src/GvimExt/gvimext.h
- src/GvimExt/resource.h
- src/alloc.c
- src/alloc.h
- src/arabic.c

»Verifiziert dieser Test
wirklich die Anforderung?«



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& Reviewer



Code Specification Items

Specification Item Mapping:

✓ parent = SW-3456 and type = Requirement

Matched Specification Items: 15

ID	Subject	open	user
SW-3212	RQ The system shall start operations in case ...	open	user
SW-3315	RQ In case of ... the system shall ...	open	user
SW-3218	RQ The System shall stop in case ...	open	user
SW-3253	RQ The System shall ...	open	user

»Haben die Anforderungen
Mängel?«



Requirements
Engineers

»Welche Anforderungen
brauchen Tests?«



Tester

»Verifiziert dieser Test
wirklich die Anforderung?«



Entwickler
& Reviewer

Kontakt



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