

sltoo – Integrating Requirements into CI/CD

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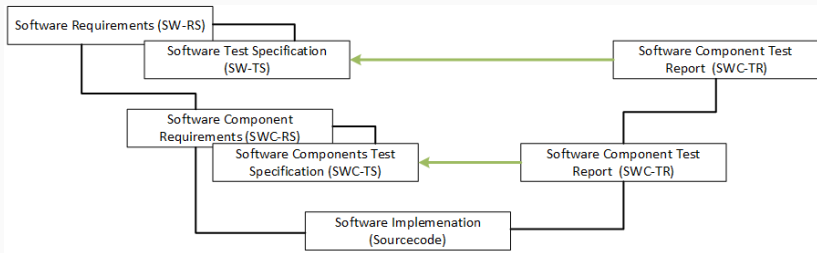
Motivation

- Fully automated traceability matrix
- Consistent and up-to-date documents from the source
- Store (requirements') meta-information with code

Theory

Requirements and Traceability

- Requirements across system hierarchies
 - Implies the need for traceability
- *Traceability* from and to specification items
- Directions
 - Forward (*Impact*) from requirements specification to dependant documents
 - Backwards from verification artefacts to specification



- *Requirement A*
 - Red button to shut down system
- *Implementation a* says implemented A
 - Traceability can be automated
 - Machine-readable
- What if *A* changes?
 - *A* knows nothing of *a*



- *Requirement A*
 - Green button with large friendly letters: don't panic
- *Implementation a says implemented A*
 - Traceability can be automated
 - Machine-readable
- What if *A* changes?
 - *A* knows nothing of *a*
 - Traceability isn't given anymore



Proposed Solution

- *Requirement A-1.0*
 - Red button to shut down system
- *Implementation a says implemented A-1.0*
 - *A-1.0* (red button) changes to *A-2.0* (green button)
 - Use hashes instead of semantic versioning
 - Calculated automatically



Example Requirement

Name: VCD Writer Inputs
Topic: ReqsDocument
Description: The output from ...
Rationale: Make the process as ...
Status: external
Owner: development
Effort estimation: 1
Invented on: 2020-05-30
Invented by: default
Type: requirement

*Hash is calculated over Name,
Description and Verification
Method*

```
$ sha256sum ${Name} \  
    ${Description} \  
    ${VerifMethod}
```

VCD Writer Inputs SW-AS-501

The output from *AggregatorInterface* can be fed into the *VCD Writer* to create an identical output file.

Rationale: Make the process as transparent as possible.

Depends on: **SW-AS-500**

Id:	SW-AS-501	Priority:	0.0	Owner:	development
Invented on:	2020-05-30	Invented by:	default	Status:	passed
Class:	detailable	Hash:	f8d68d11		

Example from pymergevcd's architecture specification

Testing the Example Requirement

- Requirement ID: SW-AS-501
- Hash: F8D68D11

Test Code

```
def test_read_write_engines(record_property, dummy_vcd_file):  
    """Write-back from read file, equal output"""  
    record_property('req', 'SW-AS-501-f8d68d11')  
    record_property('req', 'SW-AS-500-4c1a395a')  
    ...  
    assert filecmp.cmp(dummy_vcd_file, ofile)
```

xUnit Output

```
<testcase line="20" name="test_read_write_engines" time="2.830">  
  <properties>  
    <property name="req" value="SW-AS-501-f8d68d11"/>  
    <property name="req" value="SW-AS-500-4c1a395a"/>  
  </properties>  
</testcase>
```

Traceability Matrix

Table A.1: Traceability Matrix Table

Req. ID	Status	UT
SW-AS-1	passed	passed
SW-AS-100	open	open
SW-AS-101	open	open
SW-AS-102	open	open
SW-AS-200	failed	failed
SW-AS-201	passed	passed
SW-AS-202	passed	passed
SW-AS-300	passed	passed
SW-AS-301	open	open
SW-AS-302	open	open
SW-AS-500	passed	passed
SW-AS-501	passed	passed

Integrating Requirements into CI/CD

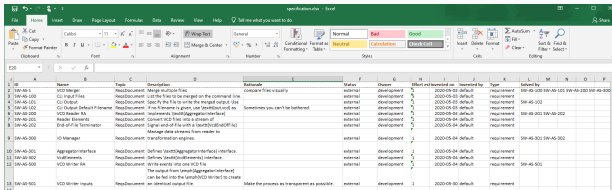
- Integration for every output document
- Match *open* and/or *failed* issues
 - Left as an exercise for the reader
- Example for *failed* issues

```
$ bash -ec 'test "$(grep -c failed \  
arch/artifacts/tracematrix.tex)" -eq "0"'
```

sltoo in Practice

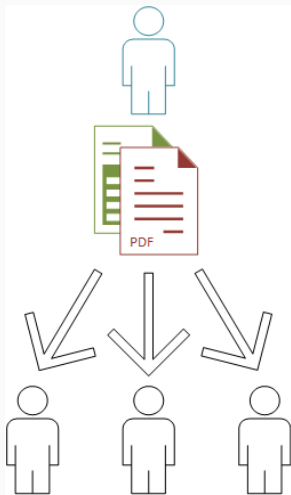
Excel Workflow (I)

- Defining system collaborative effort
- Familiarity / Ease-of-use
- Consistency of Documents
 - The *Truth* is always in your repository
 - Templating for branding
- Works if all you've got is Office and E-Mail
- Getting Started: Edit example Excel-Sheet



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1		Name	Type	Description	Reference	Status	Owner	Effect not based on	Created by	Type	Created By					
2	SN-AS-001	VSD Manager	ReqDocDocument	Manage multiple files	compare files visually	internal	development	0	2020-09-09	Default	Req	SN-AS-001	SN-AS-001	SN-AS-001	SN-AS-001	SN-AS-001
3	SN-AS-002	CU Input File	ReqDocDocument	Use the file to be merged on the command line		internal	development	0	2020-09-09	Default	Req	SN-AS-002	SN-AS-002	SN-AS-002	SN-AS-002	SN-AS-002
4	SN-AS-003	CU Output	ReqDocDocument	Specify the file to write the merged output. Use		internal	development	0	2020-09-09	Default	Req	SN-AS-003	SN-AS-003	SN-AS-003	SN-AS-003	SN-AS-003
5	SN-AS-004	CU Output Default Parameters	ReqDocDocument	If an filename is given, use [filename].out as	Sometimes you can't be bothered.	internal	development	0	2020-09-09	Default	Req	SN-AS-004	SN-AS-004	SN-AS-004	SN-AS-004	SN-AS-004
6	SN-AS-005	VSD Reader RA	ReqDocDocument	implements IReqAggregatorInterface		internal	development	0	2020-09-09	Default	Req	SN-AS-005	SN-AS-005	SN-AS-005	SN-AS-005	SN-AS-005
7	SN-AS-006	Reader Interface	ReqDocDocument	Consist VSD file into a stream of		internal	development	0	2020-09-09	Default	Req	SN-AS-006	SN-AS-006	SN-AS-006	SN-AS-006	SN-AS-006
8	SN-AS-007	End of File Terminator	ReqDocDocument	Signal end-of-file with a IReqVSDOutputFile		internal	development	0	2020-09-09	Default	Req	SN-AS-007	SN-AS-007	SN-AS-007	SN-AS-007	SN-AS-007
9	SN-AS-008	IO Manager	ReqDocDocument	Manage data stream from reader to		internal	development	0	2020-09-09	Default	Req	SN-AS-008	SN-AS-008	SN-AS-008	SN-AS-008	SN-AS-008
10	SN-AS-009	IO Manager	ReqDocDocument	transform read on engines.		internal	development	0	2020-09-09	Default	Req	SN-AS-009	SN-AS-009	SN-AS-009	SN-AS-009	SN-AS-009
11	SN-AS-001	AggregatorInterface	ReqDocDocument	Defines IReqAggregatorInterface interface.		internal	development	0	2020-09-09	Default	Req	SN-AS-001	SN-AS-001	SN-AS-001	SN-AS-001	SN-AS-001
12	SN-AS-002	VsdInterface	ReqDocDocument	Defines IReqVSDInterface interface.		internal	development	0	2020-09-09	Default	Req	SN-AS-002	SN-AS-002	SN-AS-002	SN-AS-002	SN-AS-002
13	SN-AS-003	VSD Reader RA	ReqDocDocument	implements IReqVSDFile	The output from IReqAggregatorInterface	internal	development	0	2020-09-09	Default	Req	SN-AS-003	SN-AS-003	SN-AS-003	SN-AS-003	SN-AS-003
14	SN-AS-004	VSD Reader RA	ReqDocDocument	can be fed into the IReqVSDOutputFile to create		internal	development	0	2020-09-09	Default	Req	SN-AS-004	SN-AS-004	SN-AS-004	SN-AS-004	SN-AS-004
15	SN-AS-005	VSD Reader RA	ReqDocDocument	use identical output file.	Make the process as transparent as possible	internal	development	0	2020-09-09	Default	Req	SN-AS-005	SN-AS-005	SN-AS-005	SN-AS-005	SN-AS-005

Excel Workflow (II) – Distribution



Every document has a its own version tag

```
$ git tag -a RS/1A
```

```
$ git describe $(git log -n 1 --format=%H -- docs/reqs)
```

The output from `git describe` will be used as document baseline

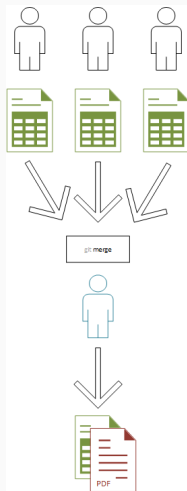
```
RS/1A - 0aec3ad0           # good  
RS/1A-8-g76b3ffe - 76b3ffe4 # tainted
```

Example excerpt from page 7:

Version SWC-RS/1A-8-g76b3ffe — 76b3ffe4

7

Excel Workflow (III) – Merging



Conclusion

- Requirements shipped with code ✓
 - Including relational meta-information
- Traceability matrix automated ✓
- Continuously updated documentation ✓
 - Document Versioning (baselining) ✓

A familiar UI for all stakeholders included

Questions

Appendix

An introduction presentation into *rmtoo* and with more details.

Traceability Rationale

- Traceability for the given requirements
- Bring code and documentation into same repository
- Integrate into build-system
 - Detect upstream changes to requirements
 - Quickly identify affected code-regions
- No silver bullet for verification

The status *external* will yield the following results:

- *open*
 - No matching requirement ID
- *passed*
 - Matching requirement ID
 - All hashes match
 - Unit-tests passed
- *failed*
 - Matching requirement ID
 - Some/all hashes didn't match, or
 - Unit-tests haven't passed

Traceability features are in the beta releases.

```
$ pip3 install sltoo>=25.1.0b3
```

```
$ wget https://kown7.github.io/pymergevcd/assets/template_p
```

- Sphinx-Needs
- Octane ALM
- Codebeamer
- Aligned elements
- See Wikipedia
- ...

Future Developements

- Write Parser for *Test Reports* ✓
- Documents with the correct identifier automatically solve the specification
 - Document Formats:
 - docx (maybe with pandoc)
 - L^AT_EX ✓
 - Text
- GUI with multi-documents support (RS/TS/..)
 - Simplify design process

- Never test against your requirements
- Always write some form of test specification

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