Information from ECSS on Validation

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Scalian on behalf CNES

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CENTRE NATIONAL D'ÉTUDES SPATIALES

ECSS-E-ST-40C
6 March 2009

Space engineering

Software

ECSS-E-HB-40A
11 December 2013

Space engineering

Software engineering handbook

Useful ECSS documentation on validation…

The validation activity demonstrates compliance with requirements.

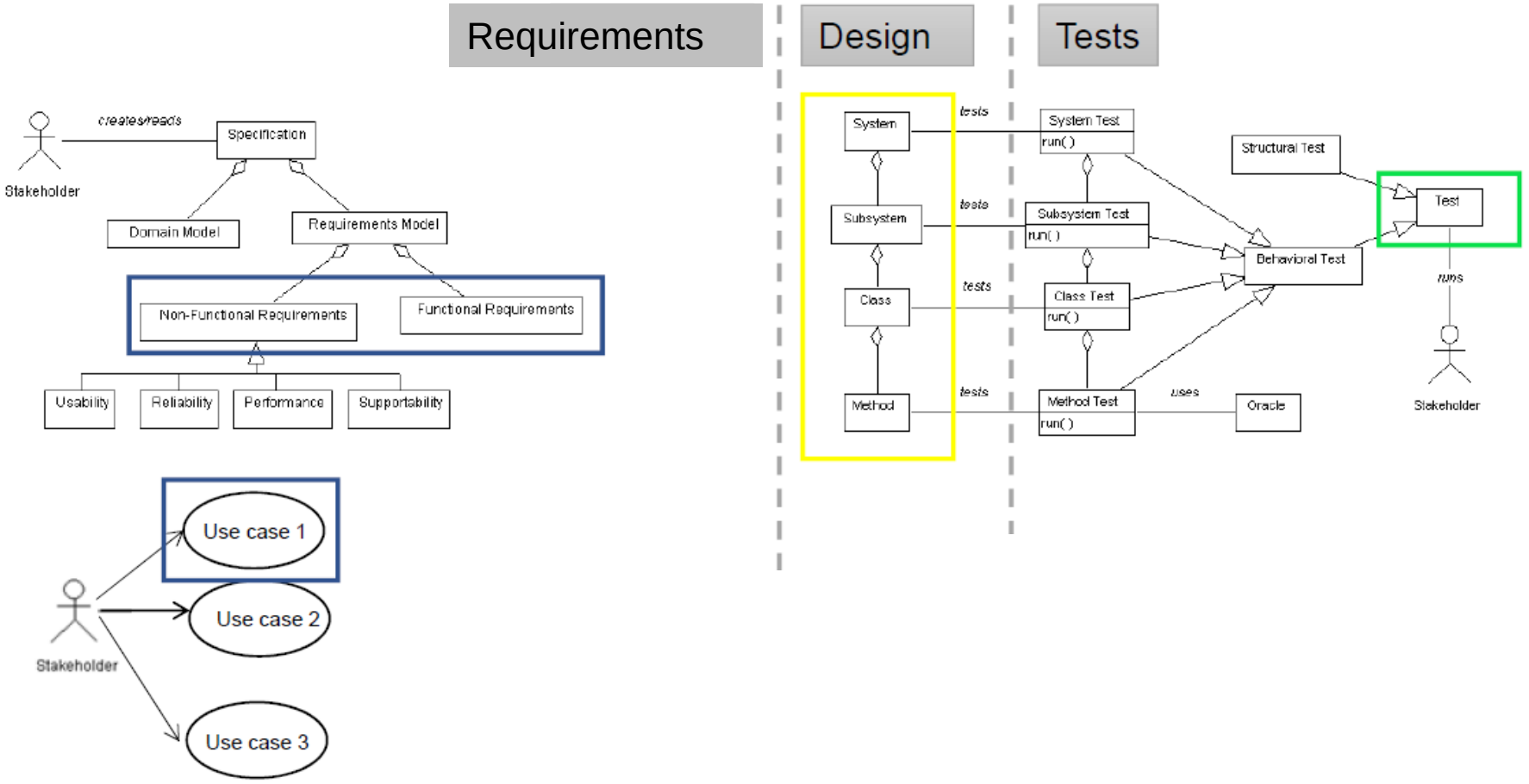
Validation is defined as the confirmation, through the provision of objective evidence that the requirements for a specific intended use or application have been fulfilled. The validation process (for software) is the process to confirm that the requirements are correctly and completely implemented in the final product.

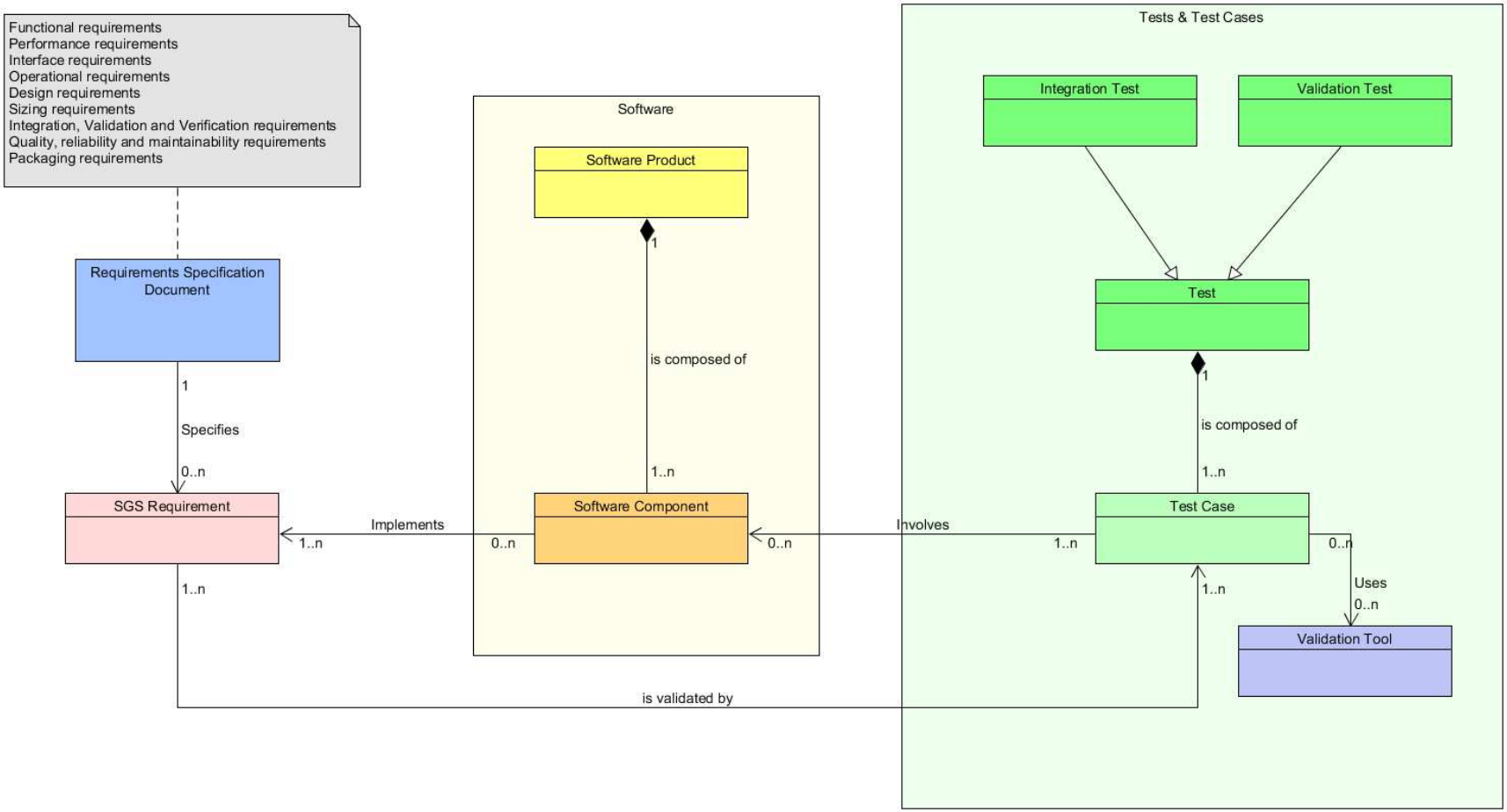
Validation: definition

The verification process (for software) is the process to confirm that adequate specifications and inputs exist for any activity, and that the outputs of the activities are correct and consistent with the specifications and inputs.

If the validation process aims at verifying that "you are building the right product", the verification process allows checking that the "product is right" which also contributes providing evidence that the "right product" has been developed.

Verification: definition


Requirements
Design
Tests
creates/reads
Specification
Stakeholder
Domain Model
Requirements Model
Non-Functional Requirements
Functional Requirements
Usability
Reliability
Performance
Supportability
Use case 1
Use case 2
Use case 3
Stakeholder
System
Subsystem
Class
Method
tests
tests
tests
tests
System Test
run( )
Subsystem Test
run( )
Class Test
run( )
Method Test
run( )
Structural Test
Behavioral Test
Test
runs
Stakeholder
uses
Oracle



Links between requirements, software products and tests

ECSS – E40
Software validation plan (SValP)

Validation plan – *Table of contents*

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Validation plan – *Table of contents*

assurance staff.

6.6. Tools, techniques and methods

m. The SValP shall describe the software tools, techniques and methods used for validation activities as well as the needed hardware facilities and, testing data, support software (simulators).

n. The SValP shall describe the validation facility in terms of :

1. level of representativeness of the physical and functional environment, including the processor and the real-time representativeness;
2. software or hardware in the loop;
3. open or closed loop capability for functional and performance testing;
4. debugging and observability capability;
5. For real-time software, the constraints on the test execution such as interdiction of code instrumentation, and test method (e.g. referring to measurement techniques and tools) associated to performance or safety requirements.

Validation plan – *Table of contents*

Validation plan – *Table of contents*

7. Software validation tasks identification

r. The SValP shall describe the software validation tasks to be performed for the identified software items.

s. The SValP shall list which are the tasks and the items under tests, as well as the criteria to be utilized for the testing activities on the test items associated with the plan.

t. The SValP shall list the testing activities to be repeated when testing is resumed.

u. The SValP shall describe for each validation tasks the inputs, the outputs as well as the resources to be used for each task.

v. The detailed information and the data for the testing procedures shall be provided in the software validation testing specifications.

8. Software validation approach

w. The SValP shall describe the overall requirements applicable to the software validation testing activities, providing for definition of overall requirements, guidelines on the kinds of tests to be executed.

x. The SValP shall describe the selected approach to accomplish validation of those software specification requirements to be validated by inspection and analysis or review of design.

y. The SValP shall define the regression testing strategy.

Validation plan – *Table of contents*

9. Software validation testing facilities

z. This SValP shall describe the test environment to execute the software validation testing activity and the non–testing validation activities whose approach is defined by this plan.

aa. The SValP shall describe the configuration of selected validation facilities in terms of software (e.g. tools and programs, and simulation), hardware (e.g. platforms and target computer), test equipment (e.g. bus analyser), communications networks, testing data and support software (e.g. simulators).

NOTE Reference to other documentation describing the facility can be done.

bb. If the validation testing against the requirements baseline and the validation testing against the technical specification use different environments, this shall be clearly stated and described.

Validation specification – *Table of contents*

ECSS – E40
Software validation specification (SVS)

Table of contents

Validation specification – *Table of contents*

6. Software validation specification task identification

NOTE The SVS w.r.t. TS or RB describes the approach to be utilized for the software validation specification, detailed as follows.

6.1. Task and criteria

a. The SVS w.r.t. TS or RB shall describe which are the tasks and the items under tests, as well as criteria to be utilized.

6.2. Features to be tested

b. The SVS w.r.t. TS or RB shall describe all the features to be tested, making references to the applicable documentation.

6.3. Features not to be tested

c. The SVS w.r.t. TS or RB shall describe all the features and significant combinations not to be tested.

6.4. Test pass - fail criteria

d. The SVS w.r.t. TS or RB shall describe the general criteria to be used to determine whether or not tests are passed.

6.5. Items that cannot be validated by test

e. The SVS w.r.t. TS or RB shall list the tasks and items under tests that cannot be validated by test.

f. Each of them shall be properly justified

g. For each of them, an analysis, inspection or review of design shall be proposed.

6.6. Manually and automatically generated code

h. The SVS shall address separately the activities to be performed for manually and automatically generated code, although they have the same objective (ECSS-Q-ST-80 clause 6.2.8.2 and 6.2.8.7).

Validation specification – *Table of contents*

7. Software validation testing specification design

7.1. General

i. The SVS w.r.t. TS or RB shall provide the definition of software validation testing specification design, giving the design grouping criteria such as function, component or equipment management.

j. For **each identified** test design, the SVS w.r.t. TS or RB shall provide the information given in <6.2>.

7.2. Organization of each identified test design

NOTE The SVS w.r.t. TS or RB provides the definition of each validation test design, detailed as follows

7.2.1. General

k. The SVS w.r.t. TS or RB shall briefly describe the test design.

7.2.2. Features to be tested

l. The SVS w.r.t. TS or RB shall describe the test items and the features to be tested.

m. Reference to appropriate documentation shall be performed and traceability information shall be provided.

7.2.3. Approach refinements

n. The SVS w.r.t. TS or RB shall describe the test approach implemented for the specific test design and the specific test class implemented.

o. The description specified in a. shall provide the rationale for the test case selection and grouping into test procedures.

p. The method for analysing test results shall be identified (e.g. compare with expected output, and compare with old results).

q. Configuration of the facility (both hardware and software) to be used to execute the identified test shall be described.

Validation specification – *Table of contents*

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o. The description specified in a. shall provide the rationale for the test case selection and grouping into test procedures.

p. The method for analysing test results shall be identified (e.g. compare with expected output, and compare with old results).

q. Configuration of the facility (both hardware and software) to be used to execute the identified test shall be described.

Validation specification – *Table of contents*

identified test shall be described.

8. Software validation test case specification

8.1. General

r. The SVS w.r.t. TS or RB shall provide the identification of software validation test cases.

s. For each identified test case, the SVS w.r.t. TS or RB shall provide the information given in 7.2

8.2. Organization of each identified test case

NOTE The SVS w.r.t. TS or RB provides the definition of each validation test case, detailed as follows.

8.2.1. Test case identifier

t. The SVS w.r.t. TS or RB shall describe the test case uniquely.

u. A short description of the test case purpose shall be provided.

8.2.2. Inputs specification

v. The SVS w.r.t. TS or RB shall describe, for each test case, the inputs to execute the test case.

8.2.3. Outputs specification

w. The SVS w.r.t. TS or RB shall describe, for each test case, the expected outputs.

8.2.4. Test pass - fail criteria

x. The SVS w.r.t. TS or RB shall describe, for each test case, the criteria to decide whether the test has passed or failed.

8.2.5. Environmental needs

y. The SVS w.r.t. TS or RB shall describe:

1. the exact configuration and the set up of the facility used to execute the test case as well as the utilization of any special test equipment (e.g. bus analyser);

2. the configuration of the software utilized to support the test conduction (e.g. identification of the simulation configuration);

8.2.6. Special procedural constraints(ECSS-Q-ST-80 clause 6.3.5.25)

z. The SVS w.r.t. TS or RB shall describe any special constraints on the used test procedures.

8.2.7. Interfaces dependencies

aa. The SVS w.r.t. TS or RB shall list all the test cases to be executed before this test case.

Validation specification

Examples

5.4. T-VIS-001000-CAT-DEPTH

Title	**Catalogue Depth**
Objective	Evaluate the VIS PF source extraction
Requirements to be tested	R-VIS-PRD-F-072
Type	Validation Test
Test Cases	TC-VIS-001001-PRD-F-072 TC-VIS-001002-PRD-F-072
Input Data	VIS PF output catalogue

5.4.1. Detailed description

Read the catalogue file and evaluate the consistency of star magnitudes and stars SNR with Euclid expectations.

The test passes if the number of detected object in each SNR bin is consistent with Euclid survey expectations.

6.2. Functional requirements

6.2.1. Data production

Requirement ID	Origin	Description	Parent req.
Main data products			
R-VIS-PRD-F-010	Derived	The VIS PF shall provide all scientific exposures calibrated according to calibration requirements in § 6.2.2	R-GDP-DL2-040
R-VIS-PRD-F-020	Derived	The VIS PF shall provide the stack of exposures for each field.	R-GDP-DL2-040
R-VIS-PRD-F-030	Derived	The dither exposures obtained from VIS shall be coadded on a common grid. The oversampling factor shall be 4, 2 in each direction.	R-GDP-DL2-030
R-VIS-PRD-F-040	Derived	Astrometric solution shall be provided for each exposure and stack.	R-GDP-DL2-040

Examples

5. Tests Specification Design

Examples

Validation tests are composed of a number of test cases specified in § 6 that provides detailed information for each of them. The Table 5-1 summarizes the validation tests designed for the VIS PF software product and the test cases that compose each test (last column).

A test being part of a given version of the test plan could include only a subset of the test cases that compose the test, depending on the maturity reached by software components and on the objective of the test campaign for which the test plan is written/updated.

Test Design ID	Test Design Descriptive Name	Type	Test Case ID
T-VIS-000000-EXIST-PROD	Check the existence of VIS PF product	Validation	TC-VIS-000001-PRD-F-020 TC-VIS-000002-PRD-F-020 TC-VIS-000003-PRD-F-040 TC-VIS-000004-PRD-F-040

Examples

8. Traceability between Requirements and Test Cases

This section provides information on the traceability between SGS requirements and the test cases that contribute to the requirements validation. The contribution that each test case brings to the validation of a requirement is expressed by means of a percentage value, the validation coverage.

8.1. From Requirements to Test Cases

This table associates each requirement to all test cases that contribute to its validation.

SGS Requirements	Test Case	Validation Coverage (%)
R-VIS-CAL-F-010	TC-VIS-001601-CAL-F-010	100%
R-VIS-CAL-F-030	TC-VIS-001801-CAL-F-030	100%
R-VIS-CAL-F-040	TC-VIS-001307-CAL-F-040	100%
R-VIS-PRD-F-040	TC-VIS-000003-PRD-F-040	50%
	TC-VIS-000004-PRD-F-040	50%

Test Case ID	*The test case ID*	Test ID	*The ID of the test related to the test case (ref. table in § 4.5)*
Requirements	*Comma separated list of the requirements validated by the test case*		
Execution Status	*OK | POK | NOK | Not Executed*		
Result	***if Execution Status = OK*** *Describe the results got from the test case execution and/or place references to any external file where the test case results can be found.* ***else if Execution Status = POK*** *Specify the reason why the execution of the test case did not fully succeed.* *Describe the results got from the test case execution and/or place references to any external file where the test case results can be found.* ***else if Execution Status = NOK*** *Explain why the test case has failed.* ***else if Execution Status = Not Executed*** *Specify clearly the reason that hampered the execution of the test case.*		
Problems met	*For each problem met, the problems reporting includes:* - *A description of the problem that occurred during the execution of the te case;* - *The identification of the step in the test procedure where the problem raised (ref. the § 6.n.8 of [AD12] where 6.n is the section that specifies this test case);* - *The reference to the corresponding issue in the tracking system;* - *The number of times the test procedure or the specific step was repeated in the attempt of correcting the problem and the outcome of each attempt (if applicable);* - *The test steps where the test procedure was resumed for retesting (if applicable).*		
Deviations from the test case	*For each deviation from the test case and its related test procedure, the deviation reporting includes:* - *A description of the deviation (e.g. substitution of any resource, procedural step not followed, schedule deviation, etc.);* - *The rationale of the deviation;* - *An assessment of the deviation impact on the validity of the test case.*		

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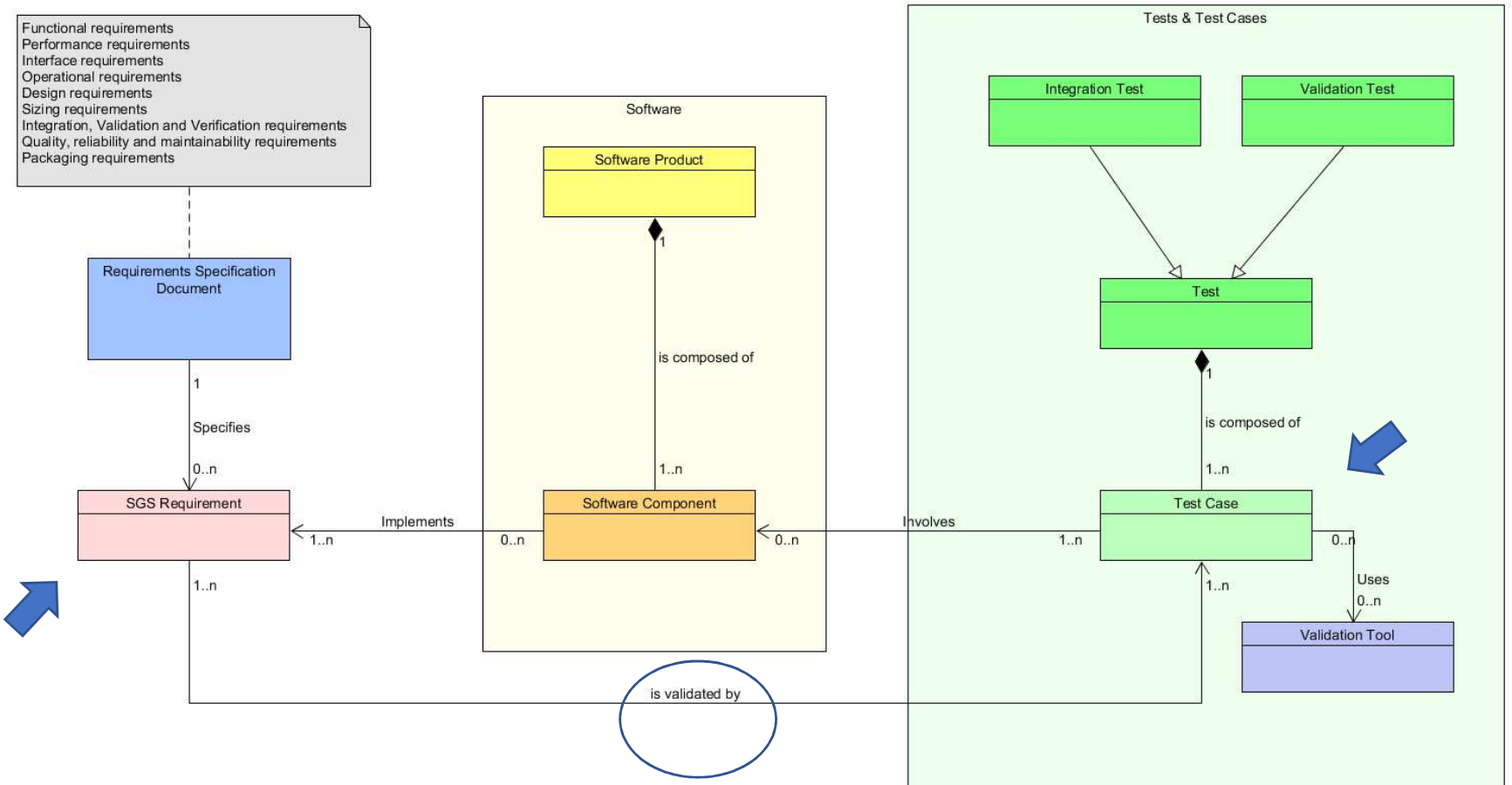
Examples

Test Case ID	TC-EAS-M-130	Test ID	T-EAS-M-130
Requirements	R-EAS-M-130		
Execution Status	OK		
Result	SQL execution OK See A.3		
Problems met			
Deviations from the test case			



Links between requirements, software products and tests