BERNER & MATTNER
AN ASSYSTEM COMPANY

TESTONA

Next Level Classification Tree Method and Combinatorial Test Design

2014-11-17 | PK

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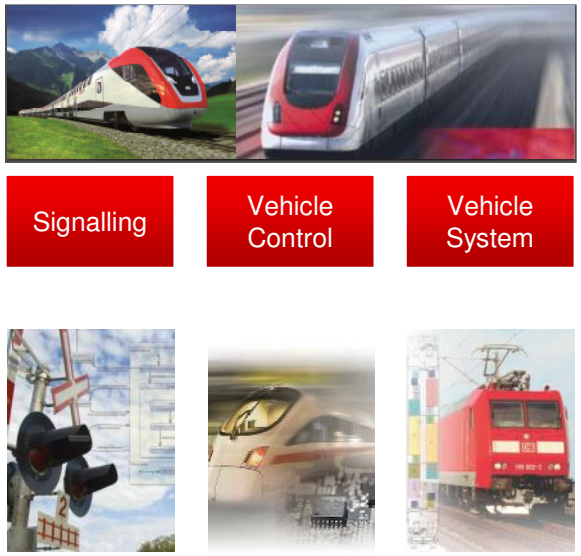
Overview Berner & Mattner

Automotive

Transportation Systems



Industrial Embedded Systems

Berner & Mattner Overview

Founded:	1979
Employees:	430
Turnover 2012:	41,7 Mio. €
Sites:	Munich, Stuttgart, Ingolstadt, Wolfsburg, Berlin, Cologne, Vienna
Offerings:	Products and Engineering
Sectors:	Automotive, Transportation, Industrial Embedded Systems
TOP clients:	DAIMLER, BMW, AUDI, Siemens, Ford, VW, Bombardier, EADS, Deutsche Bahn, MAN

Assystem Group Overview

Founded:	1966
Employees:	10.745
Turnover 2012:	855,6 Mio€
Sites:	Australia, Belgium, Germany, France, Great Britain, India, Yemen, Canada, Qatar, Morocco, Nigeria, Austria, Portugal, Romania, Russia, Switzerland, Spain, USA, United Arab Emirates
Offerings:	Engineering services and consulting
Sectors:	Energy, Automotive, Rail Transportation, Aerospace & Defence, Technology & Product Engineering
TOP clients:	Areva, Alstom, EADS, EDF, General Electric, Peugeot-PSA, Renault, Rolls-Royce, Spirit Aerosystems, Total

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Our Products

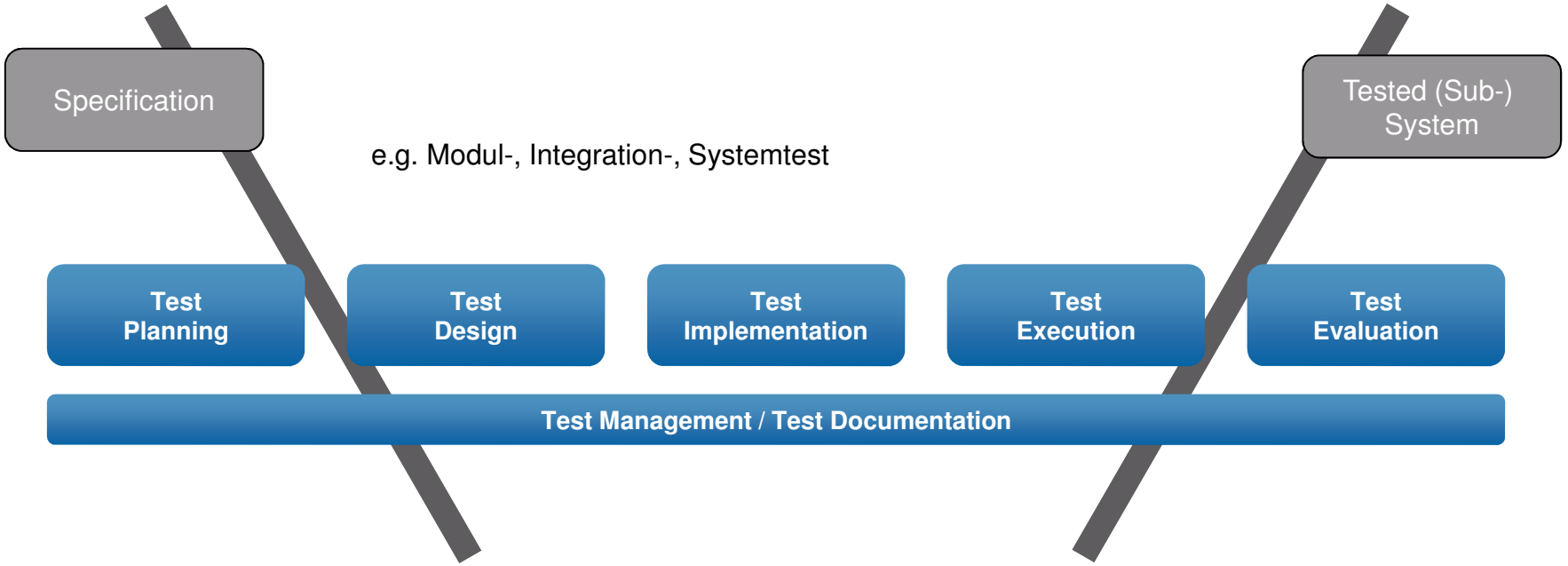
TESTONA
Test Design using the Classification Tree Method

MERAN
Specification of Systems with many Variants

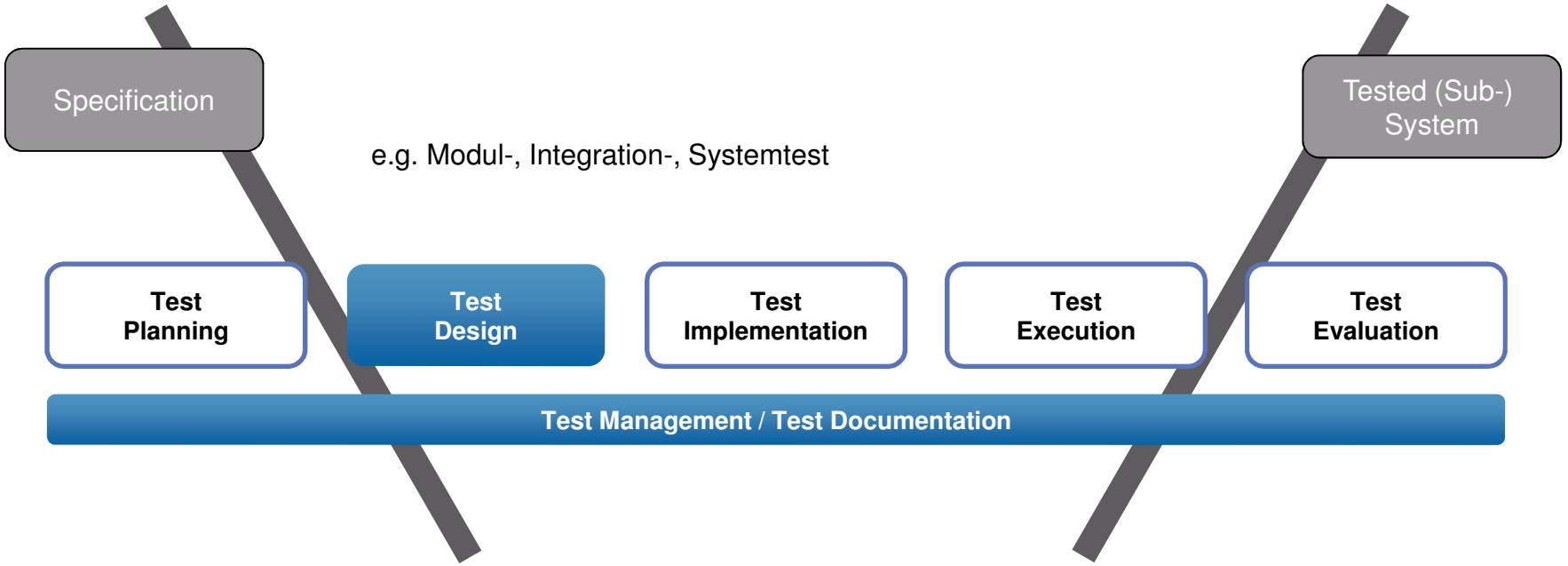
MESSINA
Platform for virtual integration, model-based simulation, SiL and HiL testing

MODENA
Infotainment & body specification and test system

Test Process and Test Activities



Test Process and Test Activities



Classification Tree Method

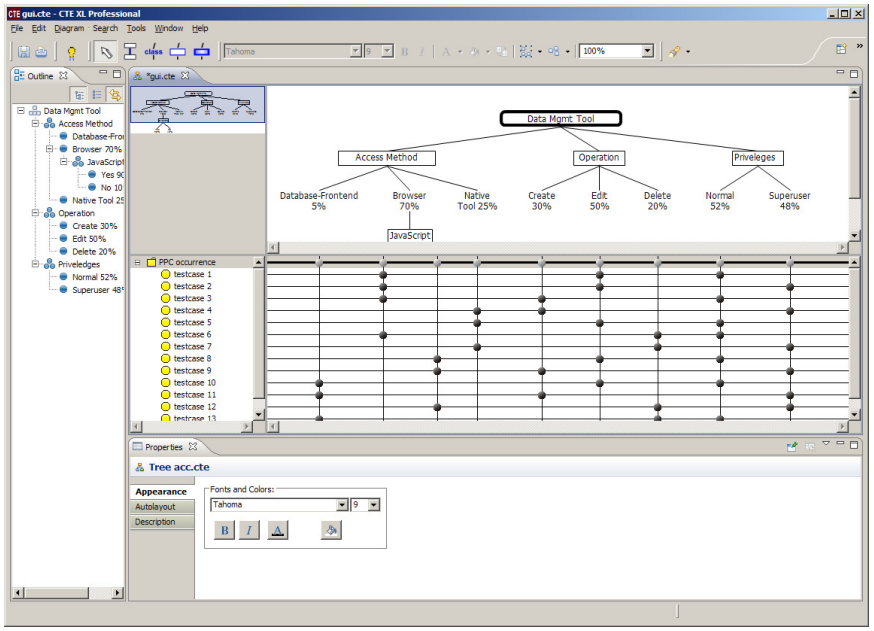
- Black box Test Design Technique
- Systematic Process
- Graphical Representation of Test Problem
- Independent of Test Domain, Test Level and Test Object
- Tool Support:

  TESTONA

- Recommended for

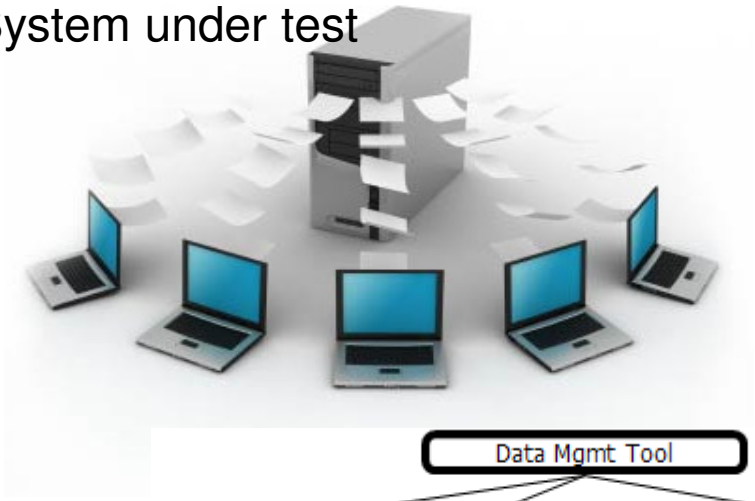
  Certified Tester

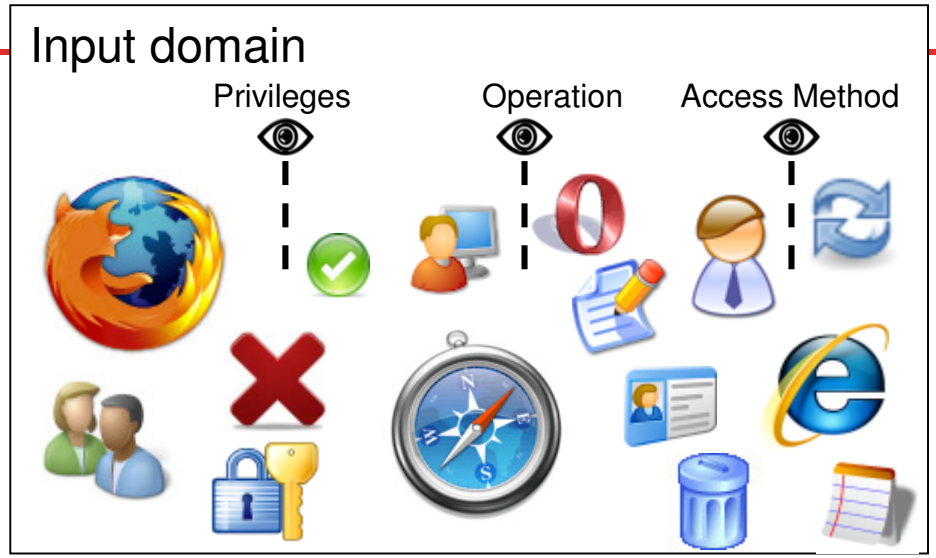
  ISTQB International Software Testing Qualifications Board

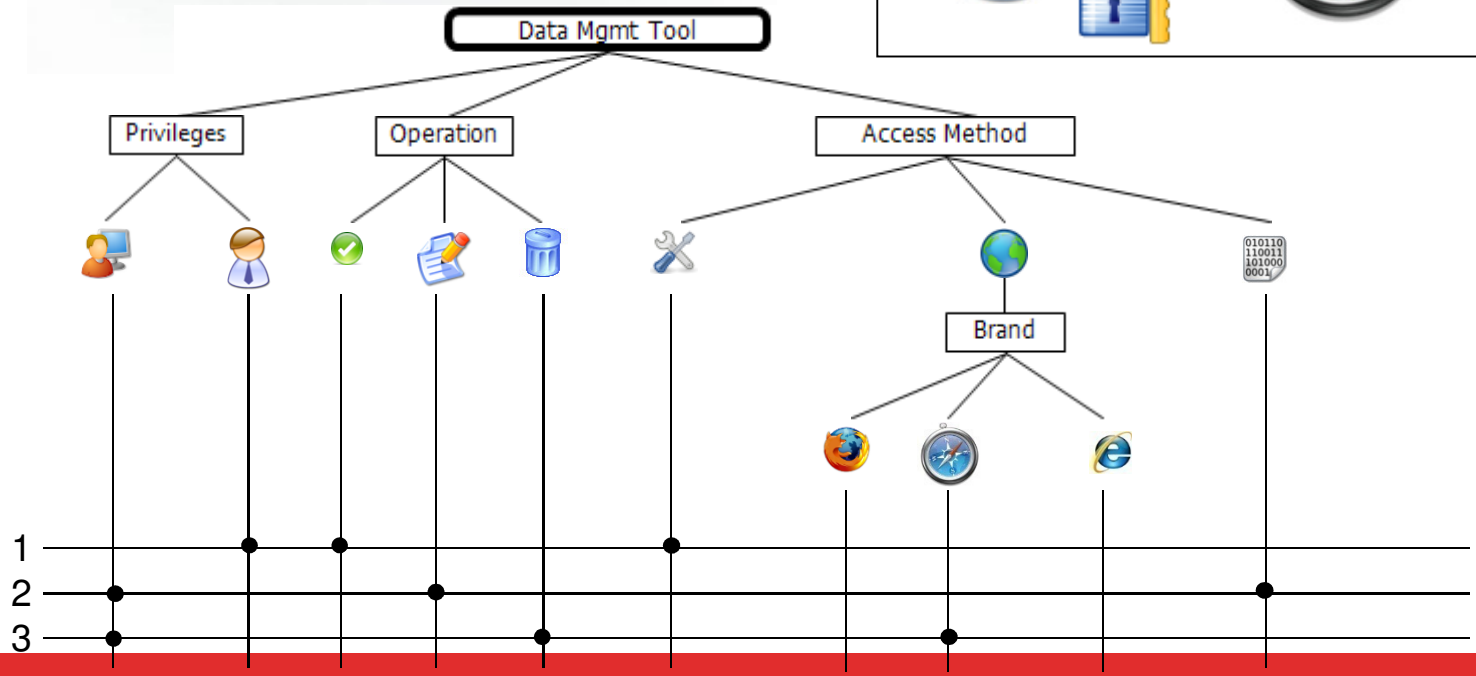


Example

System under test

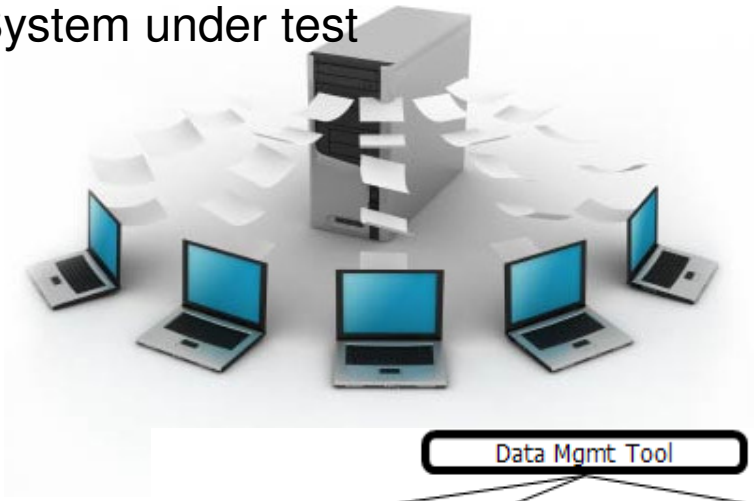




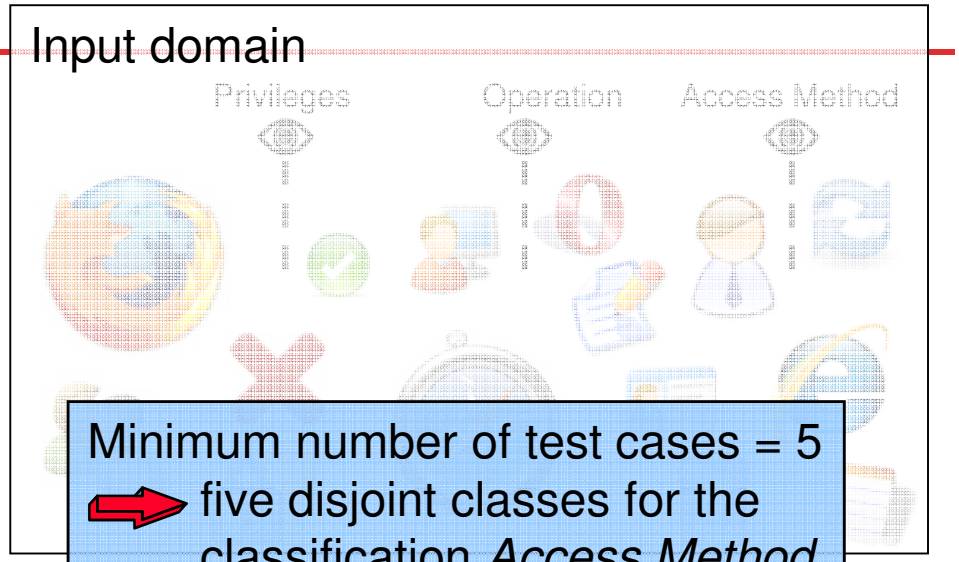


Example

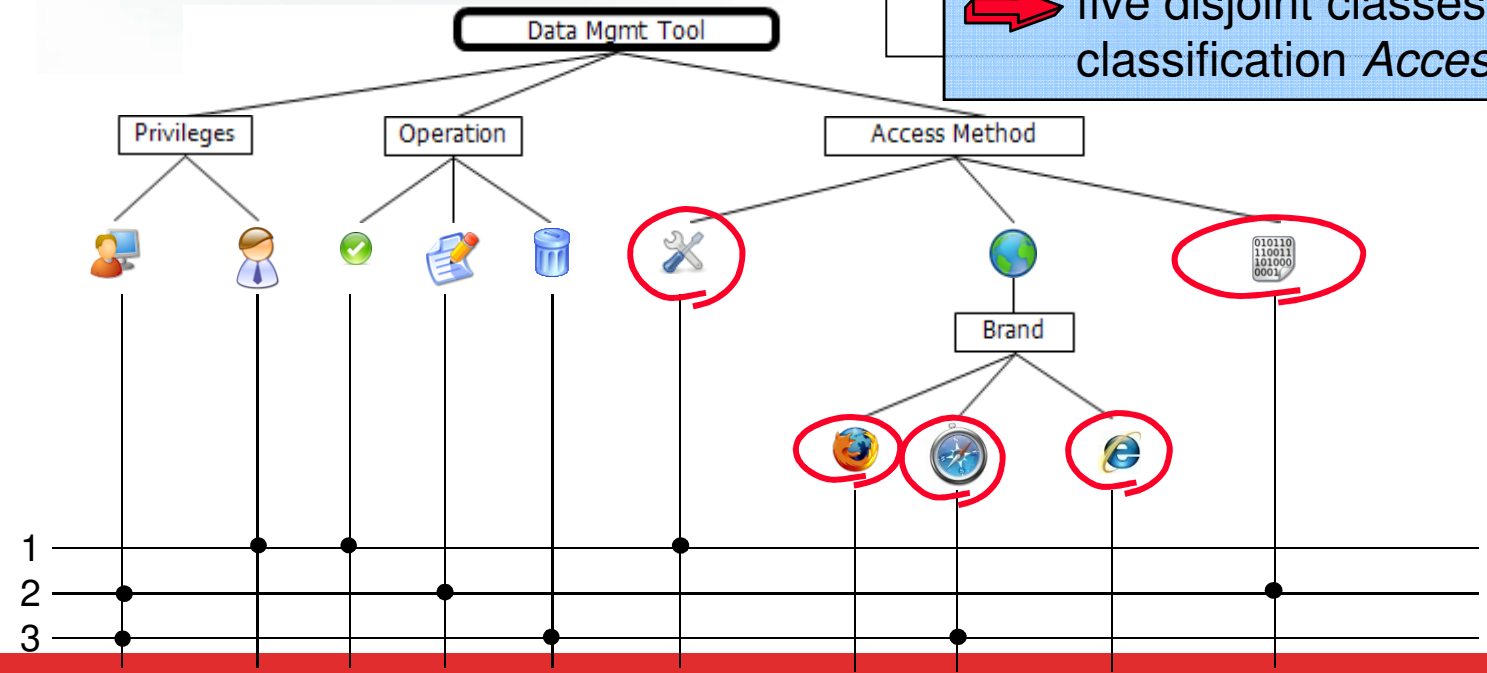
System under test



Input domain

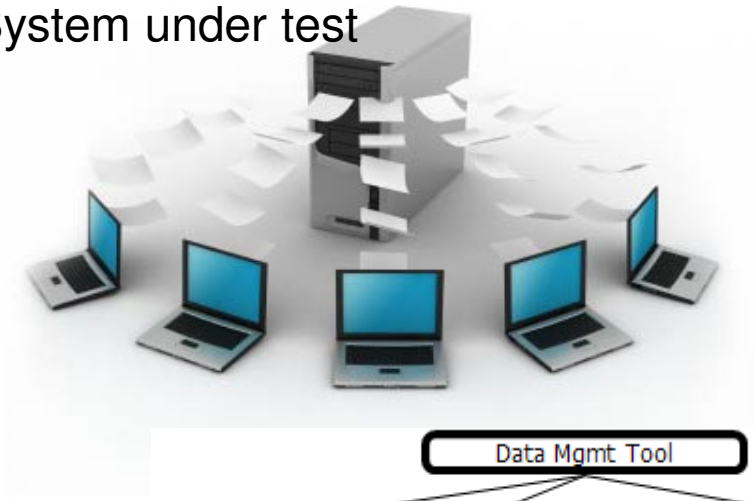


Minimum number of test cases = 5
⇨ five disjoint classes for the classification *Access Method*

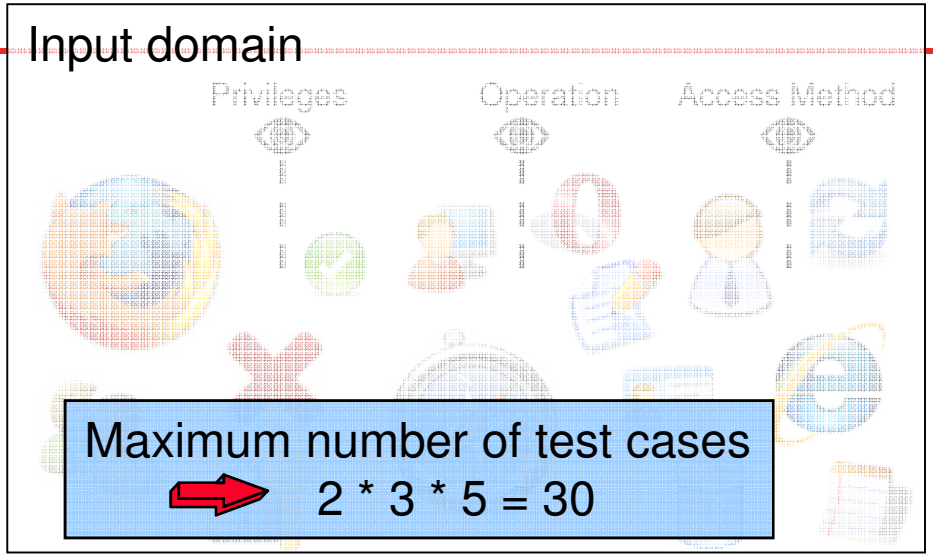


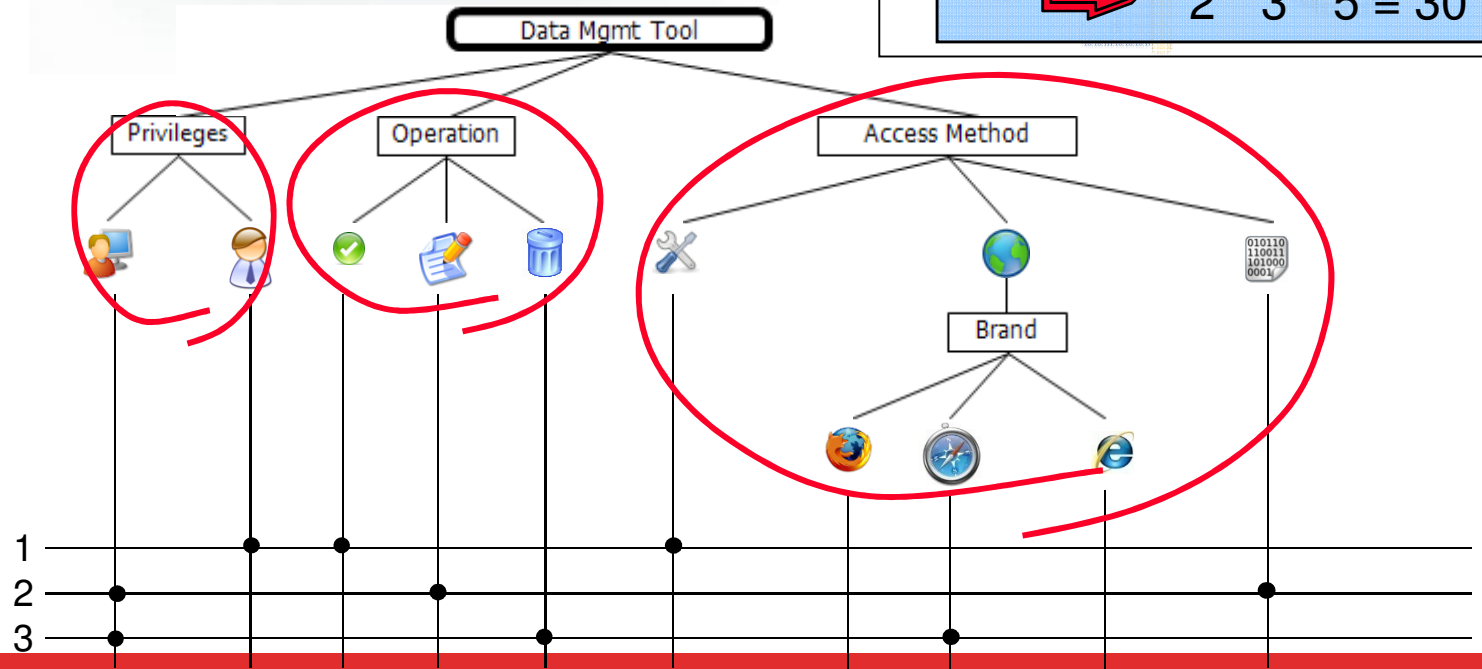
Example

System under test



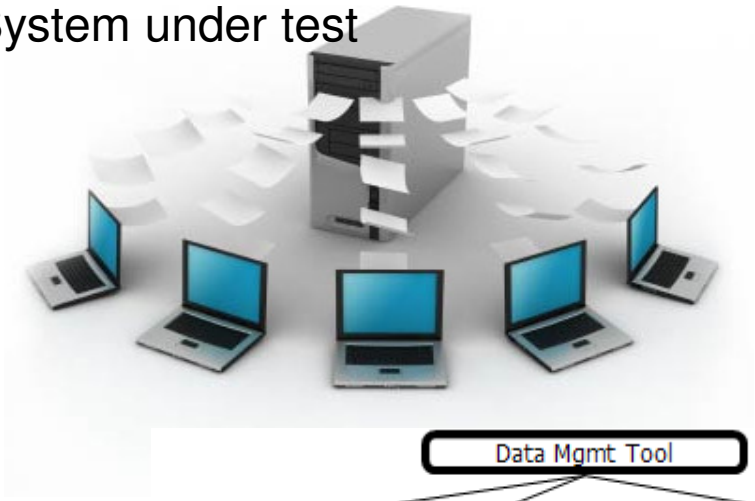
Input domain



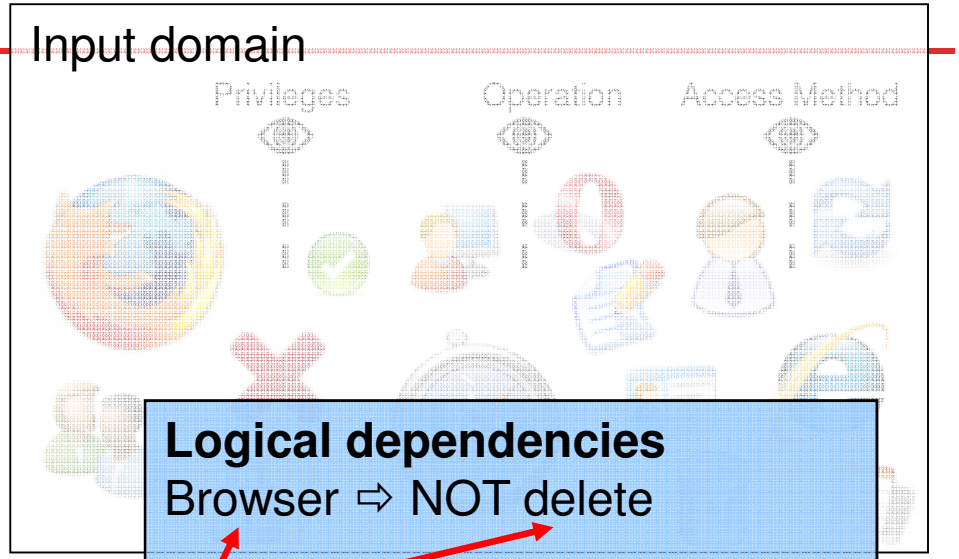


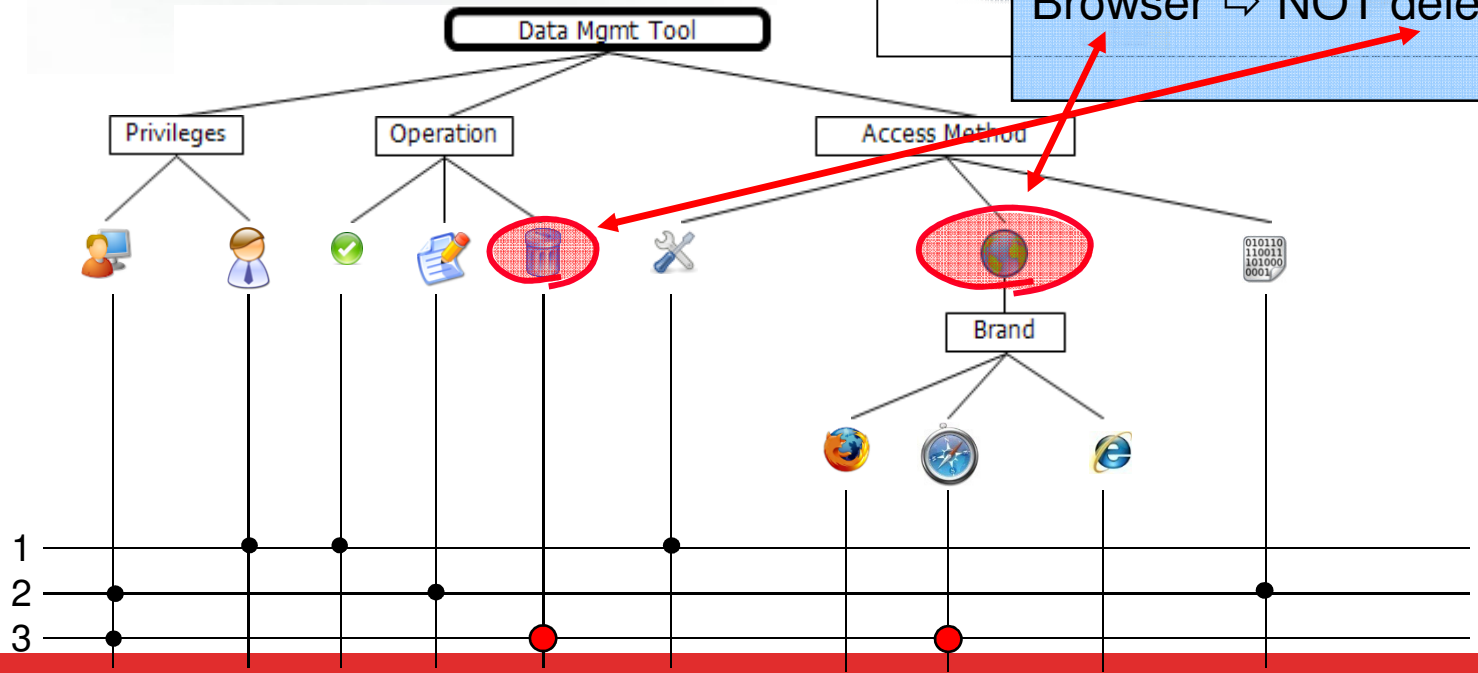
Example

System under test



Input domain





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Classification-Tree Editor TESTONA

Syntax-oriented **graphical editor** to support the classification tree method

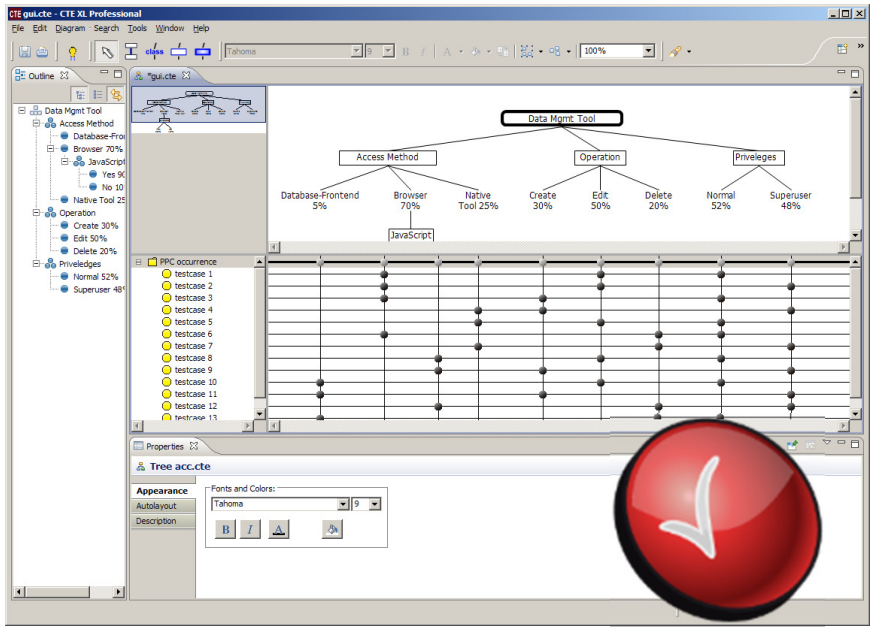
Automatic verification of test cases against defined **dependency rules**

Automatic test case generation with generation rules

Tag approach for **annotation** of additional information and **meta-data**

Generic and customized **tool coupling**

Statistics



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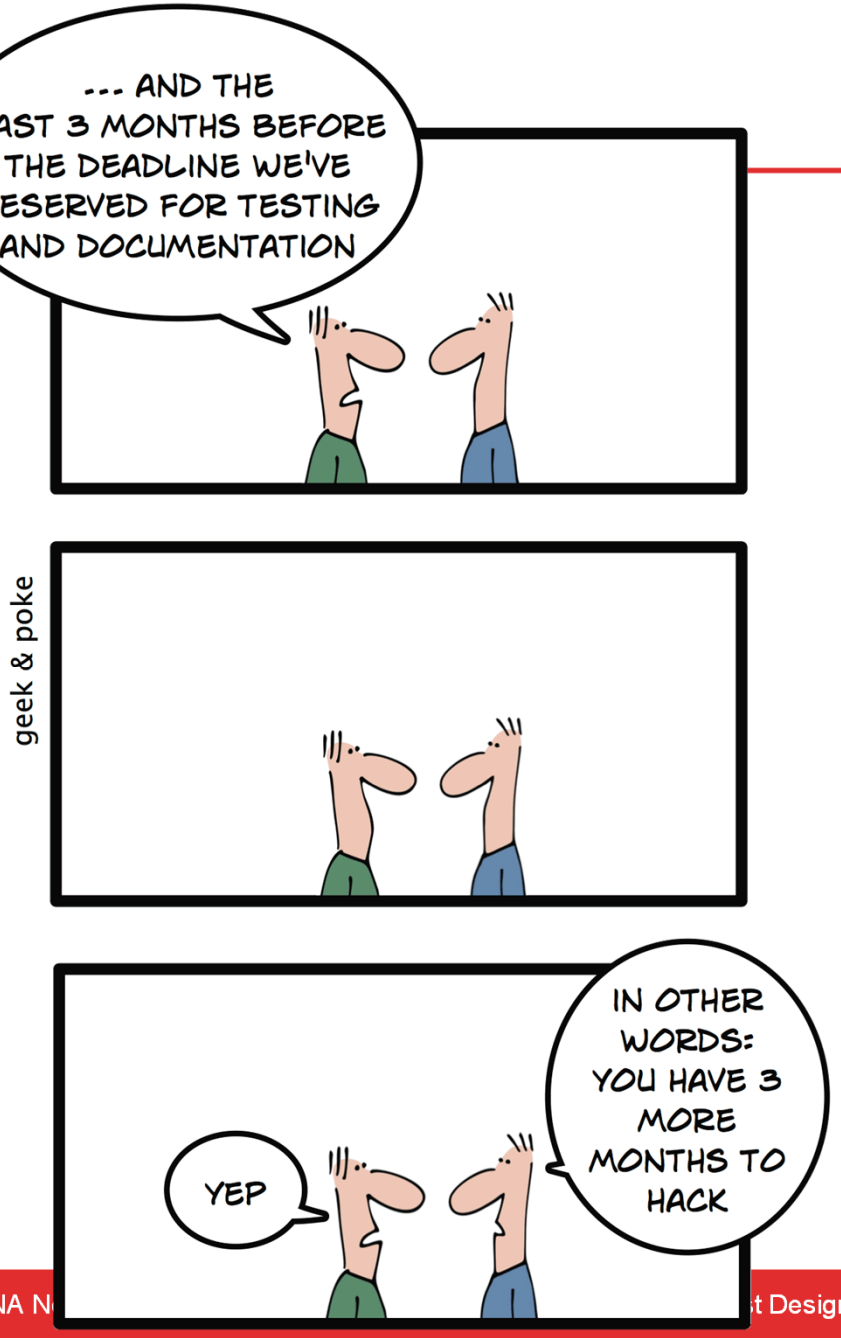
Prioritization

- How to identify test relevant aspects (and distinguish from irrelevant stuff)?
- How to distinguish between "*good*" and "*bad*" test cases?
- How to reduce size (=cost) of test suites?

Without loosing test quality?



http://geekandpoke.typepad.com/geekandpoke/2010/02/project-management-made-easy.html

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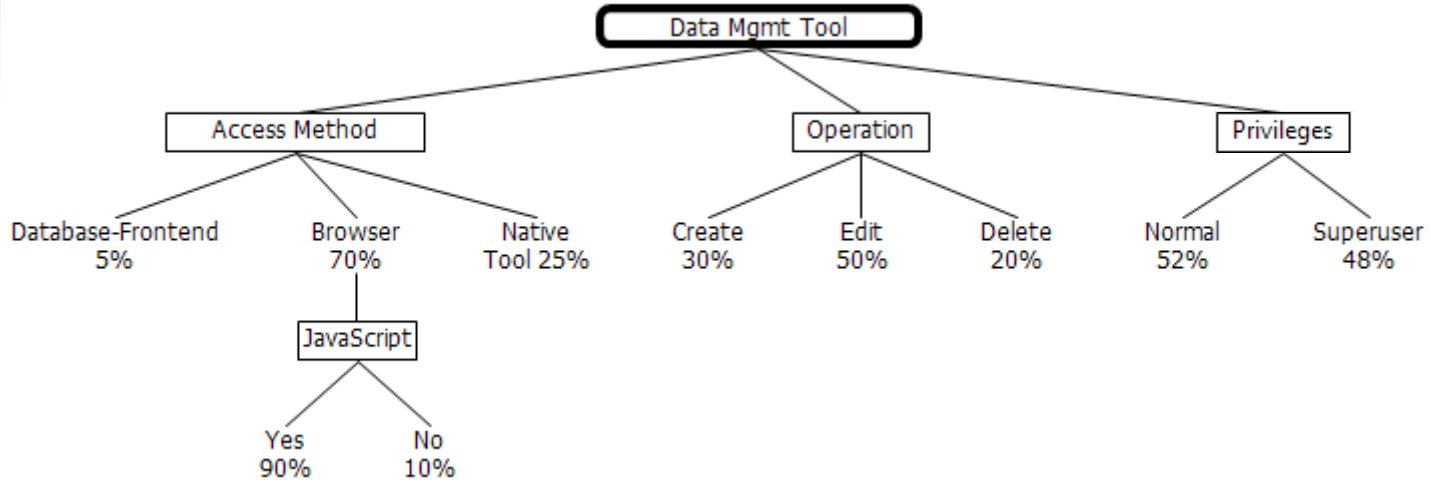
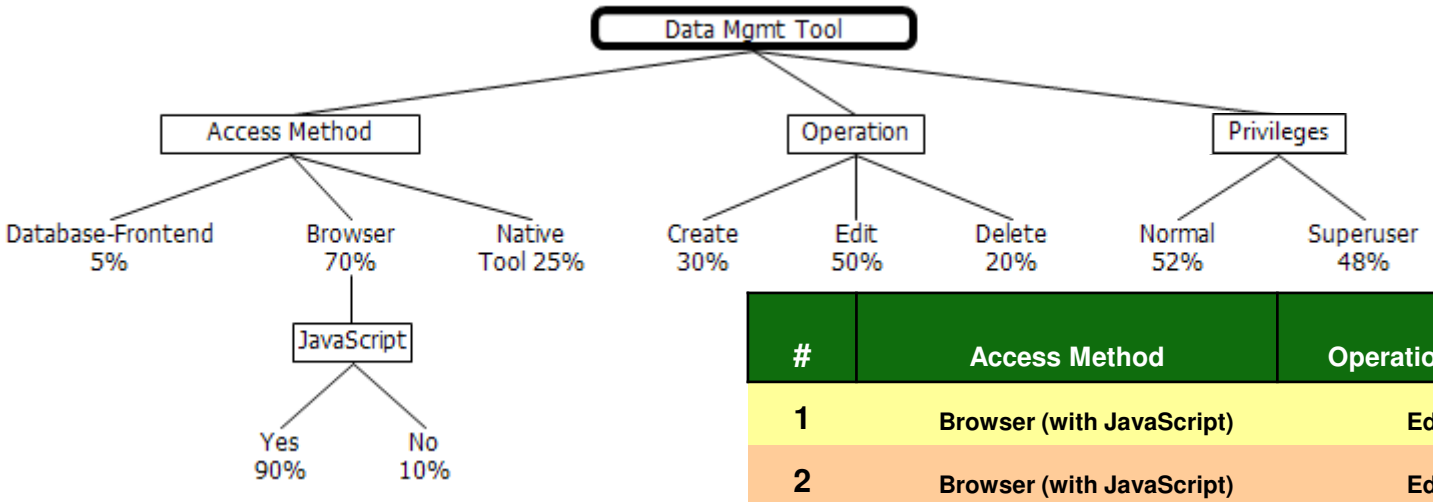
Example – Prioritization





#	Access Method	Operation	Privileges
1	Browser (with JavaScript)	Edit	Normal
2	Browser (with JavaScript)	Edit	Superuser
3	Browser (with JavaScript)	Create	Normal
4	Native Tool	Create	Superuser
5	Native Tool	Edit	Normal
6	Browser (with JavaScript)	Delete	Normal
7	Native Tool	Delete	Superuser
8	Browser (no JavaScript)	Edit	Normal
9	Browser (no JavaScript)	Create	Superuser
10	Database-Frontend	Edit	Normal
11	Database-Frontend	Create	Superuser
12	Browser (no JavaScript)	Delete	Superuser
13	Database-Frontend	Delete	Normal

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Coverage criteria

- For prioritized **pairwise** combination

Each Used Coverage (EUC)

$$EUC = \frac{number\ of\ covered\ class\ pairs}{number\ of\ coverable\ class\ pairs}$$

Weight Coverage (WC)

$$WC = \frac{sum\ of\ weights\ of\ covered\ class\ pairs}{sum\ of\ weights\ of\ all\ coverable\ class\ pairs}$$

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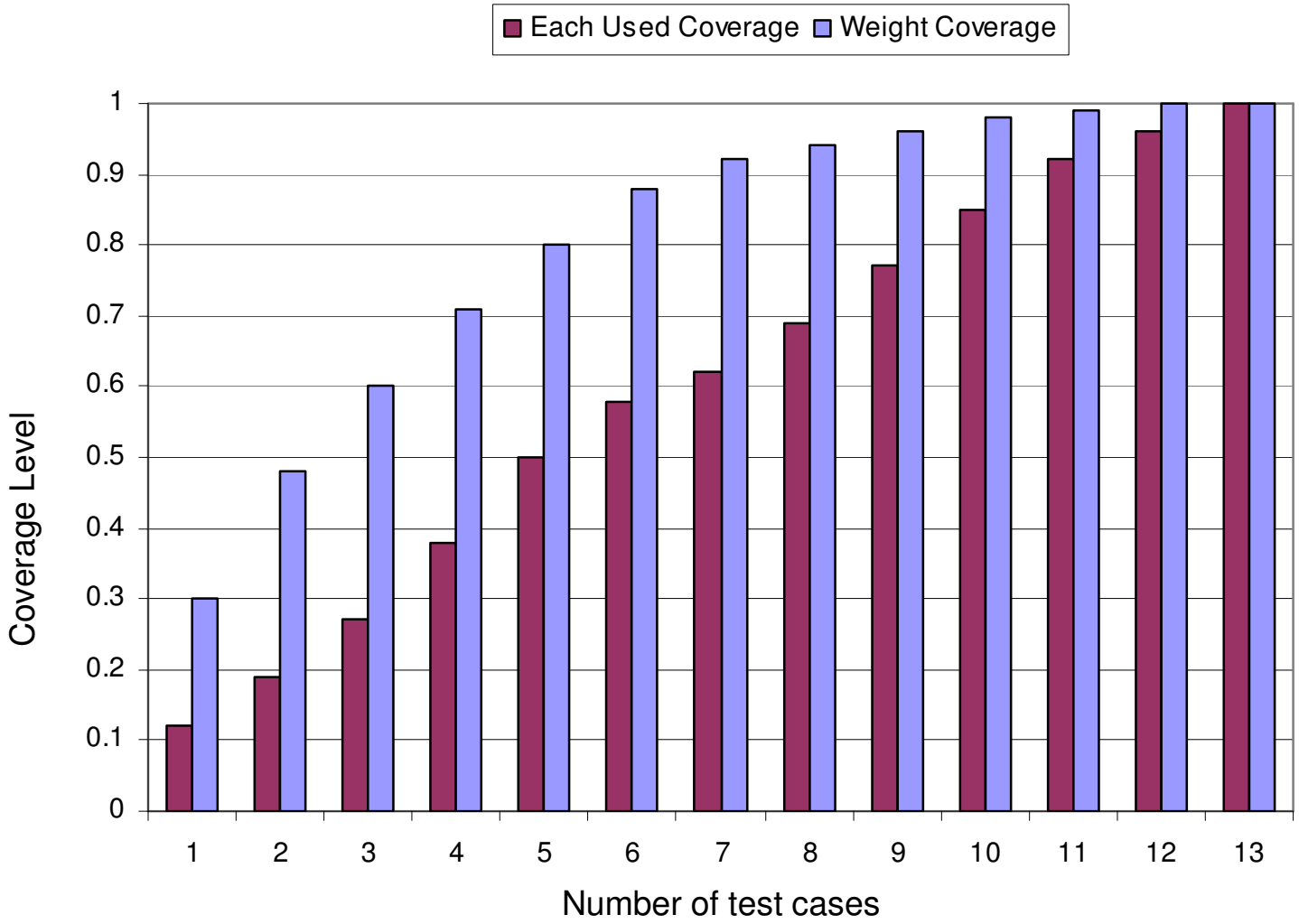
Coverage criteria



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Optimizing test suites

#	Access Method	Operation	Priv.	EUC	WC
1	**Browser (with JavaScript)**	**Edit**	**Normal**	**0.12**	**0.30**
2	Browser (with JavaScript)	Edit	Superuser	0.19	0.48
3	Browser (with JavaScript)	Create	Normal	0.27	0.60
4	Native Tool	Create	Superuser	0.38	0.71
5	Native Tool	Edit	Normal	0.50	0.80
6	Browser (with JavaScript)	Delete	Normal	0.58	0.88
7	Native Tool	Delete	Superuser	0.62	0.92
8	Browser (no JavaScript)	Edit	Normal	0.69	0.94
9	Browser (no JavaScript)	Create	Superuser	0.77	0.96
10	Database-Frontend	Edit	Normal	0.85	0.98
11	Database-Frontend	Create	Superuser	0.92	0.99
12	Browser (no JavaScript)	Delete	Superuser	0.96	0.99
13	Database-Frontend	Delete	Normal	1.00	1.00

30% weight coverage with one test case

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Optimizing test suites

#	Access Method	Operation	Priv.	EUC	WC
1	Browser (with JavaScript)	Edit	Normal	0.12	0.30
2	Browser (with JavaScript)	Edit	Superuser	0.19	0.48
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11	Database-Frontend	Create	Superuser	0.92	0.99
12	Browser (no JavaScript)	Delete	Superuser	0.96	0.99
13	Database-Frontend	Delete	Normal	1.00	1.00

60% weight coverage with only three test cases

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Optimizing test suites

#	Access Method	Operation	Priv.	EUC	WC
1	Browser (with JavaScript)	Edit	Normal	0.12	0.30
2	Browser (with JavaScript)	Edit	Superuser	0.19	0.48
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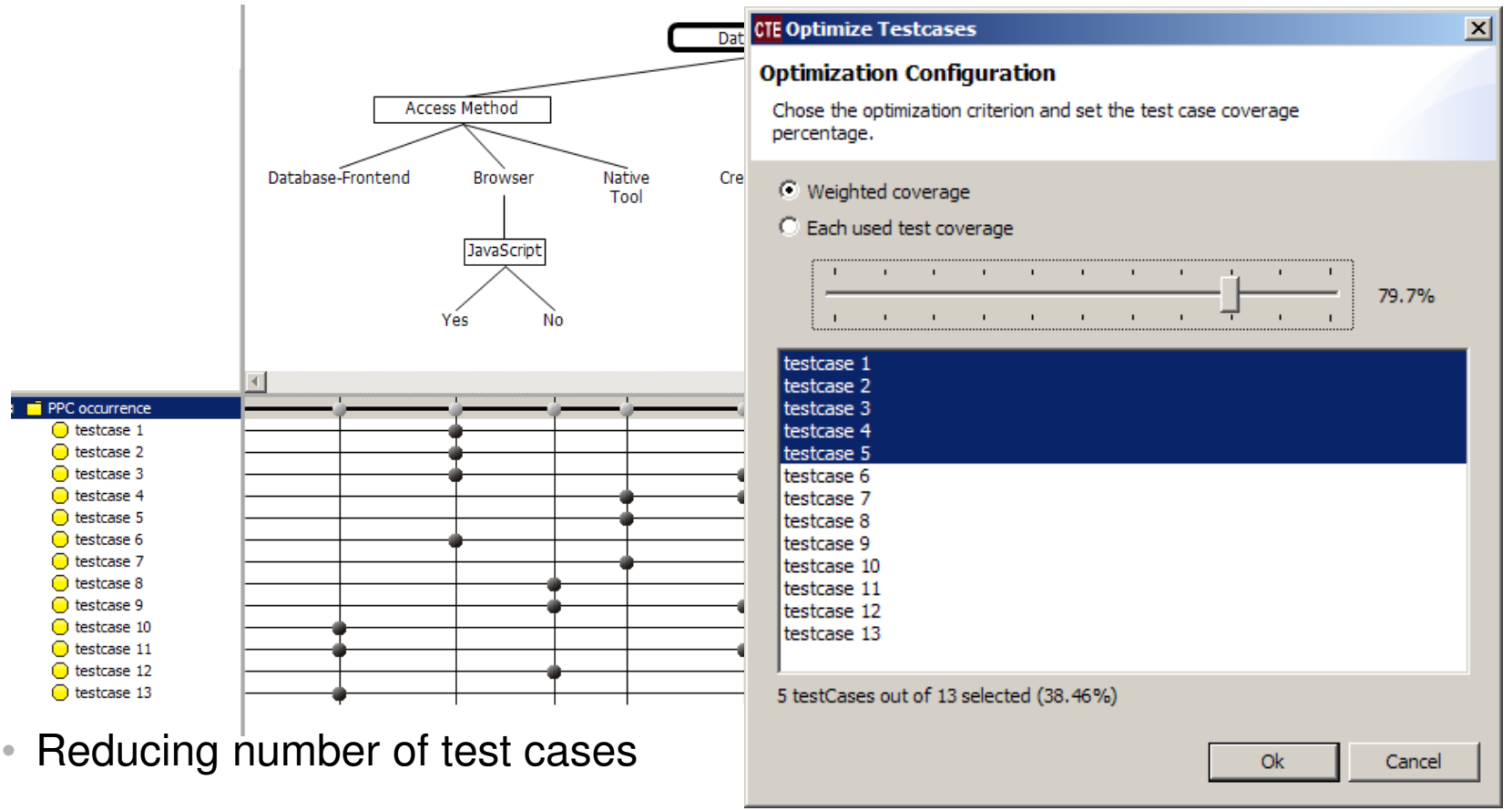
10	Database-Frontend	Edit	Normal	0.85	0.98
11	Database-Frontend	Create	Superuser	0.92	0.99
12	Browser (no JavaScript)	Delete	Superuser	0.96	0.99
13	Database-Frontend	Delete	Normal	1.00	1.00

90% weight coverage with just seven test cases

Solution: Weighted Test Cases



- Reducing number of test cases
- Based on preferred coverage
- Interactive preview

Requirements Traceability

DOORS
(or other RMTool)

Requirement 1 → Test Case 1
Requirement 2 → Test Case 2
Requirement 3 → Test Case 3
Requirement 4 → Test Case 4
Requirement 5 → Test Case 5
Requirement 6 → Test Case 6

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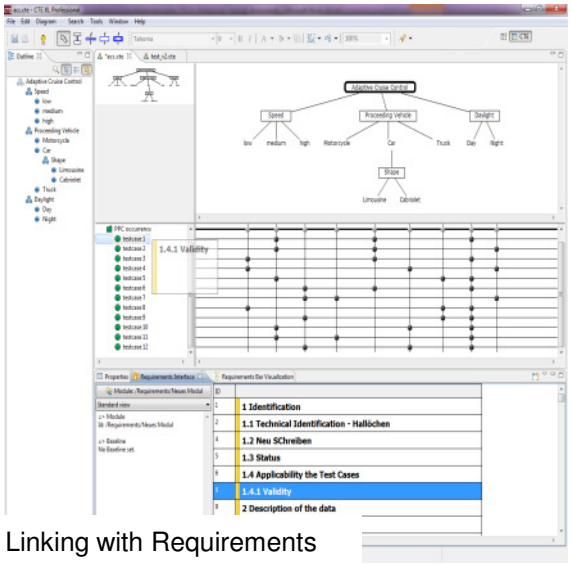
Coverage of Requirements by one/many Test Cases or Tree Items



Linking with Requirements

Requirements View

Obj	Value	Connection	Linked CTE Objects
9	2 Description of the data	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- testcase 11
10	2.1 This is a new Text	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- testcase 5
12	2.2 Sensitivity	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- testcase 2
13	3 Representation	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- Motorcycle
30	3.1 A new object	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- Cabriolet
14	4 Content	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- testcase 4
15	5 Access	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- testcase 2
16	6 Responsibilities	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- testcase 3
17	6.1 Application-oriented responsibility	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- testcase 12
18	6.2 Organizational responsibility	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- testcase 10
19	6.3 Technical responsibility	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- high
			- testcase 10

Linked Requirements

Requirements View

Obj	Value	Connection	Linked CTE Objects
29	9 Appendixes	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	
28	8.3 U		
27	8.2 D		
26	8.1 C		
25	8 As		
24	7.3 E		
23	7.2 R		
8	1.4.1		
5	1.3 Status	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	
2	1.1 Technical Identification - Hallöchen	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	

Non-Linked Requirements

Bonus: Automatic Tracing of Requirements Changes

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Requirements Traceability

DOORS
(or other RMTool)

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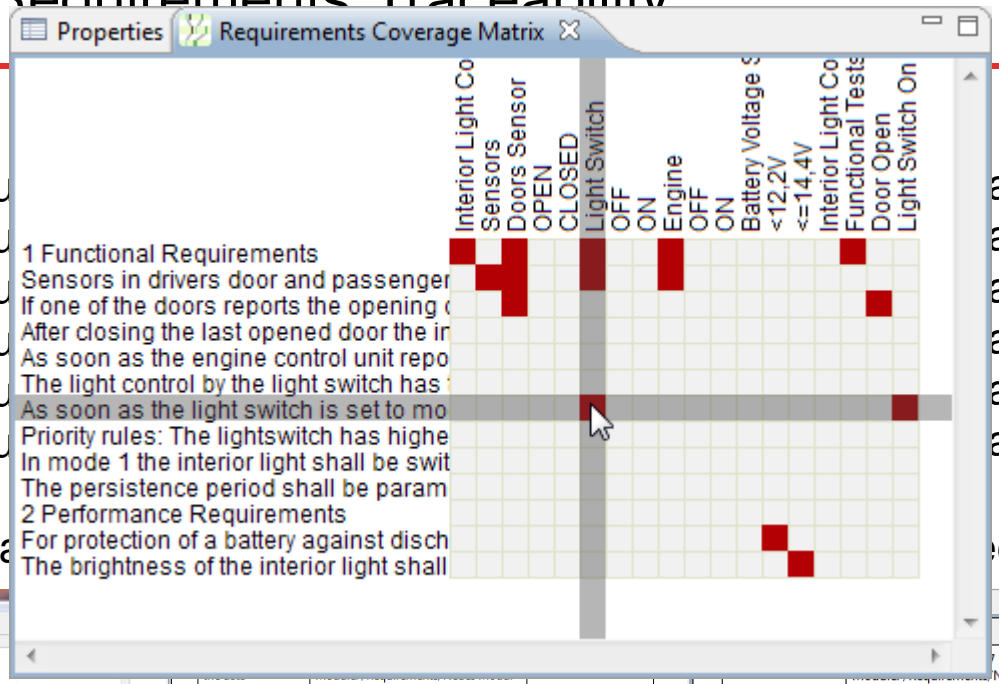
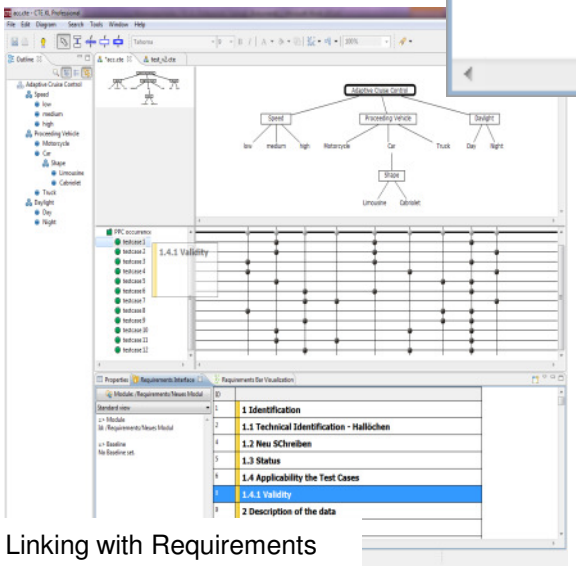




Linking with Requirements

10	2.1 This is a new Text	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- testcase 5
12	2.2 Sensitivity	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- testcase 2
13	3 Representation	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- Motorcycle
30	3.1 A new object	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- Cabriolet
14	4 Content	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- testcase 4
15	5 Access	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- testcase 2
16	6 Responsibilities	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- testcase 3
17	6.1 Application-oriented responsibility	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- testcase 12
18	6.2 Organizational responsibility	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- testcase 10
19	6.3 Technical responsibility	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	- high
			- testcase 10

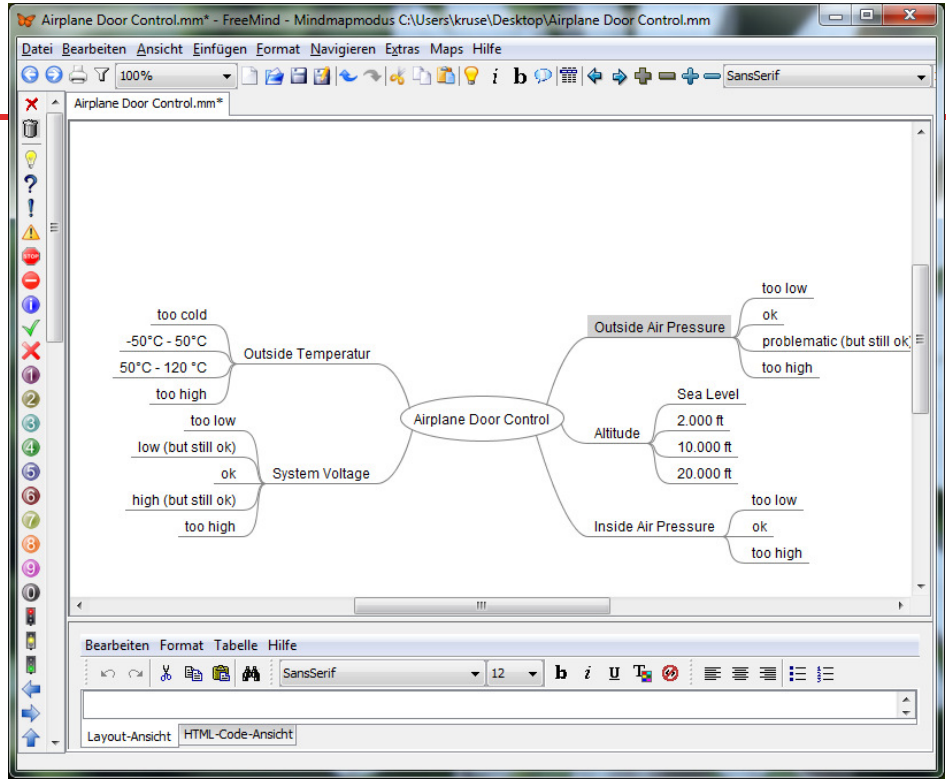
Linked Requirements

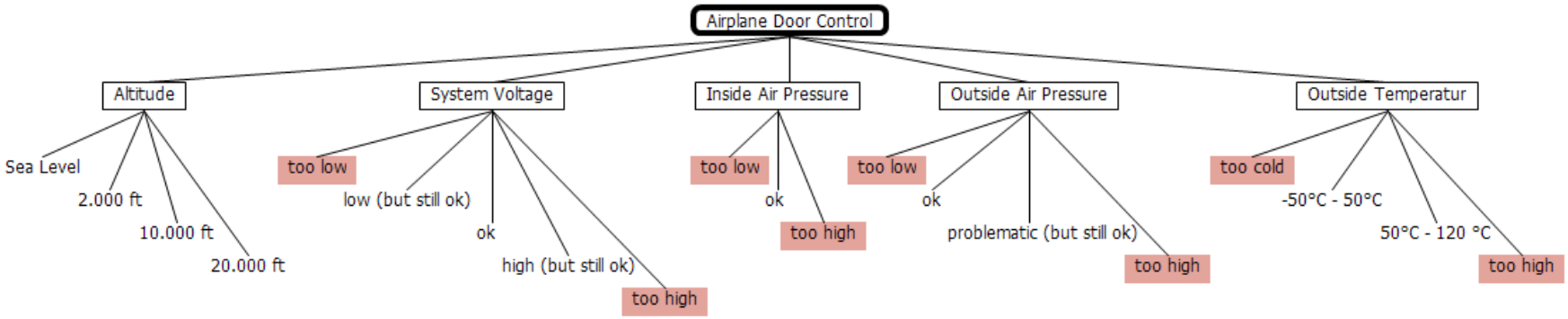
			Linked CTE Objects
28	8.3 U		
27	8.2 D		
26	8.1 C		
25	8 As		
24	7.3 E		
23	7.2 R		
8	1.4.1		
5	1.3 Status	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	
2	1.1 Technical Identification - Hallöchen	Interface: NBK1130;36677 Module: /Requirements/Neues Modul	

Non-Linked Requirements

Bonus: Automatic Tracing of Requirements Changes

MindMap Import





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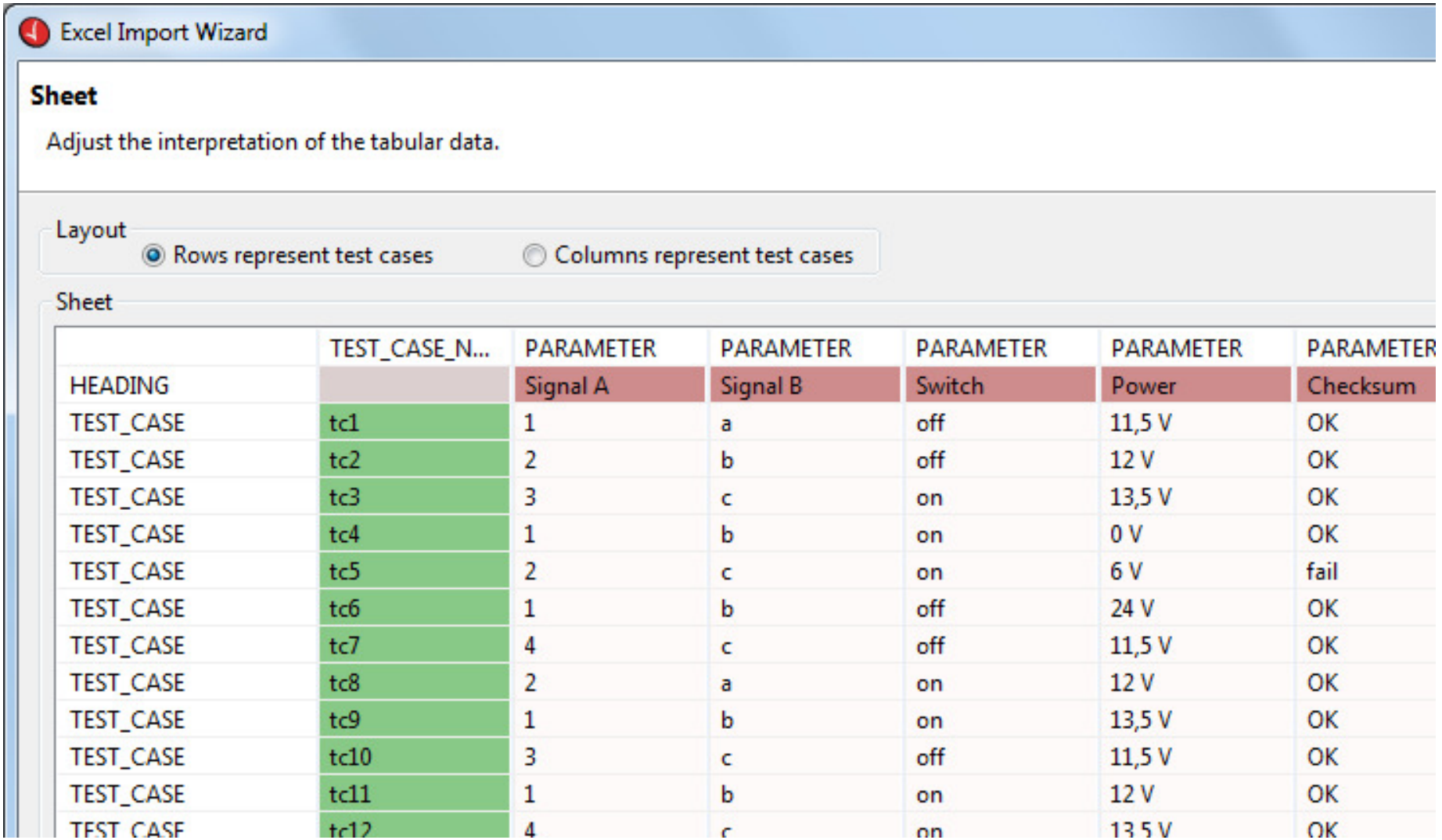
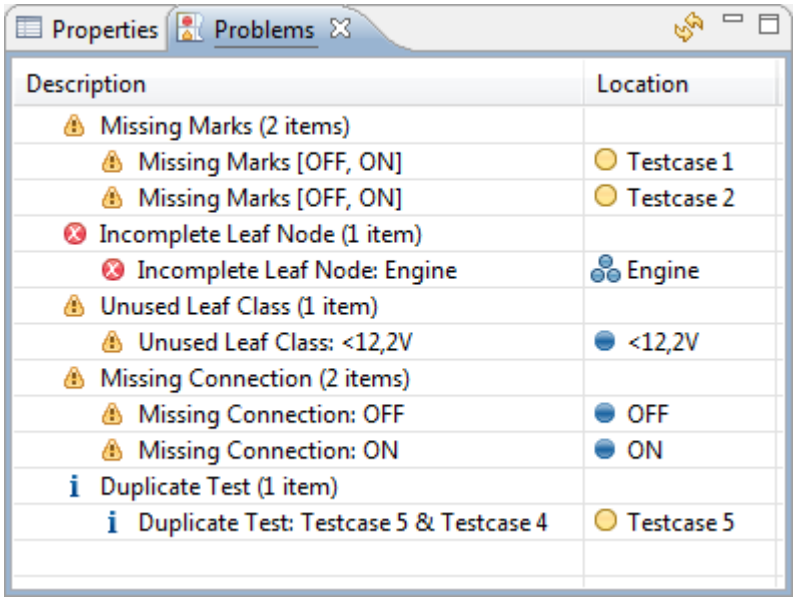
Excel Import



	TEST_CASE_N...	PARAMETER	PARAMETER	PARAMETER	PARAMETER	PARAMETER
HEADING		Signal A	Signal B	Switch	Power	Checksum
TEST_CASE	tc1	1	a	off	11,5 V	OK
TEST_CASE	tc2	2	b	off	12 V	OK
TEST_CASE	tc3	3	c	on	13,5 V	OK
TEST_CASE	tc4	1	b	on	0 V	OK
TEST_CASE	tc5	2	c	on	6 V	fail
TEST_CASE	tc6	1	b	off	24 V	OK
TEST_CASE	tc7	4	c	off	11,5 V	OK
TEST_CASE	tc8	2	a	on	12 V	OK
TEST_CASE	tc9	1	b	on	13,5 V	OK
TEST_CASE	tc10	3	c	off	11,5 V	OK
TEST_CASE	tc11	1	b	on	12 V	OK
TEST_CASE	tc12	4	c	on	13,5 V	OK

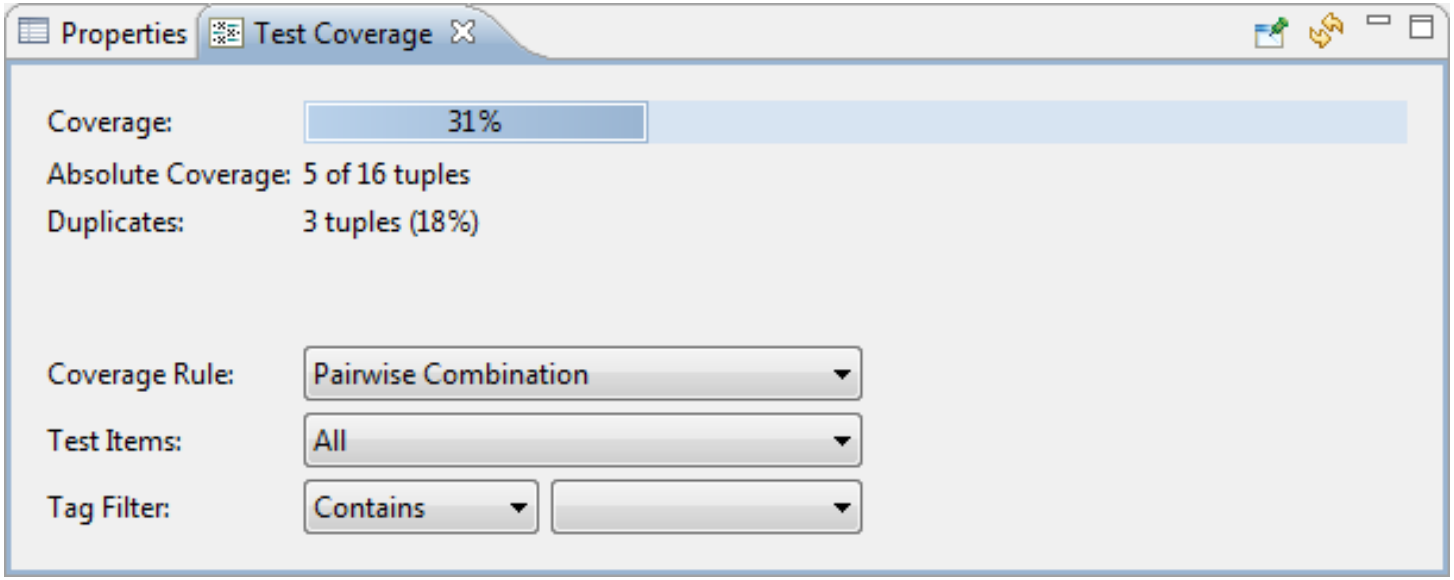
Inspector

- Checks both the classification tree and test case tree.
- The output contains all relevant information about possible problems:
  - **Missing Marks**
  - **Incomplete Leaf Node**
  - **Unused Leave Class**
  - **Missing Connection**
  - **Duplicate Test**



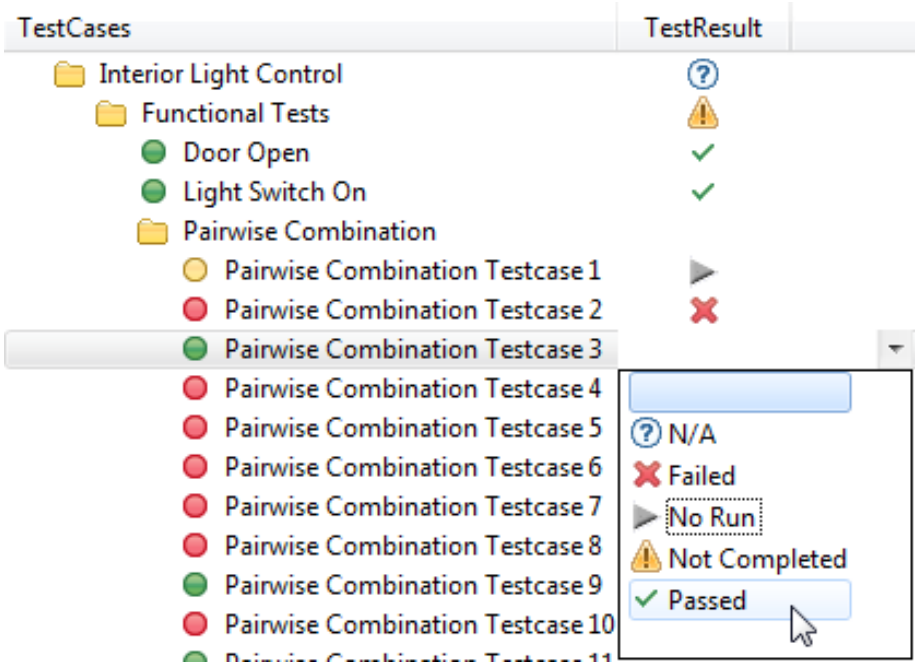
Test Completeness Analysis

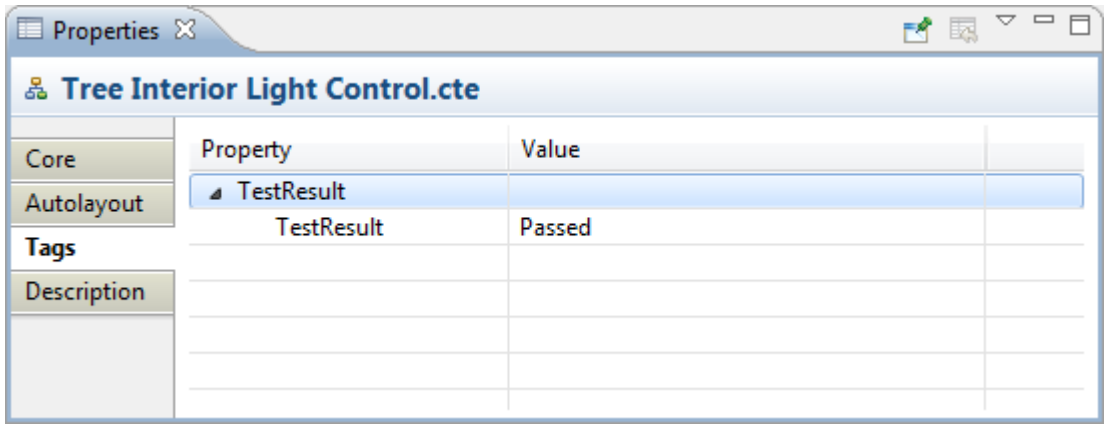
- Test Coverage
  - Analyze existing test suite, Check fulfillment of Coverage Levels (*e.g. Minimal, Maximal, Pairwise, …*)



Test result annotation

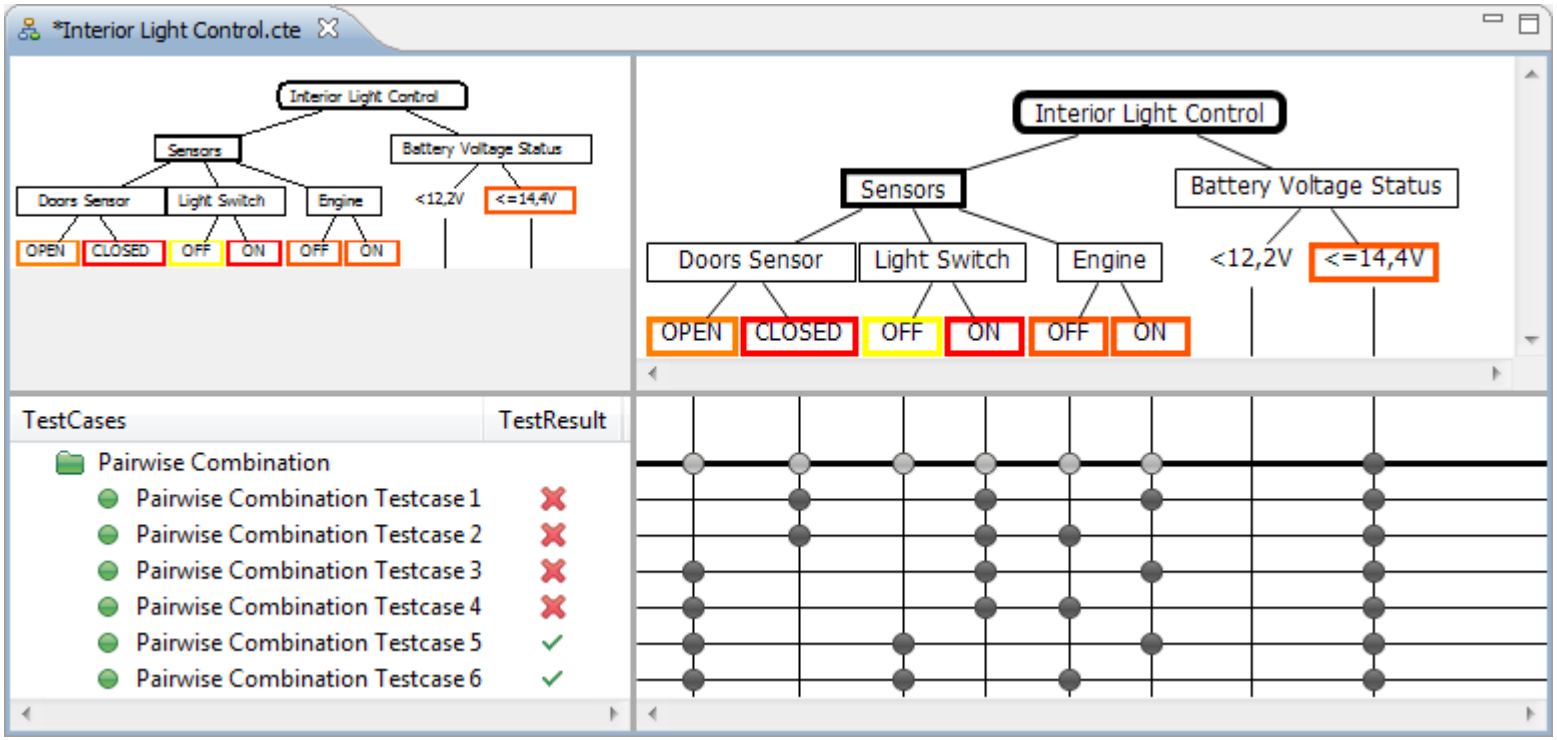
- Test result management
- Monitor test status, e.g.
  - **Failed**
  - **N/A**
  - **No Run**
  - **Not Completed**
  - **Passed**



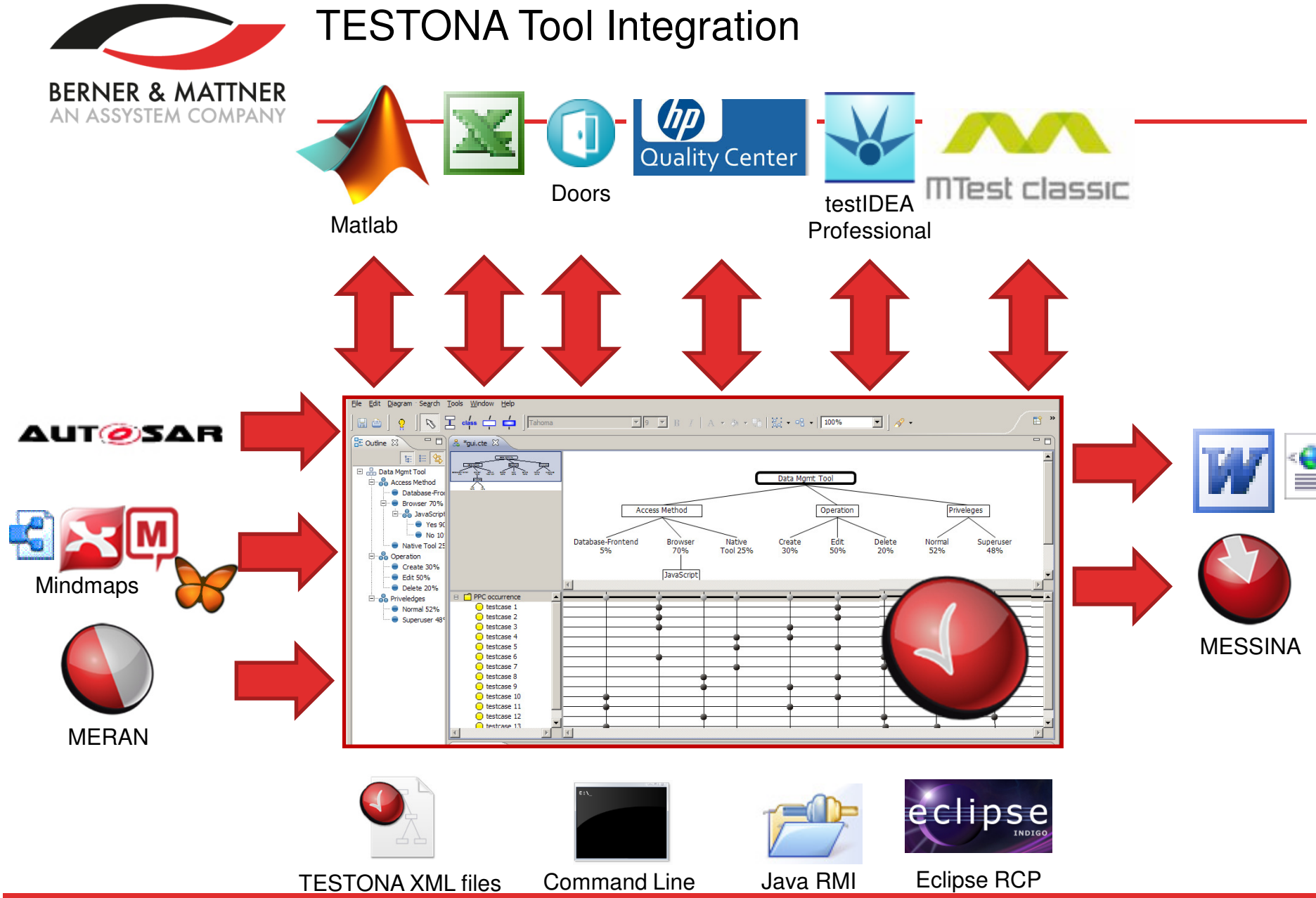


Test Evaluation

- Root Cause Analysis
  - Analyze individual test results to check for problematic system configurations



TESTONA Tool Integration



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