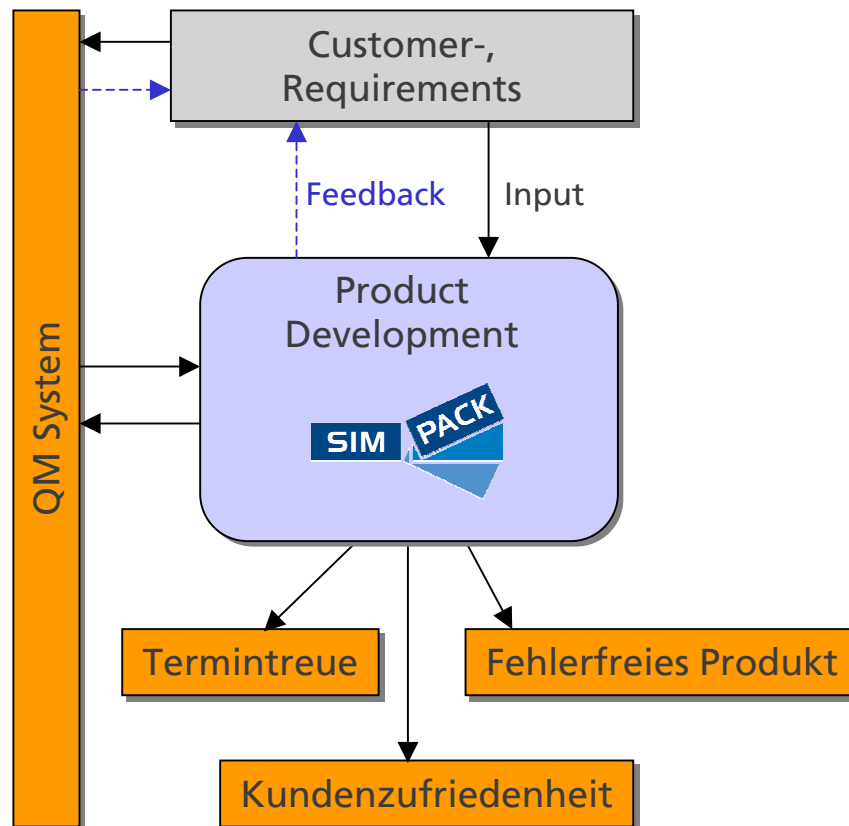




- > QM-System at INTEC
- > Workflow in SIMPACK Development
- > Unit and Component Test
- > System and Acceptance Test
- > Software Release Process

## > Goals of the QM-System at INTEC



### ANSI Normen

- 1008-1987 Unit Testing
- 1012-1986 Verification/Validation Plans
- 1016-1987 Software design descriptions
- 1028-1988 Standards for Reviews and Audits
- 1042-1987 Configuration Management
- 1061-1992 Quality Metrics Methodology
- 1063-1987 Standards for User Documentation
- 1074-1991 Software Life-Cycles
- 1219-1992 Software Maintenance

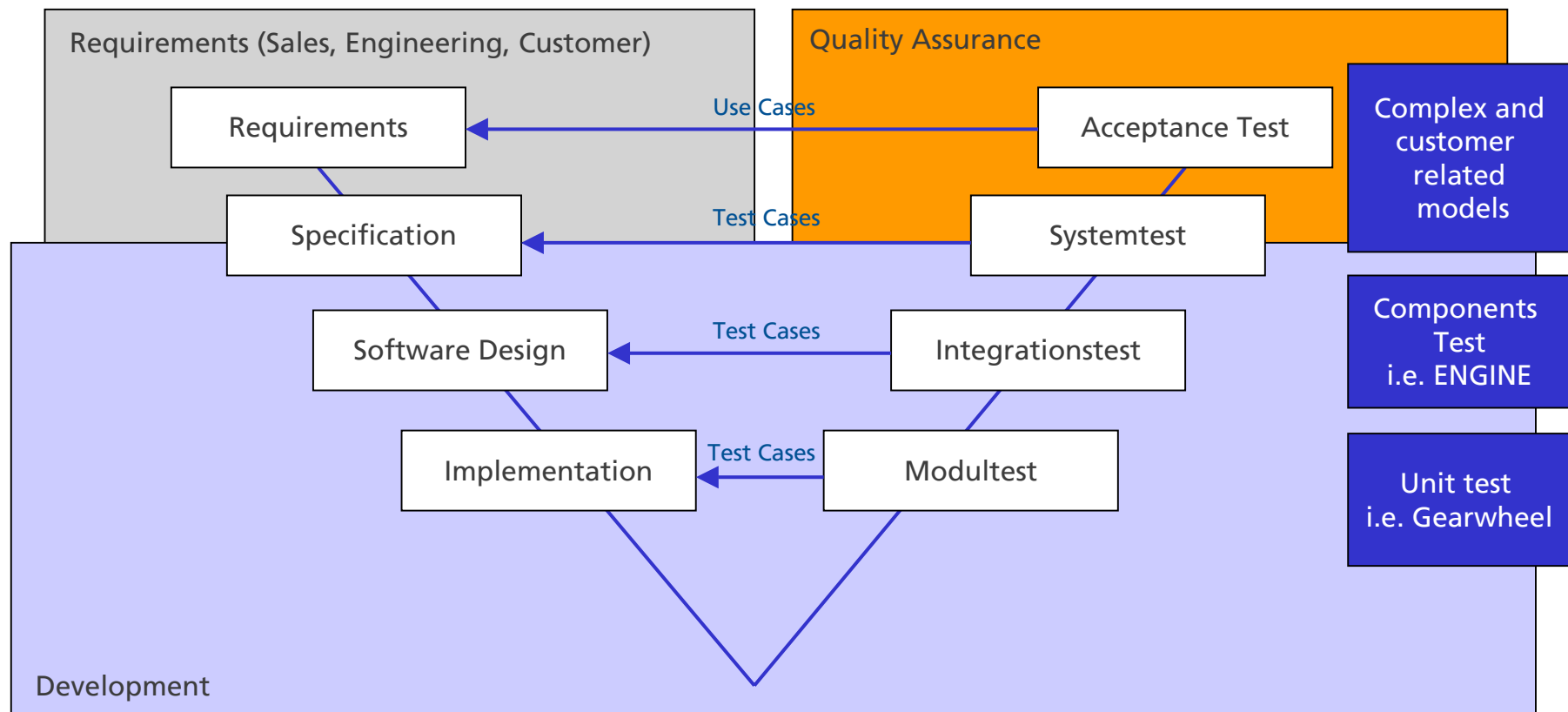
...

### DIN/EN/ISO/IEC Normen

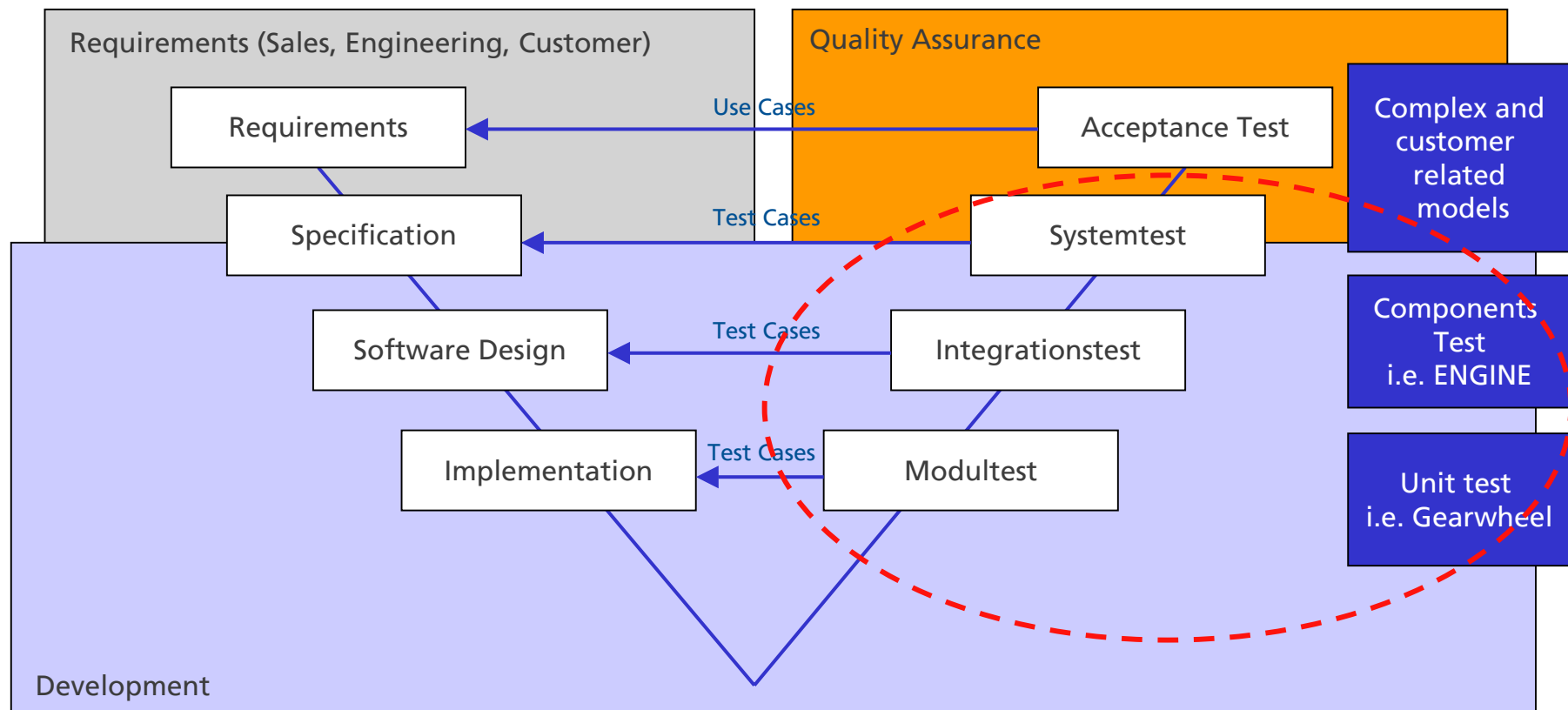
- DIN EN ISO 9000, 9001, 9002, 9004
- E DIN ISO 9000-2 Leitfaden zu ISO 9000
- E DIN ISO 8402 QM und Qualitätssicherung
- DIN ISO 10011 Audits, ~durchführung
- ISO 10007 Guidelines for Config. Management
- E DIN ISO 10013 QM Handbücher
- ISO/IEC 9126 Quality Characteristics and Guidelines
- DIN 66272 Beurteilen von Software Produkten, Qualitätsmerkmale
- DIN 66285 Anwendungssoftware: Gütebestimmung
- IEC 1704 Guide to test methods for reliability
- IEC 1713 Software life cycle processes
- ISO/IEC 9126 Quality characteristics
- ISO 9127 User documentation
- ISO/IEC TR 9294 Software documentation
- ISO 10005 Quality Management – Guidelines

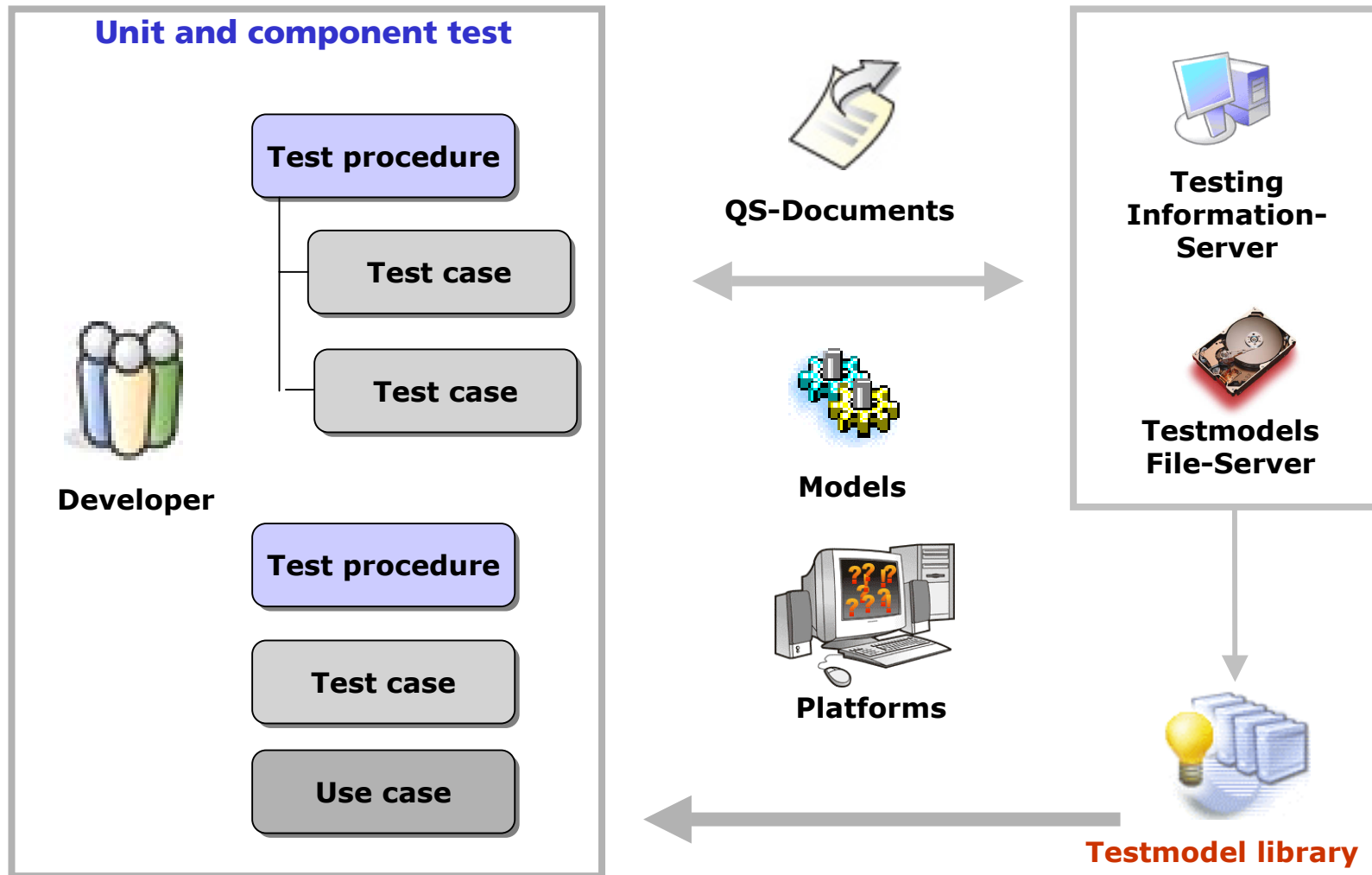
...

## > Workflow in SIMPACK Development

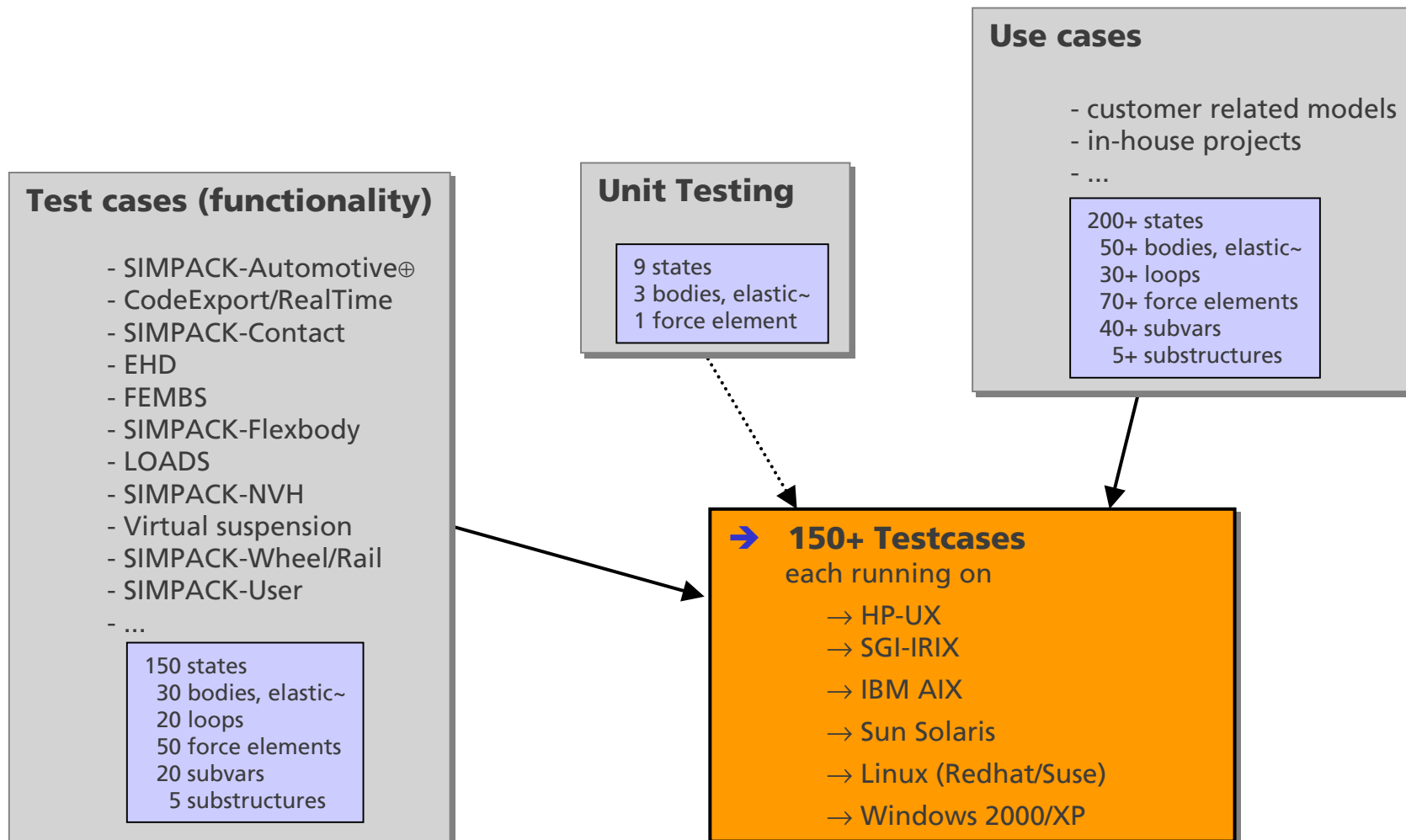


## > Unit and Component Test





## > Library of Testcases (models)



## > Test Case: 1000 RHS Calls

rps_13_a	AIX ibm	8624	1.370000124	23.10.2004
	AIX ibm	8624	1.909999847	23.10.2004
	AIX ibm	8619a	2.019999981	18.10.2004
	AIX ibm	8619a	2.510000229	18.10.2004
	HP-UX b2000	8626	2.35	28.10.2004
	HP-UX b2000	8626	2.94	28.10.2004
	HP-UX b2000	8624	2.37	21.10.2004
	HP-UX b2000	8624	2.96	21.10.2004
	HP-UX b2000	8619a	2.34	18.10.2004
	HP-UX b2000	8619a	2.93	18.10.2004
	IRIX64 fuel	8626	1.870000	28.10.2004
	IRIX64 fuel	8625	1.880000	27.10.2004
	IRIX64 fuel	8625	1.880000	27.10.2004
	IRIX64 fuel	8624	1.600000	21.10.2004
	IRIX64 fuel	8624	1.890000	21.10.2004
	IRIX64 fuel	8619a	1.590000	18.10.2004
	IRIX64 fuel	8619a	1.870000	18.10.2004
	Linux redhat	8626	0.7200000	28.10.2004
	Linux redhat	8626	0.9100000	28.10.2004
	Linux redhat	8625	0.7200000	28.10.2004

Model

Platform

Release

Results  
- CPU Time  
- Test Output

## > Test Case: Time Integration (ParVar)

rps_13_a	AIX ibm	8619a	19.15	2951	19	0.31120606
	AIX ibm	8619a	19.15	2951	19	0.31120606
	AIX ibm	8619a	19.15	2951	19	0.31120606
	HP-UX b2000	8626	44.13	5967	34	5.9481E-02
	HP-UX b2000	8624	43.4	<b>5696</b>	35	0.60042145
	HP-UX b2000	8619a	42.61	<b>5696</b>	35	0.60042145
	HP-UX b2000	8619a	42.61	<b>5696</b>	35	0.60042145
	HP-UX b2000	8619a	42.61	<b>5696</b>	35	0.60042145
	IRIX64 fuel	8626	27.19	5625	32	0.33720037
	IRIX64 fuel	8625	26.68	5625	32	0.33720037
	IRIX64 fuel	8619a	4.43	<b>4978</b>		
	IRIX64 fuel	8619a	24.16	<b>4978</b>		
	IRIX64 fuel	8619a	24.16	<b>4978</b>		
	IRIX64 fuel	8619a	24.16	<b>4978</b>		
	Linux redhat	8626	13.21	5439		
	Linux redhat	8625	13.28	5439	29	0.31266162
	Linux redhat	8624	14.45	<b>5877</b>	34	0.49690916
	SunOS ultra10	8624	68.36	6052	30	0.34108403
	Windows_NT VOYAGER	8621d	59.28	7112	32	5.939E-003
	Windows_NT DIEGO	8621d	59.95	7112	32	5.939E-003
	Windows_NT DIEGO	8621d	59.95	7112	32	5.939E-003

Model

Platform

Release

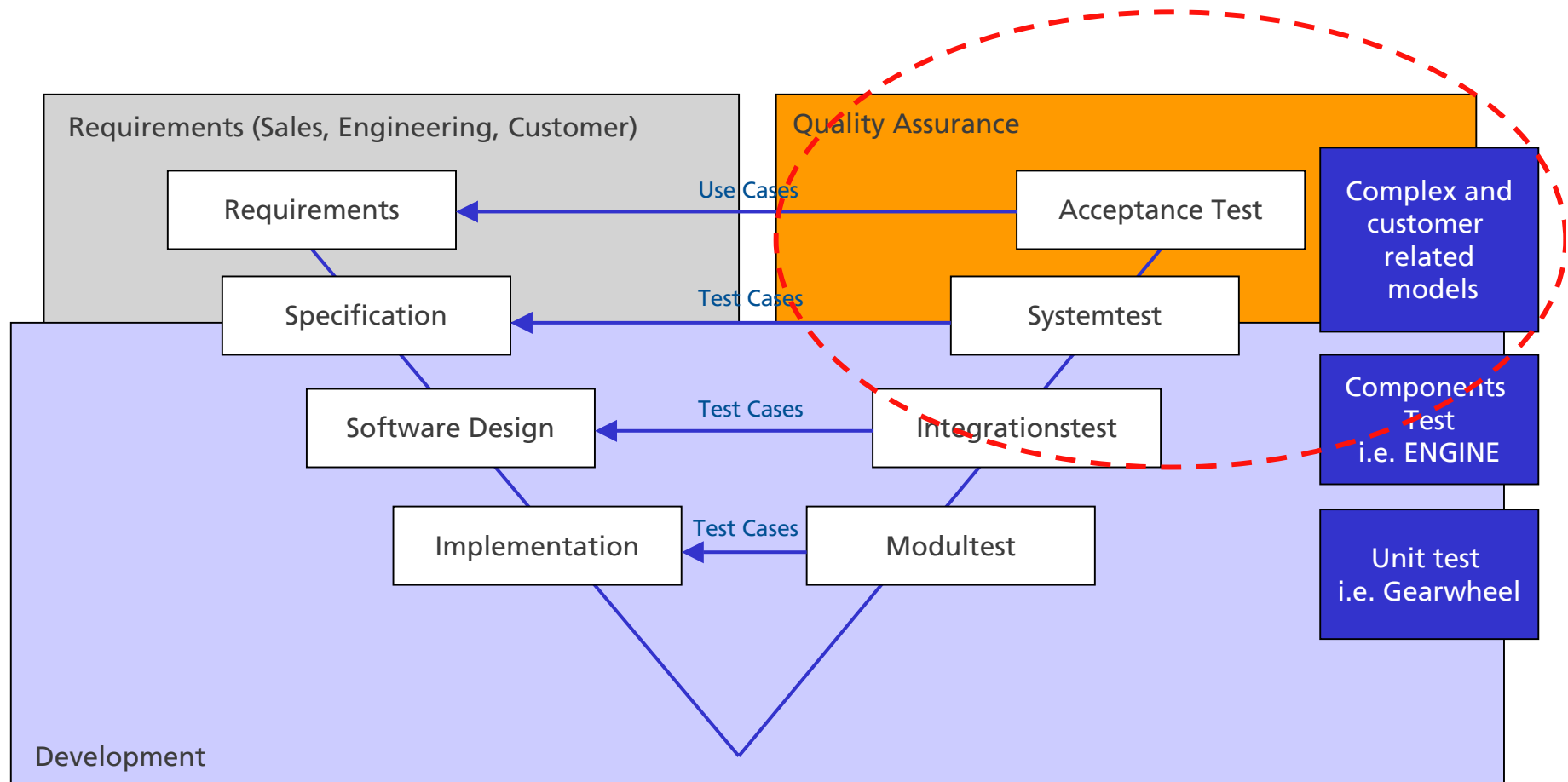
Results

- Integration Steps
- Jacobian
- Step Size
- Order



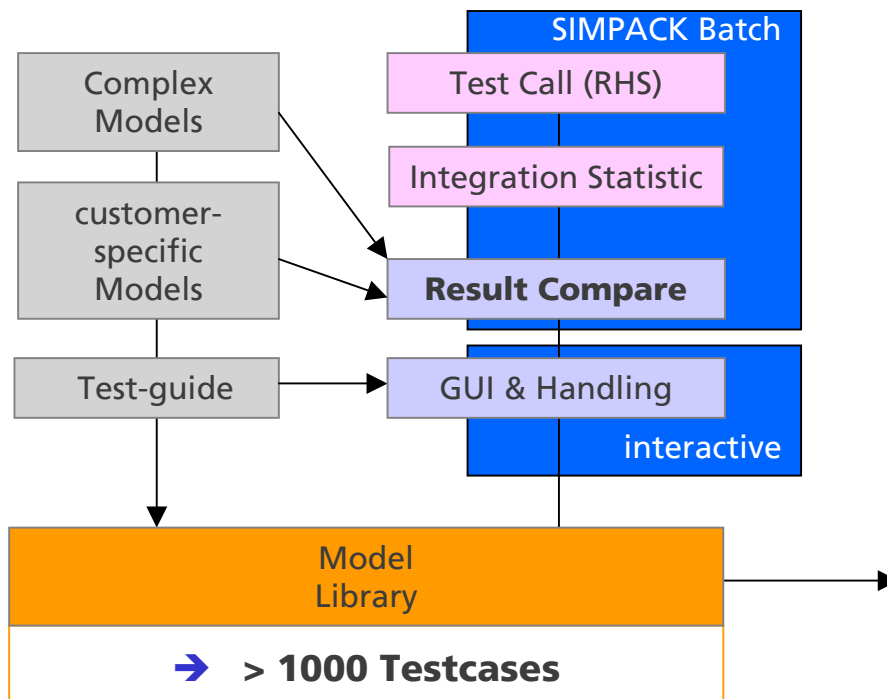


## > System and Acceptance Test





## > Testing Procedure



**Modell TEST\_INTECSwitch\_Elastic:**

Modell:	TEST_INTECSwitch_Elastic
Test Suite:	WheelRail_Switch
SIMPACK Version:	8625
Platform:	IRIX64
Error-Text:	the equations of motion failed and where and why IRES
Hint:	
Datum:	27.10.2004

**Modell Statistik für TEST\_INTECSwitch\_Elastic:**  
Testreihen des Solvertests: *simpac\_integ\_nomes (modell)*

Test Suite	Test Modell	Platform	Version	CPU Zeit	Int-Steps	Nr. Jacobian	Last Step	Last Order	Datum
WheelRail_Switch	TEST_INTECSwitch_Elastic	AIX ibm	8624	2076.48	6942	190	0.2540E-01	1	27.10.2004
		AIX ibm	8621d						18.10.2004
									18.10.2004
		AIX ibm	8619a						18.10.2004
									18.10.2004
		HP-UX b2000	8625						27.10.2004
		HP-UX tarzan	8624	1982.27	8422	196	2.0279E-02	1	27.10.2004
		HP-UX b2000	8624						21.10.2004
		HP-UX b2000	8619a						18.10.2004
		IRIX64 fuel	8625						27.10.2004
		IRIX64 fuel	8624	1614.09	8351	215	2.557E-002	1	21.10.2004
		Linux redhat	8625						27.10.2004
		Linux redhat	8624	963.98	6939	177	1.204E-002	1	21.10.2004
		Linux redhat	8621d	965.56	6939	177	1.204E-002	1	19.10.2004
		Linux redhat	8619a	1027.42	6935	185	2.416E-002	1	18.10.2004
		SunOS ultra10	8624						26.10.2004
		SunOS ultra10	8619a						18.10.2004

## > Part of Wheel/Rail Testplan

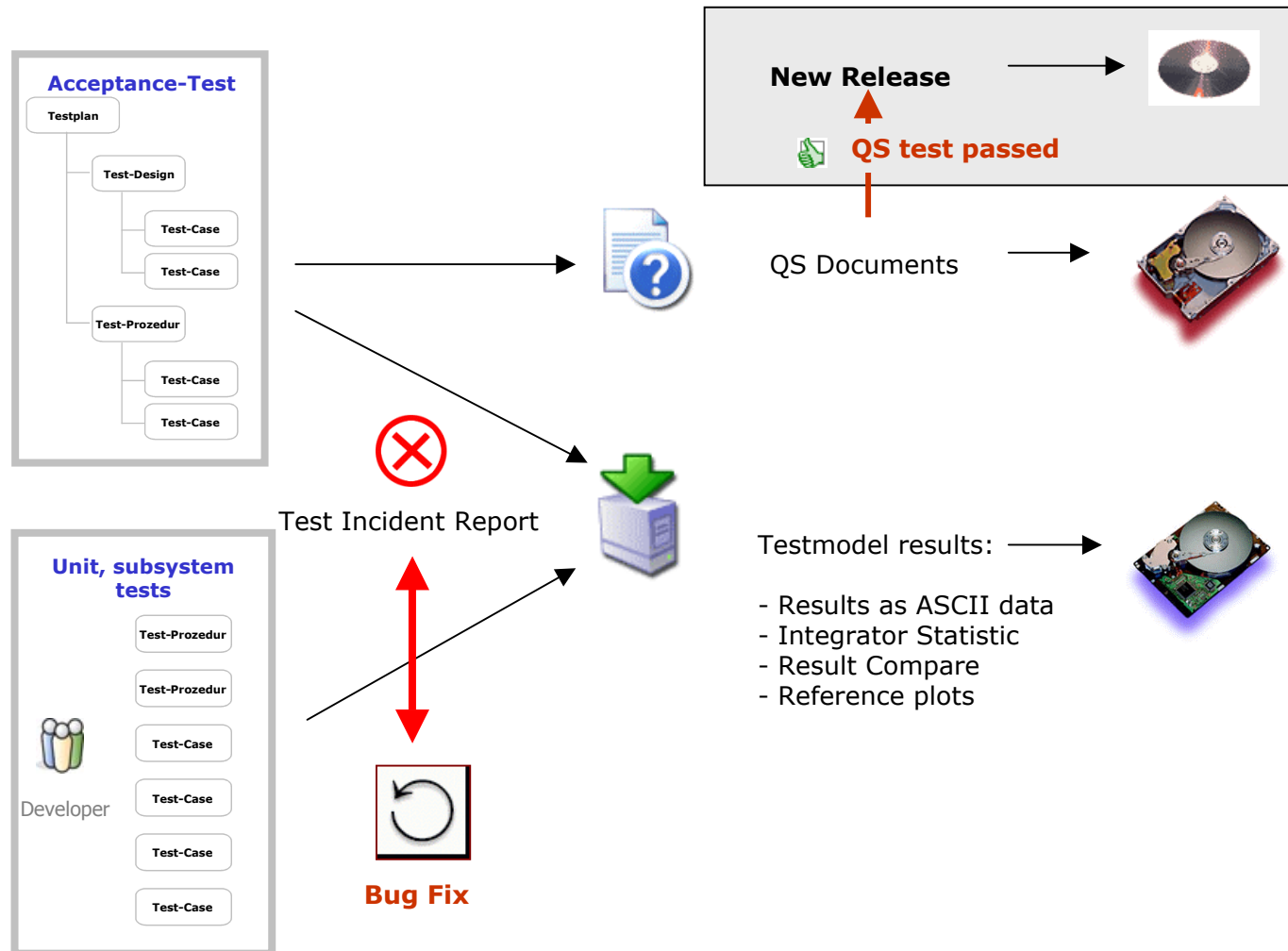
- Anhalten/Wiederanfahren
  - Bremsen (mit blockierten Radsätzen)
  - Anfahren (mit/ohne durchdrehenden Rädern)
  - Anhalten im Gefälle im überhöhten Gleis mit anschließendem Lösen der Bremse
- Kraftschlußgesetze
  - FATSIM Diskretisierung
- (skalierte) Gleisanregungen
- elastischer Mehrpunktkontakt
  - TimeInt
  - Statiq equilibrium
  - Nom. Forces
  - parameter Var. (Wechsel der Schienenprofile)
- Weichenüberfahrt
- Track
  - cartographic ~
  - measured ~
  - ASCII/binary data
  - track data from database



## > Acceptance Test - Test Results

### 8629 - Gesamtübersicht

Test Suite	HP-UX	IRIX64	SunOS	AIX	Linux	Windows
<a href="#">Automotive (4)</a>	?	?	?	?	+	+
<a href="#">Customer 1 (50)</a>	+	+	+	+	+	+
<a href="#">Customer 2 (60)</a>	+	+	+	+	+	+
<a href="#">Customer 3 (50)</a>	+	+	+	+	+	?
<a href="#">Customer 4 (30)</a>	+	+	+	+	+	?
<a href="#">Customer 5 (73)</a>	+	+	+	+	+	?
<a href="#">DelftTyre (598)</a>	-	+	+	+	+	+
<a href="#">Elastomer Pfeffer (5)</a>	?	?	?	?	+	+
<a href="#">FEMBS (46)</a>	+	+	+	+	+	+
<a href="#">GasForce (47)</a>	+	+	+	+	+	+
<a href="#">Gearwheel (8)</a>	?	?	?	?	+	+
<a href="#">Customer 6 (23)</a>	?	+	+	+	+	?
<a href="#">NVH (12)</a>	+	+	+	+	+	+
<a href="#">OldWheelRail (118)</a>	+	+	+	+	+	+
<a href="#">Customer 7 (4)</a>	?	?	?	?	-	-
<a href="#">VirtSusp (254)</a>	+	+	+	+	+	+
<a href="#">WheelRail Excitations (14)</a>	?	?	?	?	+	+
<a href="#">WheelRail Switch (30)</a>	+	+	+	+	+	?
<a href="#">WheelrailContact (131)</a>	+	+	+	+	+	+
<a href="#">WheelRailBox (18)</a>	?	?	?	?	+	?



## Quality Assurance in the Software Development

- > today: 50+ customer related use cases
- > today: 150+ (complex) test cases
- > In future: Test reports will be part of the delivery bill
- > Non-disclosure Agreement for customer model data
- > ongoing development of the test-model library

**New Versions tested with your models**



SIMPACK User Meeting 04, Quality Assurance, Claus Schwientek, 09.11.2004



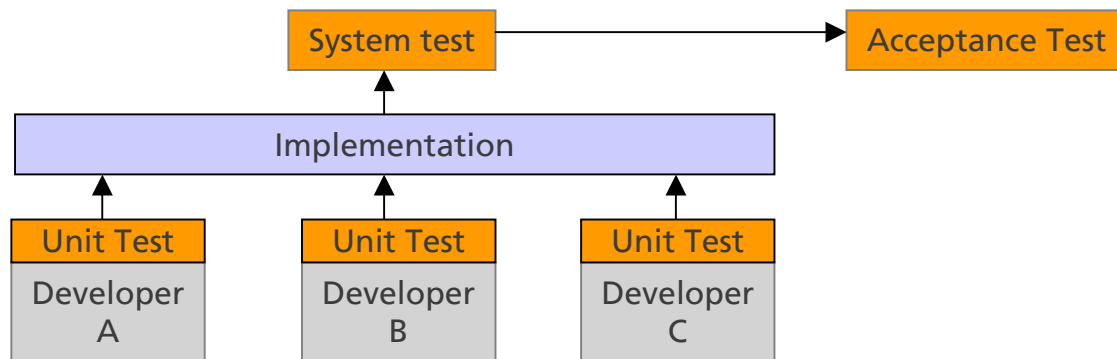
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16

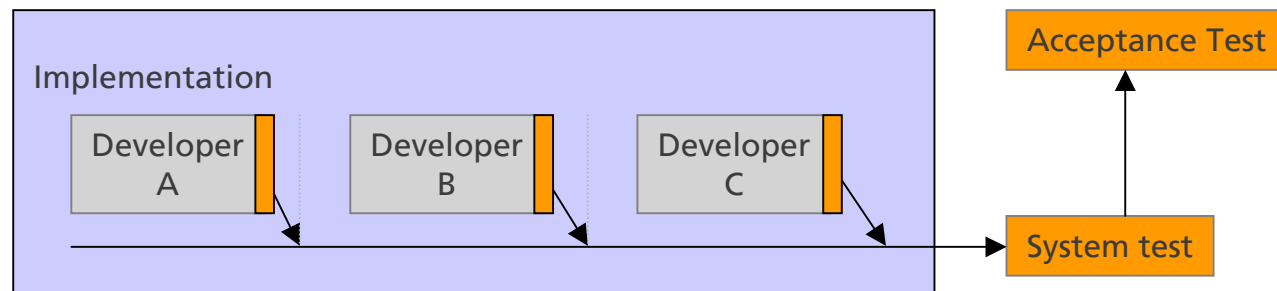


### > Testing Procedure

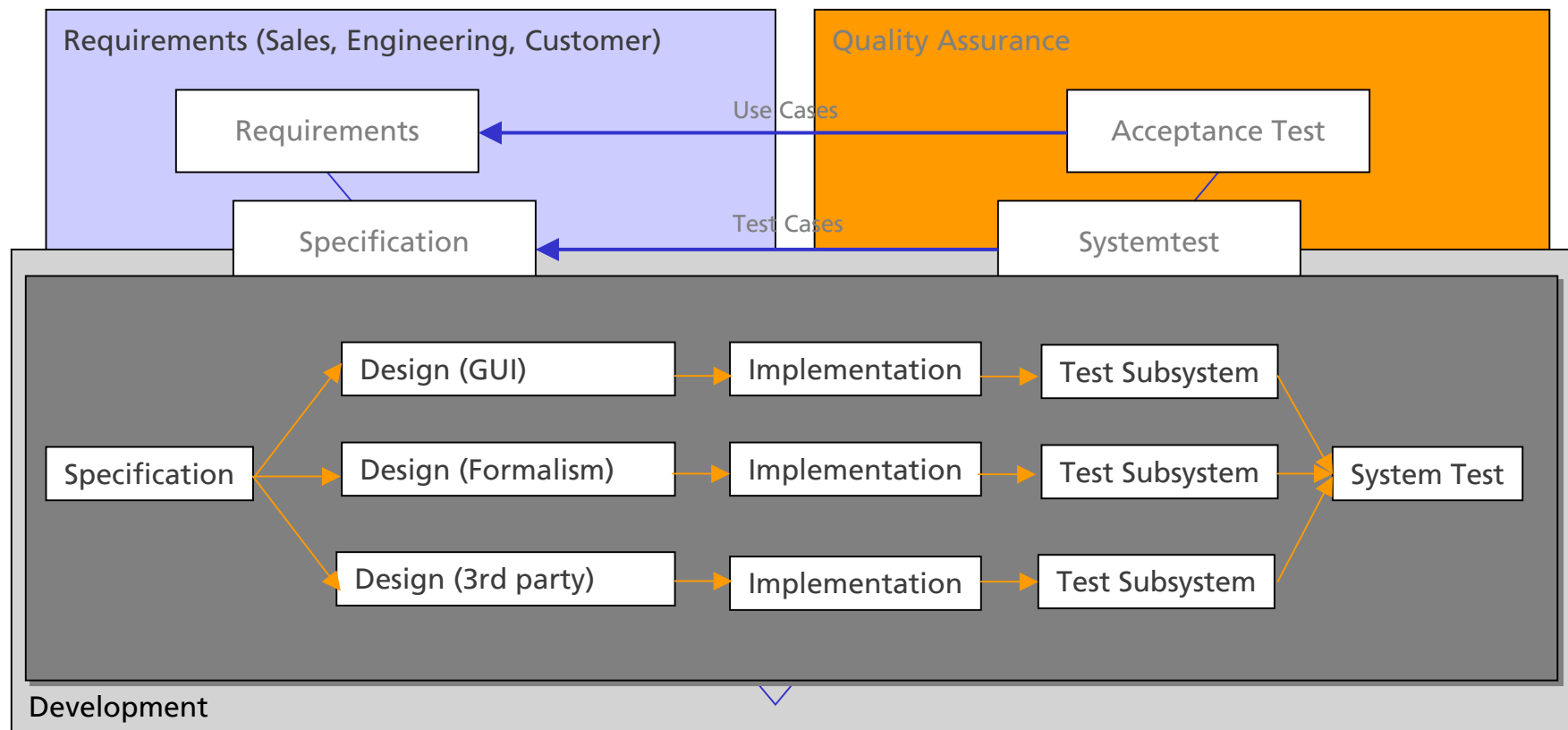
#### Big-Bang Method



#### Incremental Testing



## > Workflow process in SIMPACK Development

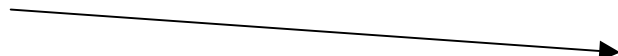
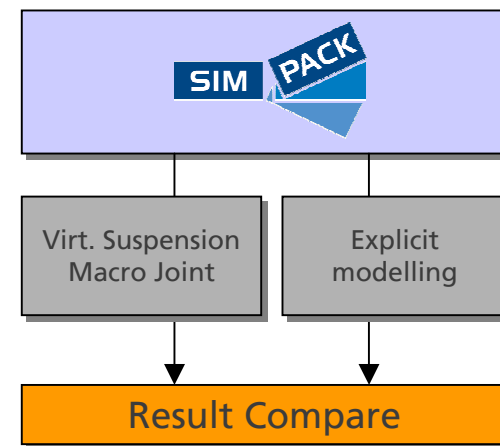


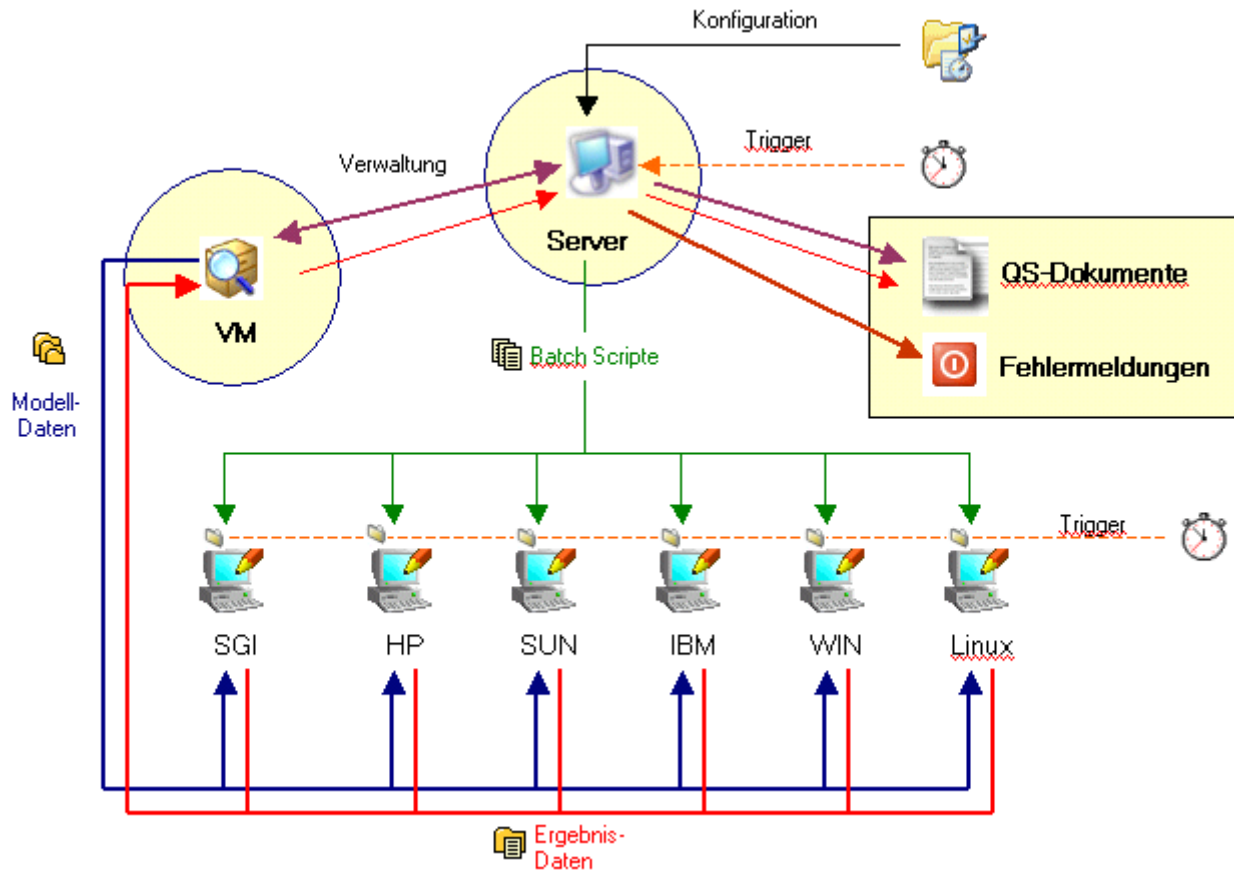
## > Testing Methods

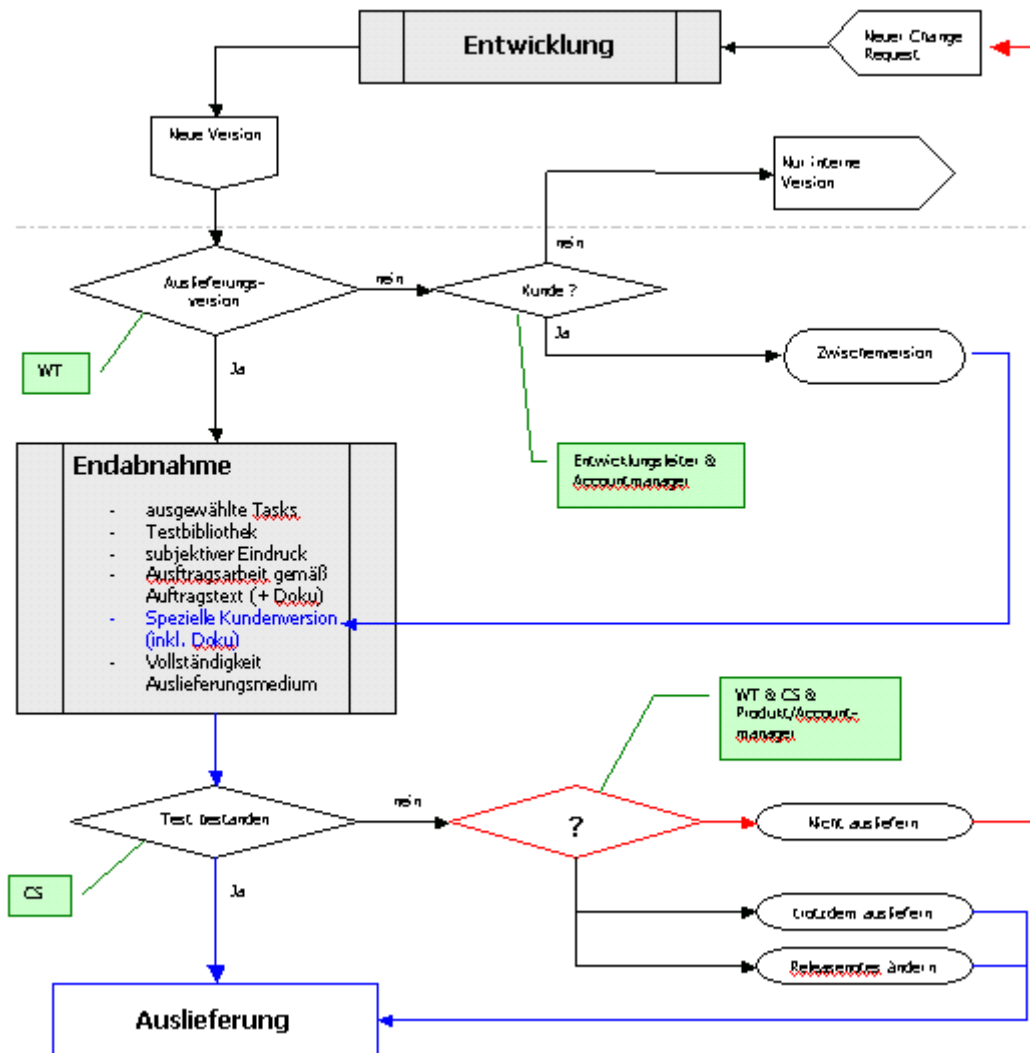
- White Box Testing
  - formalism and source code related
  - i.e. compact rubber with "r x F"
  
- Black Box Testing
  - application related
  
- Acceptance test
  - (Useability, Performance, Compatibility, Validation, ...)

```

386 C .....
387 C Return and Error Handling
388 C .....
389
390 END IF
391
392 RETURN
393
394 $001 continue
395
396 call $pch_wm_force@dName( uforce_ptr, ic, id, ierr )
397
398 write(string, '*** E200 in Pre-Processing of User Force Element')
399 call $pch_wm_pname(string, ierr)
400 write(string, ' ', uforce_ptr(1:10))
401 call $pch_wm_pname(string, ierr)
402 write(string, ' ', force_in_defining_Pack_Measurement_ID = ', mid
403 call $pch_wm_pname(string, ierr)
404
405 ierr = 1
406
407 RETURN
408
409 $002 continue
410 call $pch_wm_force@dName( uforce_ptr, ic, id, ierr )
411
412 write(string, '*** E200 in Pre-Processing of User Force Element')
413 call $pch_wm_pname(string, ierr)
414 write(string, ' ', uforce_ptr(1:10))
415 call $pch_wm_pname(string, ierr)
416 write(string, ' ', force_ptr(2) must not be negative')
417 call $pch_wm_pname(string, ierr)
418
            
```







*Abbildung: das magische Quadrat*

