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# Test Management

Author:  
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Is this information helpful?



## Learning objectives

- Get to know where and how testing happens within the product lifecycle
- Understand how to define and use metrics for test exit criteria
- Learn how to improve an existing testing approach

## Agenda

### Test Process

Metrics for Test Exit Criteria

Continuous Test Improvement

Summary

## Testing lifecycle

**Testing lifecycle, testing process, testing organization depend on / should be adapted to ...**

- software development lifecycle, development process, organization
- hardware development lifecycle and hardware testing approach

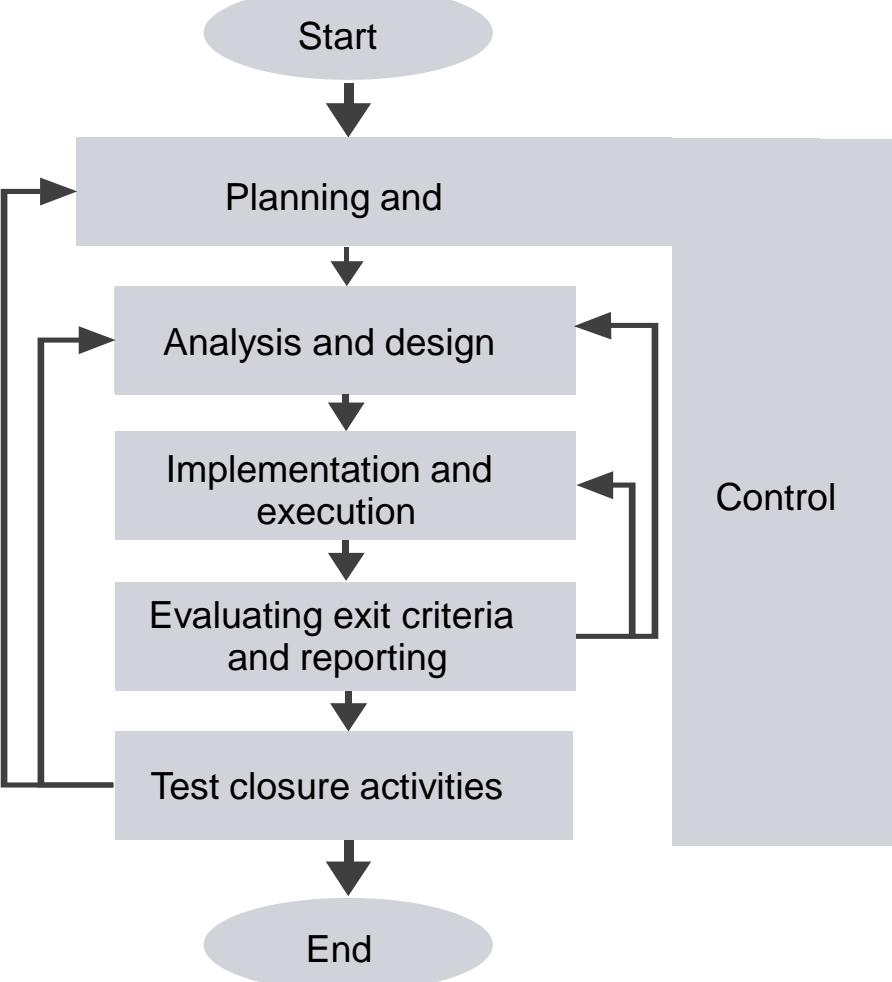
**Testing must be  
*embedded, integrated,  
concurrent, aligned  
with development,  
working together***



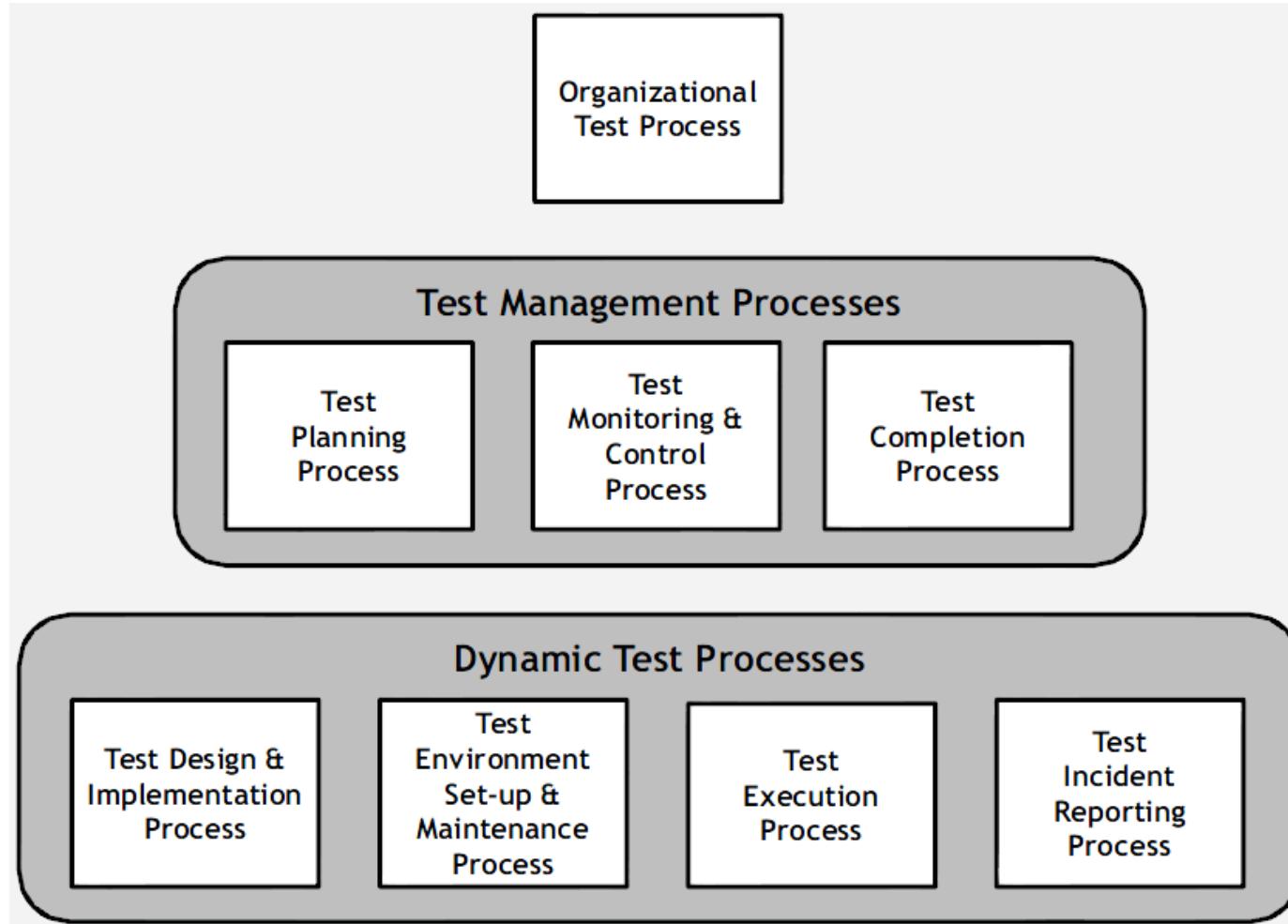
**Testing must be *independent,*  
"4 eyes principle,"  
reporting line**

**Wide cognition frame and wide reporting frame by  
*independence of spirit & collaboration*, not necessarily separate group**  
→ Can be achieved by writing tests before implementing code  
→ Test-driven development (xTDD: TDD, A-TDD, BDD, SbE, etc.)

# ISTQB® fundamental testing process



**Although logically sequential,  
the activities in the process may  
overlap or take place  
concurrently**



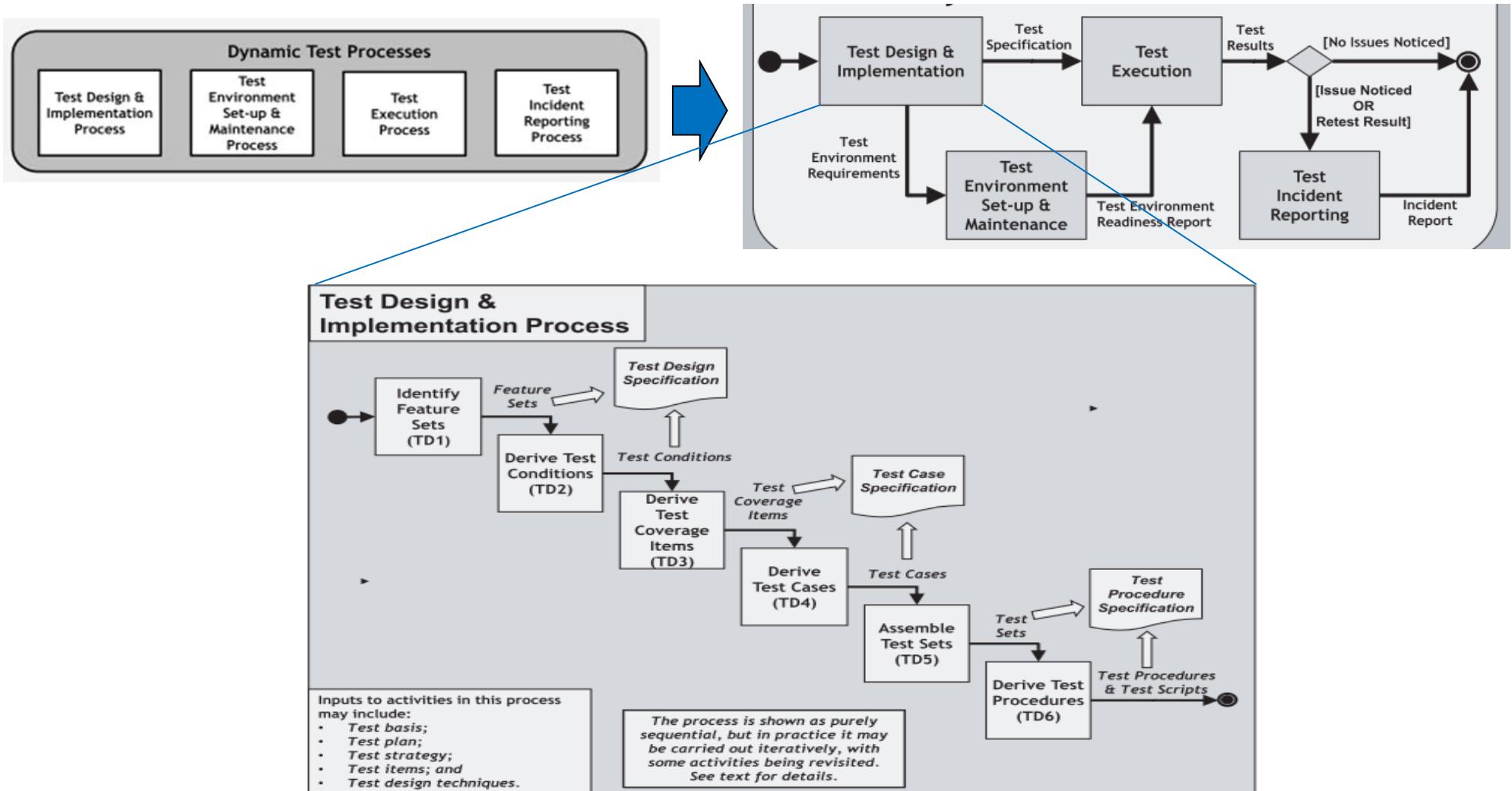
ISO 29119  
Processes

## The multi-layer model showing all test processes

# ISO/IEC/IEEE 29119-2 Dynamic Test Process

## Phase Test Design & Implementation

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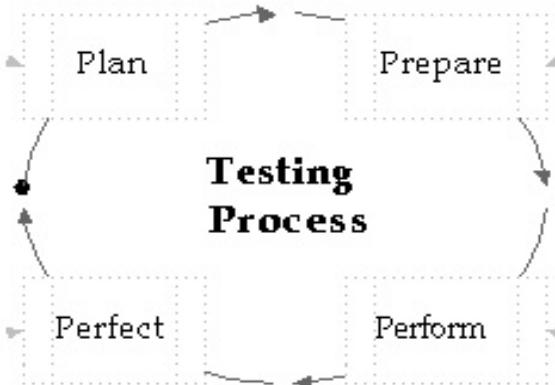
# Rex Black: Critical testing processes

## Understand the testing effort

- Discover the context of testing
- Analyze the quality risks
- Estimate the testing
- Plan the testing

## Guide adaptation and improvement

- Report any bugs
- Report test results
- Manage changes



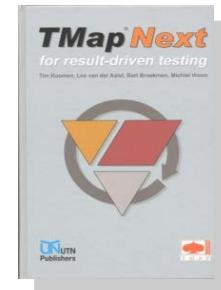
## Assemble the people and tests

- Build the test team
- Design and implement a test system

## Do the testing and gather the results

- Obtain a test release
- Run and track the tests

**The test engineer's role focuses on some of these activities, not all, depending on how roles are defined. However, the effective and efficient test engineer must understand how the test process works and how it fits into the overall project from a big picture perspective.**

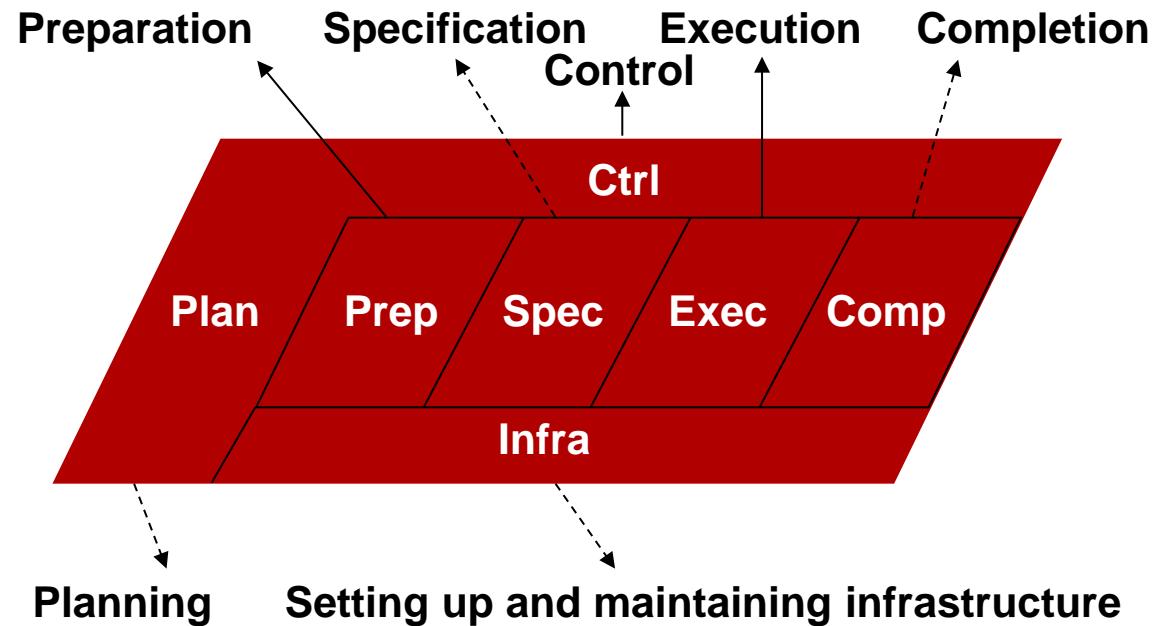
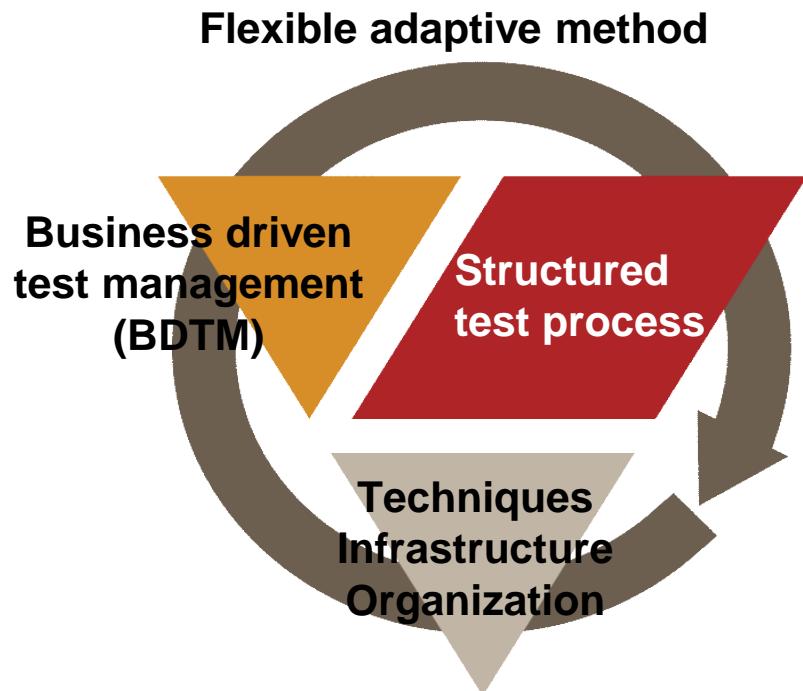


## Testing lifecycle – Example

T. Koomen, L. Aalst, B. Broekman, M. Vroon:  
*TMap Next, for result-driven testing*

### TMap® (Test Management Approach by Sogeti)

The lifecycle model is a generic model. It can be applied to all test levels and test types and used in parallel with the lifecycle models for system development.



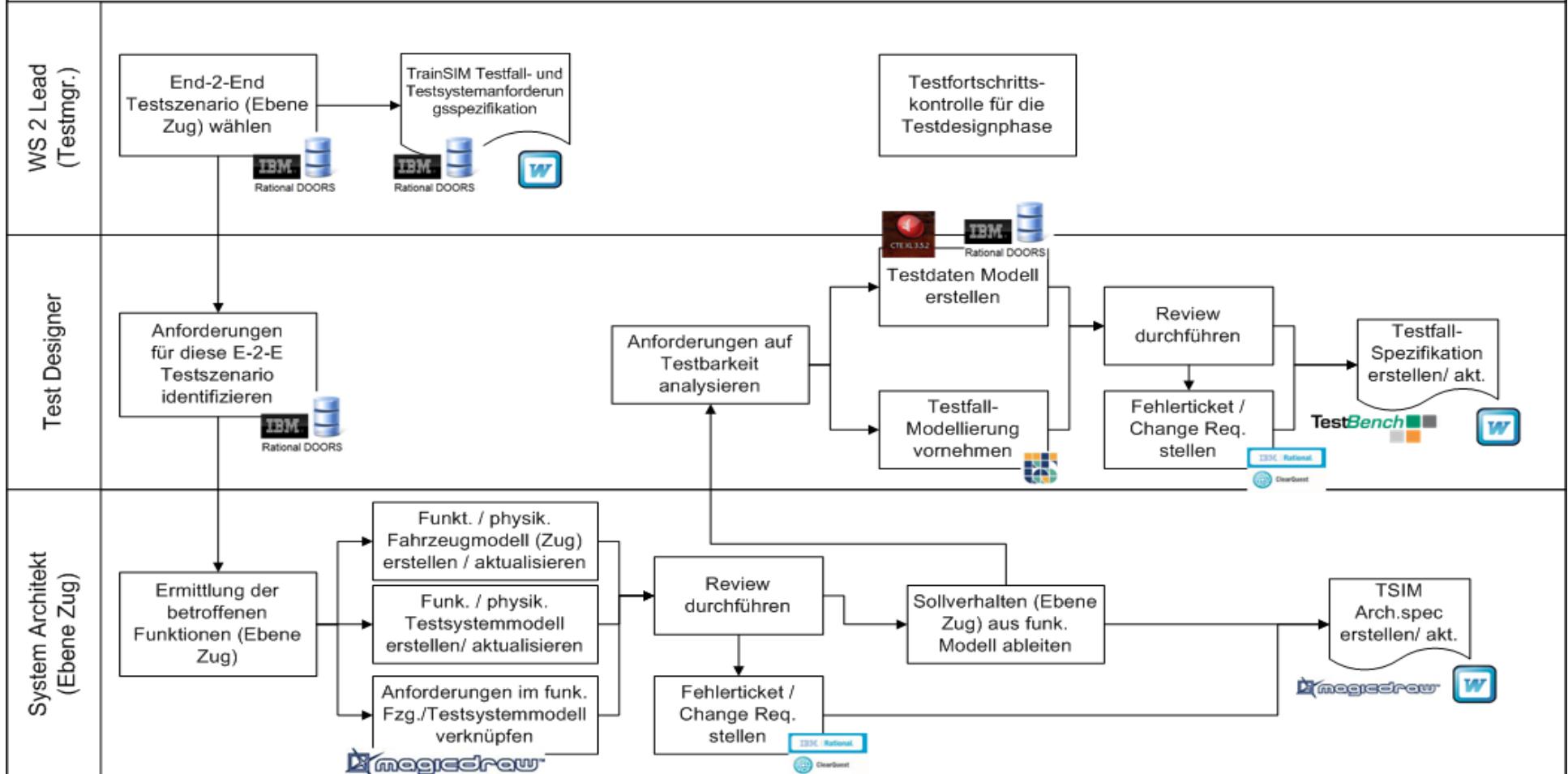
# Test Design & Implementation Process

## Example from TrainSIM



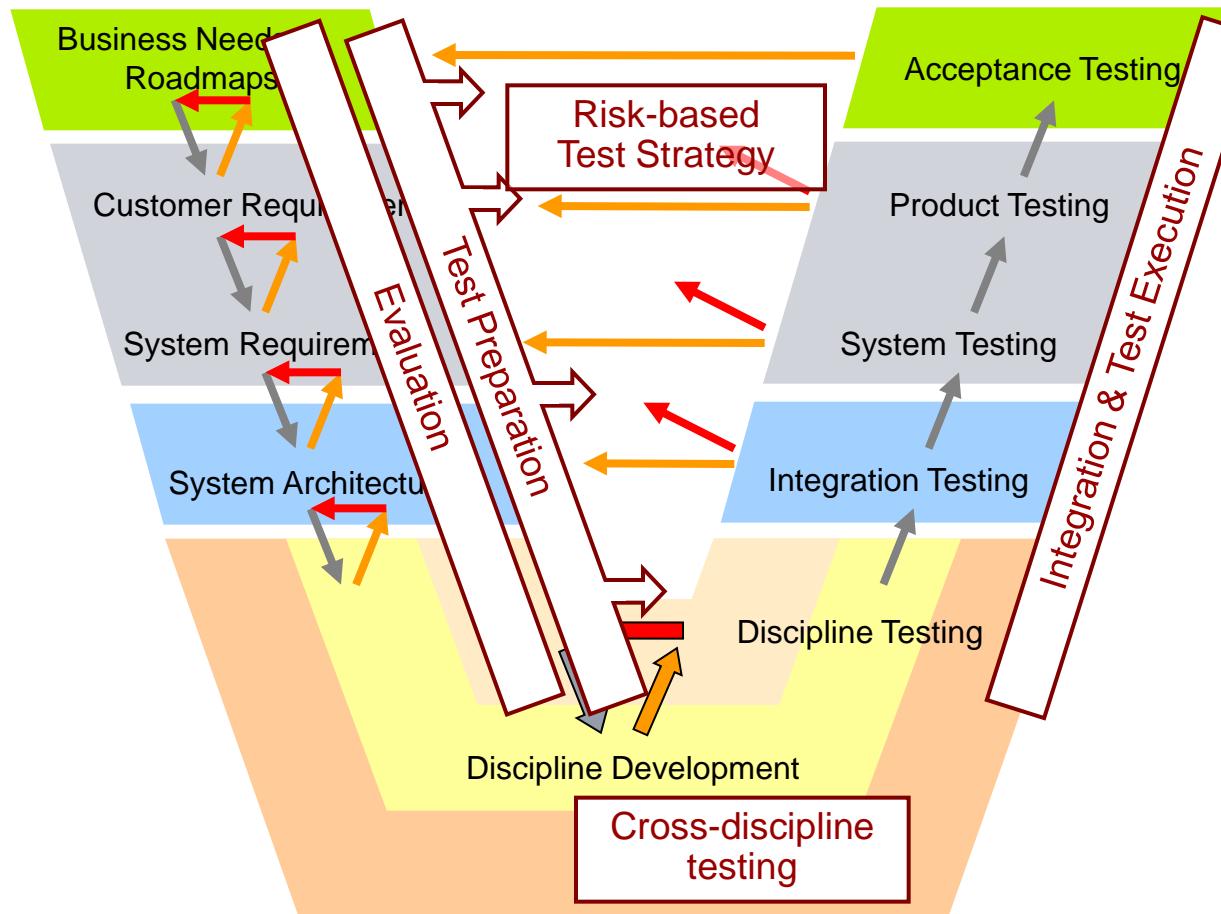
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### TSIM WS 2 Test Design & Implementation

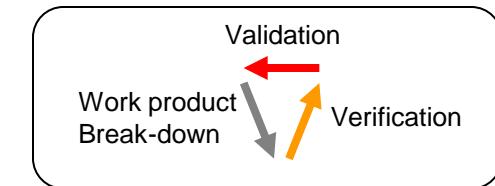
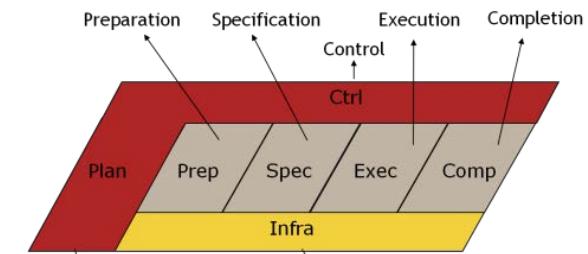
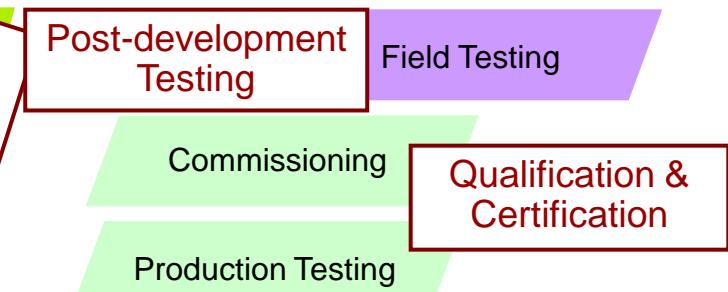


## Testing and evaluation throughout the lifecycle

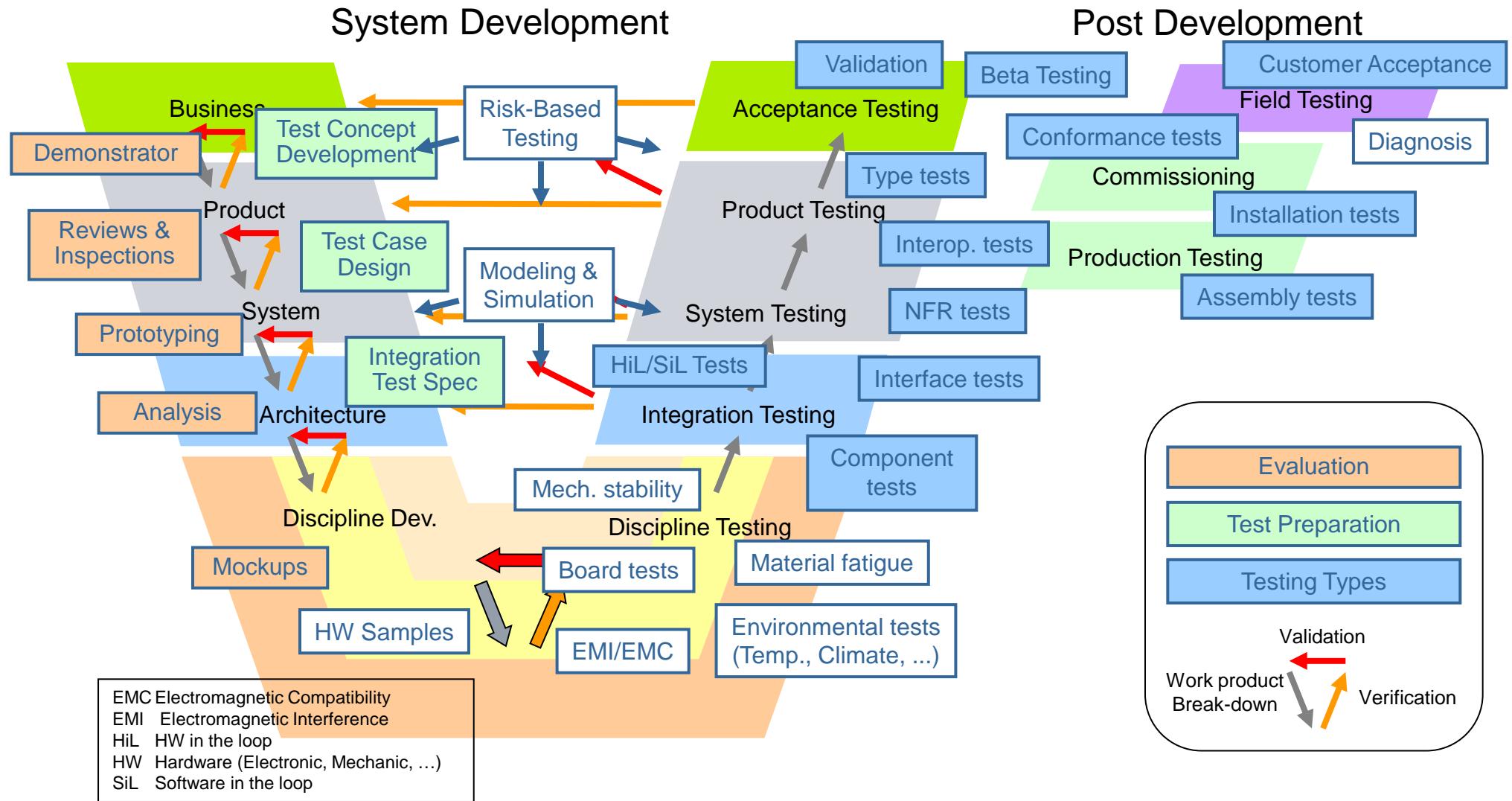
### System Definition & Development



### Post Development



## Example: Evaluation methods and testing types



# Test Management

## Agenda

Test Process

**Metrics for Test Exit Criteria**

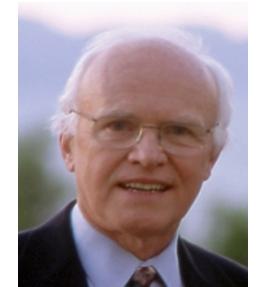
Continuous Test Improvement

Summary

## Test exit criteria and measurement ... (1)

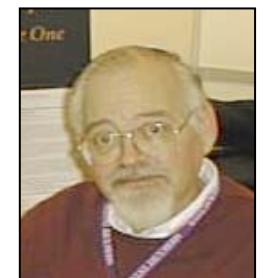
***You can't manage what you can't control;  
and you can't control what you don't measure.***

**Tom DeMarco, 1986**



***There is no single, valid, rational criterion for stopping.  
Furthermore, given any set of applicable criteria, how each  
is weighed depends very much on the product, the  
environment, the culture, and the attitude to risk.***

**Boris Beizer**



## Test exit criteria and measurement ... (2)

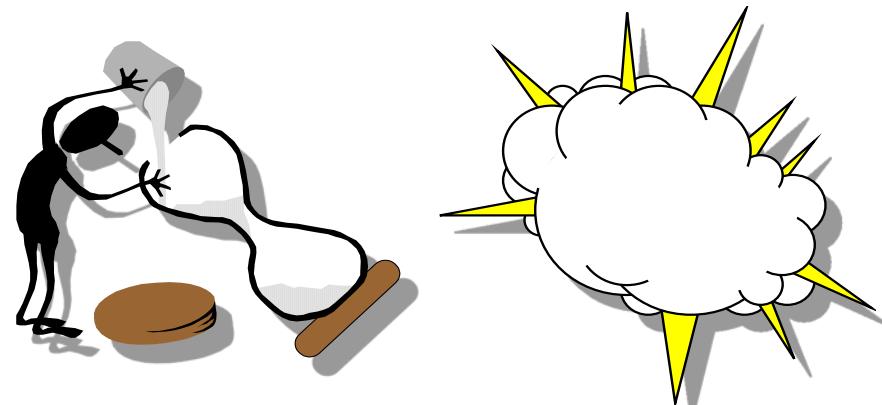
*When you can measure what you are speaking about, and express it in numbers, you know something about it;  
but when you cannot measure it [...] your knowledge is of a meager and unsatisfactory kind.*

Lord William Thomson Kelvin, 1883



## Test exit criteria (1)

Time is over



Budget is used up

The boss says "*Ship it!*"  
So, *ship happens* ...

Testing is never finished,  
it is stopped!

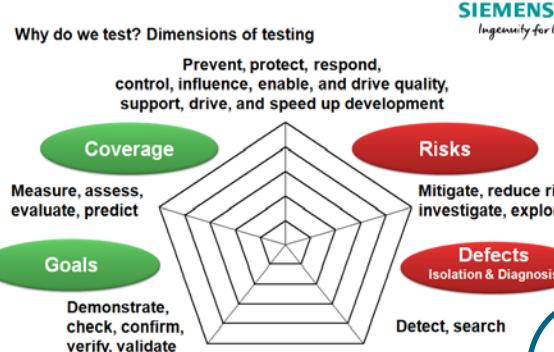
Software products are  
never released – they escape!



## Test exit criteria (2)

# Why do we test?

# What is the *value* of testing?



***Empirical technical investigation  
of the product / system / artifact / service under test  
conducted to provide stakeholders  
with information about the quality.***

## Intended Behavior

A  
B

**Message** *Information is effectively used, we create real value for the business, i.e. the business value of testing lies in the savings that the organization can achieve from improvements based on the information that is provided by testing.*

**More / better testing means more / better information and evidence!**

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## Test exit criteria (3)

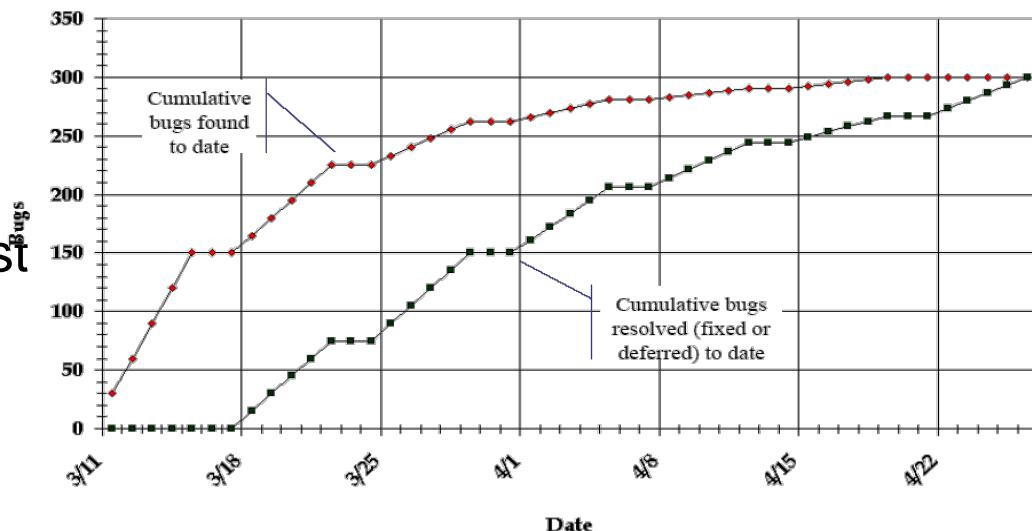
### System status

- Unfixed defects with their effects and consequences
- Reliability of the system (MTBF)



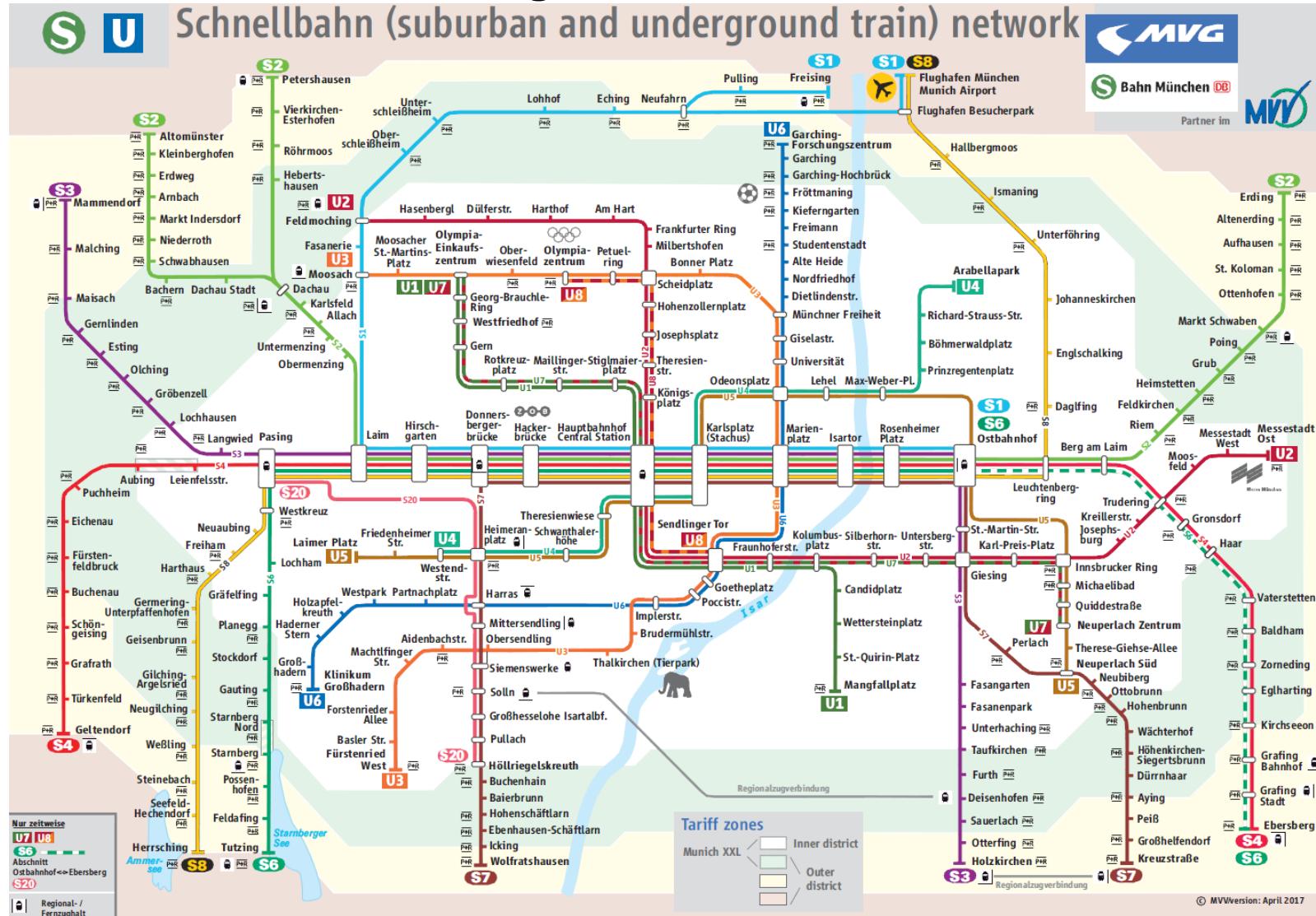
### Defects – Defect-based metrics

- Defect arrivals over time, density, rate, history, age, type, root cause, open, closed, fixed, deferred
- Defects sorted by criticality, severity, and priority
- Defect trends (S curve)
- Reliability prognosis, failure forecast
- Defect detection percentage (DDP)
- Defect removal efficiency (DRE)
- Bugs fixed first time (BFFT)



# Coverage – Example: Munich suburban and underground train network

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## Test exit criteria (4)

### Coverage – Test basis / test object based metrics

→ The extent to which the test **covers the system under test (SUT)**

Black-box (behavior, external) and white-box (structure, internal)

- Risks, quality attributes, requirements, features, scenarios, use cases, workflows, user profiles, operations, functions, error handling, (error) states, constraints, (error) messages, data (conflicts), platforms, environments, configurations, versions
- Models, systems, subsystems, architecture / design elements, frameworks, libraries, components, services, classes, objects, files, modules, threads, tasks
- Interfaces, APIs, code, call pairs, assertions, check points
- Date, time, interrupts, synchronization primitives, shared variables, communication, scheduling

### Coverage (“of what?” and “why?”) is a relationship

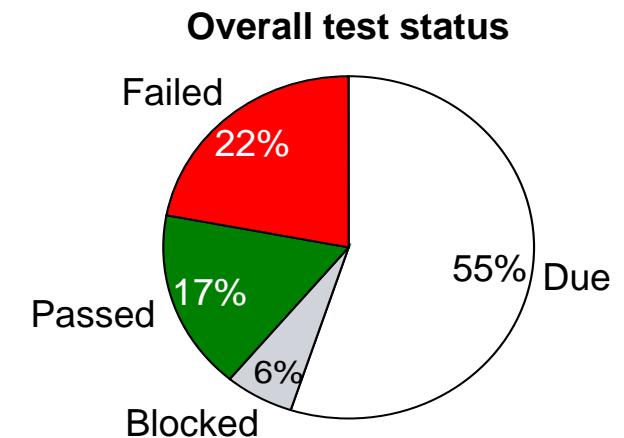
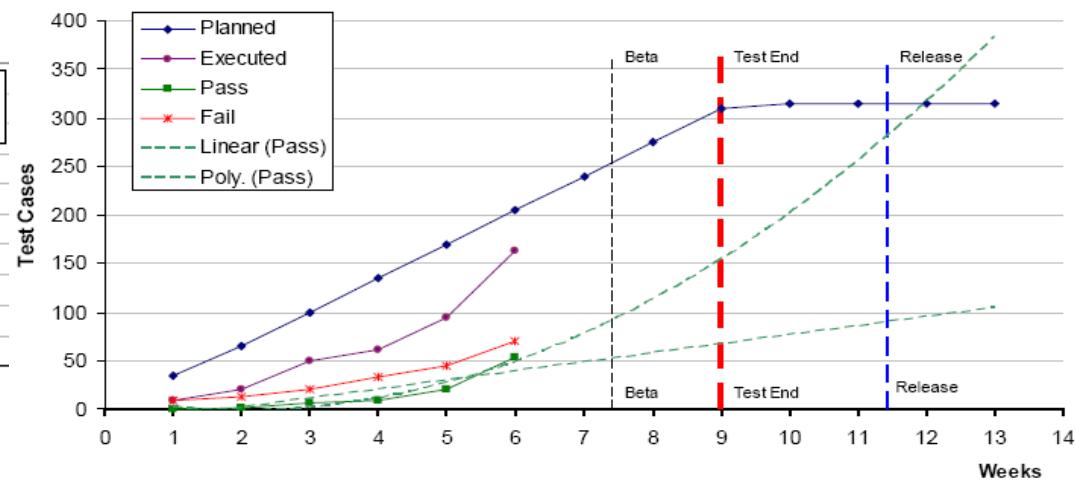
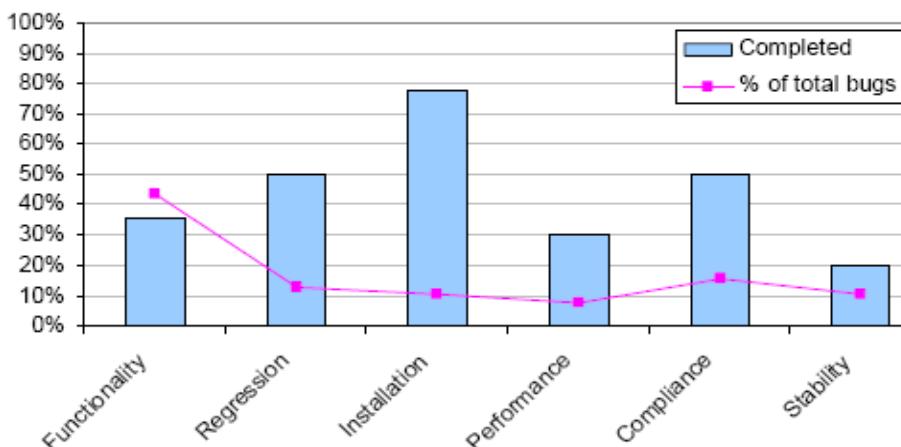
- between tests (set of tests, test cases) and
- what-is-tested (system under test)



## Test exit criteria (5)

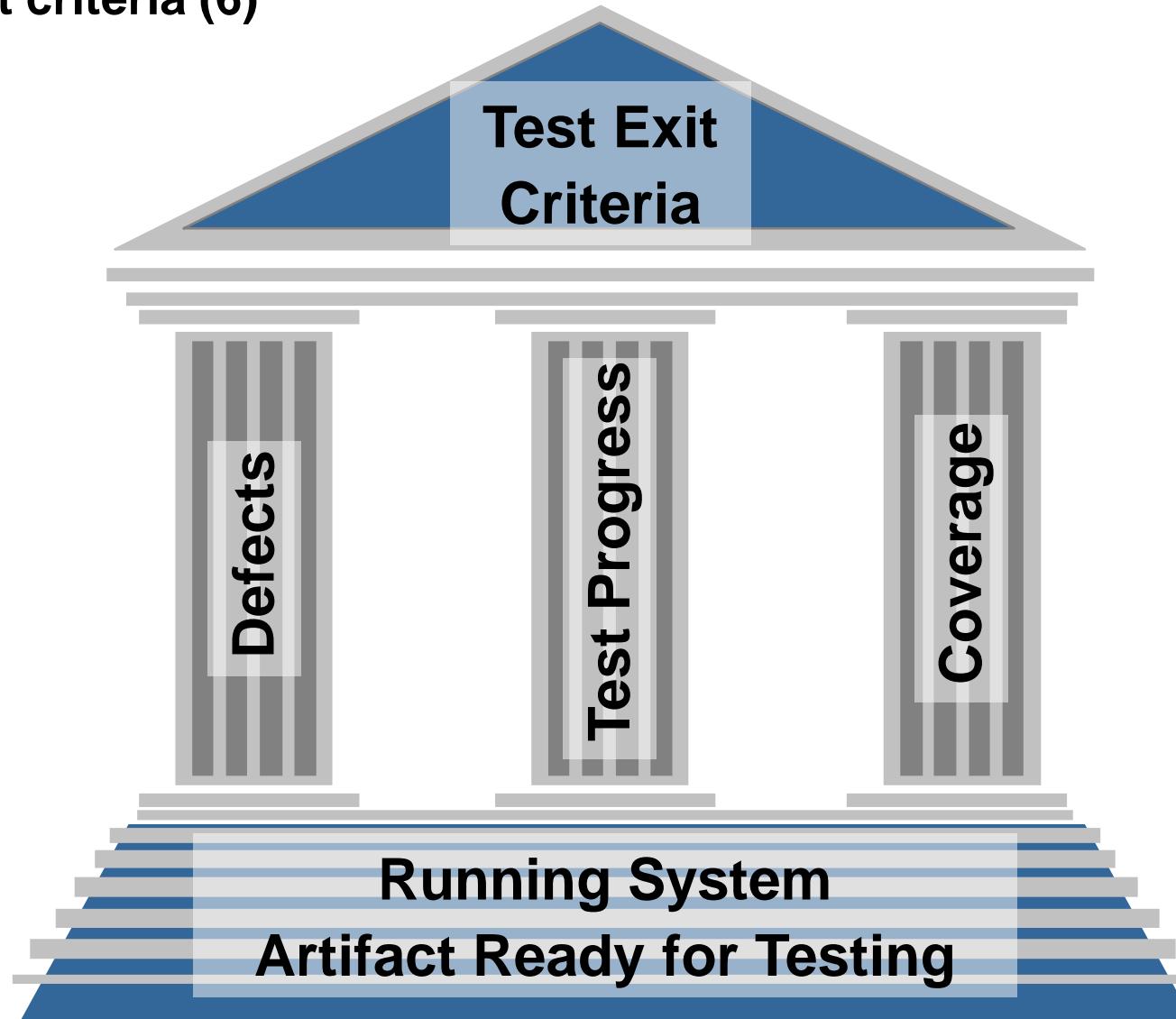
### Test progress – Cost and effort based metrics

- Progress in quality and product areas (S curve)
- Test status and completion: Planned, actual
- Test case completion:  
Planned, executed, passed, failed, blocked
- Resource utilization: Planned, actual



Test status

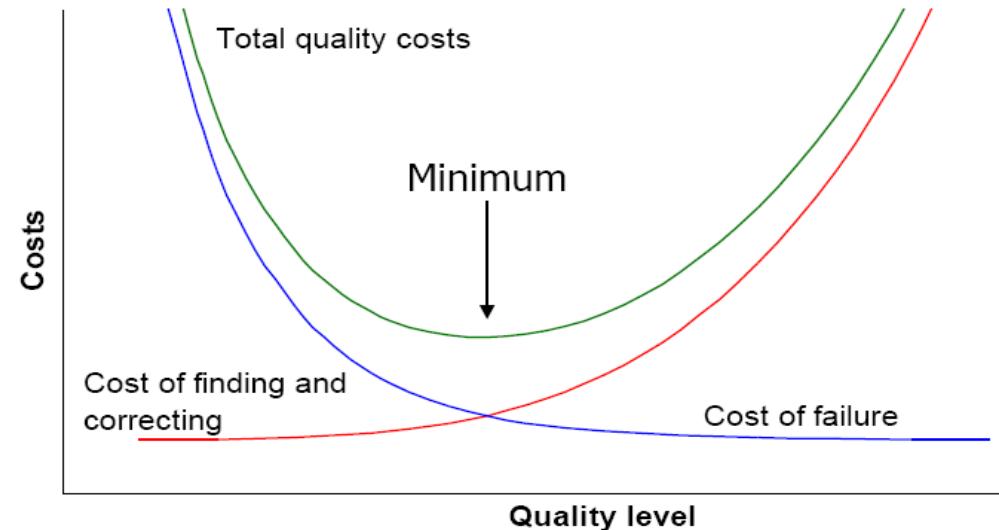
## Test exit criteria (6)



## Test exit criteria (7)

**The marginal cost of finding the next bug exceeds the expected loss from that bug.**

**The project team and management reach consensus that it is appropriate to release the product.**



*There is no single, valid, rational criterion for stopping. Furthermore, given any set of applicable criteria, how each is weighed depends very much on the product, the environment, the culture, and the attitude to risk.*

Boris Beizer

**There is no universal formula for knowing how much testing is enough!**

## Testing dashboard for reporting

**Snapshot data is only the beginning**

**It is definitely required to provide *good information* on**

- Progress
- Trending
- Deviation
- Forecast



Never forget

**To release or not release  
is a business decision of  
the product manager or the product management board,  
not a decision of the test manager / test department**

**The job of the test manager / test department is  
to provide objective input with timely, accurate, credible,  
fact-based information  
to facilitate and support this business decision  
in the best possible way!**

Be honest ...

## Some typical goals for test pass rates

- Passing 95% of the test cases
- Passing 100% of the “priority 1” test cases

***What do you do if you are at a milestone exit,  
and your pass rate is only 94%?***

## Better approach

- Investigate 100% of the failures
  - Ensure that none of those failures are serious enough to block the release
  - There is nothing special in reaching a magic pass rate number
  - BTW, if you have a high pass rate, you will have fewer failures to investigate ... ☺
- Rely on a decision process rather than hard criteria carved in stone

# Test Management

## Agenda

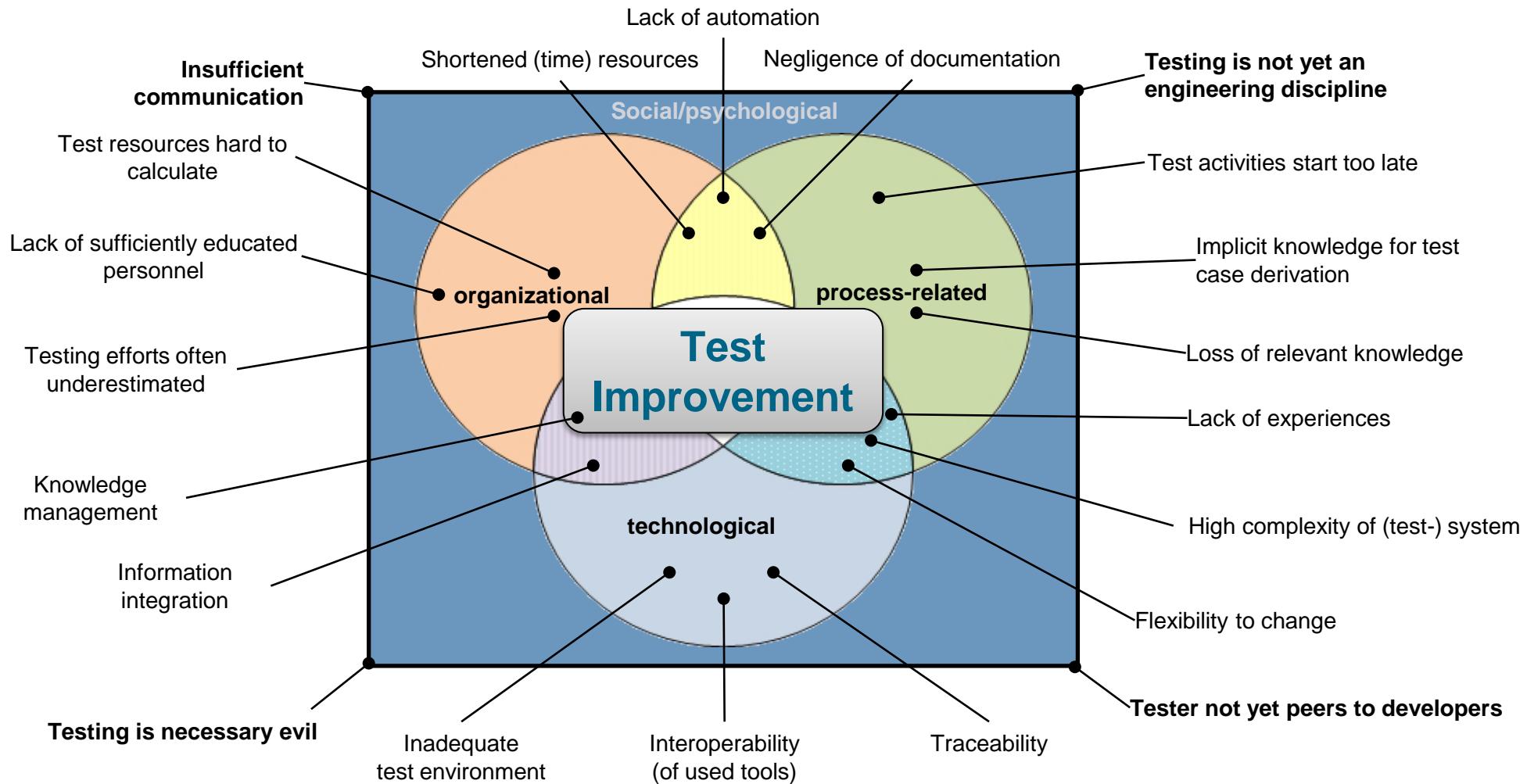
Test Process

Metrics for Test Exit Criteria

**Continuous Test Improvement**

Summary

# Testing challenges → Test improvement



# Motivation and objectives for systematic test process improvement (TPI)



## Good testing is effective and efficient

- Find defects, find most critical ones
- Find defects early, or even better prevent them
- Give evidence of project status and product quality
- Enforces quality orientation, helps to ship the right product in time

## Good testing relies on

- Teams, competences, skills
- Methods, techniques, tools
- Processes, management, cooperation
- Improvement, guidance, coordination

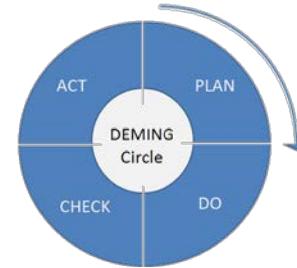
## Good testing is not for free. TPI guides improvement.

- Analyze the current testing practice
- Identify strengths and weaknesses
- Recommend improvement measures

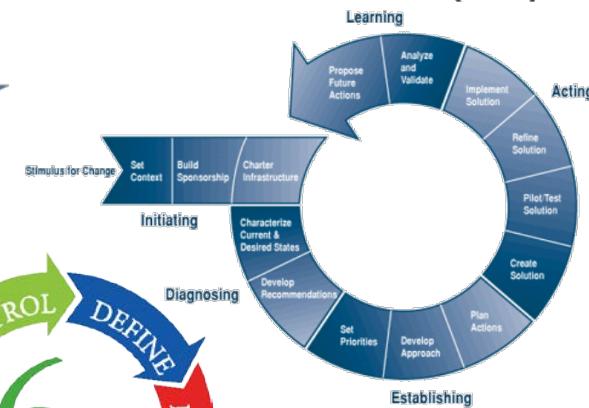
## How to improve? Different approaches and options

### Generic improvement process

- Deming cycle: Plan, Do, Check, Act
- IDEAL improvement framework: Initiating, Diagnosing, Establishing, Acting, Learning
- EFQM, TQM, six sigma, balanced score cards, etc.



### The IDEAL Model (SEI)



### Model-based approaches

- CMMI
- SPICE ISO 15504
- TMMi®
- TPI® Next

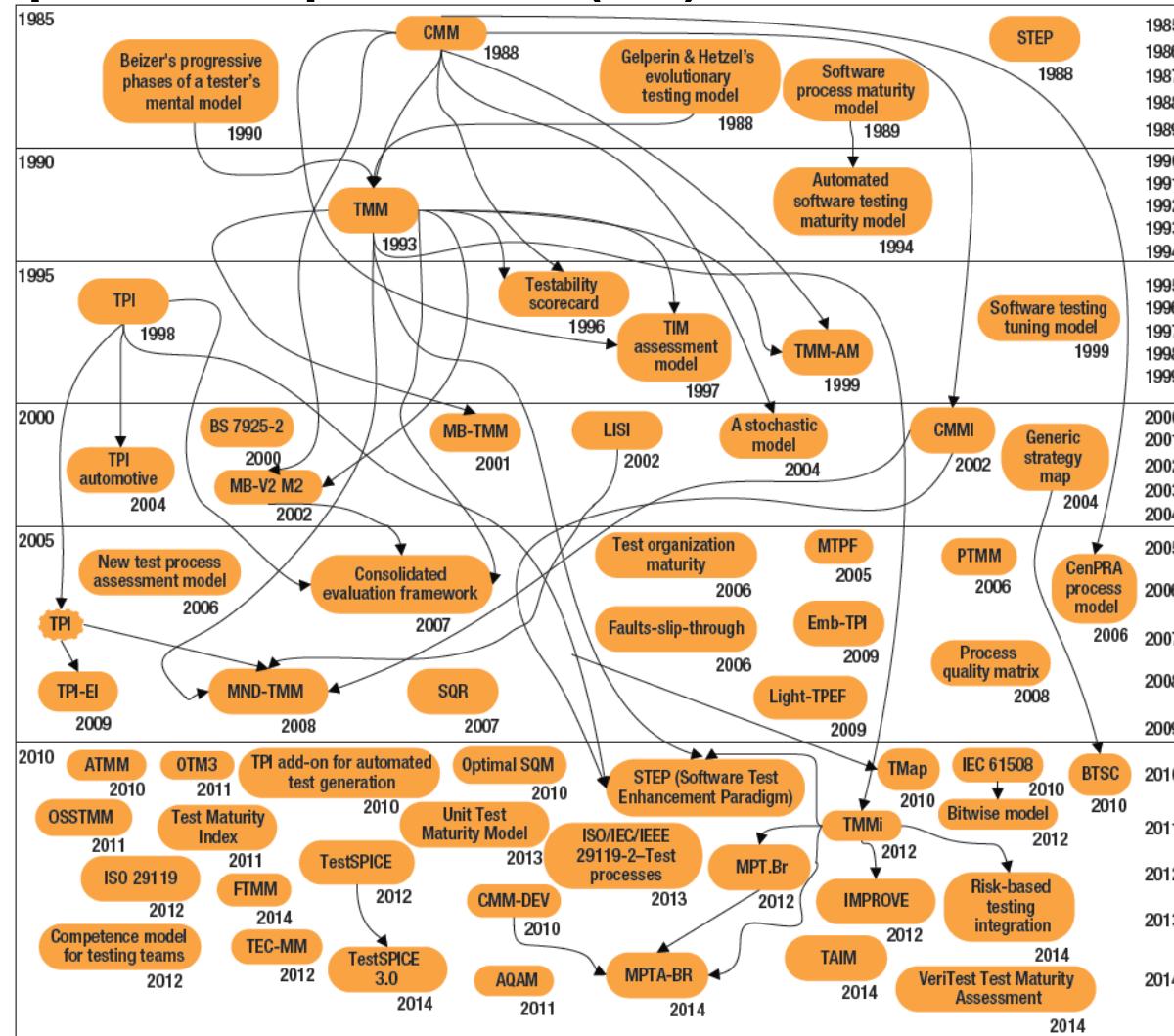


### Analytical approaches

- Causal analysis (cause-effect diagrams, anomaly classifications)
- Goal-Question-Metric approach (GQM)
- Analysis using measures, metrics, indicators

### Hybrid approaches

# **Evolution of test maturity assessment (TMA) and test process improvement (TPI)**

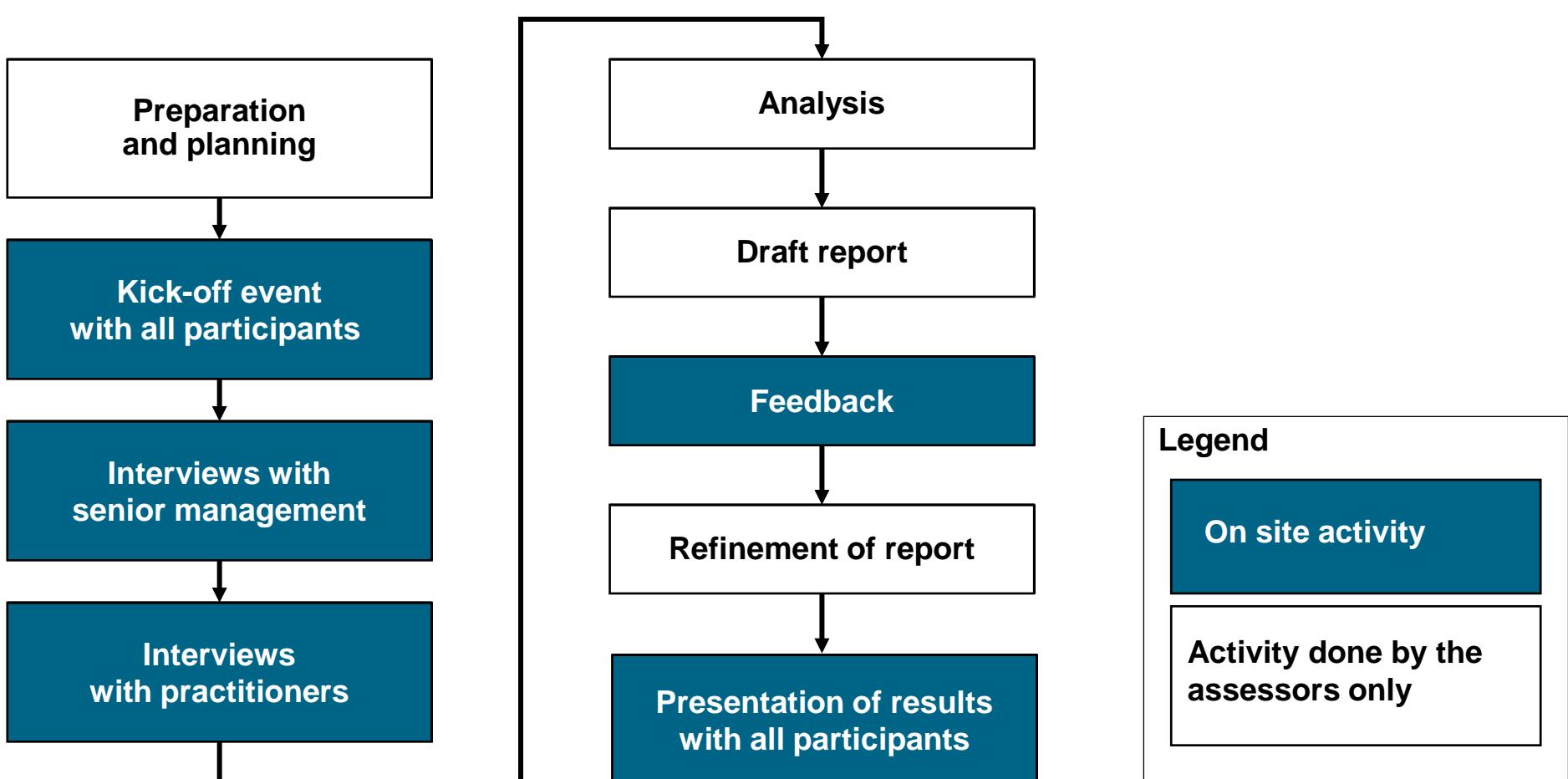


Reference: Vahid Garousi, Michael Felderer, Tuna Hacaloglu: What We Know about Software Test Maturity and Test Process Improvement

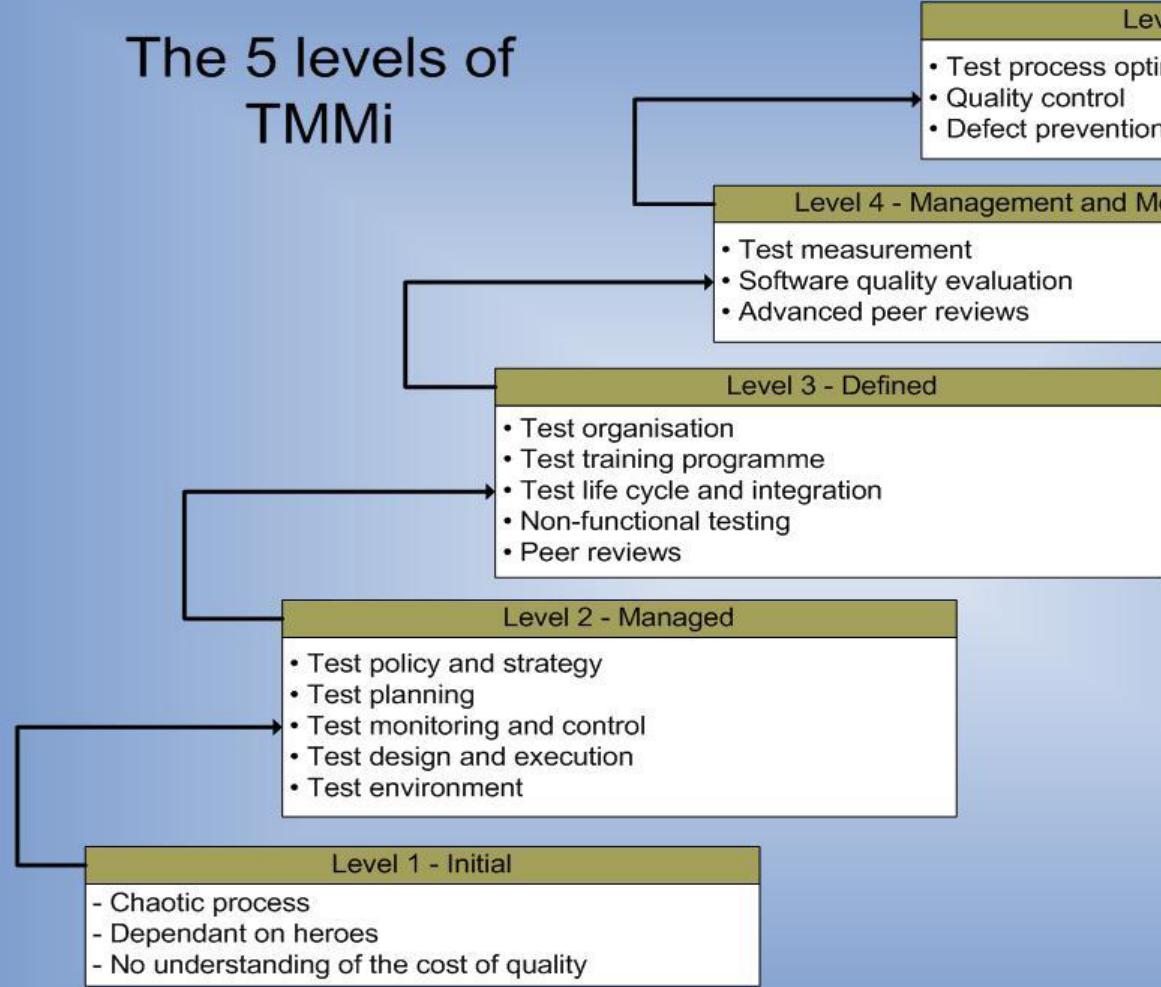
IEEE Software, Vol. 35, No. 1, Jan / Feb 2018: 84-92

IEEE Software, Vol. 33, No. 1, Jan/Feb  
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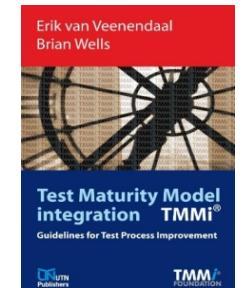
# Test process improvement procedure



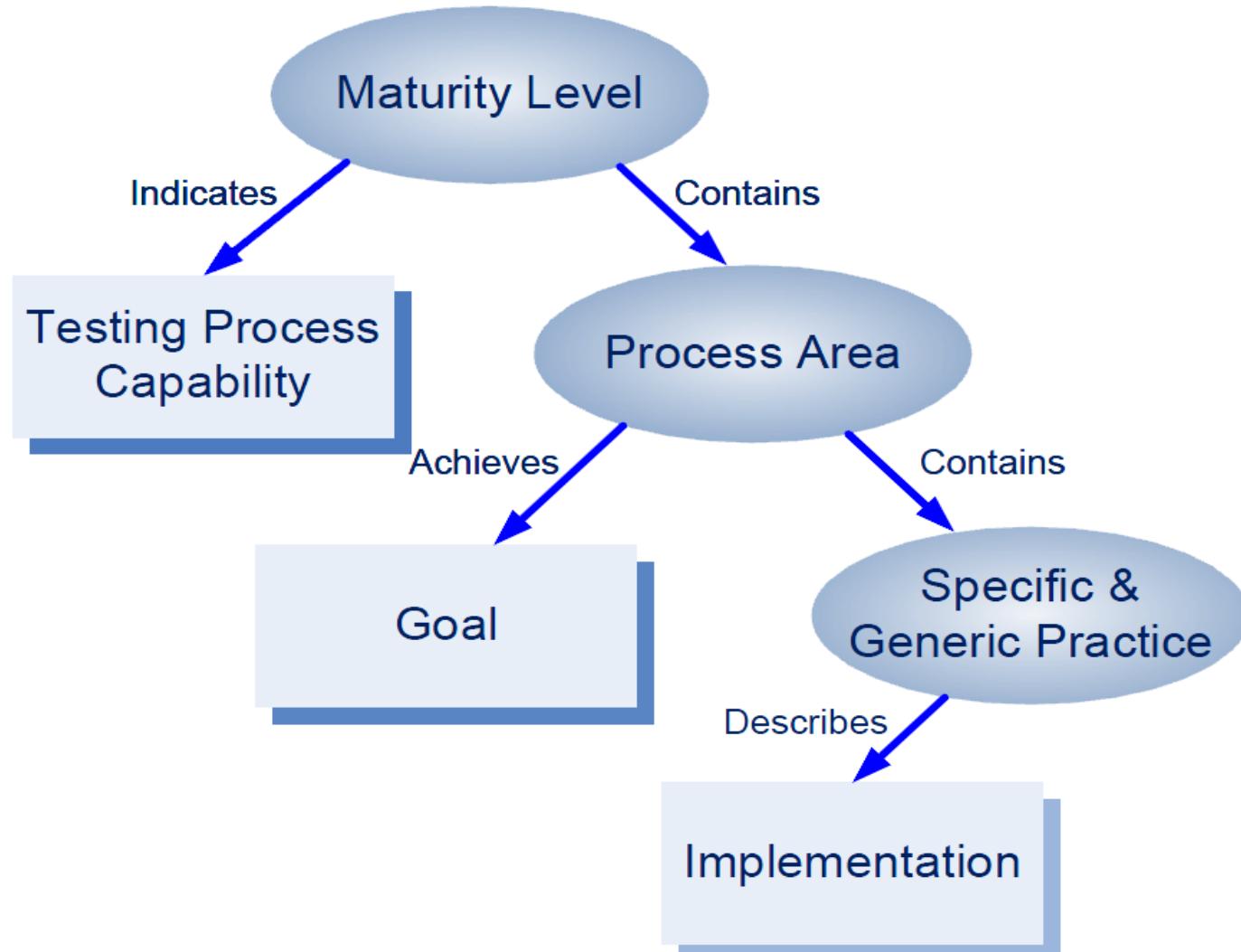
## The 5 levels of TMMI

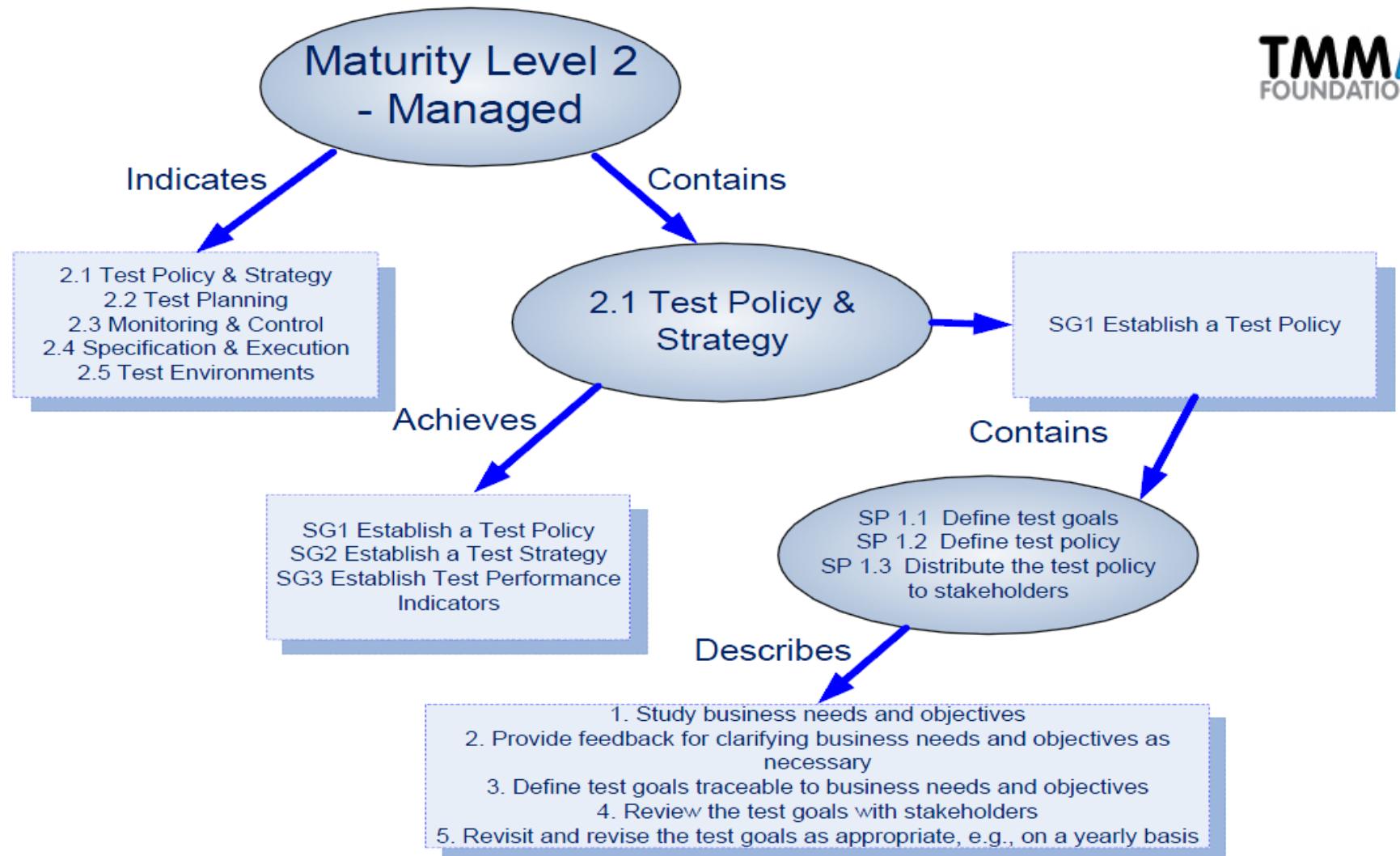


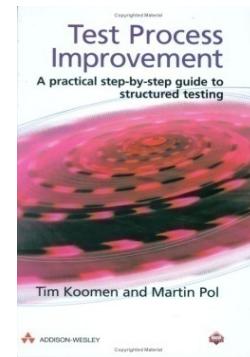
Erik van Veenendaal, Jan Jaap Cannegieter:  
The Little TMMI –  
Objective-Driven Test Process Improvement



Erik van Veenendaal, Brian Wells:  
Test Maturity Model integration TMMI®  
(Guidelines for Test Process Improvement)

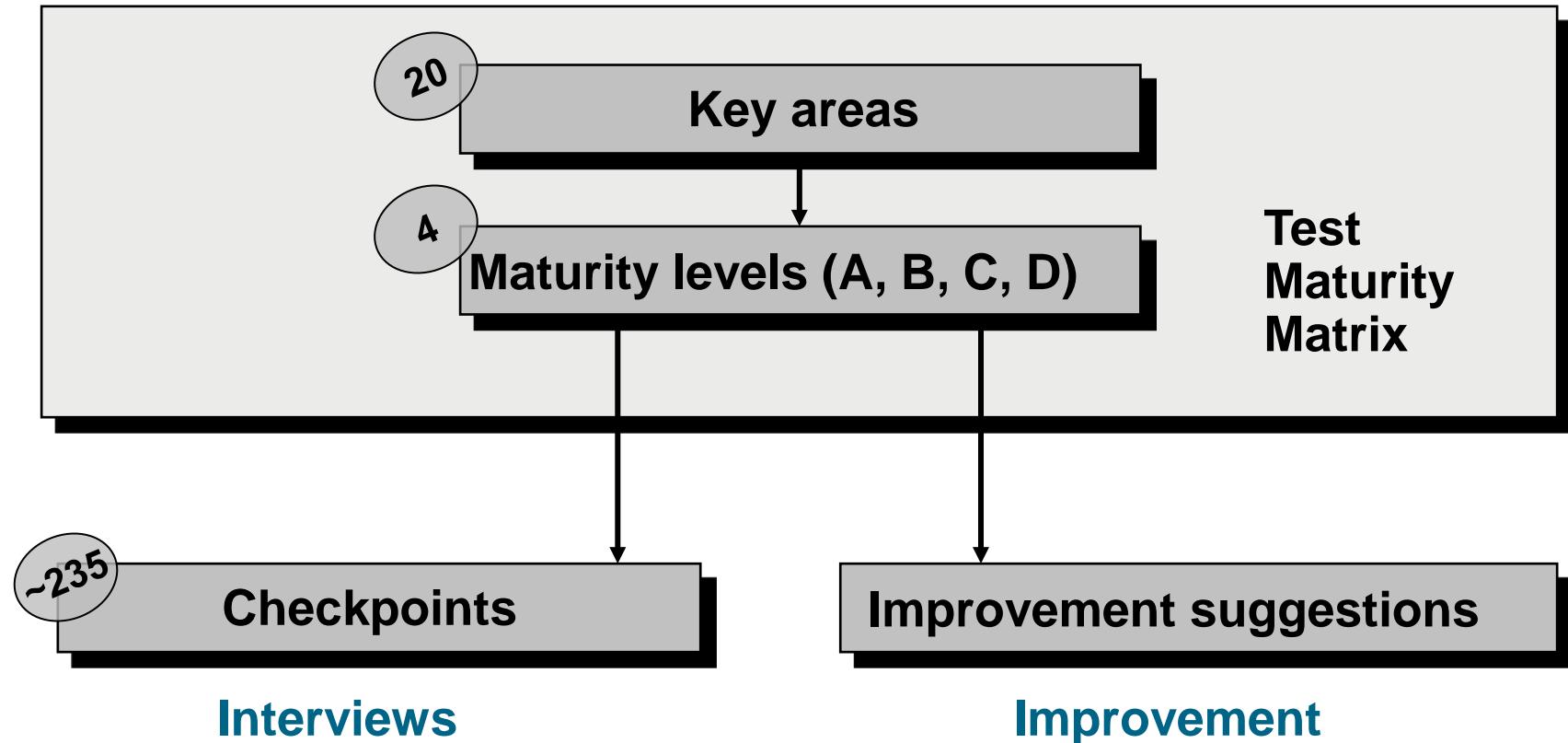






# TPI® Approach

## Reference model



[http://www.sogeti.nl/Home/Expertise/Testen/tpi\\_overview\\_uk.jsp](http://www.sogeti.nl/Home/Expertise/Testen/tpi_overview_uk.jsp)  
<http://www.sogeti.de/tpi-test-process-improvement.html>

## TPI® Key areas

- Test strategy
- Life-cycle model
- Moment of involvement
- Estimation and planning
- Test specification techniques
- Static test techniques
- Metrics
- Test tools
- Test environment
- Office environment

We have added this new key area →

- Commitment and motivation
- Test functions and training
- Scope of methodology
- Communication
- Reporting
- Defect management
- Testware management
- Test process management
- Evaluation
- Low level testing
- Integration testing

# TPI® Test maturity matrix – Baseline and improvement

Schedule for Improvement	Controlled						Efficient					Optimizing		
	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Key areas														
Test strategy	A					B				C		D		
Life cycle model	A			B										
Moment of involvement		A			B					C		D		
Estimation and planning			A				B					C		
Test specification technique	A		B											
Metrics					A			B		C		D		
Test tools				A			B		C					



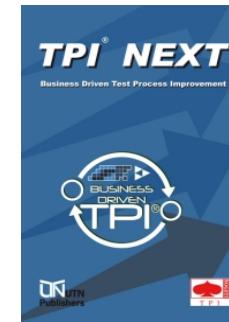
Baseline



Recommended improvement

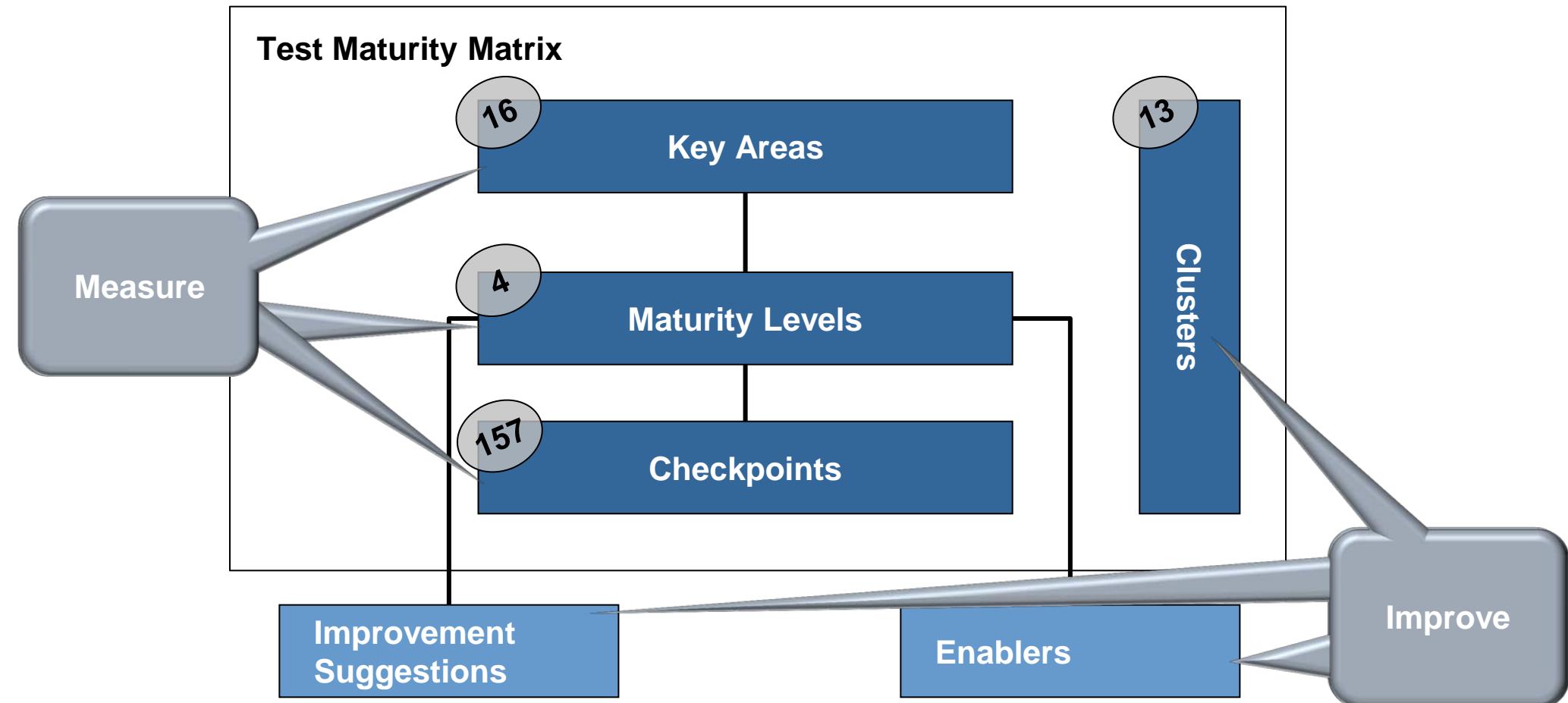
There are dependencies between  
the maturity levels of different key areas!

# Business Driven Test Process Improvement: TPI® NEXT Approach



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<http://www.tpinext.com/>



# Business Driven Test Process Improvement: TPI® NEXT Changes in key areas

<b>TPI classic</b>		<b>Business Driven TPI</b>	
#	<b>Key Area</b>	#	<b>Key Area</b>
1	Test strategy	3	Test strategy
2	<b>Life-cycle model</b>		
3	<b>Moment of involvement</b>	2	<b>Degree of involvement</b>
4	Estimating and planning	8	Estimating and planning
5	Test specification techniques	14	Test case design
6	<b>Static test techniques</b>		
7	Metrics	9	Metrics
8	Test tools	15	Test tools
9	Test environment	16	Test environment entfällt
10	Office Environment	1	<b>Stakeholder commitment</b>
11	<b>Commitment and motivation</b>	13	<b>Tester professionalism</b>
12	<b>Test functions and training</b>	12	Methodology practice
13	Scope of methodology	5	Communication
14	Communication	6	Reporting
15	Reporting	10	Defect management
16	Defect management	11	Testware management
17	Testware management	7	<b>Test process management</b>
18	<b>Test process management</b>		entfällt
19	Evaluation		entfällt
20	Low-level testing	4	<b>Test organization</b>

# Business Driven Test Process Improvement: TPI® NEXT Key Areas



## Stakeholder Relations

- Stakeholder commitment
- Degree of involvement
- Test strategy
- Test organization
- Communication
- Reporting

## Test Management

- Test process management
- Estimating and planning
- Metrics
- Defect management
- Testware management

## Test Profession

- Methodology practice
- Tester professionalism
- Test case design
- Test tools
- Test environment

# Business Driven Test Process Improvement: TPI® NEXT Test maturity matrix (1)

Key areas	Init.	Controlled				Efficient				Optimizing		
		1	2	3	4	1	2	3	1	2	3	
1 Stakeholder commitment		1	2	3	4	1	2	3	1	2	3	
2 Degree of involvement		1	2	3	4	1	2	3	1	2	3	
3 Test strategy		1	2	3	4	1	2	3	1	2	3	
4 Test organization		1	2	3	4	1	2	3	1	2	3	
5 Communication		1	2	3	4	1	2	3	1	2	3	
6 Reporting		1	2	3	4	1	2	3	1	2	3	
7 Test process management		1	2	3	4	1	2	3	1	2	3	
8 Estimating and planning		1	2	3	4	1	2	3	1	2	3	
9 Metrics		1	2	3	4	1	2	3	1	2	3	
10 Defect management		1	2	3	4	1	2	3	1	2	3	
11 Testware management		1	2	3	4	1	2	3	1	2	3	
12 Methodology practice		1	2	3	4	1	2	3	1	2	3	
13 Tester professionalism		1	2	3	4	1	2	3	1	2	3	
14 Test case design		1	2	3	4	1	2	3	1	2	3	
15 Test tools		1	2	3	4	1	2	3	1	2	3	
16 Test environment		1	2	3	4	1	2	3	1	2	3	

# Business Driven Test Process Improvement: TPI® NEXT Test maturity matrix (2)

	Key areas	Init.	Controlled				Efficient				Optimizing		
+	1 Stakeholder commitment	Init.	A	A	B	B	E	G	G	J	L	L	
O	2 Degree of involvement		A	A	D	E	H	H	J	L	L	L	
+	3 Test strategy		A	A	A	B	E	F	F	H	J	K	K
-	4 Test organization		C	E	E	F	J	J	K	K	M	M	M
+	5 Communication		A	A	B	C	E	E	I	L	L	L	L
+	6 Reporting		B	B	B		F	F	G	J	J	J	
O	7 Test process management		A	A	B	B	F	F	I	K	K	M	
O	8 Estimating and planning		B	B	C	C	G	H	I	J	K	L	L
-	9 Metrics		D	D	E		H	I	I	L	L	L	
O	10 Defect management		A	A	B	D	F	F	H	J	K	K	L
-	11 Testware management		C	C	E	F	J	J	K	M	M	M	M
-	12 Methodology practice		D	E	F	F	G	I	K	K	M	M	M
O	13 Tester professionalism		D	D	E	E	G	G	I	I	K	K	M
O	14 Test case design		A	A	E		F	I	I	J	K	K	M
O	15 Test tools		E	E	E		F	G	G	I	L	M	M
+	16 Test environment		A	C	C	D	F	G	I	I	K	L	L

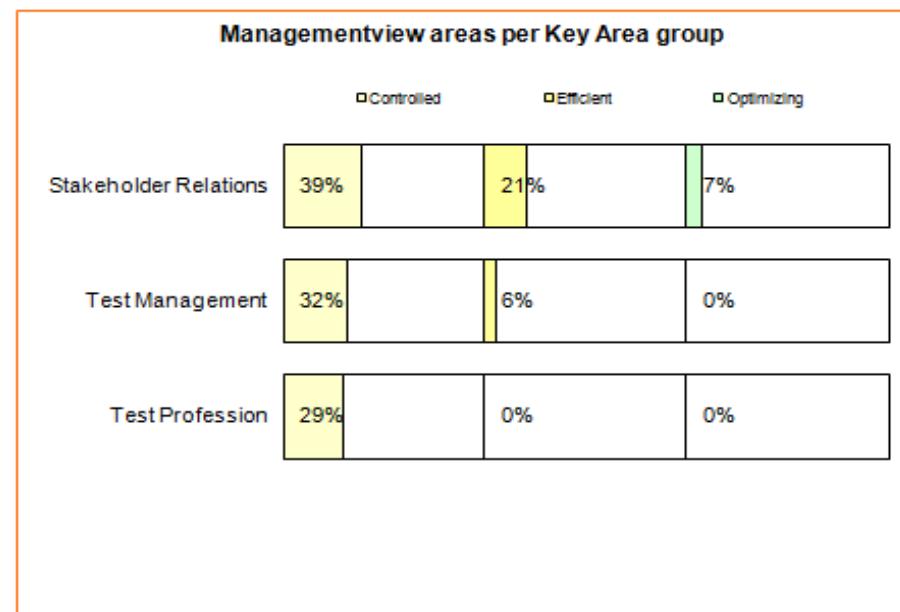
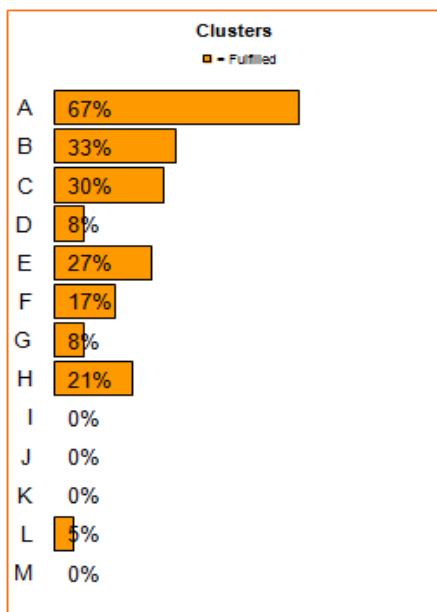
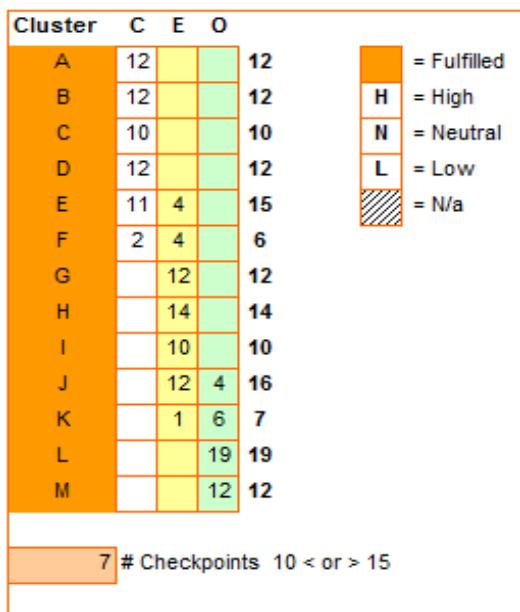
Legend:

Fulfilled Checkpoint
Step 1 (Cluster A)
Step 2 (Cluster B)
Step 3 (Cluster C)
Step 4 (Cluster D&E)

# Business Driven Test Process Improvement: TPI® NEXT Test maturity matrix (3)

**SIEMENS**  
Ingenuity for life

	# Key area	H	N	L	Initial	Controlled		Efficient		Optimizing
Stakeholder Relations	01 Stakeholder commitment	x			A	A	A	G	G	J
	02 Degree of involvement		x		A	B		H	J	L
	03 Test strategy	x			A	A		E	G	J
	04 Test organization		x		A	D		I	J	K
	05 Communication	x			B	C		F	J	M
	06 Reporting			x	B	D		H	H	L
Test Management	07 Test process management	x			A	A		H	J	K
	08 Estimating and planning	x			B	B		H	I	L
	09 Metrics	x			C	C		H	I	K
	10 Defect management		x		B	B		G	I	L
	11 Testware management	x			B	B		I	J	L
Test Profession	12 Methodology practice	x			C	D		H	J	M
	13 Tester professionalism		x		E	E	F	H	J	L
	14 Test case design	x			A	A	D	E	H	J
	15 Test tools		x		E	E	E	F	G	L
	16 Test environment	x			C	D	E	G	H	M
								J	J	M



# Test Management

## Agenda

Test Process

Metrics for Test Exit Criteria

Continuous Test Improvement

**Summary**

## What we have learned

Testing is not just a single (late) activity. It consists of a series of tasks and tactics continuously carried out over the lifecycle.

No simple yes/no decisions for test exit, but a set of applicable criteria depending on the product.

Test exit criteria are planning assumptions that could require adjustments (plan and/or criteria acceptance range).

Good testing is not for free. Systematic test process improvement guides assessment and improvement of the test process.



## Further readings

Use the SSA Wiki :

<https://wiki.ct.siemens.de/x/fReTBQ>

and check the “Reading recommendations”:

<https://wiki.ct.siemens.de/x/-pRgBg>

■ **Architect's Resources:**

- Competence related content
- Technology related content
- Design Essays
- Collection of How-To articles
- Tools and Templates
- Reading recommendations
- Job Profiles for architects
- External Trainings
- ... more resources

