Effort Comparison for Model-based Testing Scenarios

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s-lab
Software Quality Lab

UNIVERSITÄT PADERBORN
Die Universität der Informationsgesellschaft

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ICST

Software Quality Lab (s-lab)

- 5 software engineering professors at University of Paderborn
- 8 associated partners, 6 project partners
- 3 senior-researchers, 19 researchers

- Our expertise
  - Test management, test automation
  - Formal methods
  - Domain specific languages

- Domains
  - Automotive systems
  - Business information systems
  - Smart card systems

http://s-lab.upb.de

Industry ⟷ Research

Testing research transfer

How to improve testing technically and organizationally?

Industry → Research

Are there new testing techniques?

What is model-based testing?

Is model-based testing suitable for us?

What are the costs and gains of model-based testing?

Stepwise adoption of MBT in industry

Needs analysis

Scenario analysis

Technology selection

Technology adoption

Pilot project & Evaluation

Manual, Capture/Replay, Keyword-driven, …

efforts & promises

Porantim tool [Dias-Neto et al.]

Enterprise Architect, Eclipse, DSL, JUnit, …

costs & gains

Scenario analysis: Definitions (*Testing*)
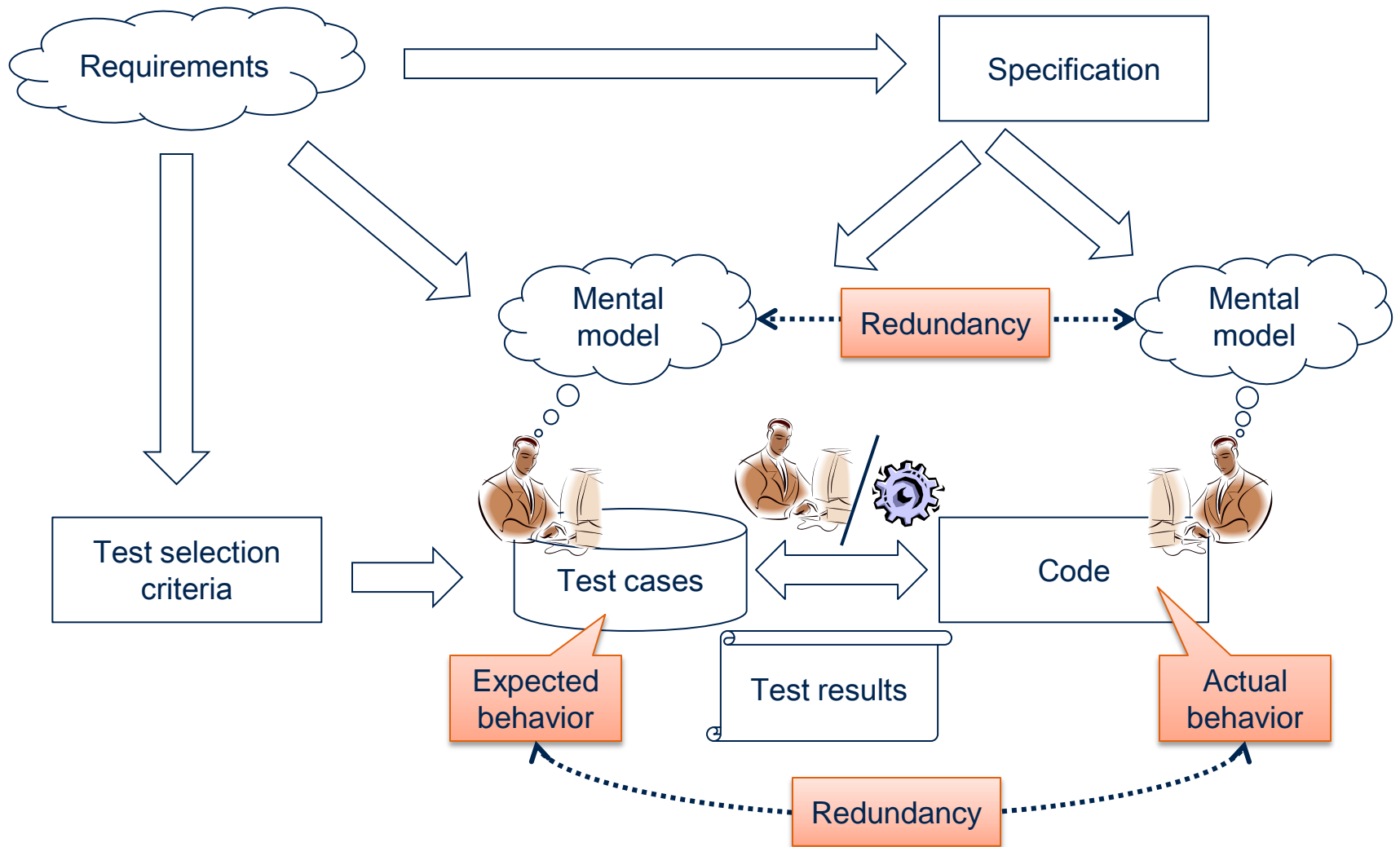
Scenario analysis: Definitions (*MBT*)
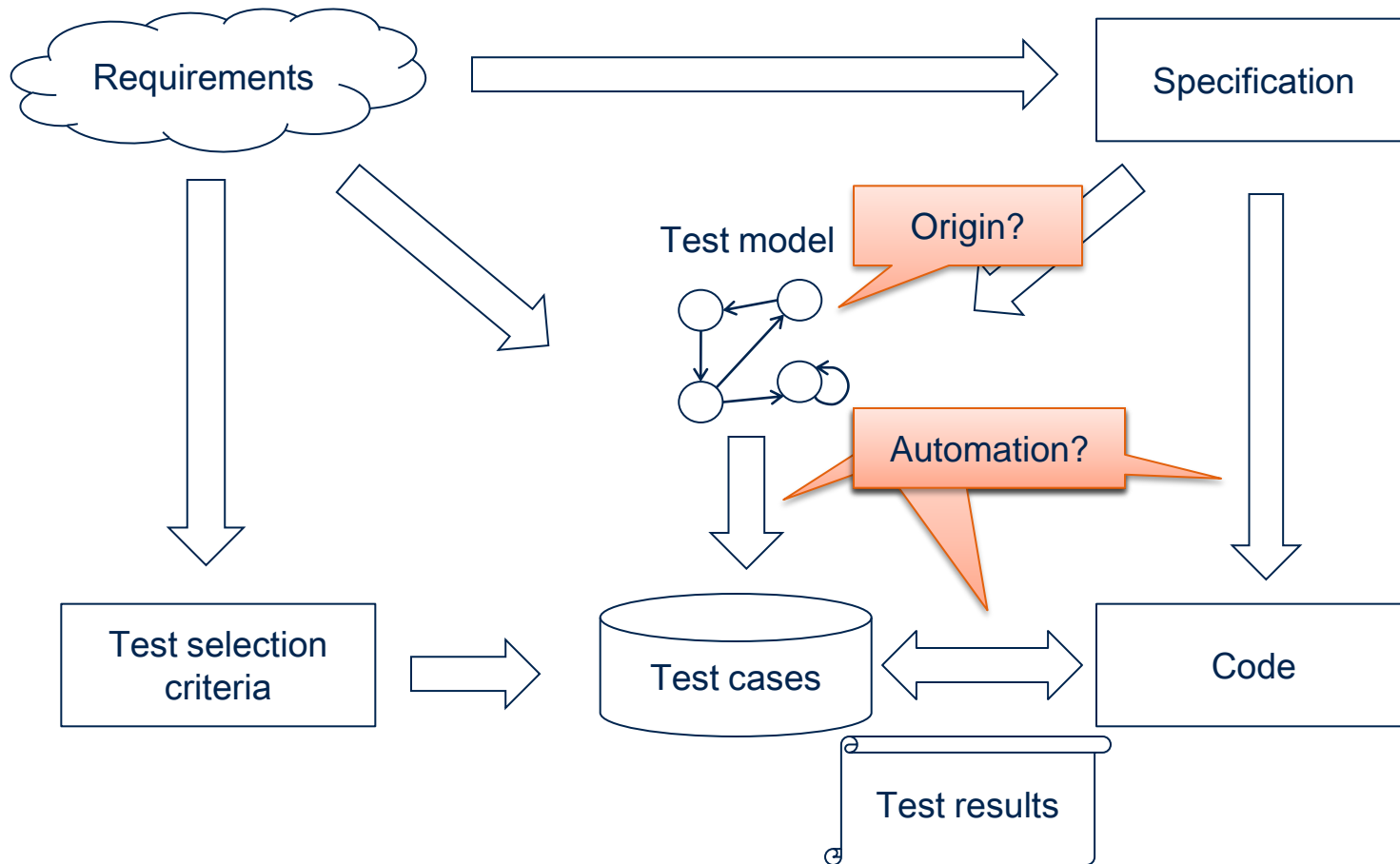
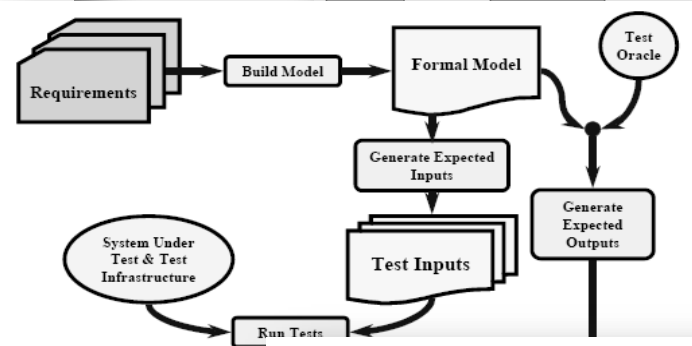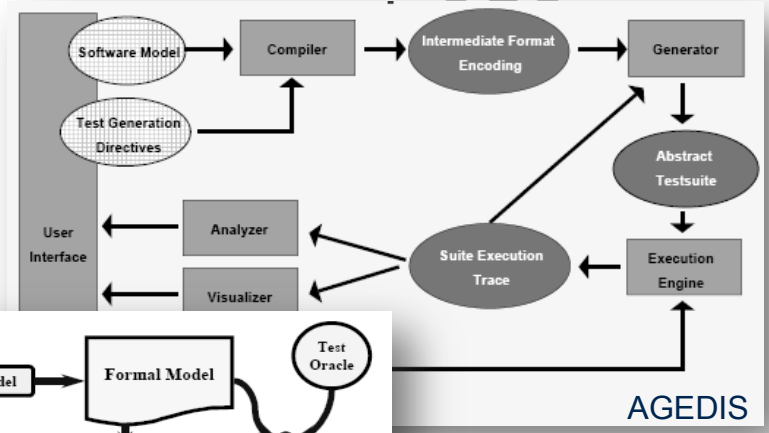[Pretschner, A., Philips, J.: Methodological Issues in Model-Based Testing. 2005]

Scenarios analysis: literature
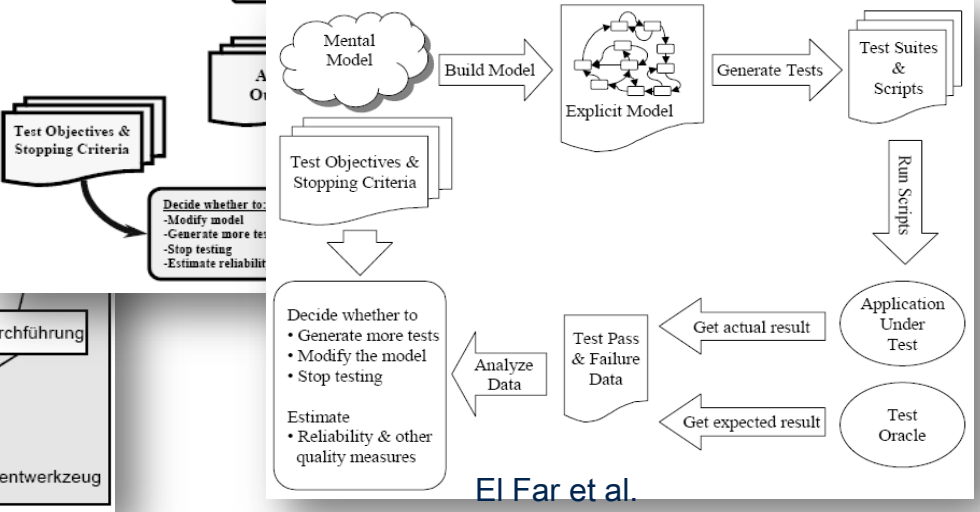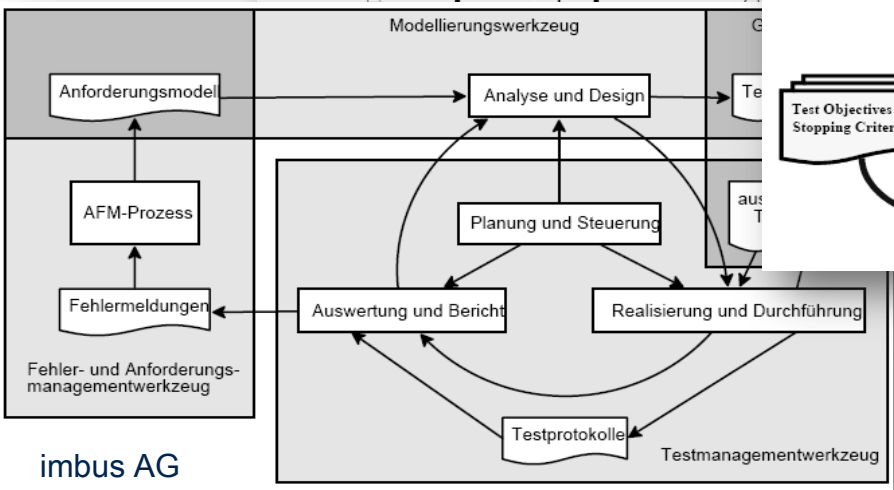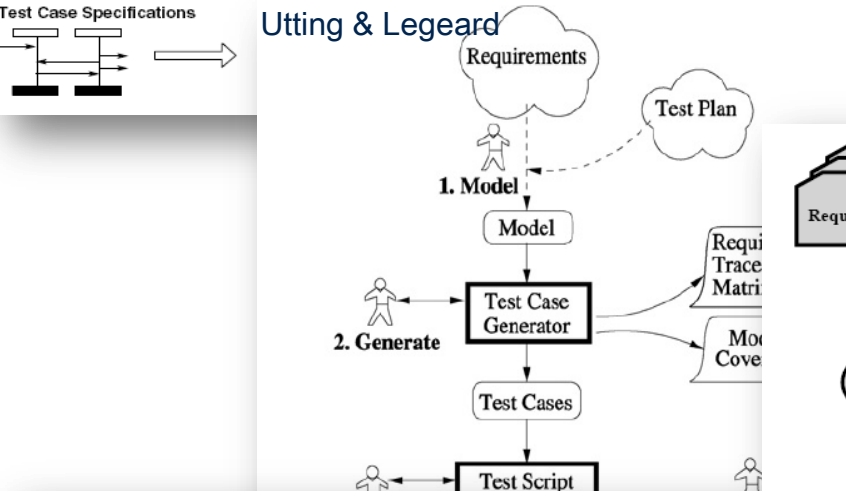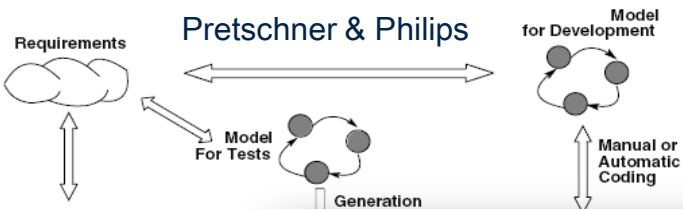
Pretschner & Philips

Utting & Legeard

AGEDIS

imbus AG

El Far et al.

? ? ?

Test cases

Efforts in MBT

Testing activities
Defining test models
Generating test cases
Executing test cases
Evaluating test results

Pretschner:
„Development of adapters is missing. Requires 50% of efforts!"

Organizational aspects
Improving test maturity
Training test personal
Adopting tools
Coordination with developers

How to measure efforts?

Testing activities
Defining test models
Generating test cases
Executing test cases
Evaluating test results

Reusability

Automation level

Redundancy

Organizational aspects
Improving test maturity
Training test personal
Adopting tools
Coordination with developers

TML : Test maturity level [TPI@Sogeti]

MML: Modeling maturity level [MDA]

Team dependency

GQM-like approach

G: How much efforts are needed for adopting a particular MBT scenario?

Testing activities

Q1: How costly is the definition of test models?

Q2: How costly is the generation of test cases?

Q3: How costly is the execution of test cases?

Q4: How costly is the evaluation of test cases?

Organizational aspects

Q8: How costly is it to coordinate the development and testing activities?

Q7: How costly is to adopt new automation tools?

Q6: How costly is it to train the testers such that they gain modeling skills?

Q5 How costly is it to lift the test process to a required maturity level?

M1: Reusability — v: high, middle, low

M2: Automation — v: high, middle, low

M3: Redundancy — v: high, middle, low

M4: TML — v: 1..13

M5: MML — v: 1..5

M6: Dependency — v: high, middle, low

Tabular comparison

Criteria / Scenarios	M1: Reusability	M2: Automation	M3: Redundancy	M4: TML	M5: MML	M6: Independency
Scenario1	v_{M1}	v_{M2}	v_{M3}	v_{M4}	v_{M5}	v_{M6}
Scenario 2	v_{M1}	v_{M2}	v_{M3}	v_{M4}	v_{M5}	v_{M6}
…	…	…	…	…	…	…

Scenarios of MBT

Test model

Test selection criteria → Test cases ↔ Code
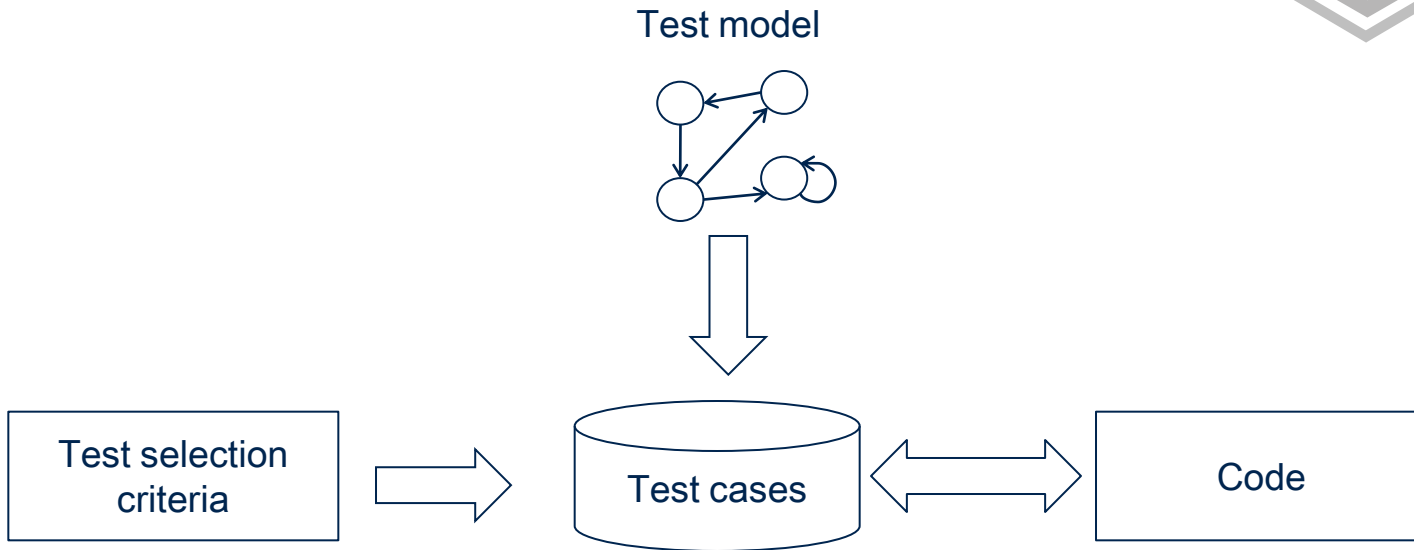
- Pretschner & Philips 2005
  - Common model
  - Automatic model extraction
  - Manual modeling
  - Separate models

- Further scenarios:
  - Model extraction from test cases
  - Model transformations

Common model

Characteristics	Metric value
high reuse of models	(V_{M1}: high)
highly automated in generation, low automation in evaluation	(V_{M2}: middle)
no redundancy	(V_{M3}: low)
maturity in test automation	(V_{M4}: 7)
maturity in modeling	(V_{M5}: 5)
teams dependent	(V_{M6}: high)

[Utting & Legeard 06]

Requirements

Model

Test selection criteria

Test cases

Code

Test results
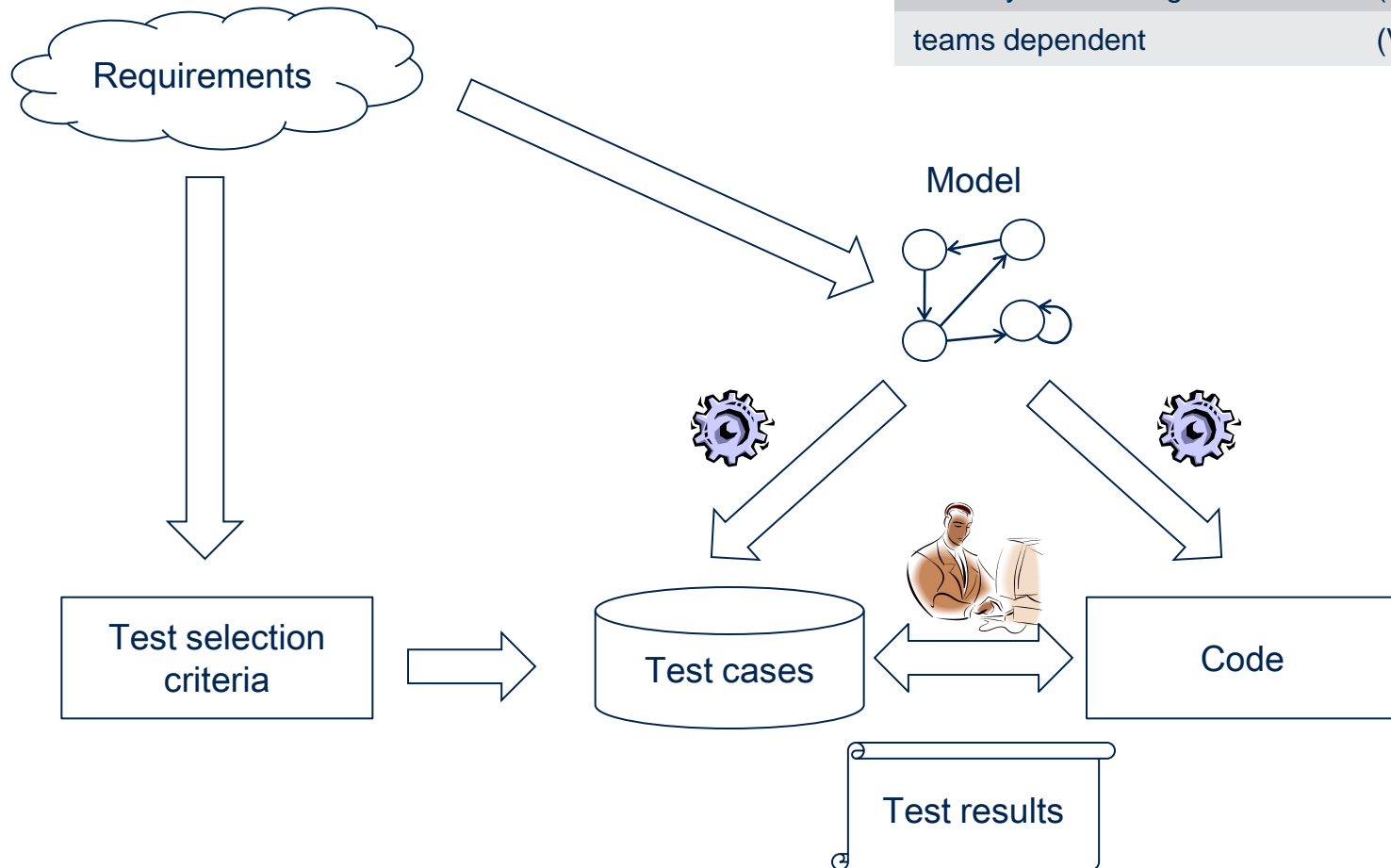
[Pretschner, A., Philips, J.: Methodological Issues in Model-Based Testing. 2005]

Separate models
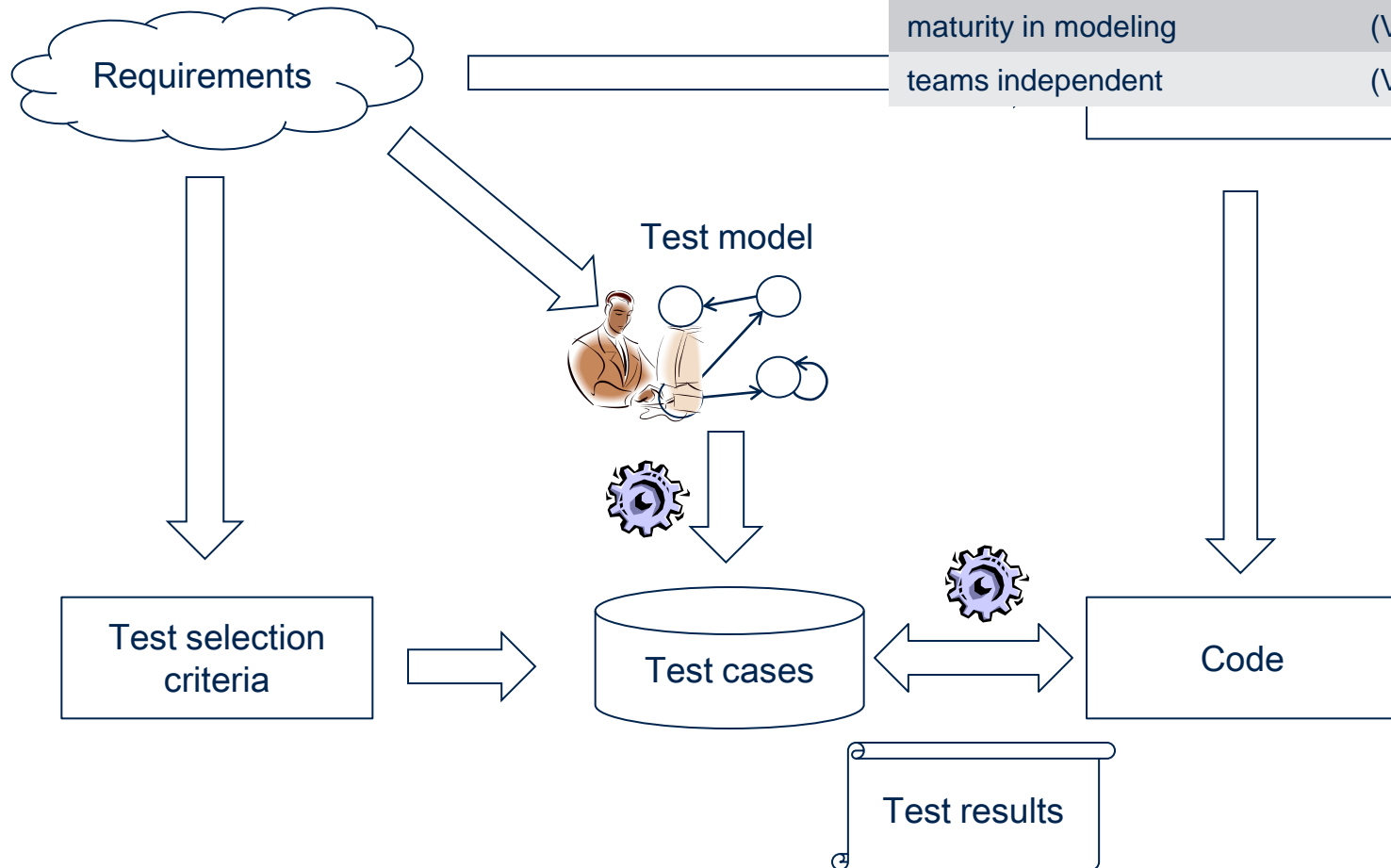
Characteristics	Metric value
no reuse of models	(V_{M1}: low)
no automation in derivation, highly automated in generation, high automation in evaluation	(V_{M2}: middle)
high redundancy	(V_{M3}: high)
maturity in test automation	(V_{M4}: 7)
maturity in modeling	(V_{M5}: ≥4/5)
teams independent	(V_{M6}: low)

Requirements

Test model

Test selection criteria

Test cases

Code

Test results

[Pretschner, A., Philips, J.: Methodological Issues in Model-Based Testing. 2005]

Characteristics	Metric value
reuse of old test cases	(V_{M1}: high)
high automation in derivation, highly automated in generation, high automation in evaluation	(V_{M2}: high)
high redundancy	(V_{M3}: high)
maturity in test automation	(V_{M4}: 7)
maturity in modeling	(V_{M5}: ≥1)
teams independent	(V_{M6}: low)

Requirements

Test model

Test selection criteria

Test cases
Old | New

Code

Test results
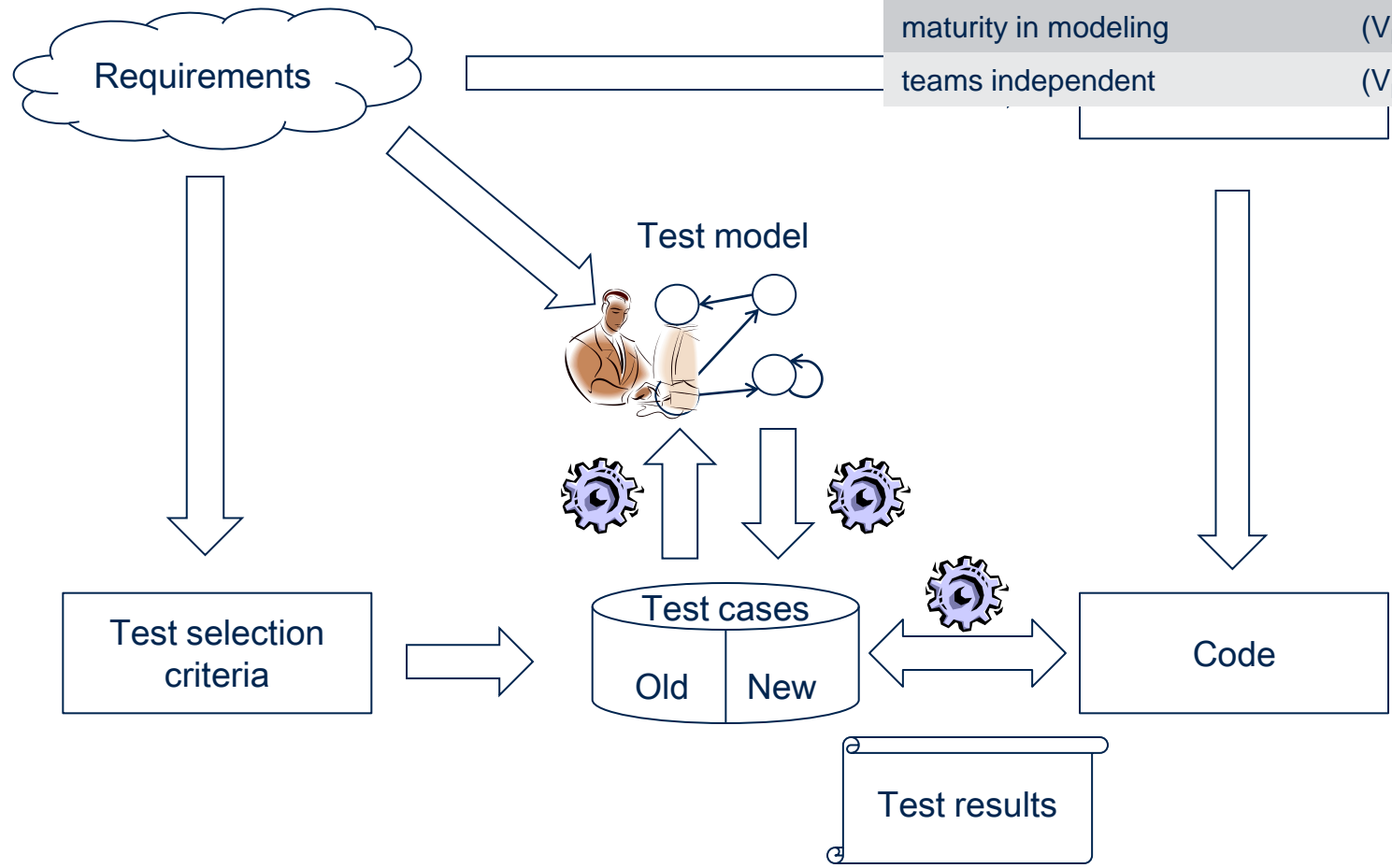
z.B. [Jääskeläinen, et al. Synthesizing Test Models from Test Cases. 2008]

Tabular comparison

H: High

M: Middle

L: Low

	M1: Reusability	M2: Automation	M3: Redundancy	M4: TML	M5: MML	M6: Dependency
1) Common model	H	M	L	7	5	H
2) Model from code	H	M	L	7	≥1	H
3) Manual modeling	M	M	M	7	≥3	M
4) Separate models	L	M	H	7	≥4/5	L
5) Model from test cases	H	H	H	7	≥1	L
6) Model from model	H	H	M	7	5	M

Tabular comparison

G: How much efforts are needed for adapting a particular MBT scenarios?

Testing activities

Q1: How costly is the definition of test models?

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Organizational aspects

Q8: How costly is it to coordinate the development and testing activities?

Q7: How costly is to adopt new automation tools?

Q6: How costly is it to train the testers such that they gain modeling skills?

Q5 How costly is it to lift the test process to a required maturity level?

↗ High effort

→ Middle effort

↘ Low effort

1) Common model	↘	→	↗	→	↗	↗
2) Model from code	↘	→	↗	→	→	↗
3) Manual modeling	→	→	→	→	↗	→
4) Separate models	↗	→	↘	→	↗	↘
5) Model from test cases	↘	↘	↘	→	→	↘
6) Model from model	↘	↘	→	→	↗	→

Messages of the comparison

- Which efforts are needed for individual MBT scenarios?

- How do efforts differ?

- No statement about
  - Total costs
  - Test quality
  - Test coverage
  - How to combine the scenarios?
  - ...

What is the next step?

Needs analysis

Manual, Capture/Replay, Keyword-driven, …

Scenario analysis

efforts & promises

Technology selection

Porantim tool [Dias-Neto et al.]

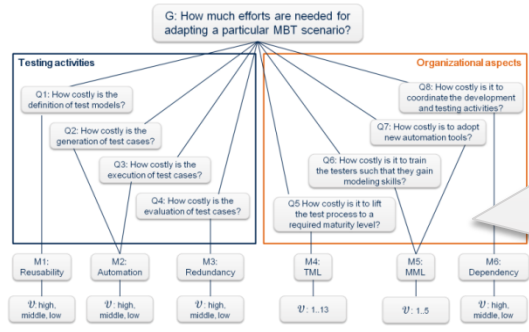Enterprise Architect, Eclipse, DSL, JUnit, …

Technology adoption

Pilot project & Evaluation

costs & gains

Conclusion

- MBT is not for free

- Different scenarios→ different efforts

- Efforts are comparable

- No best scenario! Choice is context dependent!

- Redundancy in test artifacts is important!

Pretschner:
"*Development of adapters*"
GI working Group:
"*Maintenance of test models*",
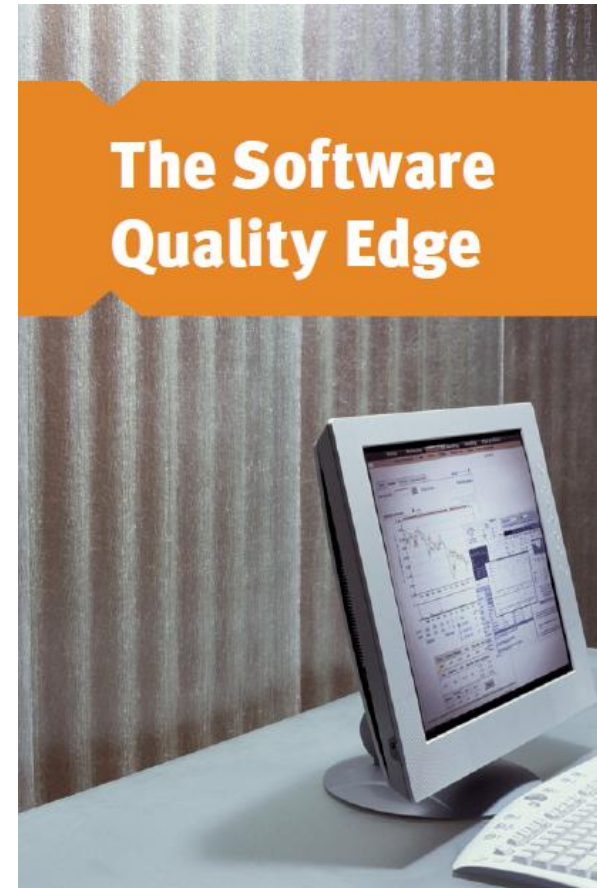"Context important, e.g. migration"

Thank you for your attention.

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The Software Quality Edge

Comparison wrt TPI key areas

Future work

TPI Key Areas / Scenarios	Teststrategie	Zeitpunkt der Beteiligung	Testspezifikations-techniken	Testautomatisierung	Testfunktionen und Training	Reichweite der Methodik	Kommunikation	Testware management	Low-Level Tests
1) Common model	?	?	?	B/7	?	?	?	?	?
2) Model from code	?	?	?	B/7	?	?	?	?	?
3) Manual modeling	?	?	?	B/7	?	?	?	?	?
4) Separate models	?	?	?	B/7	?	?	?	?	?
5) Model from test cases	?	?	?	B/7	?	?	?	?	?
6) Model from model	?	?	?	B/7	?	?	?	?	?

Model extraction from cod...

Characteristics	Metric value
high reuse of models	(V_{M1}: high)
highly automated in derivation and generation, low automation in evaluation	(V_{M2}: middle)
no redundancy	(V_{M3}: low)
maturity in test automation	(V_{M4}: 7)
maturity in modeling	(V_{M5}: ≥1)
teams dependent	(V_{M6}: high)

Requirements

Test model

Test selection criteria

Test cases

Code

Test results
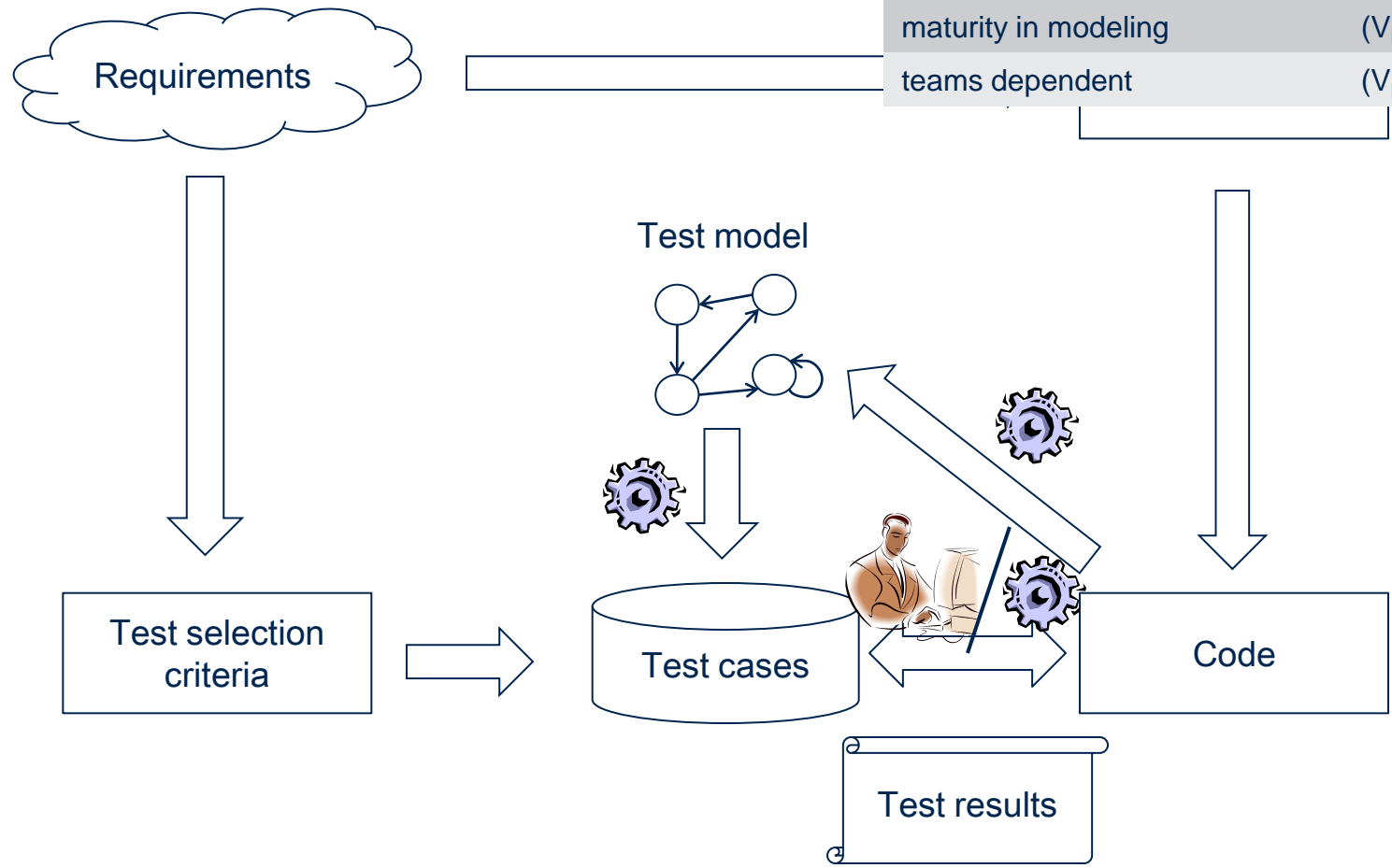
[Pretschner, A., Philips, J.: Methodological Issues in Model-Based Testing. 2005]

Manual modeling
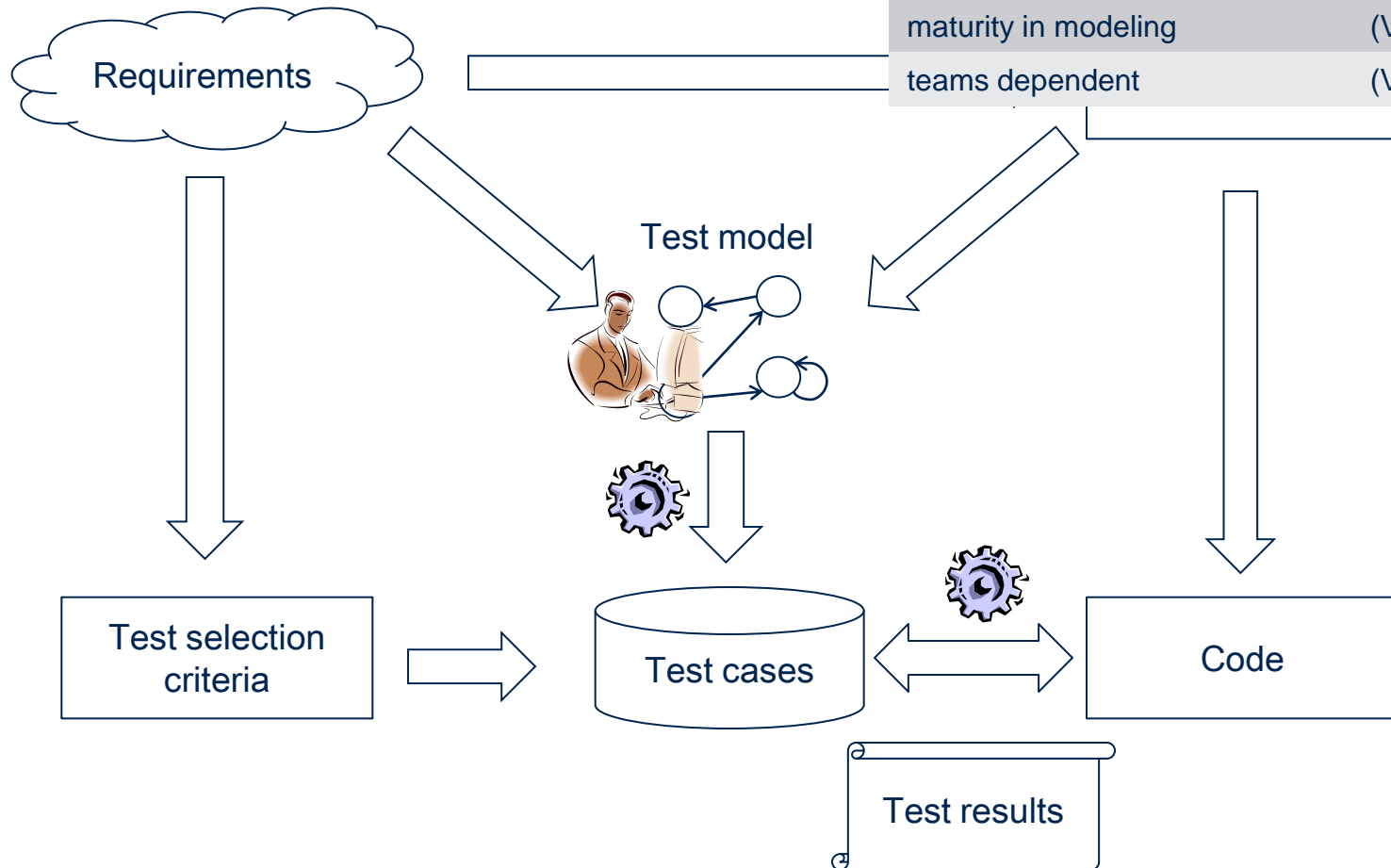
Characteristics	Metric value
reuse of models	(V_{M1}: middle)
no automation in derivation, highly automated in generation, middle automation in evaluation	(V_{M2}: middle)
middle redundancy	(V_{M3}: middle)
maturity in test automation	(V_{M4}: 7)
maturity in modeling	(V_{M5}: ≥3)
teams dependent	(V_{M6}: middle)

Requirements

Test model

Test selection criteria

Test cases

Code

Test results

[Pretschner, A., Philips, J.: Methodological Issues in Model-Based Testing. 2005]

Models from model transforma...

Characteristics	Metric value
reuse of old test models	(V_{M1}: high)
high automation in derivation, highly automated in generation, high automation in evaluation	(V_{M2}: high)
middle redundancy	(V_{M3}: middle)
maturity in test automation	(V_{M4}: 7)
maturity in modeling	(V_{M5}: 5)
teams independent	(V_{M6}: middle)
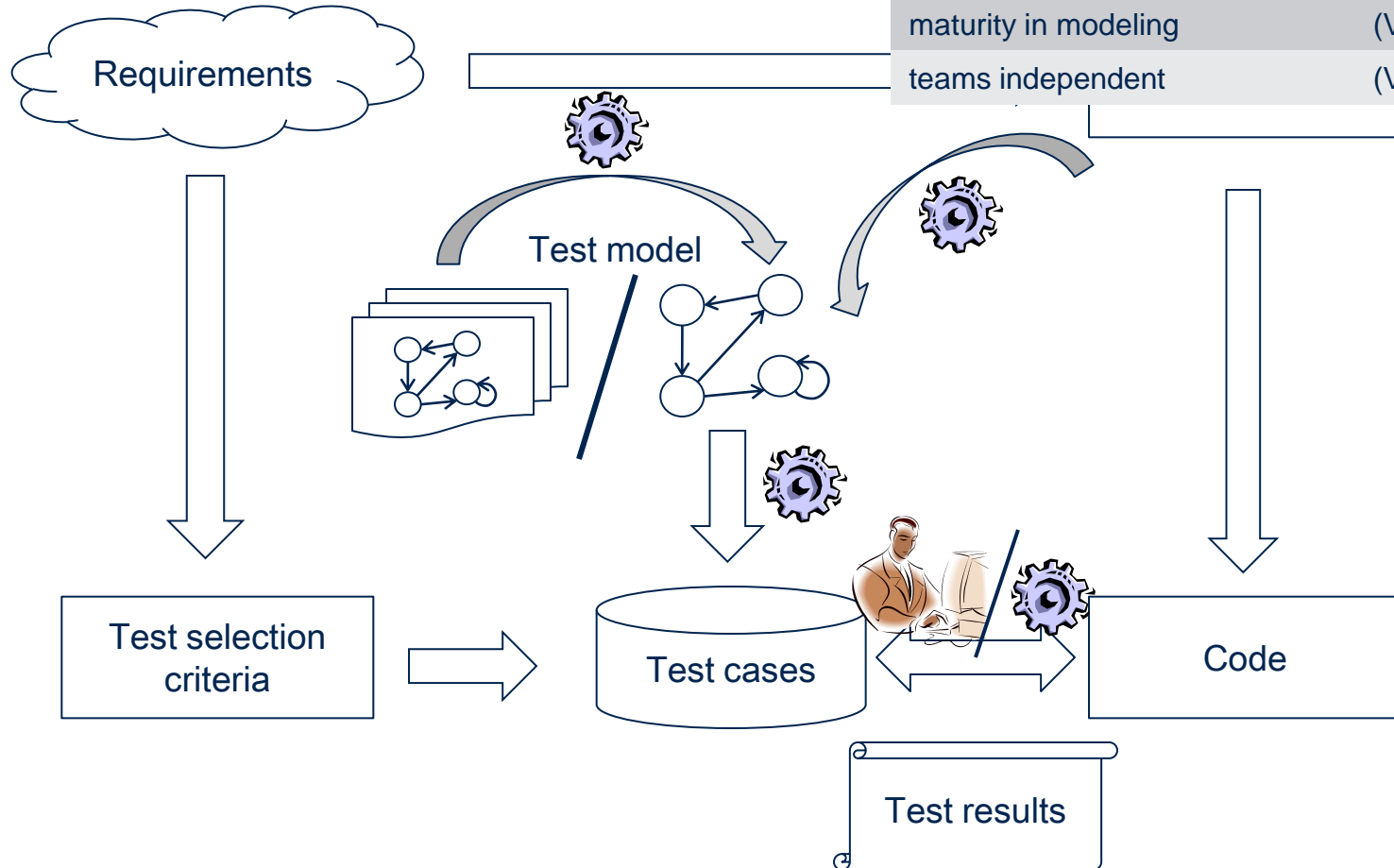
z.B. [Mlynarski, M., Güldali, B., Späth. M., Engels, G.: From Design Models to Test Models by Means of Test Ideas. 2009]