Answers and answer references exam 2019

Part 2

2.1 Match the following processes with their corresponding activities:

	Transform the test objectives into test conditions	Group tests into scripts	Write a test summary report for the stakeholders	Establish the scope and objectives of the testing
Test reporting	○	○	●	○
Test analysis	●	○	○	○
Test planning	○	○	○	●
Test implementation	○	●	○	○

2.2 When using structure-based (white-box) test techniques, which of the following alternatives could be used to assess the coverage ?

Select one or more alternatives:

- ☑ Conditions or multiple conditions exercised
- ☑ Boundaries exercised
- ☑ Decision outcomes exercised
- ☑ Partitions exercised
- ☑ Statements exercised

2.3 Which of the following is a benefit of test independence?

Select one alternative:

- ○ It does not require familiarity with the code.
- ● Independent testers sometimes question the assumptions behind requirements, designs and implementations.
- ○ It is cheaper than using developers to test their own code.
- ○ Testers are better at finding defects than developers.

2.4 As part of which test process do you determine the exit criteria?

Select one alternative:

- Evaluating exit criteria and reporting
- Test planning
- Test control
- Test closure

2.5 According to the ISTQB Glossary, which of the following alternatives is a test type?

Select one alternative:

- System testing
- Component testing
- Functional testing
- Acceptance testing

2.6

A program validates a numeric field as follows:

Values less than 10 are rejected, values between 10 and 21 are accepted, values greater than or equal to 22 are rejected.

Which of the following input values cover all of the equivalence partitions?

Select one alternative:

- 3, 20, 21
- 3,10, 22
- 10, 21, 22
- 10,11, 21

2.7 Which of the following are typical activities for a tester:

Select one or more alternatives:

- Writes test summary reports for management
- Introduces metrics for measuring the test progress
- Writes automated tests
- Gives recommendations to continue or stop the testing, based on the test execution results
- Evaluates the results of the execution of tests: pass or fail
- Acquires and prepares test data

2.8 Which of the following are typical activities for a test leader:

Select one or more alternatives:

- [x] Writes test summary reports for management
- [ ] Writes automated tests
- [ ] Evaluates the results of the execution of tests: pass or fail
- [ ] Acquires and prepares test data
- [x] Introduces metrics for measuring the test progress
- [x] Gives recommendations to continue or stop the testing, based on the test execution results

2.9 What is beta testing?

Select one alternative:

- ( ) Testing performed by product developers at the customer's location.
- ( ) Testing performed by product developers at their own locations.
- (x) Testing performed by potential customers at their own locations.
- ( ) Testing performed by potential customers at the developer's location.

2.10 Impact Analysis helps to decide ...

Select one alternative:

- ( ) how many more test cases need to written.
- ( ) exit criteria.
- ( ) different tools to perform regression testing .
- (x) how much regression testing should be done.

2.11 Which of the followings are non-functional quality characteristics?

Select one or more alternatives:

- [ ] Configuration ability
- [x] Portability
- [ ] Regression
- [x] Usability
- [ ] Coverage

2.12 Which of the following is MOST characteristic of specification based (black-box) techniques?

Select one alternative:

- Test cases can be easily automated.
- Test cases are independent of each other.
- Test cases are derived systematically from the delivered code.
- Test cases are derived systematically from models of the system.

2.13 Which of the following of types of tools is MOST LIKELY to be used by developers?

Select one or more alternatives:

- Static analysis tools
- Test management tools
- Dynamic analysis tools
- Modeling tools
- Performance testing tools

2.14 What determines the level of risk?

Select one alternative:

- The cost of dealing with an adverse event if it occurs.
- The amount of testing planned before release of a system.
- The probability that an adverse event will occur.
- The likelihood of an adverse event and the impact of the event.

2.15 Match every stage of the Software Development Life cycle with the correct test level:

Please match the values:

	Functional and non-functional requirements	Global design	Business requirements	Code
Integration tests				
Acceptance tests				
Unit tests				
System tests				

Part 3

3.1 One of the seven testing principles is called **Defect clustering.**
What does "*Defect clustering*" mean and how does it affect the testing activities?

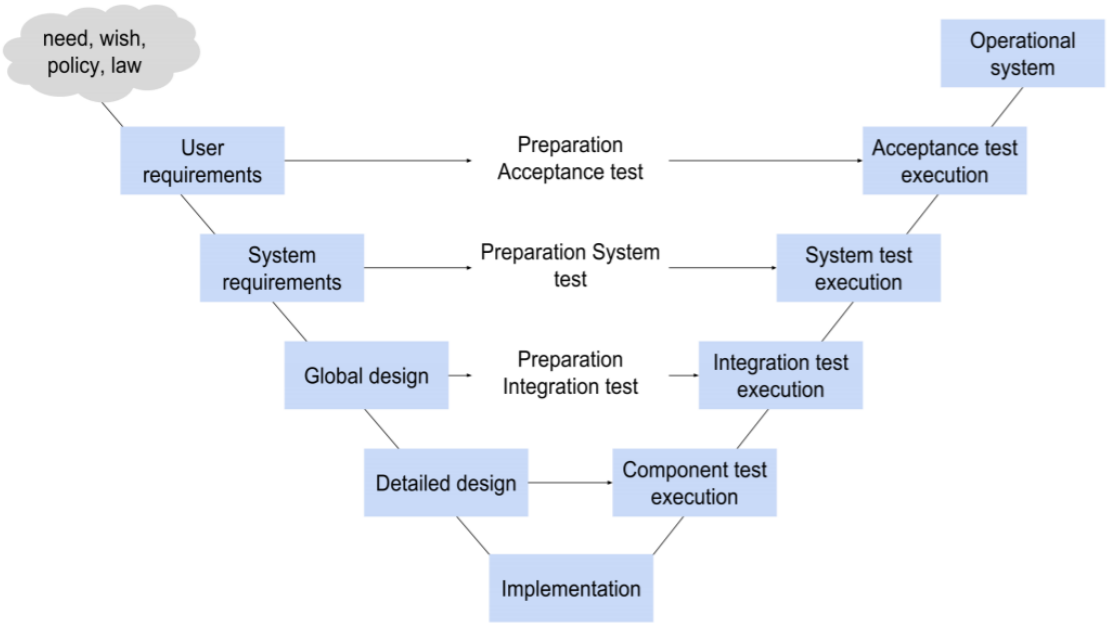
What are the remaining six principles?

REF: The textbook chapter 1.3, side 10.

3.2 *Note that in this task you can answer both in the text editor and with sketches/drawings. Use the sketching paper handed to you in the exam room. See instructions on your desk.*

Draw a figure of the **V-model** that shows the different test activities and the differents test levels. The figure should contain arrows that show the workflows and how the different test activities and test levels are related.

REF: The textbook chapter 2.1 page 39.



3.3

Equivalence partitioning (EP) and boundary value analysis (BVA) can be applied more than once to the same item specification, depending what we are focusing on.

You shall now use EP and BVA in the following case:

A company uses four digit pin codes on their doors.
The pin-codes are in the range 1000 – 9999, both boundaries included.

In this case, you shall use EP and BVA in at least **three different ways** with respect to different points of view. For each way, you shall identify:

- the equivalence partitions, both valid and, if present, invalid partitions
- and, if present, boundary values

REF: The textbook chapter 4.2.1 page 113 and 4.2.2 page 115.

Følgende tekst stod i den obligatoriske oppgaven:

The equivalence partitioning can be done in different ways on the same test object. Some of them will contain boundary values, others not. The following example from the textbook page 86 illustrates this:

> We can also apply equivalence partitioning and boundary value analysis more than once to the same specification item. For example, if an internal telephone system for a company with 200 telephones has 3-digit extension numbers from 100 to 699, we can identify the following partitions and boundaries:
>
> - digits (characters 0 to 9) with the invalid partition containing non-digits
> - number of digits, 3 (so invalid boundary values of 2 digits and 4 digits)
> - range of extension numbers, 100 to 699 (so invalid boundary values of 099 and 700)
> - extensions that are in use and those that are not (two valid partitions, no boundaries)
> - the lowest and highest extension numbers that are in use could also be used as boundary values

Svar:

1. Intervall
   Gyldig eq. partisjon: Intervallet [1000, 9999], dvs. f.o.m. 1000 t.o.m. 9999.
   Ugyldige eq. partisjon: $< \leftarrow, 999]$ og $[10000, \rightarrow >$, dvs. mindre enn 1000 og større enn 9999
   Grenseverdier: 999, 1000 og 9999, 10000

2. Siffer/ikke siffer
   Gyldig eq. partisjon: Heltall/siffer,
   Ugyldig eq. partisjon: Ikke-siffer (alle andre tegn)
   Ingen grenseverdier

3. Antall siffer
   Gyldig partisjon: 4 siffer
   Ugyldige partisjoner: færre enn 4 siffer og flere en 4 siffer
   Grenseverdier: 3, 4 og 5

Andre løsninger er også mulig.

3.4 An integer that is equal to the sum of all its *real factors*, including one (1) is called **a perfect number**.

Integrer	Real factors	Sum	Perfect?
4	1, 2	1 + 2 = 3	No 3 ≠ 4
6	1, 2, 3,	1 + 2 + 3 = 6	Yes 6 = 6
12	1, 2, 3, 4 , 6	1+ 2+ 3+ 4+ 6 = 16	No 12 ≠ 16
28	1, 2, 4, 7, 14	1+2+4+7+14 = 28	Yes 28 = 28

A real factor means a factor smaller than the number itself.

Study the Java code below:

```
public class PerfectNumbers {

  public static boolean perfect( int number ) {
    int factorSum = 1;
    for ( int divisor = 2; divisor <= number / 2; divisor++ ) {
      if ( number % divisor == 0 )
        factorSum += divisor;
    }
    return (factorSum == number);
  }
}
```

Write the necessary Java unit test(s), i.e. the test method(s), for the Java method above.

REF: slides from seminar, see below.

Trenger kun å skrive metodene. Viktig at begge returverdiene testes (både true og false). Dette kan også gjøres av en metode, men da vet man ikke hva feilen skyldes, slik at det bør gis 1 poeng trekk for det.

Slides fra ukeoppgavene:

Testing *perfect(int number)*

What to test?

Confirm perfect number is perfect

Chosen number: 6

Variables

result → Holds the returned value

expected → Set to *true*

Assert

Check that the two values match

```
import static org.junit.Assert.*;
import org.junit.Test;

public class PerfectTest1 {

    @Test
    public void perfectTest1()  {

        boolean result = PerfectNumbers.perfect( 6 );

        boolean expected = true;

        assertEquals(result, expected);

    }
}
```

Testing *perfect(int number)*

What to test?

Confirm non-perfect is non-perfect

Chosen number: 7

Variables

result → Holds the returned value

expected → Set to *false*

Assert

Check that the two values match

```
import static org.junit.Assert.*;
import org.junit.Test;

public class PerfectTest2 {

    @Test
    public void perfectTest2() {

        boolean result = PerfectNumbers.perfect( 7 );

        boolean expected = false;

        assertEquals(result, expected);

    }
}
```

3.5 Explain the difference(s) between **test execution tools** and **dynamic analysis tools** with respect to their purposes.

- What functions do they support?
- Who uses them?
- When are they used and what kind of defects might they discover?

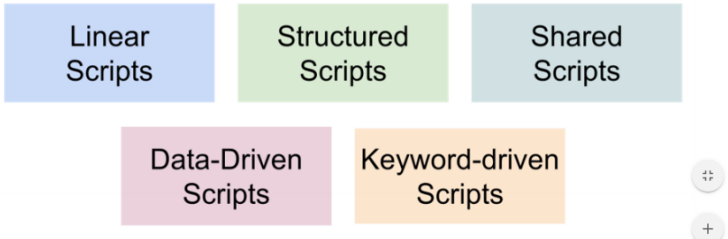
REF: The textbook chapter 6.1.1 page 210 and chapter 6.1.7 page 210.

Test exectuion tools

Test execution tools	Enable tests to be executed automatically using stored inputs & expected outcomes
	The scripting language allows to manipulate the tests with little effort(i.e. repeat the test with other data)
	Can also be used to record tests(capture &playback tools)

Tools support for test execution & logging

Levels of scripting



Dynamic analysis tools

Brukes til å overvåke programmer under kjøring, både under utvikling av programmet og når det er i drift, jfr. Task manager

Brukes også av utviklere.
Avdekker feil som minnelekasjoner, tidsavhengigheter, pekeraritmetiske feil f.eks. nullpekere.

Dynamic analysis tools (D)	Find defects that appear only when software is executing (i.e. memory leaks)
	They are typically used in component and component integration testing

Tools support for performance & monitoring

Dynamic analysis tools (D)	Find defects that appear only when software is executing (i.e. memory leaks)
	They are typically used in component and component integration testing

---

3.6 Explain the following terms:

- regression testing
- confirmation testing

REF: The textbook chapter 2.3.4 page 66.
Maks poeng: 2

4.1 Decision table

REF: The textbook chapter 4.2.3 page 121.
Løsningsforslag:

A Music Academy has the following admission requirements:

C1: The applicant must have general academic qualifications.
C2: The applicant must have passed a practical music test.
C3: The applicant must have competition points above the year's minimum.

A1: The applicant is offered a study place
A2: The applicant is placed on a waiting list if he or she has passed the practical music test but has competition points below the year's minimum.

A3: The applicant is offered a second chance to take the practical music test if he or she did not pass this test in the first place but has competition points above the year's minimum.

A4: The applicant is not offered a study place and receives no other offers.

a)

	Rule 1	**Rule 2**	**Ruke 3**	**Rule 4**	**Rule 5**	**Rule 6**	**Rule 7**	**Rule 8**
C1	*true*	*true*	*true*	*true*	*false*	*false*	*false*	*false*
C2	*true*	*true*	*false*	*false*	*true*	*true*	*false*	*false*
C3	*true*	*false*	*true*	*false*	*true*	*false*	*true*	*false*
Actions	A1	A2	A3	A4	A4	A4	A4	A4

b) Hvis C1 er false ser vi at betingelsene C2 og C3 ikke har noen betydning for utfallet for søkeren. Dermed kan reglene Rule 5, 6, 7 og 8 slås sammen og vi får følgende tabell:

	Rule 1	**Rule 2**	**Ruke 3**	**Rule 4**	**Rule 5**
C1	*true*	*true*	*true*	*true*	*false*
C2	*true*	*true*	*false*	*false*	---
C3	*true*	*false*	*true*	*false*	---
Actions	A1	A2	A3	A4	A4

c)

1. The applicant is academically qualified, has passed the practical music test, and has competition points above the year's minimum.
2. The applicant is academically qualified, has passed the practical music test, but has competition points below the year's minimum.
3. The applicant is academically qualified and has competition points above the year's minimum but did not pass the practical music test.

Test 1 dekker Rule 1, test 2 dekker Rule 2 og test 3 dekker Rule 3.

Følgelig må vi legge til to tester, en test for Rule 4 og en test for Rule 4:

4. The applicant is academically qualified, has not passed the practical music test, and has competition points below the year's minimum.
5. The applicant is not academically qualified

d)

Vi får en ny betingelse:

C4: The applicant shows impressive music abilities and skills on the practical music test

Med den nye betingelsen får vi 4 betingelser, hvilket gir oss en tabell med $\mathbf{2^4 = 16}$ kolonner/regler når alle kombinasjoner av utfall tas med.

Antall kolonner i tabellen øker eksponensielt med antall betingelser. Har vi **n** betingelser får vi $\mathbf{2^n}$ kolonner/regler. Decision tables er derfor ikke egnet når antall betingelser **n** blir stort.

4.2 State transition diagram

REF: The textbook chapter 4.2.4 page 127.

a) Based on the state transition diagram in the pdf document, you shall now set up a test case as a path (sequence of states) that describes *the main scenario*, i.e. a successful payment transaction.

- What is *the state coverage* of this test case?
- What is *the transition coverage* of this test case?

I denne oppgaven vil svarene avhenge av hva studenten har valgt som main scenario. Det vil også avhenge av om man tar med overgangen fra SX til S0. Begge deler kan anses som riktig. Coverage må beregnes ut fra studentens løsning. Hvis studenten har valgt å se bort fra overgangen fra SX til S0 må antall overganger reduseres fra 16 til 15, og prosentene for transition coverage blir da forskjellig fra svarene i løsningsforslaget.

Løsningsforslag:

Antall tilstander 11
Antall overganger: 16 (Inkludert overgangen fra SX til S0.)

S0→S1→S2→S4→S5→S7→S8→S9→SX→S0
State coverage: 9/11 = 82%.
Transition coverage: 9/16 = 56%. (hvis overgangen fra SX til S0 tas med)

b) What is the highest *transition coverage* we can achieve in one single test case?

- What is *the state coverage* of this test case?
- What is *the transition coverage* of this test case?

Løsningsforslag:
Her er det to løsninger, avhengig av om man avslutter etter en transaksjon, eller tar to transaksjoner i en test. Begge deler må anses som riktig. (NB! Det er ikke eksplisitt spurt om stien, så de kan gjerne begrunne svaret med ord.)

Alternativ 1 med kun en transaksjon får vi

1) *S0→S1→S0→S1→S2→S3→S1→S2→S4→S0→S1→S2→S4→S5→S6→S4→S5→S7→S8→S9→SX→S0*

som gir
State coverage: 11/11 = 100%.
Transition coverage: 15/16 = 94%. (når vi har tatt med overgangen fra SX til S0)

Alternativ 2 med to transaksjoner i en test får vi:

2) *S0→S1→S0→S1→S2→S3→S1→S2→S4→S0→S1→S2→S4→S5→S6→S4→S5→S7→S8→S9→SX→S0→S1→S2→S4→S5→S7→S9→SX→S0*

som gir
State coverage: 11/11 = 100%.
Transition coverage: 16/16 = 100%.

c) How many test cases do we need to achieve 100% *transition coverage*?

- What is *the state coverage* of this test case?
- What is *the transition coverage* of this test case?

Løsningsforslag:
Også her er det to alternative løsninger, avhengig av om man avslutter etter en transaksjon, eller tar to transaksjoner i en test.

Alternativ 1 med kun en transaksjon pr test:
Da trenger vi minimum 2 tester fordi det går piler ut fra tilstand S7, men ingen piler tilbake.

1) *S0→S1→S0→S1→S2→S3→S1→S2→S4→S0→S1→S2→S4→S5→S6→S4→S5→S7→S8→S9→SX→S0*

State coverage: 11/11 = 100%.
Transition coverage: 15/16 = 94%. (når vi har tatt med overgangen fra SX til S0)

2) *S0→S1→S2→S4→S5→S7→S9→SX→S0*

State coverage: 8/11 = 73%.
Transition coverage: 8/16 = 50%. (når vi har tatt med overgangen fra SX til S0)

Til sammen gir disse to testene 100% transition coverage.

Alternativ 2 med to transaksjon i en test:
Da trengs kun en test trengs.

1) *S0→S1→S0→S1→S2→S3→S1→S2→S4→S0→S1→S2→S4→S5→S6→S4→S5→S7→S8→S9→SX→S0→S1→S2→S4→S5→S7→S9→SX→S0*

State coverage: 11/11 = 100%.
Transition coverage: 16/16 = 100%. (når vi har tatt med overgangen fra SX til S0)

d) Find the *shortest path* from S0 to SX that visits *every state*.

- What is *the state coverage* of this test case?
- What is *the transition coverage* of this test case?

Løsningsforslag:

S0→S1→S2→S3→S1→S2→S4→S5→S6→S4→S5→S7→S8→S9→SX

State coverage: 11/11 = 100%.
Transition coverage: 12/16 = 75%. (hvis overgangen fra SX til S0 tas med)
Transition coverage: 12/15 = 80 %. (hvis overgangen fra SX til S0 IKKE tas med)

e) Why is 100% *state coverage* in most cases not enough as an *exit criterion* for testing?

Løsningsforslag:
100% transition coverage garanterer 100% state coverage, men ikke oppvendt! Derfor er state cover ikke tilstrekkelig for å sikre grundig testing.

5.1

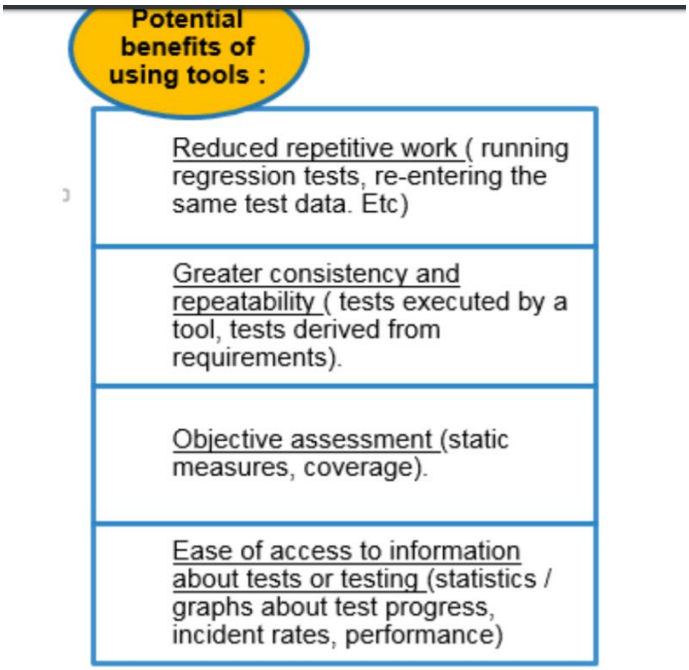
Write a text describing potential benefits as well as risks of using tools that support testing.

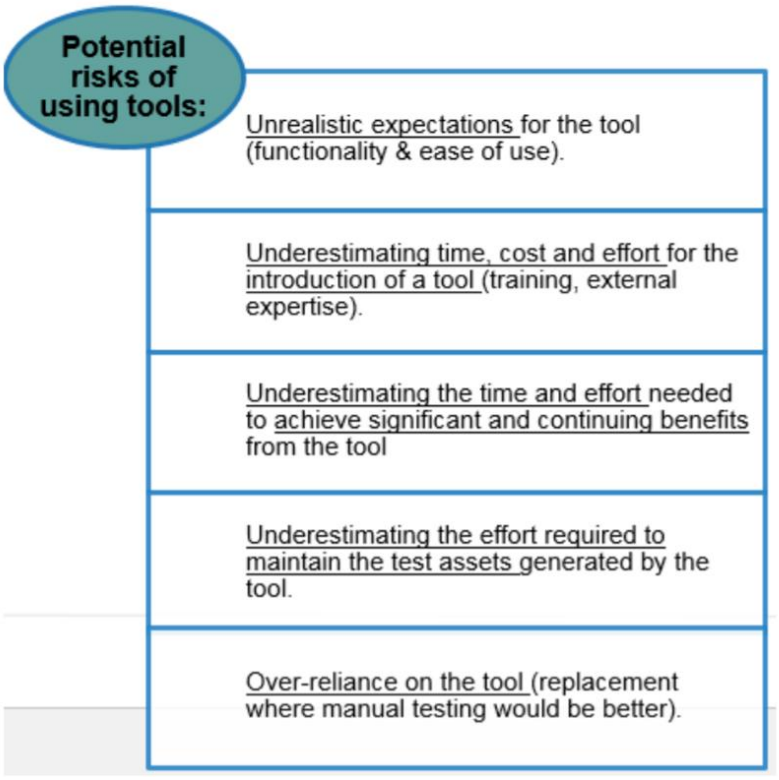
- What are the benefits?
- What risks should we be aware of?

You should recognize that some tools have special considerations.
Explain the special considerations related to

- Test execution tools
- Performance testing tools
- Static analysis tools
- Test management tools

REF: The textbook chapter 6.1.2 page 215 and 6.1.3 page 219.


Potential benefits of using tools :
Reduced repetitive work (running regression tests, re-entering the same test data. Etc)
Greater consistency and repeatability (tests executed by a tool, tests derived from requirements).
Objective assessment (static measures, coverage).
Ease of access to information about tests or testing (statistics / graphs about test progress, incident rates, performance)


Potential risks of using tools:
Unrealistic expectations for the tool (functionality & ease of use).
Underestimating time, cost and effort for the introduction of a tool (training, external expertise).
Underestimating the time and effort needed to achieve significant and continuing benefits from the tool
Underestimating the effort required to maintain the test assets generated by the tool.
Over-reliance on the tool (replacement where manual testing would be better).

Special considerations: Test execution tools

This type of tool often requires significant effort in order to achieve significant benefits.

- Capturing tests by recording the actions of a manual tester seems attractive, but this approach does not scale to large numbers of automated tests. This type of script may be unstable when unexpected events occur.
- **Data-driven approach**: separates out the test inputs (the data) and uses a more generic script that can read the test data and perform the same test with different data.
- **In a keyword-driven approach:** the spreadsheet contains keywords with the actions to be taken (also called action words), and test data. Testers can then define tests using the keywords.
- **NB! Data-driven og keyword-driver approach krever programmeringskompetanse.**

Special considerations: Performance testing tools

- The design of the load to be generated by the tool
- Timing aspects
- How to interpret the information gathered.
- These tools need tester with expertise in performance testing to design the tests and interpret results.

Special considerations: Static analysis tools

- There is a risk that the changes to make old code to conform to new standard will introduce an unexpected side-effect.
- These tools applied to source code can enforce coding standards, but if applied to existing code may generate a lot of messages.
- A gradual implementation with initial filters to exclude some messages would bean effective approach.

Special considerations: Test management tools

- They need to interface with other tools or spreadsheets in order to produce information in the best format for the current needs of the organization.