


Risk based testing

How to choose what to test more and less

by Hans Schaefer
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- What is risk
- Factors determining damage
- Factors determining probability
- A simple method to calculate risk
- Risk management in test projects: Risks before, during and after the test

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The duty of testing

“It shall be the duty of managers to make decisions and the duty of engineers to make them informed ones.”

*Jukka Talvio, Development Manager,
F-Secure*

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Why this presentation

Because testing is always under pressure
Testing is the last thing done in a project (“caboose effect”)
You must be able to cut down the least important things

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Strategy

Objective: Find the most important defects as early as possible at the lowest price

No risk -> No test

Business / user / client based decision

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What is risk?

The product of **the probability**, that something negative, a failure, will happen, and the **cost**, (damage) of the consequences which will then happen.

```

    graph TD
      RISK --> Damage["Damage  
(cost of failure)"]
      RISK --> Prob["Probability of failure"]
      Damage --> Usage["Usage frequency"]
      Damage --> DamageUse["Damage / Use"]
      Prob --> Quality["Quality  
(failure rate / defect density)"]
    
```

Risk:= You don't know what will happen but you do know the probabilities
Uncertainty = You don't even know the probabilities.

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Determining probability of failure

```

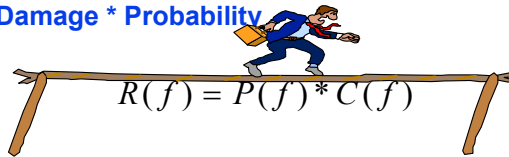
    graph TD
      Prob["Probability of failure"] --> Quality["Quality  
(failure rate / defect density)"]
      Prob --> Volume["Functional volume  
(how much is 'in there?')"]
    
```

Probability = defect density / volume

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Risk definition

- **Damage**
 - Catastrophic: Loss of lives, loss of license
 - Financial, loss of (faith of) clients, damage to corporate identity
 - Impact on other functions or systems
 - Detection and repair time
- **Probability of failure**
 - Globally = complexity / (estimated) size
 - In detail = knowledge of development project (just before testing)
- **Risk = Damage * Probability**



$R(f) = P(f) * C(f)$

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Risk analysis

- **Applicable on the level of**
 - system
 - subsystem
 - individual function or module (e.g. insert new entry into phone database)
- **Fundamental problems:**
 - Difficult to measure
 - Failure to account for risk compensation (people compensate for greater safety by taking more risks)

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STP

Risk analysis

- Risk analysis should lead to a **limited number of classes of approximately equal risks (3-5)**
- **Quality characteristics: What is the probability that failures will happen and the damage for**
 - functional defects
 - bad performance
 - bad usability
 - low maintainability
 - ...

ISO/IEC Std 9126 as checklist


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STP

Risk based Test - Practice

Before the Test: Identify what is critical

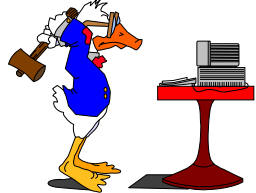
①





Test identifies areas with lots of detects

②




Extra Testing:

- Extra Test by product specialist
- automated regression test

③

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Prioritization for the first test


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Product Risks: What to think about

Damage factors:

- Which functions and attributes are **critical**?
 - (essential for the business success *to reduce the business risk*).
- How **visible** is a problem in a function or attribute? (for customers, users, people outside)
- How **often** is a function used?
- Can we do without?
- Legal consequences




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Failure probability: What is (presumably) worst?

- Complex areas
- Changed areas
- Number of people involved
- Turnover
- New technology, solutions, methods
- New tools
- Time pressure
- Areas which needed optimizing
- Areas with many defects before
- Geographical spread
- History of prior use
- Local factors

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Do not forget

Can we test **ONLY PART** of the product?

Other versions later?

Fight time pressure!

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How to calculate priority of risk areas?

Assign weights to the chosen factors. (1 - 3 - 10)
 Assign points to every area and factor
 (1 - 2 - 3 - 4 - 5)
 Calculate the weighted sum (damage * probability).
 The spreadsheet does not contain the “surprise” factor, but that can be added.

Spreadsheet

Download: <http://home.c2i.net/schaefer/testing/riskcalc.hqx>

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Example

Damage
Probability

Area to test	Usage frequency	Visibility	Complexity	Geography	Turnover	SUM
Weight	3	10	3	1	3	
Function A	5	3	2	4	5	1125
Function A performance	5	3	5	4	5	1530
Function B	2	1	2	2	5	368
F B usability	1	1	4	2	5	377
Function C	4	4	3	2	0	572
Function D	5	0	4	1	1	240

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What is the formula?

Risk = Damage * Probability

Damage =
(Weight for impact factor 1 * value for this factor +
Weight for impact factor 2 * value for this factor + + +
Weight for impact factor n * value for this factor)

Probability =
(Weight for probability factor 1 * value for this factor +
Weight for probability factor 2 * value for this factor + + +
Weight for probability factor n * value for this factor)

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The mathematics behind it

It works well enough.
We may actually be on a logarithmic scale (humans assigning points do so), which means we should **ADD** instead of **MULTIPLY**.

The highest weighted sums -> thorough testing
Middle weighted sums -> ordinary testing
Low weighted sums -> light testing

Make sure you use your head! Analyze unexpected results!

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Selecting test techniques

Example

Reliability	30	State trans test Boundary value, branch coverage
Usability	40	Paper review, Usability lab
Efficiency	10	No test
Flexibility (maintain)	20	Design review Monitoring of repairs

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What to do if you do not know anything about the product?

Run a test.
Prioritize roughly by risk.

First a breadth test ("smoke test"), everything a little, risky items more. (Explore the product).
Then prioritize a more thorough test for the second test cycle.


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Another risk based approach: Project risks for the Tester

- Risks BEFORE Test**
- Risks DURING Test**
- Risks AFTER Test**

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Risks BEFORE Testing

- Bad Quality**
 - Many faults overlooked
 - Blocking faults
 - Too many new versions

-> Requirements to, and follow up of quality assurance before test
- Delays**
 - > Alternative plans
- Lack of knowledge**
 - > Test of earlier versions

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Risks AFTER Testing

THESE SHOULD NOT HAPPEN...

- Customer finds faults.**
- Customer uses the product in new ways.**

Analysis of necessary reliability!

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Risks in the Test project itself

- Bad management**
- Lack of qualification**
- Too few or the wrong people, too late**
- Bad coordination**
- Bad cooperation**
- Problems with equipment and tools**

Medicine: Normal good project management.

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How to make testing cheaper?

Good people save time and money
Good Prioritization

Try to get rid of part of the task...

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Getting rid of work

Get someone else to pay for it or cut it out completely!

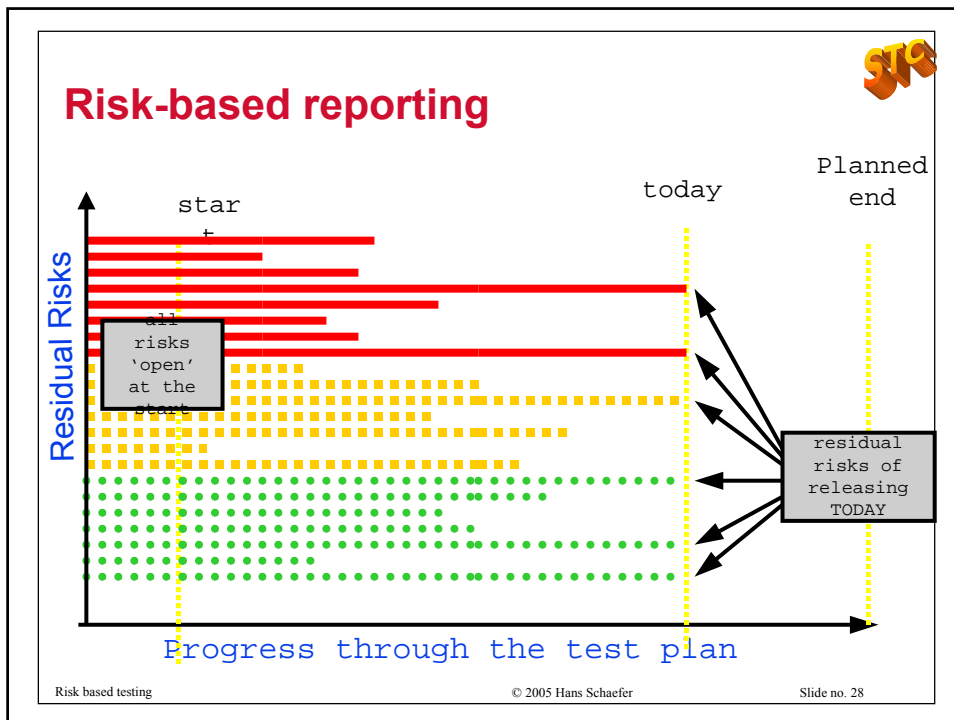
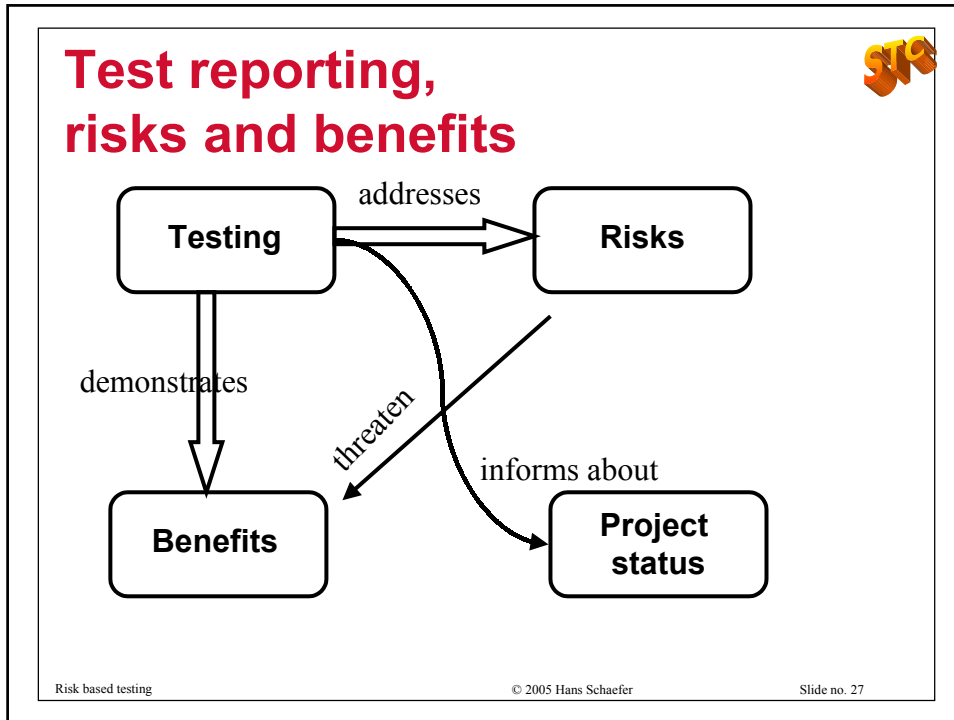
- Who pays for unit testing?
- What about test entry criteria?
- Less documentation - more exploratory test


Cutting installation cost - strategies for defect repair

- When to correct a defect, when not?
- Rule 1: Repair only defects causing important failures!
- Rule 2: Change requests to next release!
- Rule 3: Install corrections in groups!
- Rule 4: Daily build!

Less Test, should the customers pay ????

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References

IEEE Standard 1044-2002: Standard Classification for Software Anomalies
IEEE Standard 1044.1-2002: Guide to Classification for Software Anomalies
Soon to come: IEEE Std. 16085 Standard for Software Engineering - Software Life Cycle Processes - Risk Management
-You find them at sales@ieee.org

Rex Black, Managing the Testing Process, John Wiley, 2002. (includes CD with a test priority spreadsheet)

Hall, Payson: A Calculated Gamble. In STQE Magazine No 1 +2 / 2003.

- Stamatis, D.H., Failure Mode and Effect Analysis: □FMEA from Theory to Execution, ASQ Quality Press, 2003, ISBN 0-873-895983.

Schaefer, Hans: „Strategies for Prioritizing Test“, STAR WEST 1998.
<http://home.c2i.net/schaefer/testing/risktest.doc>

James Bach, Risk Based Testing, STQEMagazine, Vol1, No. 6,
www.stqemagazine.com/featured.asp?stamp=1129125440

Felix Redmill in „Professional Tester“, April 2003. www.professional-tester.com

Tom DeMarco and Tim Lister. "Waltzing with Bears: Managing Risk on Software Projects", 2003.

Leveson, N. G. (1995). Safeware: System Safety and Computers. Reading, Massachusetts: Addison Wesley.

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Thank you for listening

Questions?

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