Risk based testing

How to choose what to test more and less

by Hans Schaefer
hans.schaefer@ieee.org

- 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

Risk based testing   © 2005 Hans Schaefer   Slide no. 1

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

Risk based testing   © 2005 Hans Schaefer   Slide no. 2

© Hans Schaefer, 2000

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

Risk based testing   © 2005 Hans Schaefer   Slide no. 3

Strategy

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

No risk -> No test
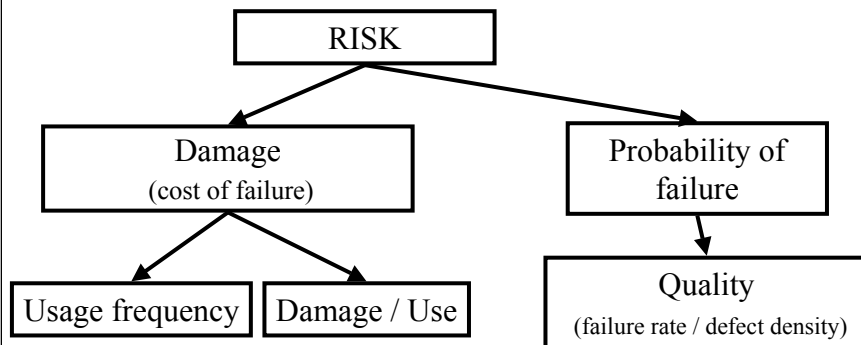
Business / user / client based decision

Risk based testing   © 2005 Hans Schaefer   Slide no. 4

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.

```
                        ┌─────────────┐
                        │    RISK     │
                        └─────────────┘
              ┌──────────────┘        └──────────────┐
┌─────────────────────────┐          ┌─────────────────────┐
│       Damage            │          │   Probability of    │
│   (cost of failure)     │          │      failure        │
└─────────────────────────┘          └─────────────────────┘
      ┌────────┘    └────────┐                    └──────────┐
┌──────────────┐   ┌──────────────┐      ┌─────────────────────────────┐
│Usage frequency│  │ Damage / Use │      │          Quality            │
└──────────────┘   └──────────────┘      │ (failure rate / defect density)│
                                         └─────────────────────────────┘
```
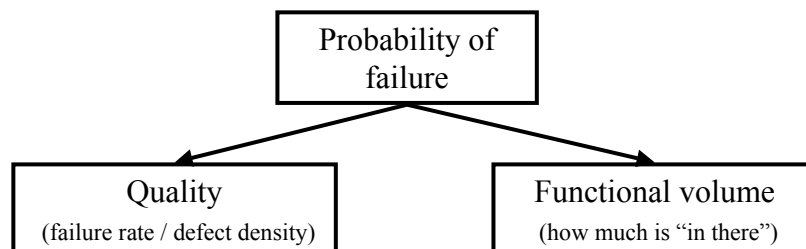
**Risk:= You don't know what will happen but you do know the probabilities
Uncertainty = You don't even know the probabilities.**

Risk based testing   © 2005 Hans Schaefer   Slide no. 5

Determining probability of failure

```
              ┌──────────────┐
              │Probability of│
              │   failure    │
              └──────────────┘
         ┌────────┘        └────────┐
┌─────────────────────────┐  ┌─────────────────────────┐
│        Quality          │  │    Functional volume    │
│(failure rate / defect density)│ │ (how much is "in there")│
└─────────────────────────┘  └─────────────────────────┘
```

Probability = defect density / volume

Risk based testing   © 2005 Hans Schaefer   Slide no. 6

© Hans Schaefer, 2000

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**

$$R(f) = P(f) * C(f)$$
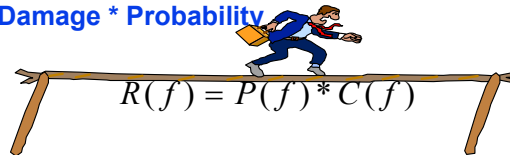
Risk based testing © 2005 Hans Schaefer Slide no. 7

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)**

Risk based testing © 2005 Hans Schaefer Slide no. 8

© Hans Schaefer, 2000

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

Risk based testing   © 2005 Hans Schaefer   Slide no. 9
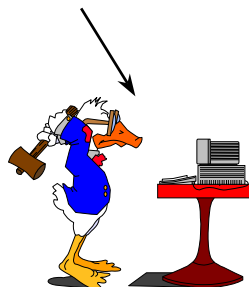
Risk based Test - Practice

Before the Test: Identify what is critical

① *"Top-20"*

Test identifies areas with lots of detects

②

Extra Testing:
- Extra Test by product specialist
- automated regression test

③

Risk based testing   © 2005 Hans Schaefer   Slide no. 10

© Hans Schaefer, 2000

Prioritization for the first test

Risk based testing   © 2005 Hans Schaefer   Slide no. 11

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**

Risk based testing   © 2005 Hans Schaefer   Slide no. 12

© Hans Schaefer, 2000

Failure probability: What is (presumably) worst?

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

Risk based testing   © 2005 Hans Schaefer   Slide no. 13

Do not forget

Can we test ONLY PART of the product?

Other versions later?

Fight time pressure!

Risk based testing   © 2005 Hans Schaefer   Slide no. 14

© Hans Schaefer, 2000

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

Risk based testing   © 2005 Hans Schaefer   Slide no. 15

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

Risk based testing   © 2005 Hans Schaefer   Slide no. 16

© Hans Schaefer, 2000

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)

Risk based testing   © 2005 Hans Schaefer   Slide no. 17

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!

Risk based testing   © 2005 Hans Schaefer   Slide no. 18

© Hans Schaefer, 2000

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

Risk based testing   © 2005 Hans Schaefer   Slide no. 19

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.

Risk based testing   © 2005 Hans Schaefer   Slide no. 20

© Hans Schaefer, 2000

Another risk based approach: Project risks for the Tester

Risks BEFORE Test
Risks DURING Test
Risks AFTER Test

Risk based testing   © 2005 Hans Schaefer   Slide no. 21

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

Risk based testing   © 2005 Hans Schaefer   Slide no. 22

Risks AFTER Testing

THESE SHOULD NOT HAPPEN…

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

Analysis of necessary reliability!

Risk based testing   © 2005 Hans Schaefer   Slide no. 23

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.

Risk based testing   © 2005 Hans Schaefer   Slide no. 24

How to make testing cheaper?

Good people save time and money
Good Prioritization

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

Risk based testing   © 2005 Hans Schaefer   Slide no. 25

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 ????

Risk based testing   © 2005 Hans Schaefer   Slide no. 26

© Hans Schaefer, 2000

Test reporting, risks and benefits

Risk based testing — © 2005 Hans Schaefer — Slide no. 27

Risk-based reporting

Risk based testing — © 2005 Hans Schaefer — Slide no. 28

© Hans Schaefer, 2000
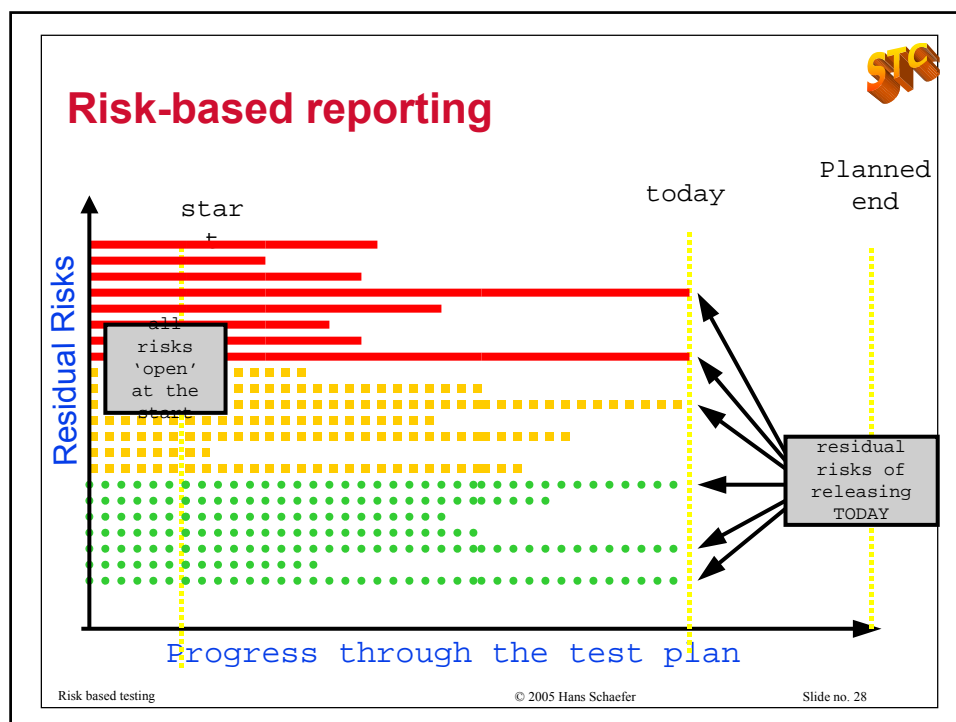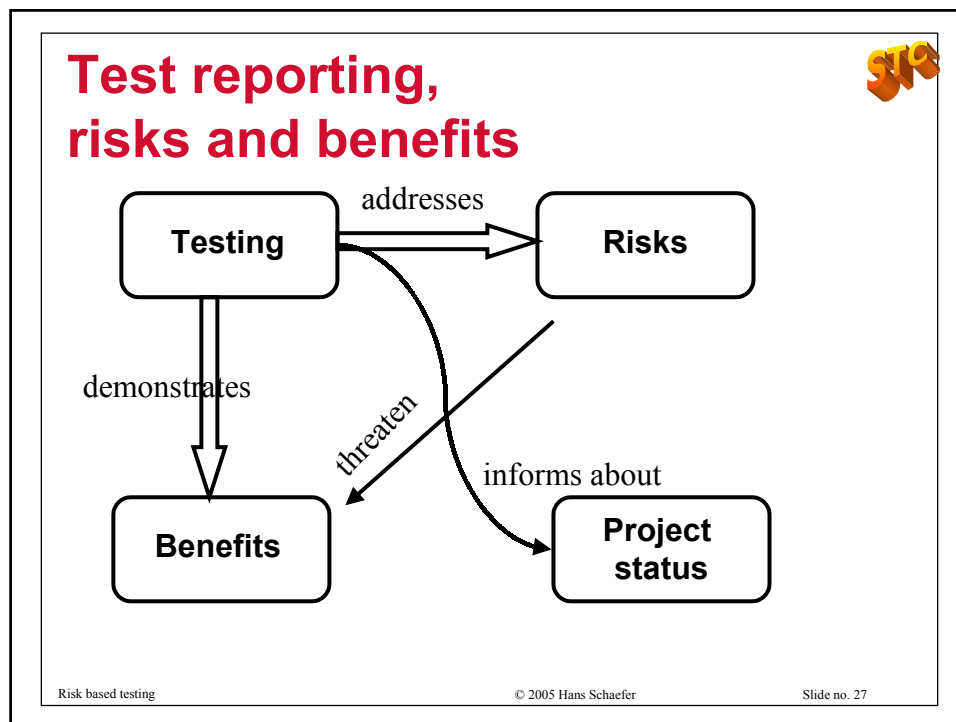
References

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.

Risk based testing   © 2005 Hans Schaefer   Slide no. 29

Thank you for listening

Questions?

Risk based testing   © 2005 Hans Schaefer   Slide no. 30

© Hans Schaefer, 2000