# Risk-Based Testing

## Increasing Effectiveness and Efficiency in Testing

Michael Felderer[1] and Rudolf Ramler[2]

[1] Institute of Computer Science, University of Innsbruck, Austria

[2] Software Competence Center Hagenberg GmbH, Hagenberg, Austria

**PROFES 2016**

# Contact & Introduction

- Michael Felderer

Institute of Computer Science, University of Innsbruck
Technikerstr. 21a, 6020 Innsbruck
+43 512 507 53228
michael.felderer@uibk.ac.at

- Rudolf Ramler

Software Competence Center Hagenberg GmbH
Softwarepark 21, 4232 Hagenberg
+43 7236 3343 872
rudolf.ramler@scch.at

# Administrative Notes

- Start, Finish
  - 9:00 - 12:00

- Web Site → **http://mfelderer.at/profes16rbt**
  - Slides
  - TED Forms

# Overview of the Tutorial

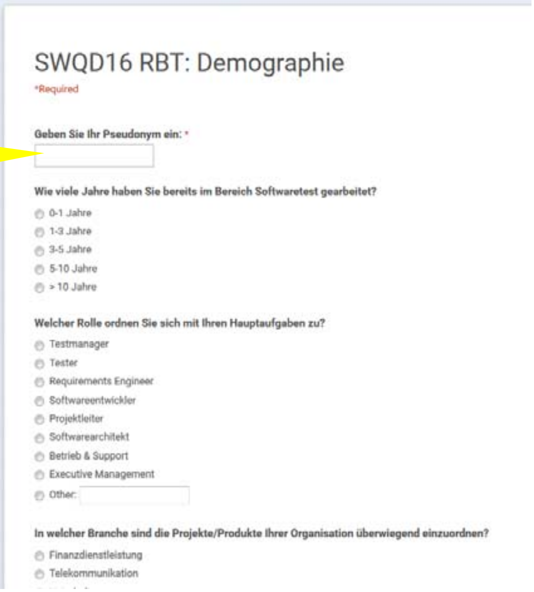
- Introduction and Background
  - Software Testing
  - Risk and Quality
  - Probability and Impact
- Benefits of Risk-Based Testing
- Risk-Based Testing Process
  - Estimation of Probability and Impact
  - Risk Value and Risk Levels
  - Test Strategy Development & Refinement
- Results and Lessons Learned

# TED – Making the Tutorial Interactive

TED

- Share your experience and opinion via TED polls
  - http://mfelderer.at/profes16rbt
- Instant evaluation of aggregated results

Your key here!



SWQD16 RBT: Demographie

*Required

Geben Sie Ihr Pseudonym ein: *

Wie viele Jahre haben Sie bereits im Bereich Softwaretest gearbeitet?

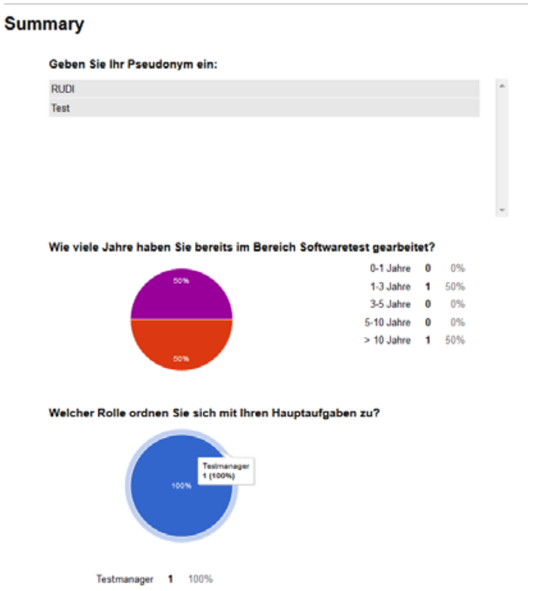
○ 0-1 Jahre
○ 1-3 Jahre
○ 3-5 Jahre
○ 5-10 Jahre
○ > 10 Jahre

Welcher Rolle ordnen Sie sich mit Ihren Hauptaufgaben zu?

○ Testmanager
○ Tester
○ Requirements Engineer
○ Softwareentwickler
○ Projektleiter
○ Softwarearchitekt
○ Betrieb & Support
○ Executive Management
○ Other:

In welcher Branche sind die Projekte/Produkte Ihrer Organisation überwiegend einzuordnen?

○ Finanzdienstleistung
○ Telekommunikation



Summary

Geben Sie Ihr Pseudonym ein:

RUDI
Test

Wie viele Jahre haben Sie bereits im Bereich Softwaretest gearbeitet?

| | | |
|---|---|---|
| 0-1 Jahre | 0 | 0% |
| 1-3 Jahre | 1 | 50% |
| 3-5 Jahre | 0 | 0% |
| 5-10 Jahre | 0 | 0% |
| > 10 Jahre | 1 | 50% |

Welcher Rolle ordnen Sie sich mit Ihren Hauptaufgaben zu?

| | | |
|---|---|---|
| Testmanager | 1 | 100% |

# TED – Who are you?

TED

→ http://mfelderer.at/profes16rbt

- TED-1 Demographics

# TED – Why Risk-based Testing?

TED

- What is the motivation for Risk-Based Testing?

→ http://mfelderer.at/profes16rbt

  - TED-2 Motivation

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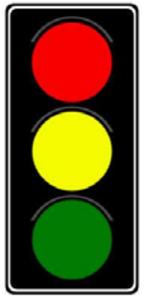
# Software Testing

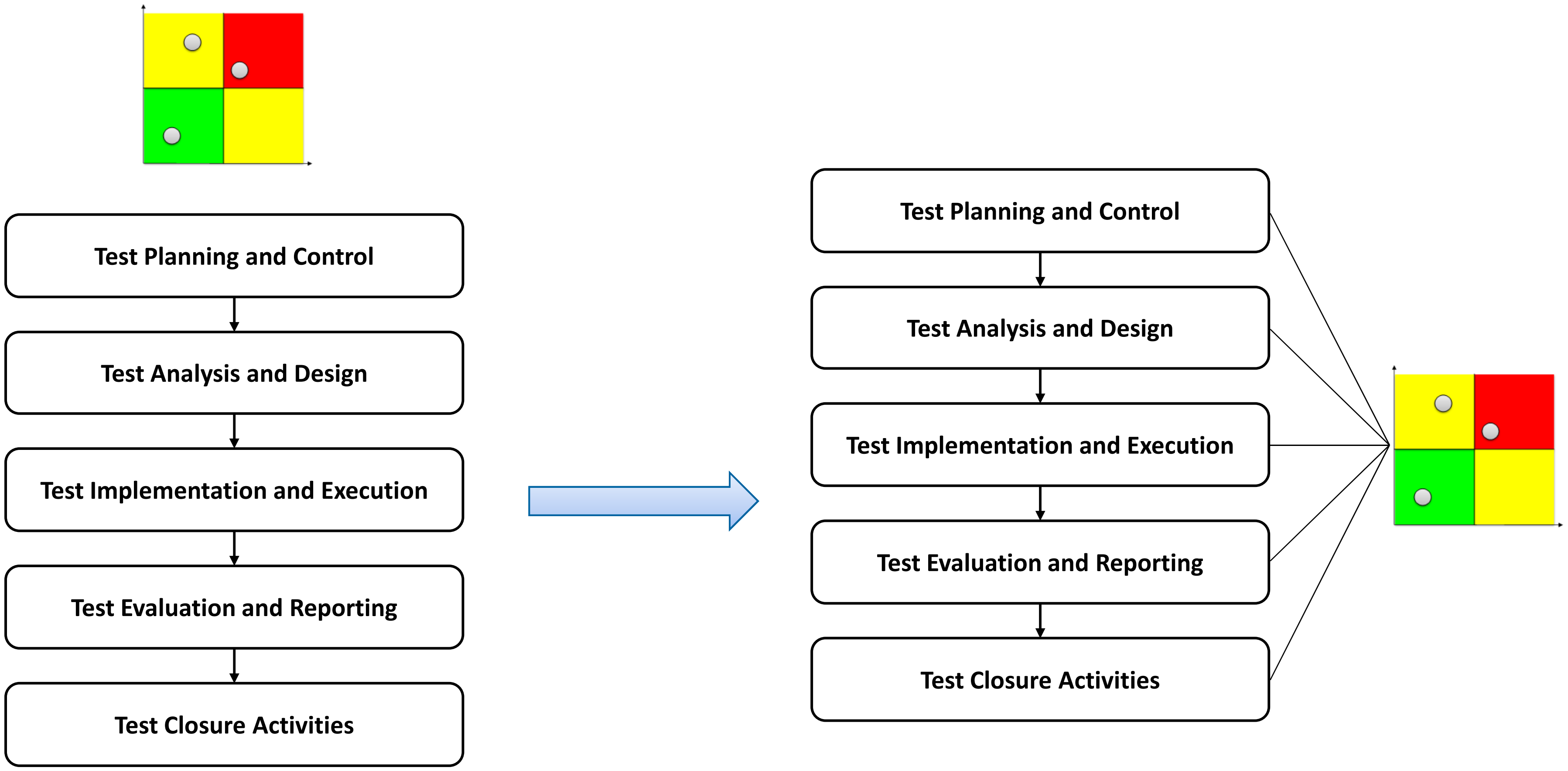
- Software testing is an **investigation** conducted to **provide stakeholders with information about the quality** of the product or service under test
- **Process** consisting of all lifecycle activities concerned with **planning**, **preparation** and **evaluation** of **software products** or **services** and related work products to determine that
  - they **satisfy specified requirements**,
  - to demonstrate that they are **fit for purpose** and
  - to **detect defects**

# Risk-Based Testing (RBT)

- Approach to testing to **reduce the level of product risks** and **inform stakeholders** of their status, starting in the initial stages of a project
  - It involves the identification of product risks and the use of risk levels to guide the test process
- Testing approach which considers **risks of the software product** as the guiding factor to **support decisions** in all phases of the **test process**



# Risk-Based Testing



Test Planning and Control

Test Analysis and Design

Test Implementation and Execution

Test Evaluation and Reporting

Test Closure Activities

Test Planning and Control

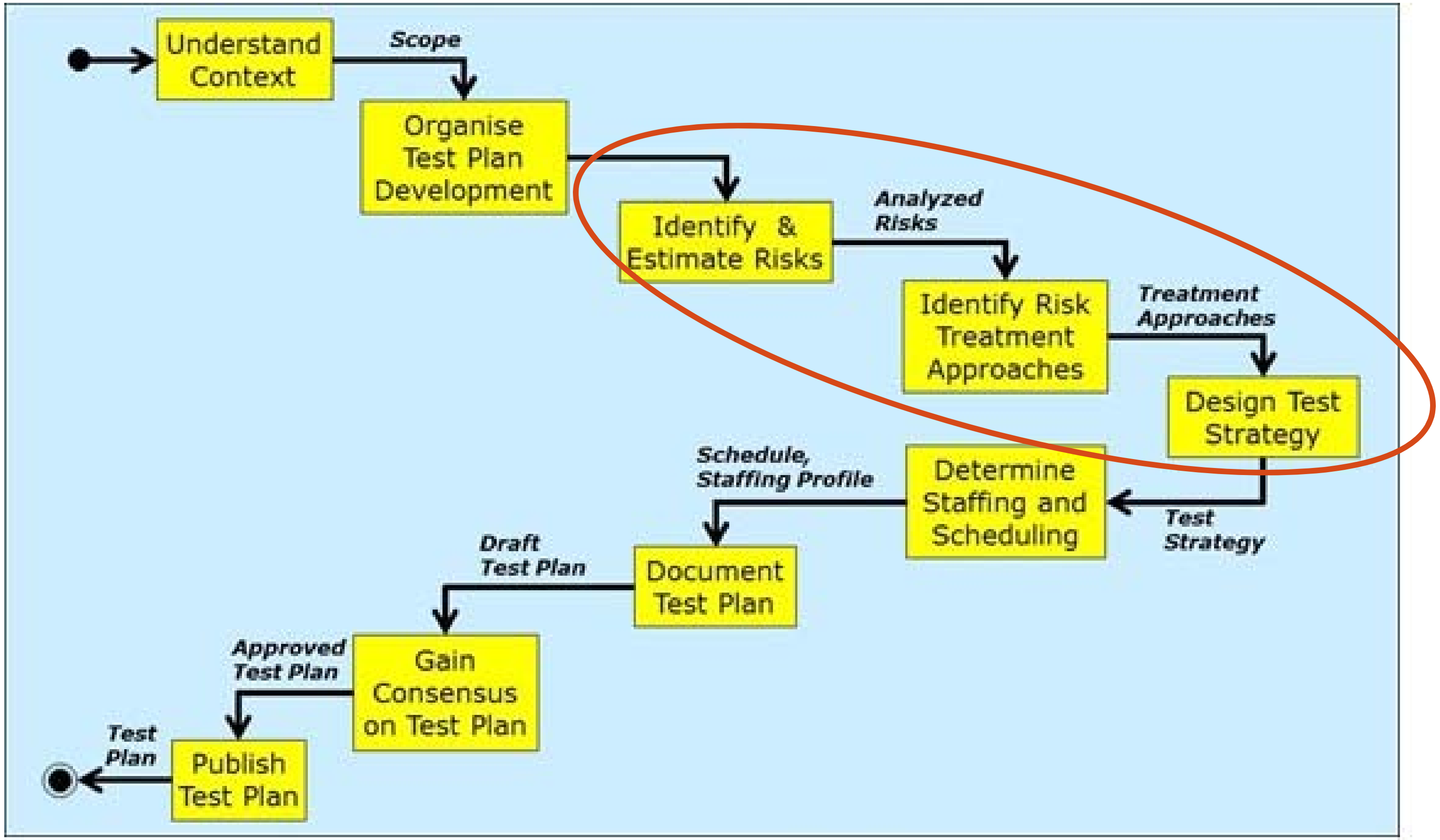
Test Analysis and Design

Test Implementation and Execution

Test Evaluation and Reporting

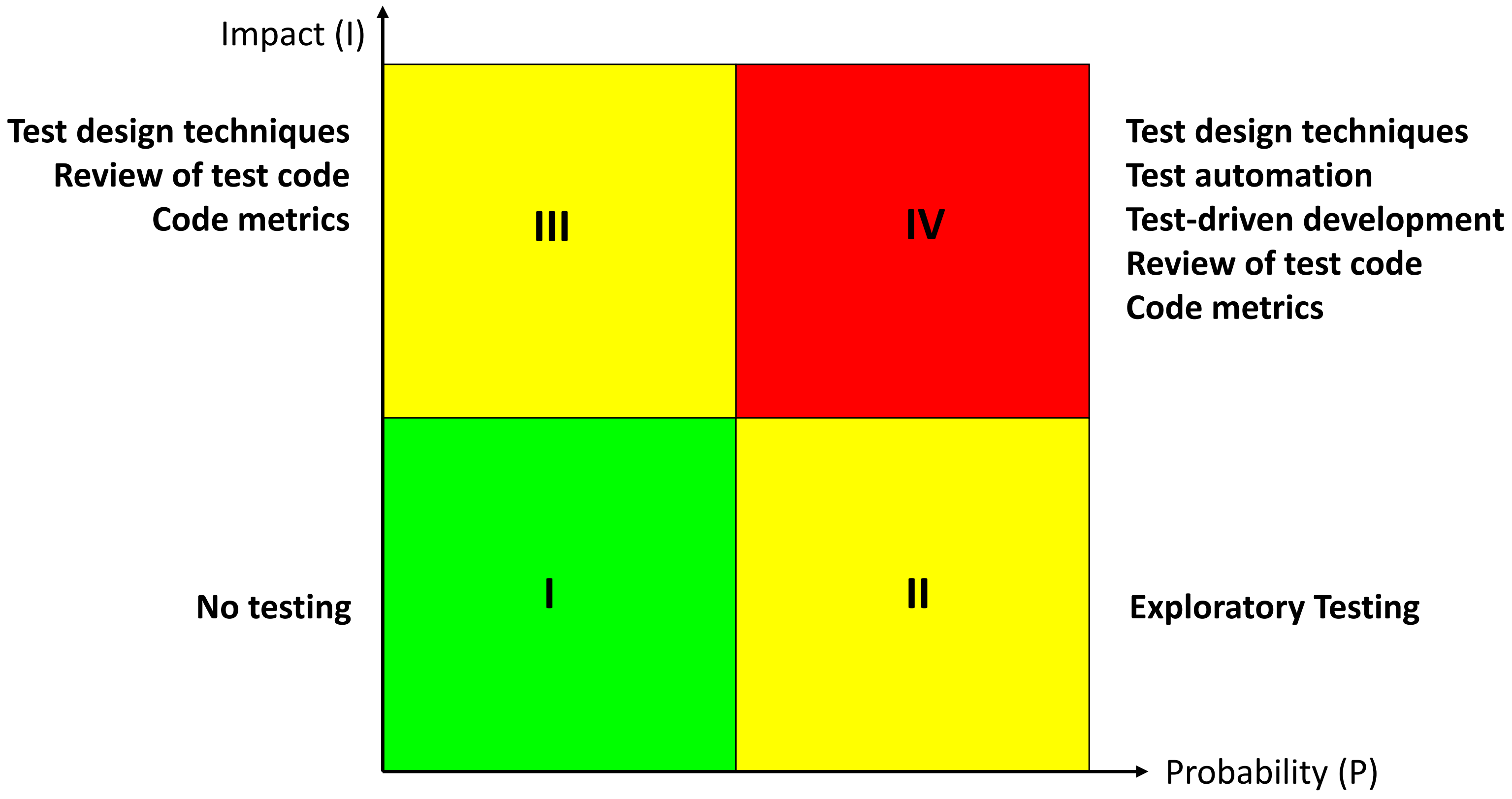
Test Closure Activities

# Compliance with Standards: ISO/IEC/IEEE 29119



Understand Context
Scope
Organise Test Plan Development
Identify & Estimate Risks
Analyzed Risks
Identify Risk Treatment Approaches
Treatment Approaches
Design Test Strategy
Test Strategy
Determine Staffing and Scheduling
Schedule, Staffing Profile
Document Test Plan
Draft Test Plan
Gain Consensus on Test Plan
Approved Test Plan
Publish Test Plan
Test Plan

# Decision Support: Risk-Based Test Strategy



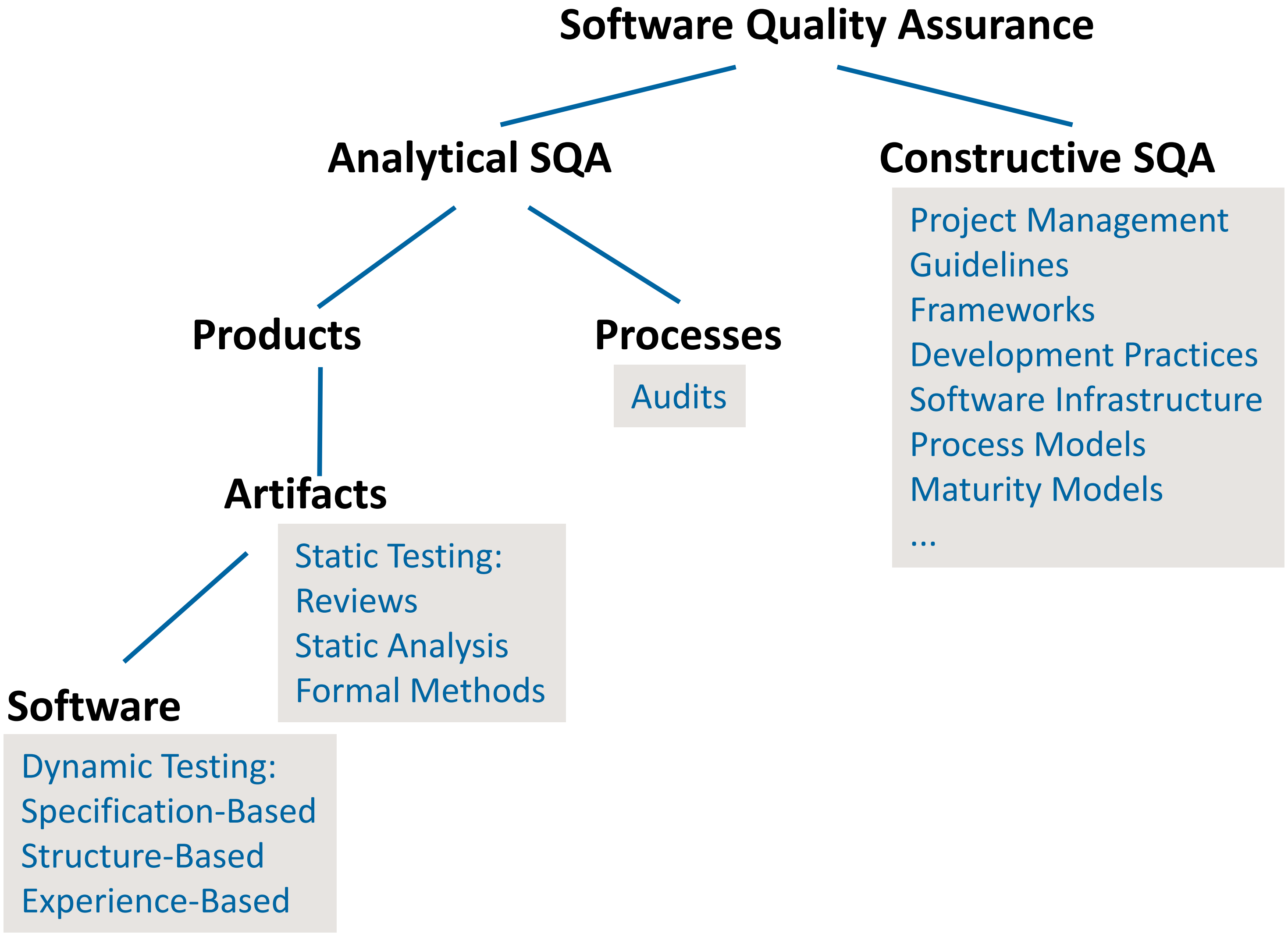
Test design techniques
Review of test code
Code metrics

Test design techniques
Test automation
Test-driven development
Review of test code
Code metrics

No testing

Exploratory Testing

# Software Quality Assurance (SQA)



Software Quality Assurance

Analytical SQA

Constructive SQA

Project Management
Guidelines
Frameworks
Development Practices
Software Infrastructure
Process Models
Maturity Models
...

Products

Processes

Audits

Artifacts

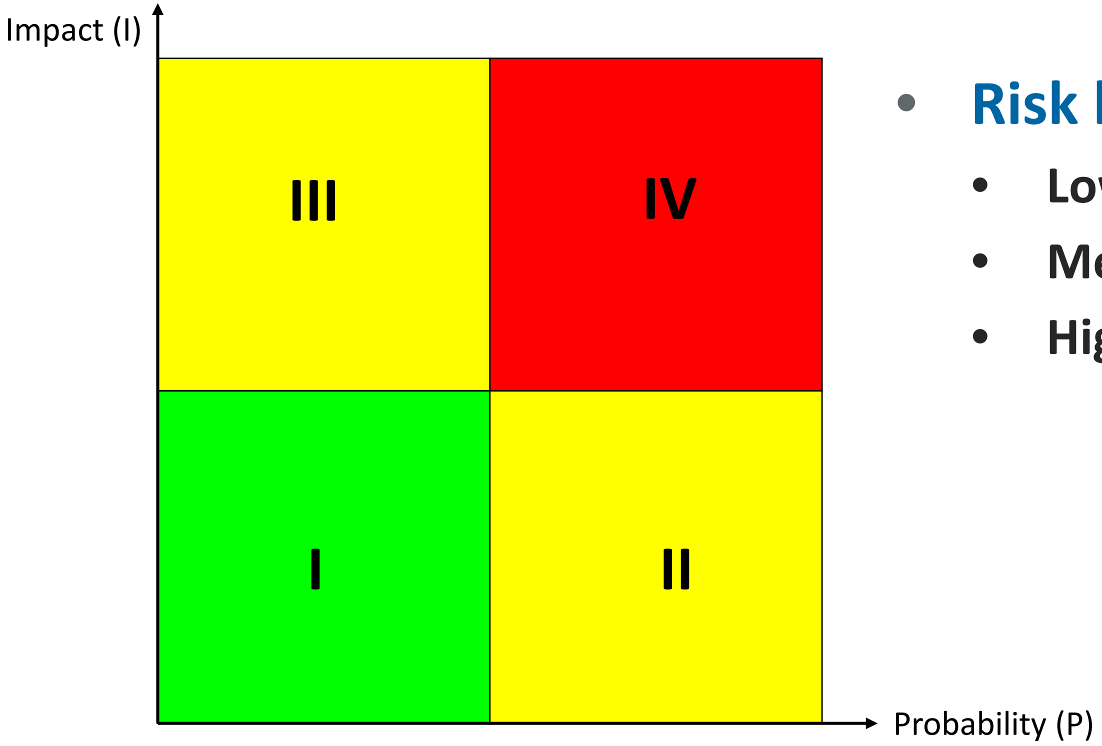
Static Testing:
Reviews
Static Analysis
Formal Methods

Software

Dynamic Testing:
Specification-Based
Structure-Based
Experience-Based

# Risk Definition

- A factor that could result in **future negative consequences**; usually expressed as **impact** and **probability**



- **Risk levels as 2x2 matrix**
  - **Low Risk: I**
  - **Medium Risk: II, IV**
  - **High Risk: III**

# Business Risk

- **Strategic Risk**
  - associated with the operations of that particular industry
- **Financial Risk**
  - associated with the financial structure and transactions of industry
- **Operational Risk**
  - associated with the operational and administrative procedures of the particular industry which are very common in today's generation
- **Compliance Risk (Legal Risk)**
  - associated with need to comply with rules and government regulations
- **Other Risks**
  - different risks like natural disaster (floods) and others depend upon the nature and scale of the industry

# Software Risk

- Factor that **could result in future negative** software related **consequences**
  - typically determined by the **probability** of its occurrence and its **impact**

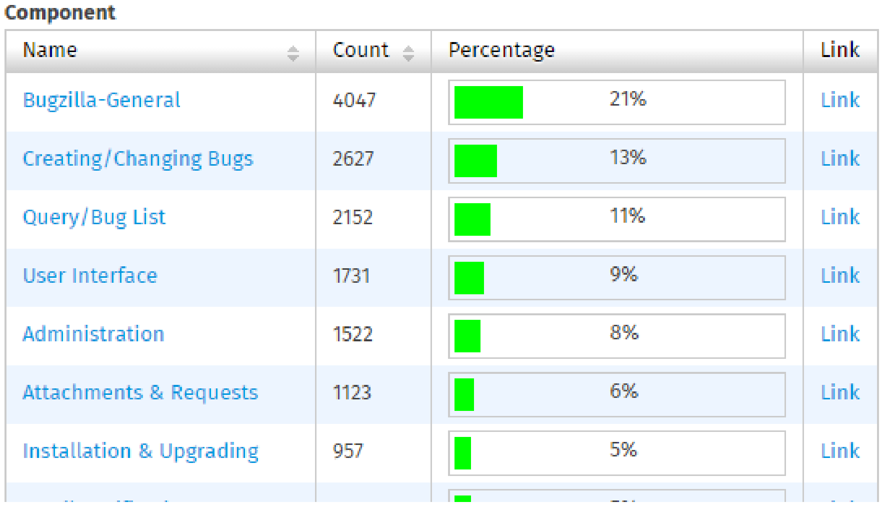
- **Product Risk**
  - Risk directly related to **product** or **test object**, e.g. deployment of software with severe faults, low security, low usability, low performance, low data quality, missing functionality
- **Project Risk**
  - Risk related to **management and control of the (test) project**, e.g. lack of staffing, strict deadlines, changing requirements

# Product Quality and Risk

- Product quality and risk may be considered as **two different sides of the same coin**
- **Product Quality**
  - degree to which a product satisfies the stated and implied needs of its various stakeholders and thus provides value to the enterprise
- **Product Risk**
  - degree to which a product does not satisfy the stated and implied needs of its various stakeholders and thus represents potential damages and losses to the enterprise

# Probability and Impact

- *Probability values* – express the **likelihood of defectiveness** of a risk item
  - i.e., the likelihood that a **fault exists in a specific product component** due to an error in a previous development phase that may lead to a failure



**Component**

| Name | Count | Percentage | Link |
|---|---|---|---|
| Bugzilla-General | 4047 | 21% | Link |
| Creating/Changing Bugs | 2627 | 13% | Link |
| Query/Bug List | 2152 | 11% | Link |
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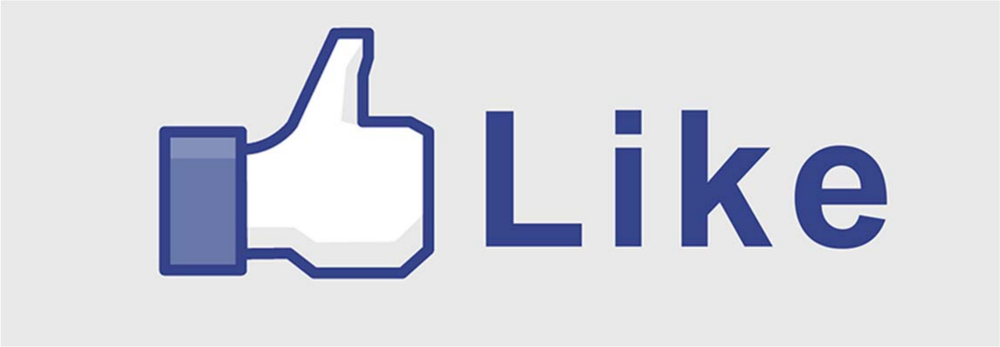
# Probability and Impact

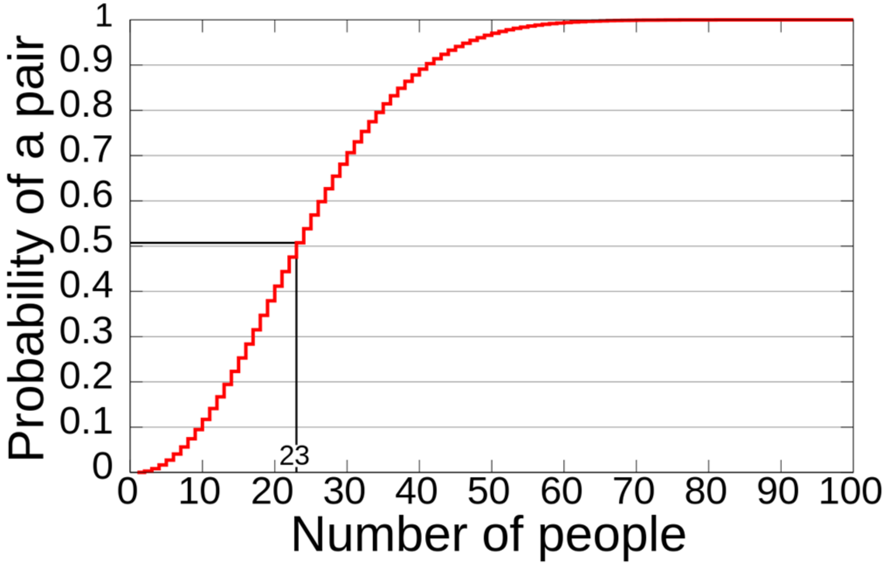
- *Impact values* – express the **consequences of risk items** being defective
  - i.e., the **negative effect** that a defect in a specific component has on the user or customer and, ultimately, on the company's **business success**



# Example: Probability Estimation

*How high is the probability that two people in this room have the same birthday?*

$$P(n) = 1 - \frac{365 \cdot 364 \cdots (365 - (n-1))}{365^n}$$



Probability estimation can be counter-intuitive. Try to count or compute!

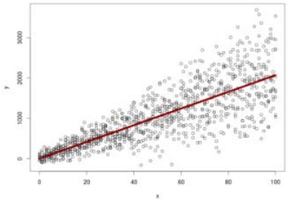
# Insights from Software Estimation

- **Count if at all possible**

  If you can count the answer directly, you should do that first. That approach produces the most accurate answer.

- **Compute when you can’t count**

  If you can’t count the answer directly, you should count something else and then compute the answer by using some sort of calibration data.



- **Seek judgment as a last resort**

  Forecasting with estimation and prediction techniques

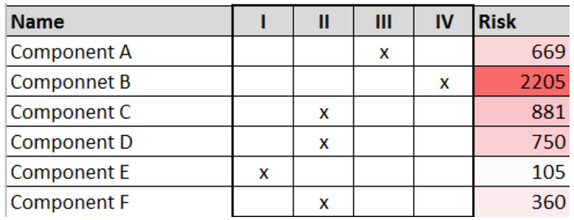
  Use range estimates (three-points: best-case, most likely, worst-case)

  Incorporate opinions of a range of different experts to improve estimation results

# Types of Risk Assessment

- **Implicit** risk assessment without explicit risk values or levels
  - **Subjective** view of each tester
  - **Objective** view common between testers

- **Explicit** risk assessment
  - **Qualitative** assessment by listing and prioritizing risks
  - **Quantitative** assessment by explicitly calculating risks



| Name | I | II | III | IV | Risk |
|---|---|---|---|---|---|
| Component A | | | x | | 669 |
| Componnet B | | | | x | 2205 |
| Component C | | x | | | 881 |
| Component D | | x | | | 750 |
| Component E | x | | | | 105 |
| Component F | | x | | | 360 |

# TED – How are Risks Defined?

TED

- In which phases/activities do you use risks?
- How do you define risks?

→ http://mfelderer.at/profes16rbt

- TED-3 Used Risks

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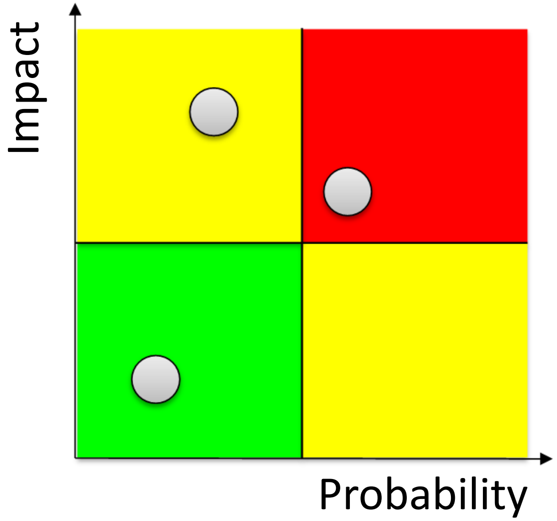
# Risk Analysis and Evaluation

Cost and **ratings**



What is the impact
if a failure occurs?

What is the probability
a failure will occur?

Counted or predicted **defect data**

# Possible Benefits of Risk-Based Testing

- **Improved efficiency**
  - Reduce testing time
  - Reduce testing budget
  - Earlier release date
- **Improved test effectiveness**
  - Detection of additional defects
  - Early detection of critical defects
  - Increased defect detection rate of single tests
- **Management support**
  - Improvement of decisions and processes
  - Fulfillment of industry standards and organizational regulations

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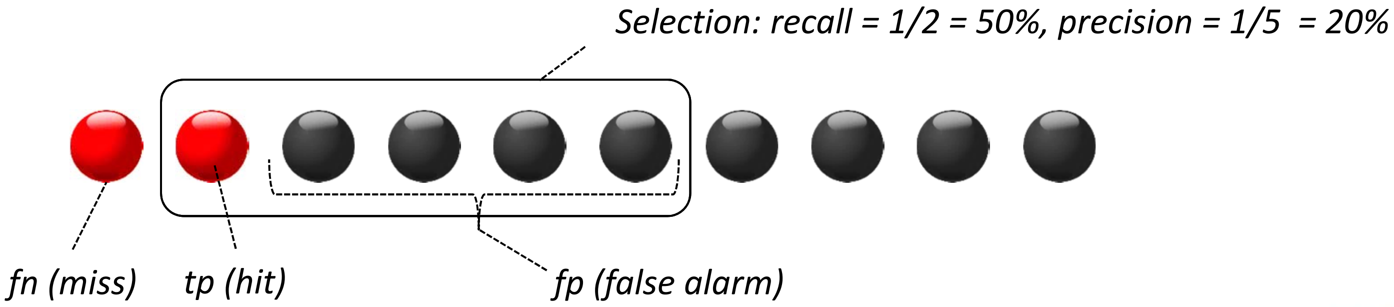
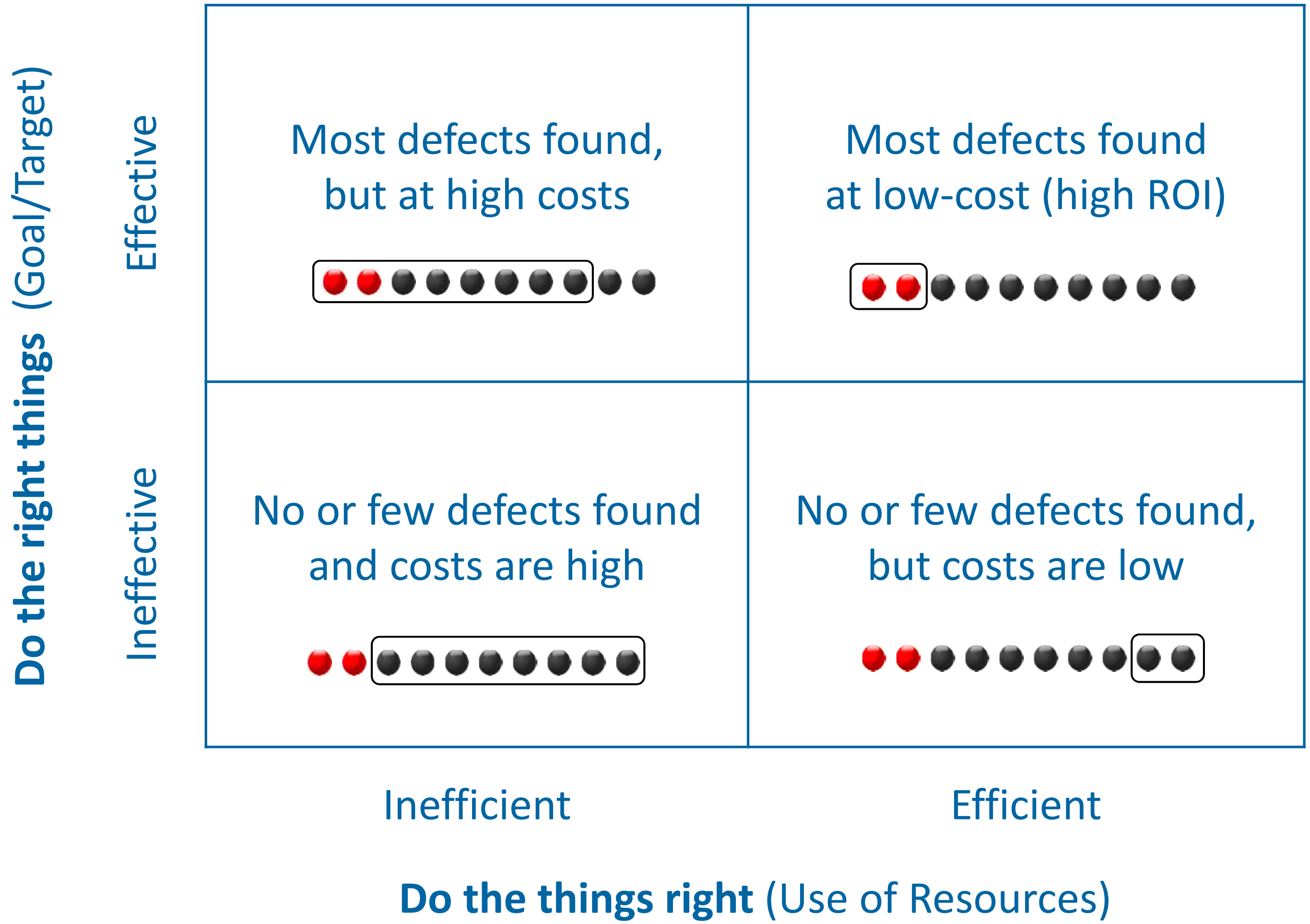
# Effectiveness and Efficiency in Software Testing

- Effectiveness | *Recall = tp / (tp + fn)*
  - How many defects out of all defects have been found?
  - Goal: Finding more defects, earlier, critical ones ...

- Efficiency | *Precision = tp / (tp + fp)*
  - How many of the executed tests actually revealed defects?
  - Goal: Reduce time of testing, cost, ...



# Effectiveness and Efficiency in Software Testing



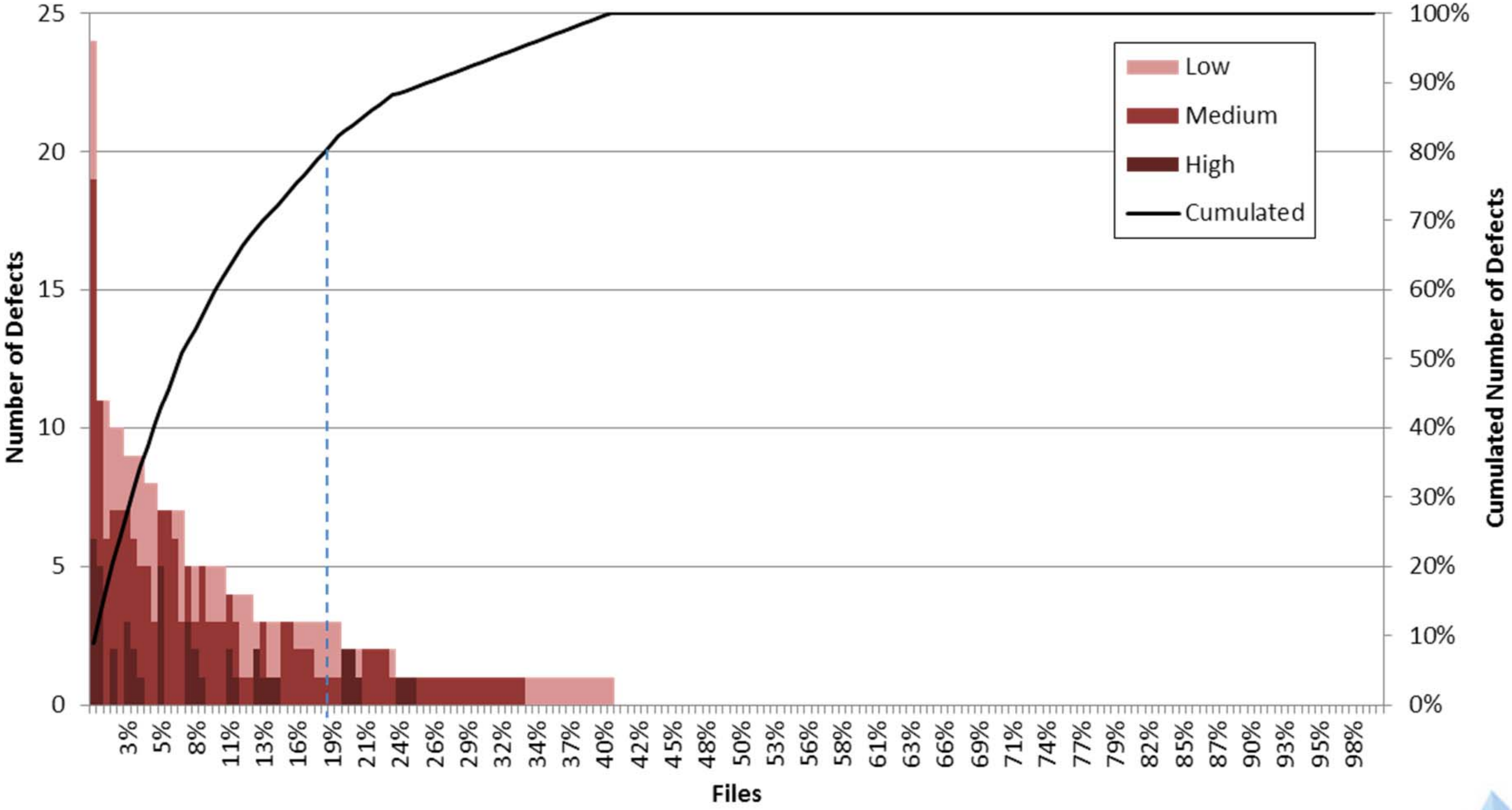
**Do the right things** (Goal/Target)

| | Inefficient | Efficient |
|---|---|---|
| Effective | Most defects found, but at high costs | Most defects found at low-cost (high ROI) |
| Ineffective | No or few defects found and costs are high | No or few defects found, but costs are low |

**Do the things right** (Use of Resources)

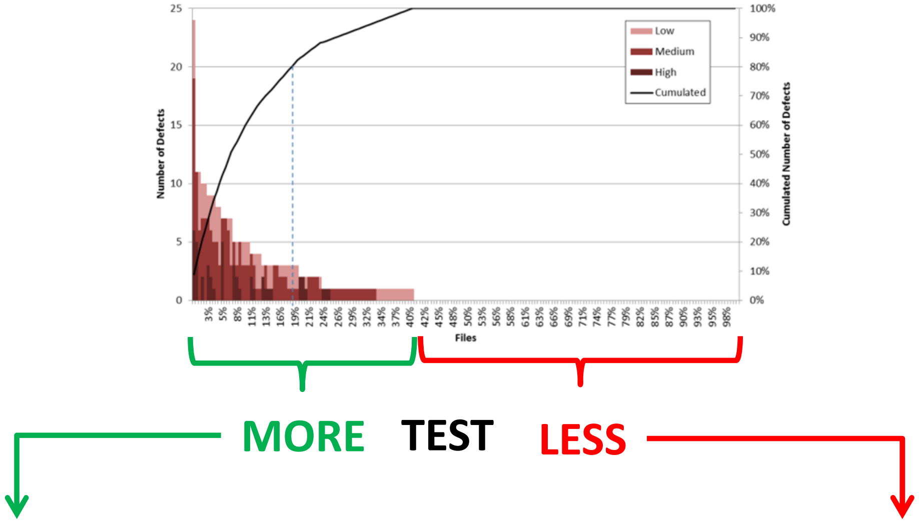
# Effectiveness and Efficiency in Software Testing

Inhomogeneous distribution of defects



# Effectiveness and Efficiency in Software Testing

## Inhomogeneous distribution of defects



MORE TEST LESS

### Effectiveness

- Finding more defects
- Finding defects earlier
- Finding the critical defects
- ...

### Efficiency

- Reduce time of testing
- Reduce cost of testing
- ...

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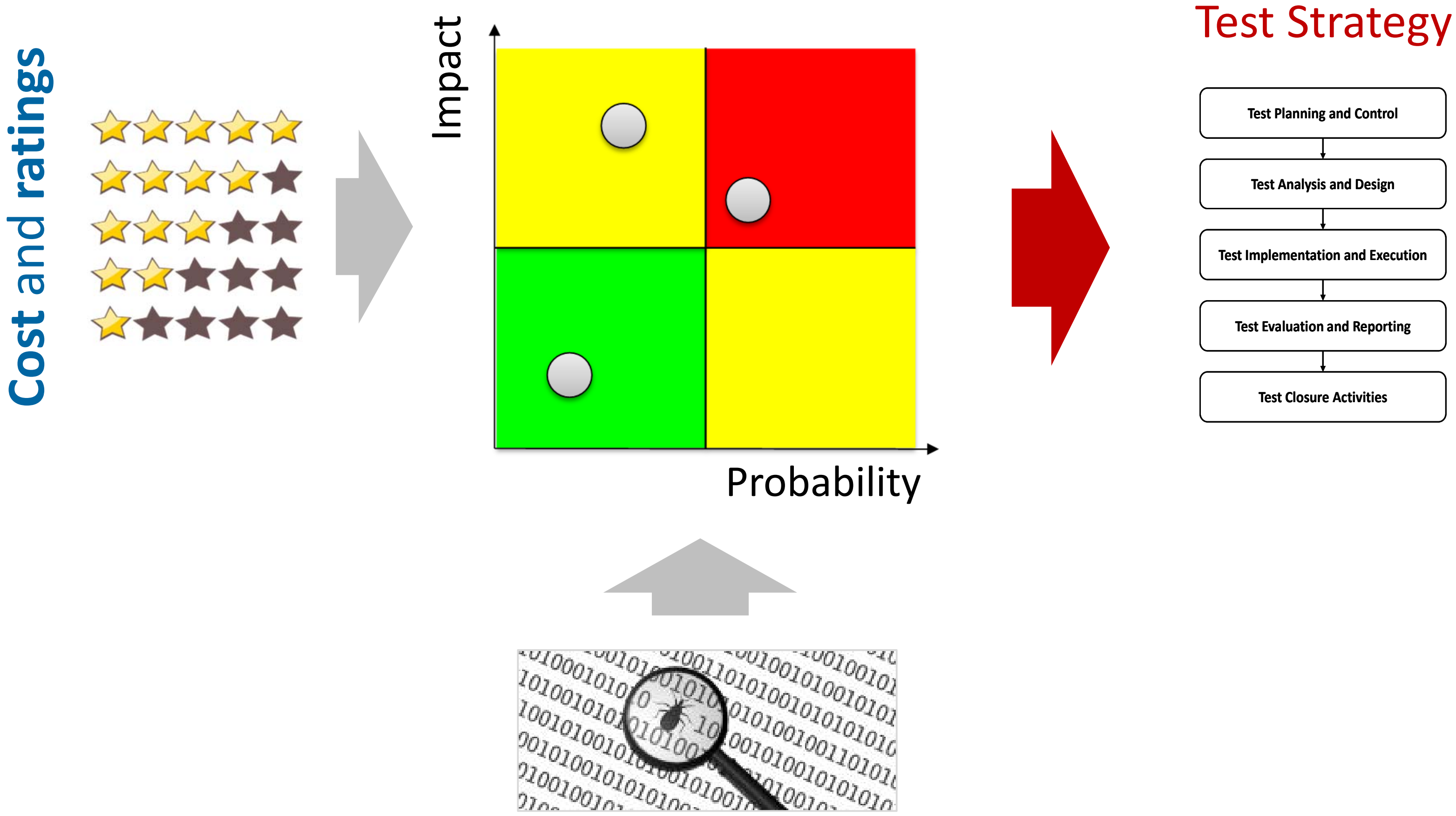
# Risk Analysis and Evaluation



**Cost and ratings**

Impact

Probability

Test Strategy

Test Planning and Control

Test Analysis and Design

Test Implementation and Execution

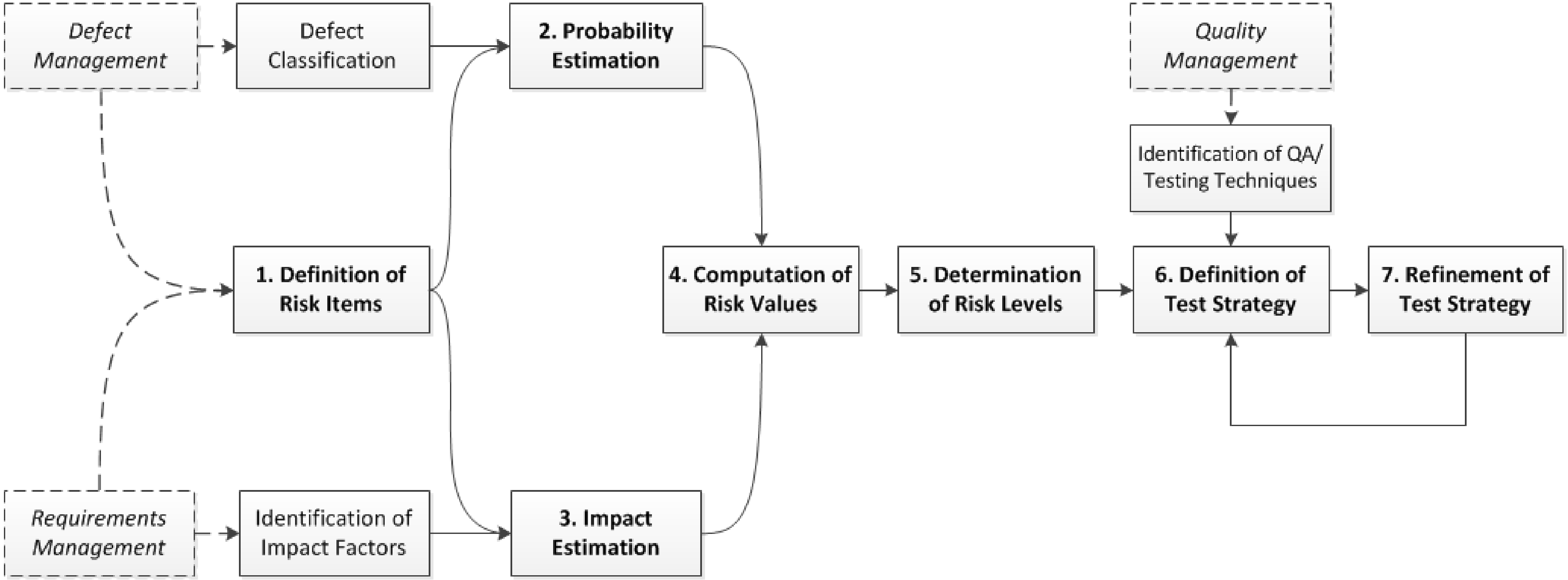
Test Evaluation and Reporting

Test Closure Activities

Counted or predicted **defect data**

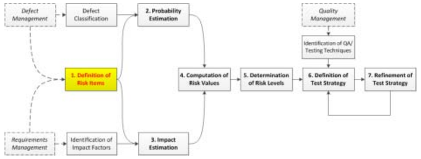
# Process for Risk-based Test Strategy Development

- Overview



*Defect Management*
Defect Classification
2. Probability Estimation
*Quality Management*
Identification of QA/ Testing Techniques
1. Definition of Risk Items
4. Computation of Risk Values
5. Determination of Risk Levels
6. Definition of Test Strategy
7. Refinement of Test Strategy
*Requirements Management*
Identification of Impact Factors
3. Impact Estimation

# 1. Definition of Risk Items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4. Computation of Risk Values
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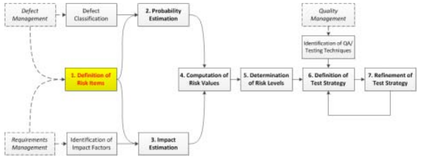
Quality Management
Identification of QA/ Testing Techniques
6. Definition of Test Strategy
7. Refinement of Test Strategy

- *Risk Item* – Basic elements of software product that can be associated with risks
  - Typically derived from **functional structure** of the product, but can also represent **non-functional aspects** or system properties
  - **Testable** objects such as sub-systems, features, components, modules or functional as well as non-functional requirements
- Possible sources of risk items: Bug tracking, requirements management, test management, ...
  - Items may have different types and granularity
  - Avoid hierarchical structures
  - Selected items should be tangible, testable objects

Reuse existing, well-established structures

- **Example:** Reuse *components* defined for bug tracking

# 1. Definition of Risk Items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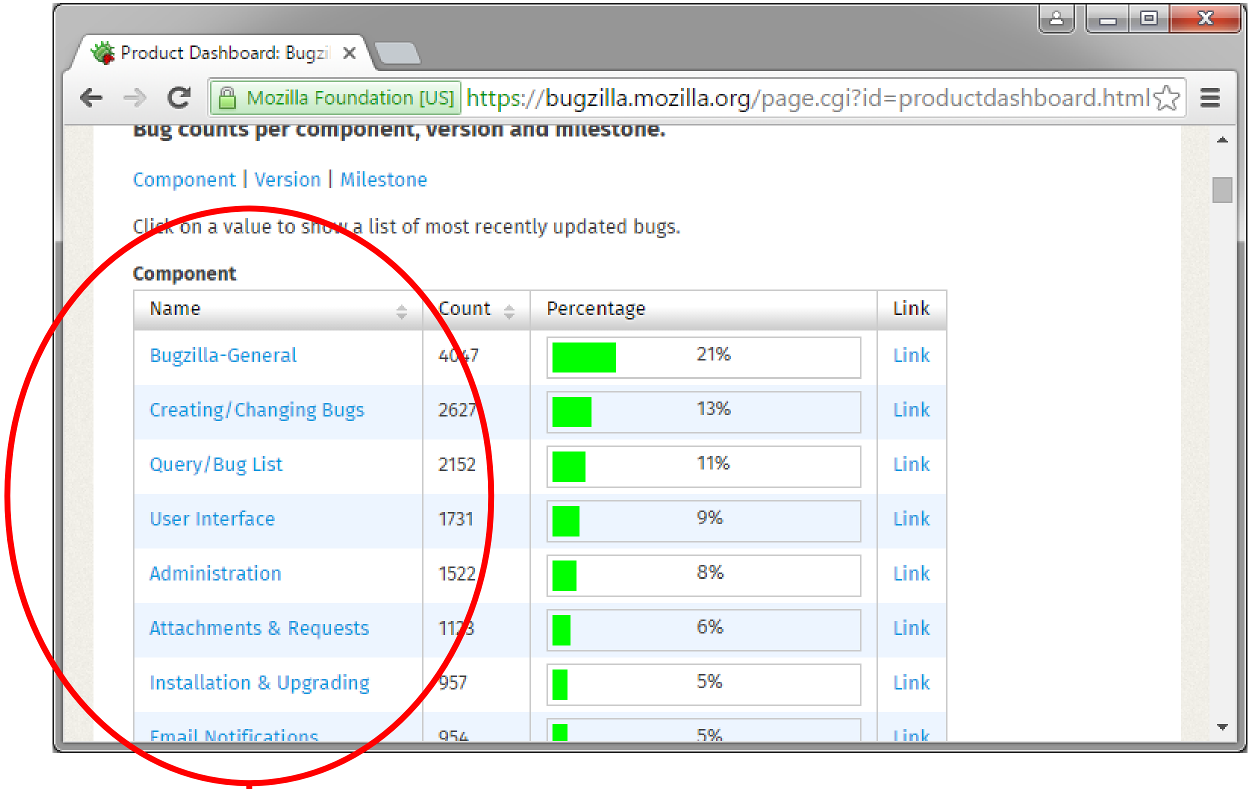
Product Dashboard: Bugzi
Mozilla Foundation [US]
https://bugzilla.mozilla.org/page.cgi?id=productdashboard.html

Bug counts per component, version and milestone.

Component | Version | Milestone

Click on a value to show a list of most recently updated bugs.

Component

| Name | Count | Percentage | Link |
|---|---|---|---|
| Bugzilla-General | 4047 | 21% | Link |
| Creating/Changing Bugs | 2627 | 13% | Link |
| Query/Bug List | 2152 | 11% | Link |
| User Interface | 1731 | 9% | Link |
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| Installation & Upgrading | 957 | 5% | Link |
| Email Notifications | 954 | 5% | Link |

use components from bug tracking as *risk items*

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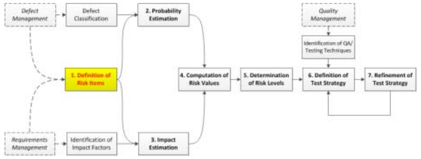
# 1. Definition of Risk Items

- Example using an Microsoft Excel template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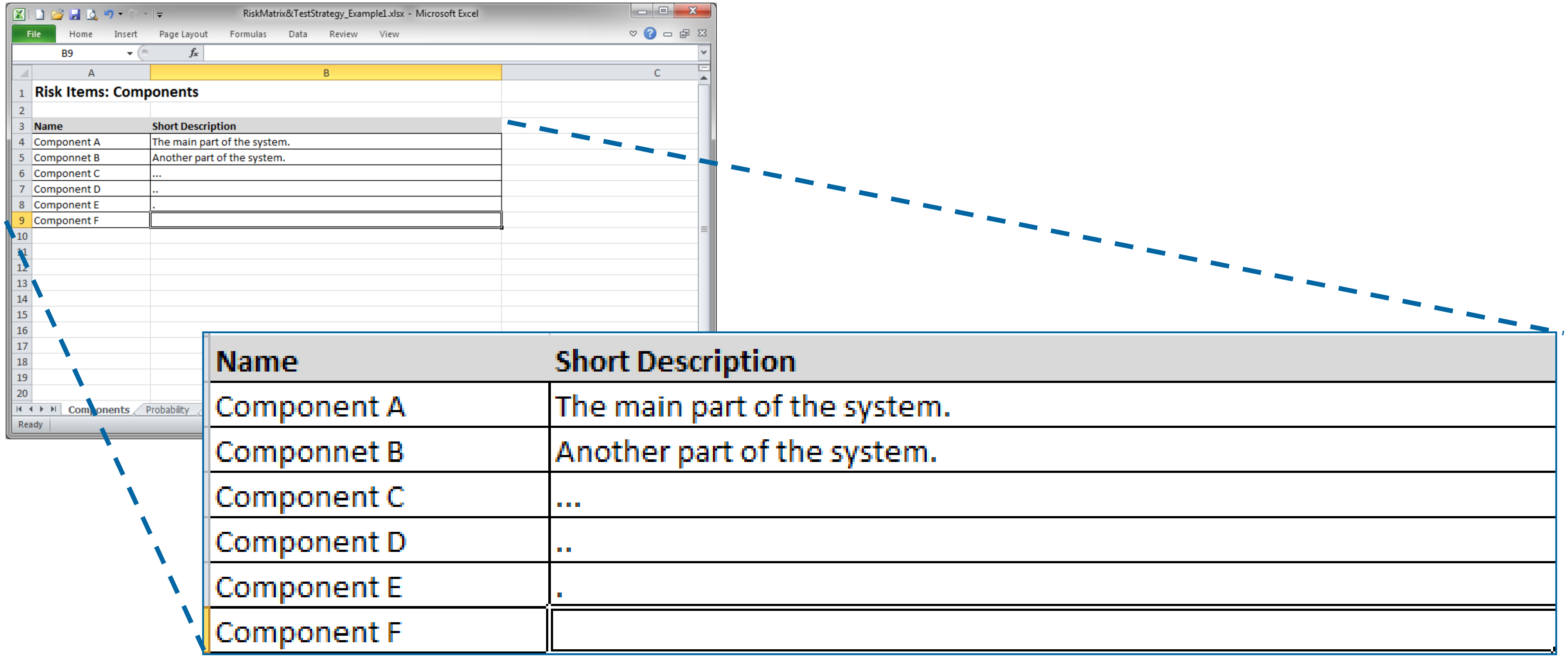

Risk Items: Components

| Name | Short Description |
|---|---|
| Component A | The main part of the system. |
| Componnet B | Another part of the system. |
| Component C | ... |
| Component D | .. |
| Component E | . |
| Component F | |

| Name | Short Description |
|---|---|
| Component A | The main part of the system. |
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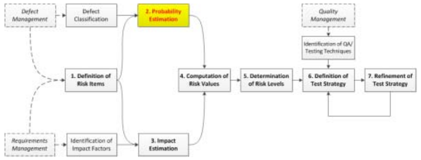
# TED – How do you track defects?

TED

→ http://mfelderer.at/profes16rbt

- TED-4 Defect Management

# 2. Probability Estimation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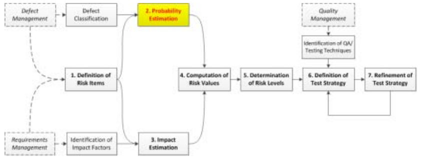
3. Impact Estimation

- *Probability* – likelihood of defectiveness of a risk item (e.g., fault exists in product component)
- Several ways to estimate probability
  - Guess, ask experts (e.g., developers), random, ...
  - Extrapolation from historical defect data
- Defect classification, defect prediction

Count if possible, compute when you can't count, guess as last resort

- **Example:** Bug data included the number of defects and the severity, aggregation to a final probability value by summing up *number of defects* weighted with Fibonacci numbers for *severity*

# 2. Probability Estimation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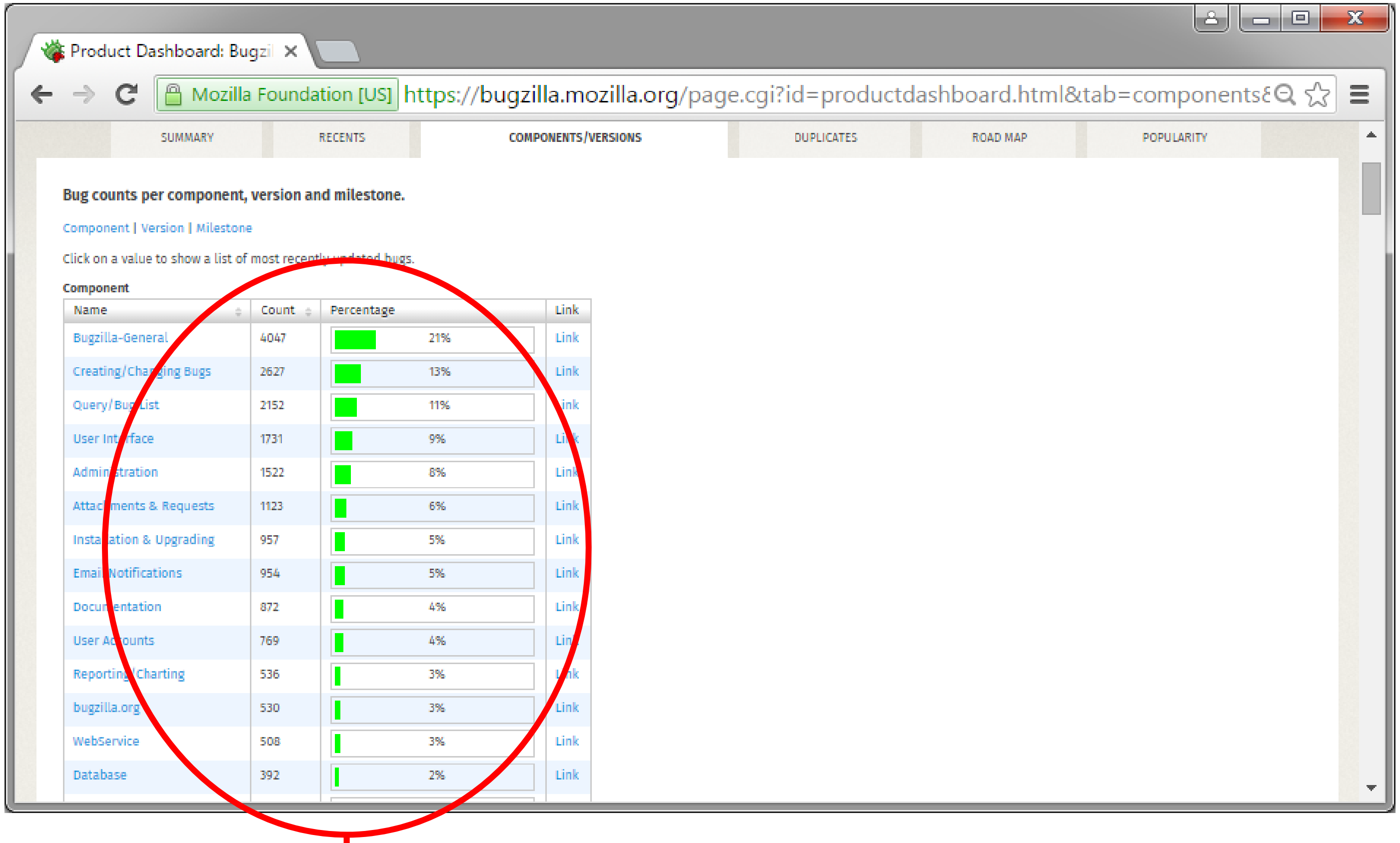

Bug counts per component, version and milestone.

Component | Version | Milestone

Click on a value to show a list of most recently updated bugs.

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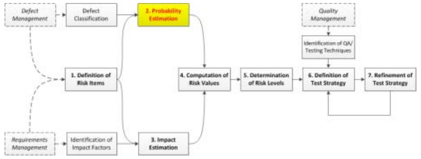
| Installation & Upgrading | 957 | 5% | Link |
| Email Notifications | 954 | 5% | Link |
| Documentation | 872 | 4% | Link |
| User Accounts | 769 | 4% | Link |
| Reporting/Charting | 536 | 3% | Link |
| bugzilla.org | 530 | 3% | Link |
| WebService | 508 | 3% | Link |
| Database | 392 | 2% | Link |

derive *probability* from bug counts

# 2. Probability Estimation

- Example using Excel template


Defect Management
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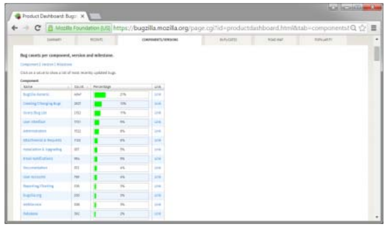
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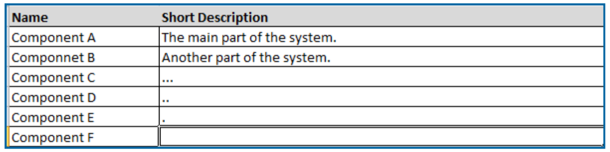
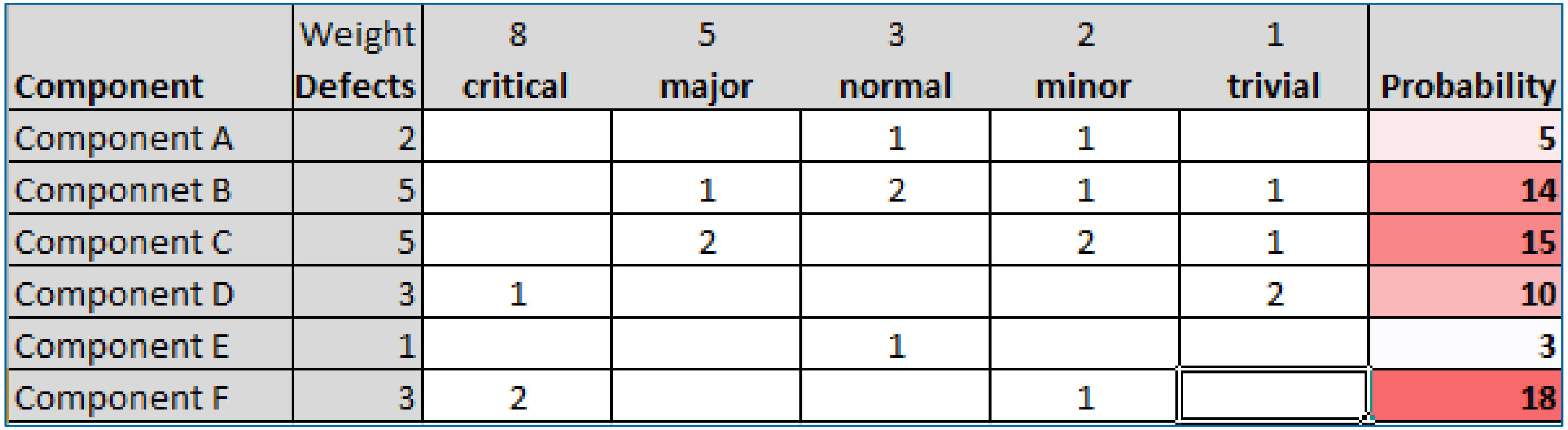
Mozilla Foundation (US)
https://bugzilla.mozilla.org/page.cgi?id=productdashboard.html&tab=components

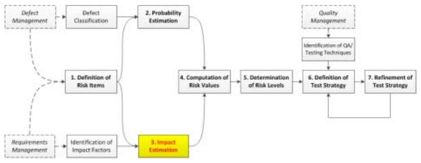


| Name | Short Description |
|---|---|
| Component A | The main part of the system. |
| Componnet B | Another part of the system. |
| Component C | ... |
| Component D | .. |
| Component E | . |
| Component F | |



| | Weight | 8 | 5 | 3 | 2 | 1 | |
|---|---|---|---|---|---|---|---|
| **Component** | **Defects** | **critical** | **major** | **normal** | **minor** | **trivial** | **Probability** |
| Component A | 2 | | | 1 | 1 | | **5** |
| Componnet B | 5 | | 1 | 2 | 1 | 1 | **14** |
| Component C | 5 | | 2 | | 2 | 1 | **15** |
| Component D | 3 | 1 | | | | 2 | **10** |
| Component E | 1 | | | 1 | | | **3** |
| Component F | 3 | 2 | | | 1 | | **18** |

# 3. Impact Estimation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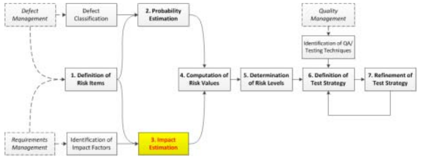
- *Impact Value* – Expresses the consequences of risk items being defective (negative effect on user or customer and, ultimately, on the company's business success)
- Impact is related to
  - Expected value of the item for the user/customer (as elicited in requirements engineering)
  - Number of affected users/customers
  - Cost of failures (internal and external failure cost)

Determine impact factors using a fishbone diagram

- **Example:** business values associated with requirements
  - Use requirements prioritization techniques for estimating impact value
  - Derive the impact values from license revenues (if software components are licensed individually)

# 3. Impact Estimation (from Cost of Quality)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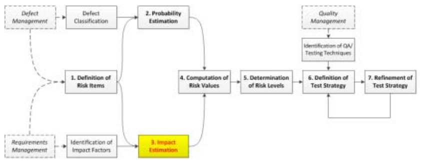
- **Internal failure costs –** to remedy defects discovered before the product is delivered to the customer
  - **Waste:** unnecessary extra work (e.g., meetings, defect tracking)
  - **Scrap:** useless code in defective components
  - **Rework and/or rectification:** correction of defective components
  - **Failure analysis:** effort required to find the root causes of failure

- **External failure costs** – to remedy defects discovered by users and/or customers in the field
  - **Repairs and servicing:** creating hotfix, updates of systems in the field
  - **Warranty claims:** services that are re-performed under a guarantee
  - **Complaints:** service hotline handling customer complaints
  - **Returns:** handling rejected or recalled products

# 3. Impact Estimation

- Example using Excel template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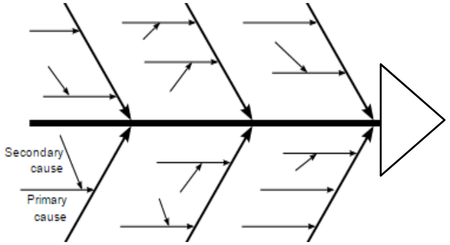

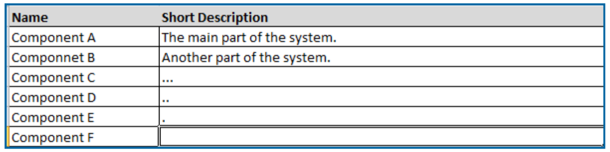

| Name | Short Description |
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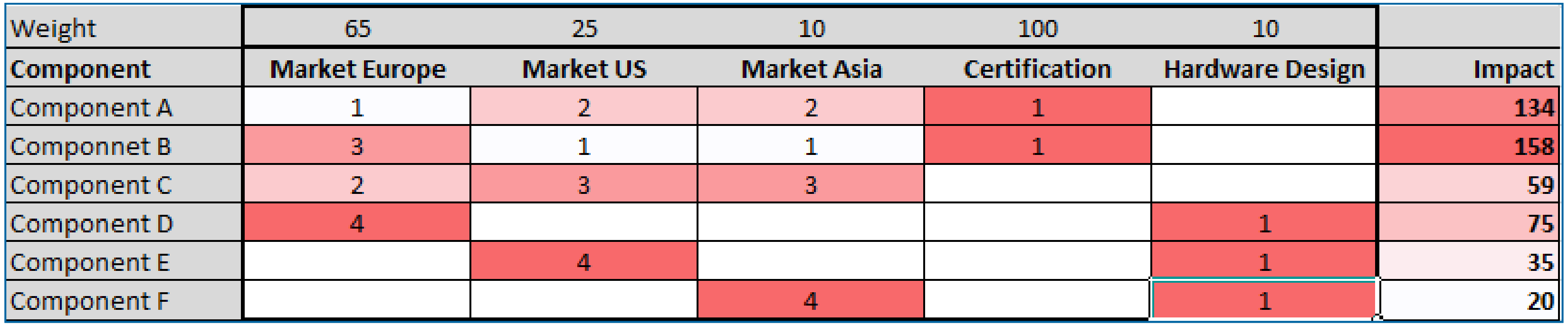
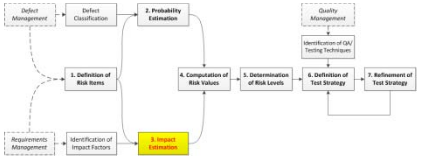


| Weight | 65 | 25 | 10 | 100 | 10 |  |
|---|---|---|---|---|---|---|
| **Component** | **Market Europe** | **Market US** | **Market Asia** | **Certification** | **Hardware Design** | **Impact** |
| Component A | 1 | 2 | 2 | 1 |  | 134 |
| Componnet B | 3 | 1 | 1 | 1 |  | 158 |
| Component C | 2 | 3 | 3 |  |  | 59 |
| Component D | 4 |  |  |  | 1 | 75 |
| Component E |  | 4 |  |  | 1 | 35 |
| Component F |  |  | 4 |  | 1 | 20 |

# 3. Impact Estimation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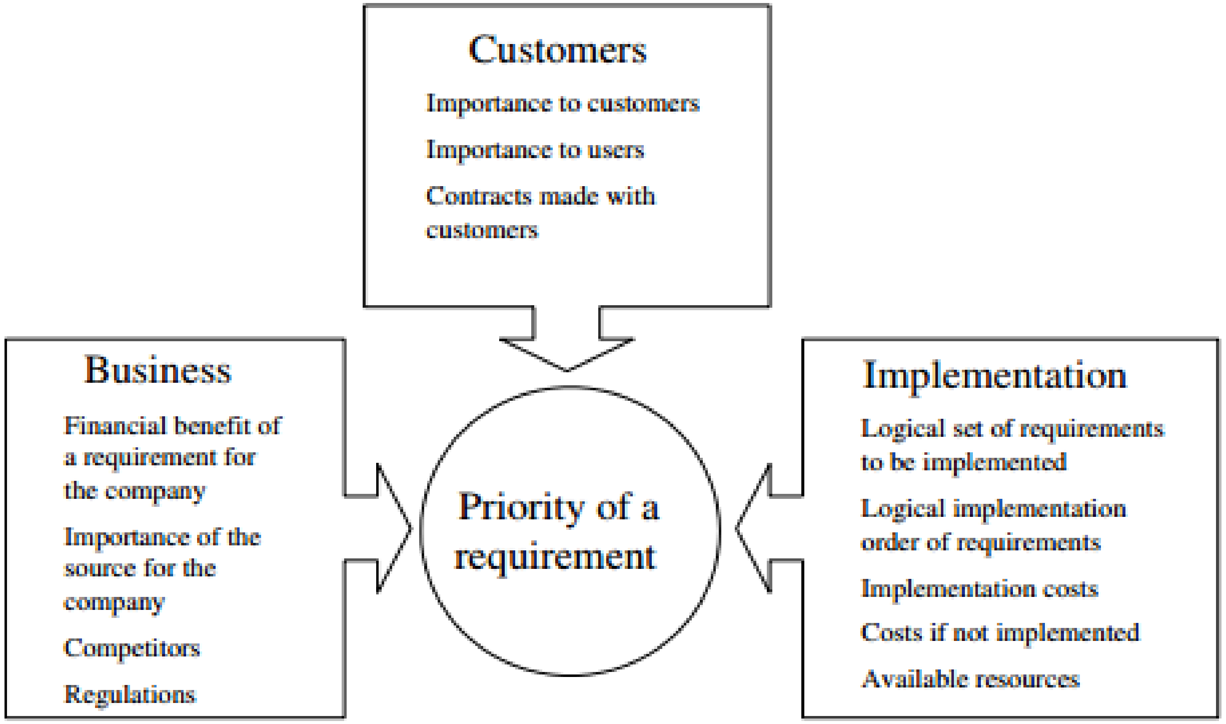
- Three points of views having an effect on requirement's priorities



Customers

Importance to customers

Importance to users

Contracts made with customers

Business

Financial benefit of a requirement for the company

Importance of the source for the company

Competitors

Regulations

Priority of a requirement

Implementation

Logical set of requirements to be implemented

Logical implementation order of requirements

Implementation costs

Costs if not implemented

Available resources

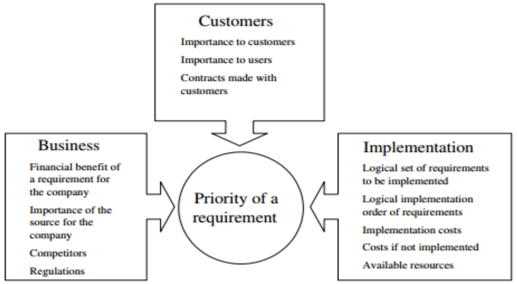
Lehtola L., et al.: Requirements prioritization challenges in practice. PROFES 2004

# TED – What are your impact factors?

TED

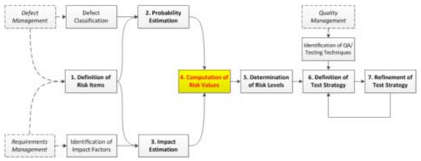
→ http://mfelderer.at/profes16rbt

- TED-5 Impact Factors



Customers
Importance to customers
Importance to users
Contracts made with customers
Business
Financial benefit of a requirement for the company
Importance of the source for the company
Competitors
Regulations
Priority of a requirement
Implementation
Logical set of requirements to be implemented
Logical implementation order of requirements
Implementation costs
Costs if not implemented
Available resources

# 4. Computation of Risk Values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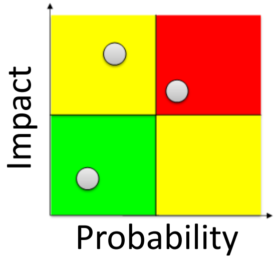
- *Risk Values* – Computed from the estimated probability and impact values according to the definition of risk as $R = P \times I$
- Aggregating probability and impact to a single risk value allows
  - Prioritization of the risk items according to risk values or ranks
  - Grouping of risk items (e.g., high, medium and low risk)

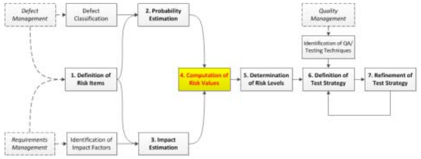
Show *P* and *I* as two separate dimensions

- **Example:** Aggregated risk value was computed by *Probability* times *Impact* and classifying the risk items in high/medium/low. In addition, risk items were shown in a bubble chart (matrix).



# 4. Computation of Risk Values

- Example using Excel template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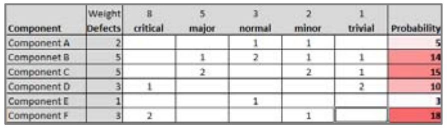
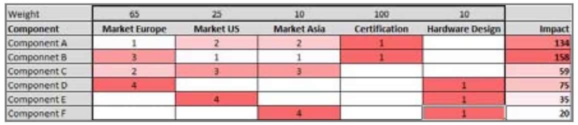
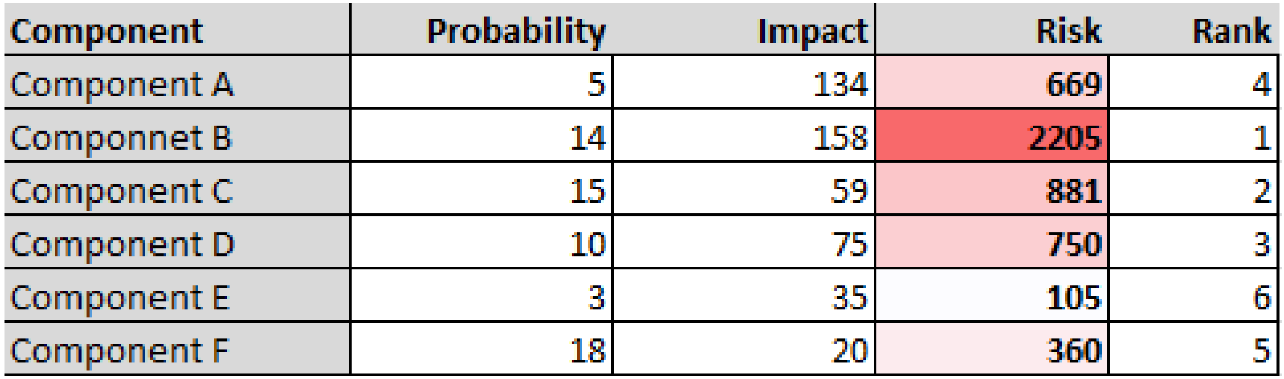


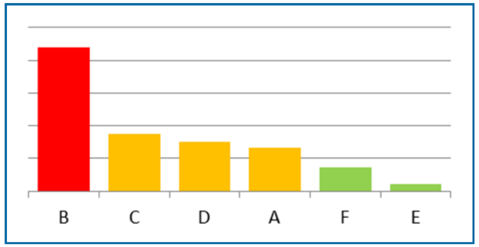
| | Weight | 8 | 5 | 3 | 2 | 1 | |
|---|---|---|---|---|---|---|---|
| Component | Defects | critical | major | normal | minor | trivial | Probability |
| Component A | 2 | | | 1 | 1 | | 5 |
| Componnet B | 5 | | 1 | 2 | 1 | 1 | 14 |
| Component C | 5 | | 2 | | 2 | 1 | 15 |
| Component D | 3 | 1 | | | | 2 | 10 |
| Component E | 1 | | | 1 | | | 3 |
| Component F | 3 | 2 | | | 1 | | 18 |



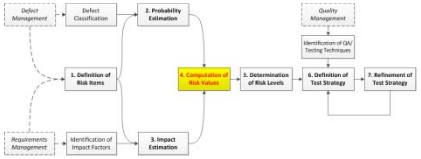
| Weight | 65 | 25 | 10 | 100 | 10 | |
|---|---|---|---|---|---|---|
| Component | Market Europe | Market US | Market Asia | Certification | Hardware Design | Impact |
| Component A | 1 | 2 | 2 | 1 | | 134 |
| Componnet B | 3 | 1 | 1 | 1 | | 158 |
| Component C | 2 | 3 | 3 | | | 59 |
| Component D | 4 | | | | 1 | 75 |
| Component E | | 4 | | | 1 | 35 |
| Component F | | | 4 | | 1 | 20 |



| Component | Probability | Impact | Risk | Rank |
|---|---|---|---|---|
| Component A | 5 | 134 | 669 | 4 |
| Componnet B | 14 | 158 | 2205 | 1 |
| Component C | 15 | 59 | 881 | 2 |
| Component D | 10 | 75 | 750 | 3 |
| Component E | 3 | 35 | 105 | 6 |
| Component F | 18 | 20 | 360 | 5 |



# 4. Computation of Risk Values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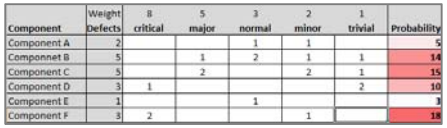
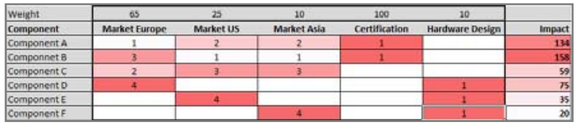
- Example using Excel template



| Component | Weight<br>Defects | 8<br>critical | 5<br>major | 3<br>normal | 2<br>minor | 1<br>trivial | Probability |
|---|---|---|---|---|---|---|---|
| Component A | 2 | | | 1 | 1 | | 5 |
| Componnet B | 5 | | 1 | 2 | 1 | 1 | 14 |
| Component C | 5 | | 2 | | 2 | 1 | 15 |
| Component D | 3 | 1 | | | | 2 | 10 |
| Component E | 1 | | | 1 | | | 3 |
| Component F | 3 | 2 | | | 1 | | 18 |



| Weight | 65 | 25 | 10 | 100 | 10 | |
|---|---|---|---|---|---|---|
| Component | Market Europe | Market US | Market Asia | Certification | Hardware Design | Impact |
| Component A | 1 | 2 | 2 | 1 | | 134 |
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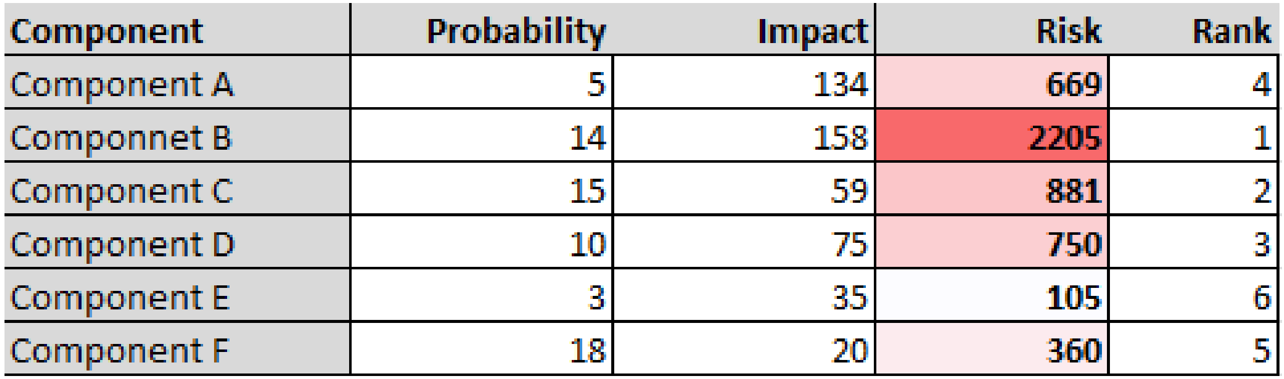

| Component | Probability | Impact | Risk | Rank |
|---|---|---|---|---|
| Component A | 5 | 134 | 669 | 4 |
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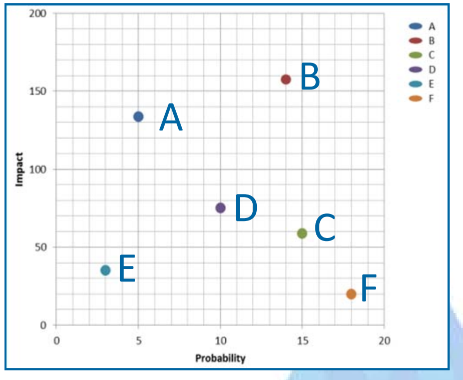
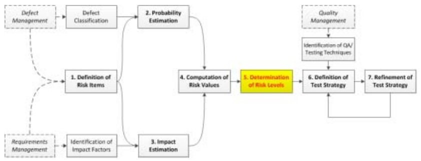
| Component F | 18 | 20 | 360 | 5 |



# 5. Determination of Risk Levels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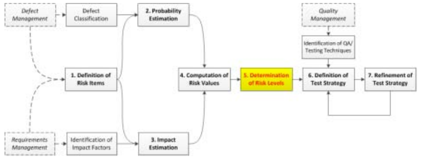
- *Risk Levels* – define classes of risks such that all risk items associated to a class are considered equally risky. Risk items of the same class are subject to the same intensity of QA and testing.
  - *Probability* and *Impact* are treated as two different dimensions
  - Risk matrix supports visual definition of risk levels by clustering risk items
  - Conducted as a manual step used to review and adjust the initially classification from computation

Individual discussion of *special cases* (e.g., risk items located close to the border of risk levels)

- **Example:** 2 × 2 risk matrix correspond to four risk levels (*level I* = low probability and low impact, *level IV* = high probability and high impact)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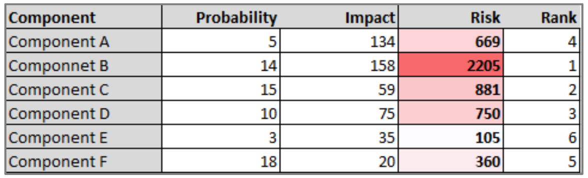
# 4. Computation of Risk Values

- Example using Excel



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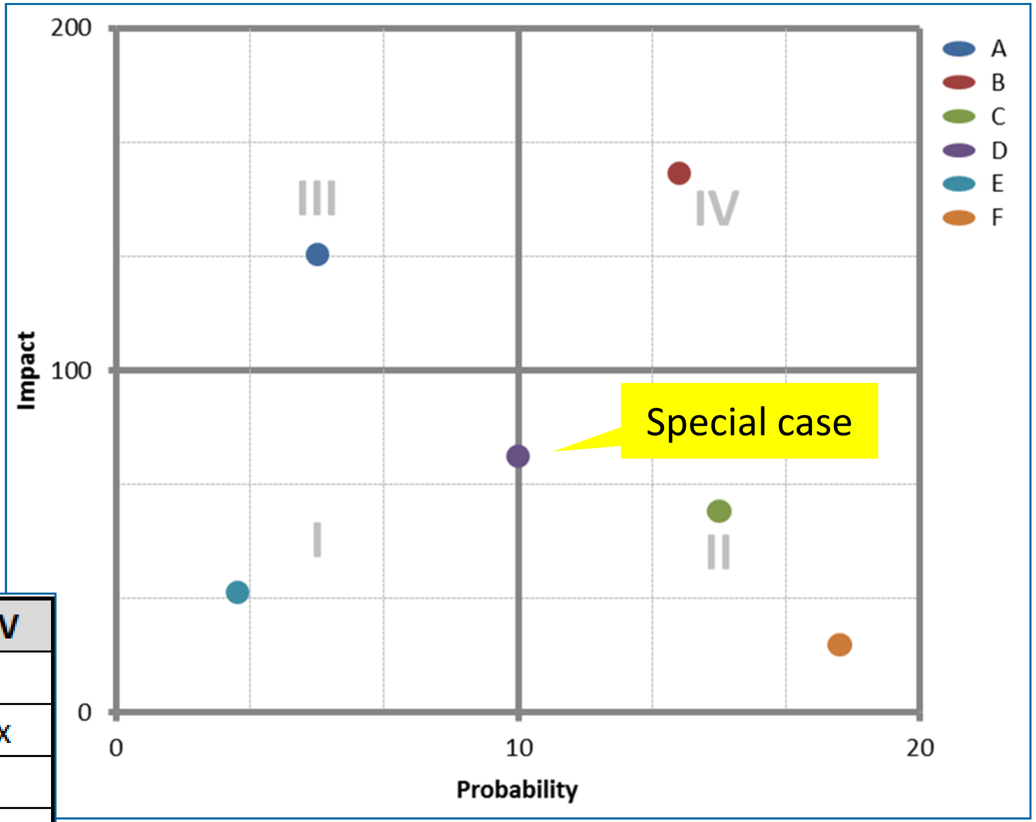
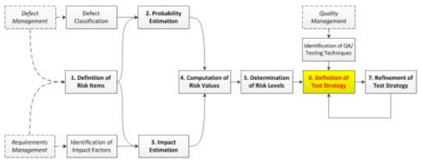


Special case

| Name | I | II | III | IV |
|---|---|---|---|---|
| Component A | | | x | |
| Componnet B | | | | x |
| Component C | | x | | |
| Component D | | x | | |
| Component E | x | | | |
| Component F | | x | | |

# 6. Definition of Test Strategy



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7. Refinement of Test Strategy

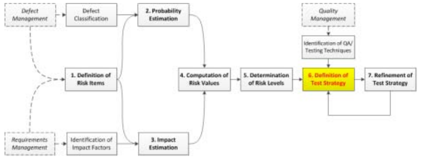
- *Test Strategy* – describes how testing is organized and performed on each risk level, i.e., with different rigorousness
  - by applying specific testing techniques (e.g., unit testing, use case testing, beta testing, reviews)
  - by applying techniques with more or less intensity (e.g., unit testing at the level of 100% branch coverage or use case testing for basic flows and/or alternative flows)
- Strategy includes mapping of techniques to components

testing + QA techniques

- **Example:** Basis was a list of quality assurance and testing techniques; selection of techniques including coverage criteria for each risk level

# 6. Definition of Test Strategy

- Example using Excel template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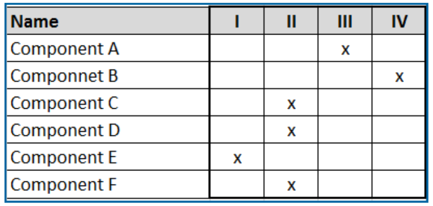
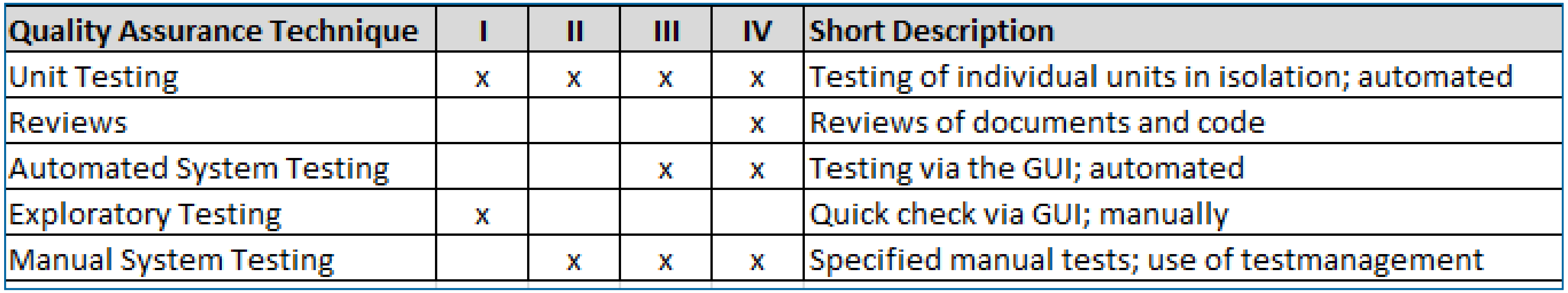
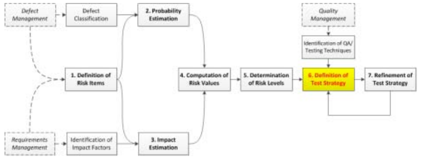


| Name | I | II | III | IV |
|---|---|---|---|---|
| Component A | | | x | |
| Componnet B | | | | x |
| Component C | | x | | |
| Component D | | x | | |
| Component E | x | | | |
| Component F | | x | | |



| Quality Assurance Technique | I | II | III | IV | Short Description |
|---|---|---|---|---|---|
| Unit Testing | x | x | x | x | Testing of individual units in isolation; automated |
| Reviews | | | | x | Reviews of documents and code |
| Automated System Testing | | | x | x | Testing via the GUI; automated |
| Exploratory Testing | x | | | | Quick check via GUI; manually |
| Manual System Testing | | x | x | x | Specified manual tests; use of testmanagement |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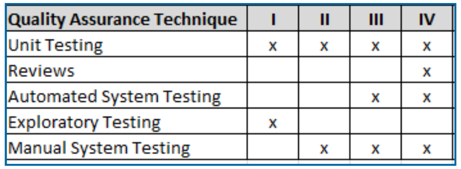
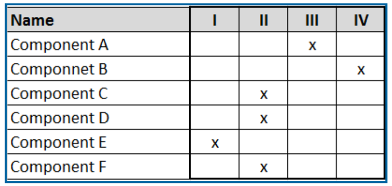
# 6. Definition of Test Strategy

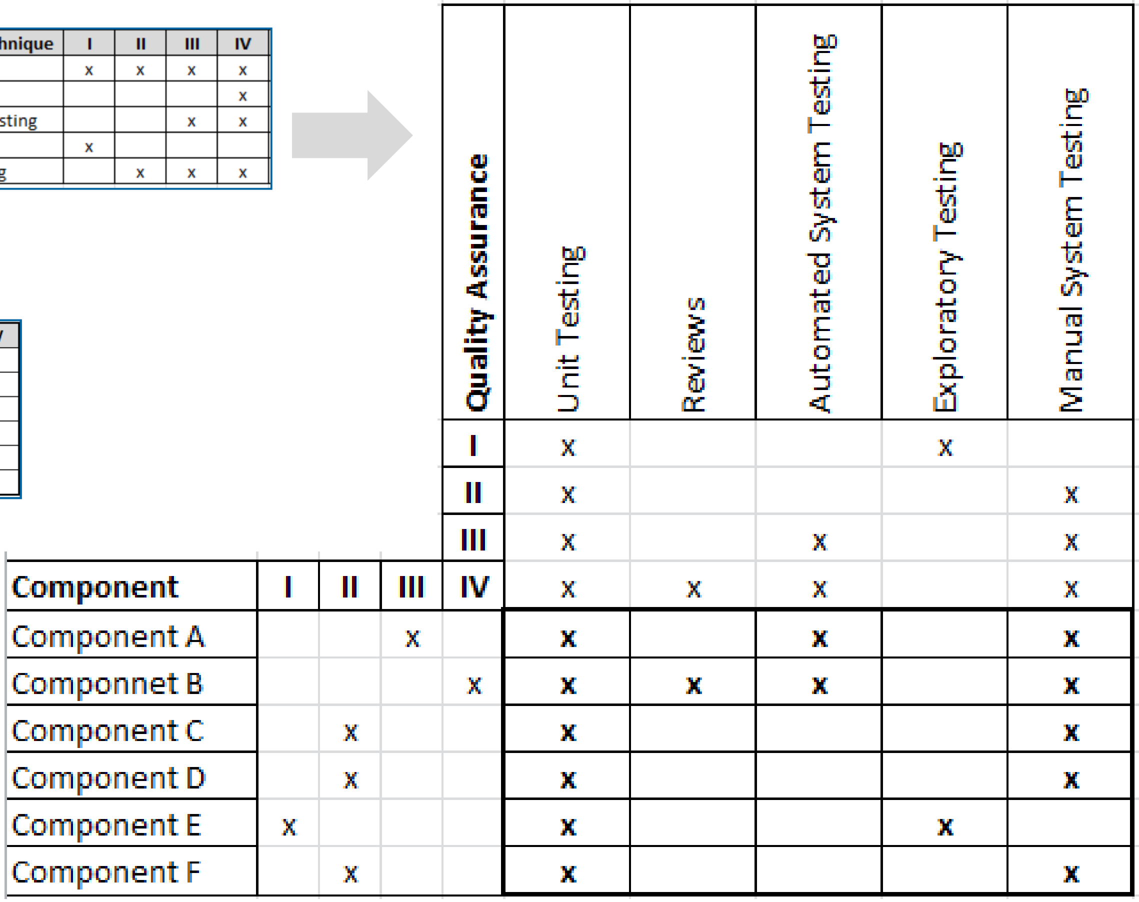
- Example using Excel template



| Quality Assurance Technique | I | II | III | IV |
|---|---|---|---|---|
| Unit Testing | x | x | x | x |
| Reviews | | | | x |
| Automated System Testing | | | x | x |
| Exploratory Testing | x | | | |
| Manual System Testing | | x | x | x |



| Name | I | II | III | IV |
|---|---|---|---|---|
| Component A | | | x | |
| Componnet B | | | | x |
| Component C | | x | | |
| Component D | | x | | |
| Component E | x | | | |
| Component F | | x | | |



| Quality Assurance | Unit Testing | Reviews | Automated System Testing | Exploratory Testing | Manual System Testing |
|---|---|---|---|---|---|
| I | x | | | x | |
| II | x | | | | x |
| III | x | | x | | x |
| IV | x | x | x | | x |

| Component | I | II | III | IV | Unit Testing | Reviews | Automated System Testing | Exploratory Testing | Manual System Testing |
|---|---|---|---|---|---|---|---|---|---|
| Component A | | | x | | x | | x | | x |
| Componnet B | | | | x | x | x | x | | x |
| Component C | | x | | | x | | | | x |
| Component D | | x | | | x | | | | x |
| Component E | x | | | | x | | | x | |
| Component F | | x | | | x | | | | x |

# TED – Your testing and QM activities?

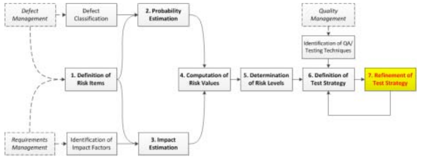
TED

- What testing activities are you doing/planning to do risk-based?
- What QM activities are you doing/planning to do risk-based?

→ http://mfelderer.at/profes16rbt

- TED-6 Quality Assurance

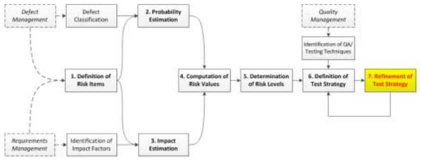
# 7. Refinement of Test Strategy


Defect Management
Defect Classification
2. Probability Estimation
Quality Management
Identification of QA/ Testing Techniques
1. Definition of Risk Items
4. Computation of Risk Values
5. Determination of Risk Levels
6. Definition of Test Strategy
7. Refinement of Test Strategy
Requirements Management
Identification of Impact Factors
3. Impact Estimation

- *Refinement of Test Strategy* – develop implementation of test strategy
  - Define details about how to apply the specified techniques for each individual component
  - Balance the planned overall test budget with estimated effort under the light of the risk exposure

Create feedback loop

- **Example:** Quick, bottom-up effort estimation to cross-check that testing approaches are compatible with available time and resources
  - Technical and organizational details for applying the specified techniques to a concrete software component
  - Component lead developer makes estimate for each intersection point
  - Subtotals and grand total compared to availability of personnel and planned testing budgets


Defect Management
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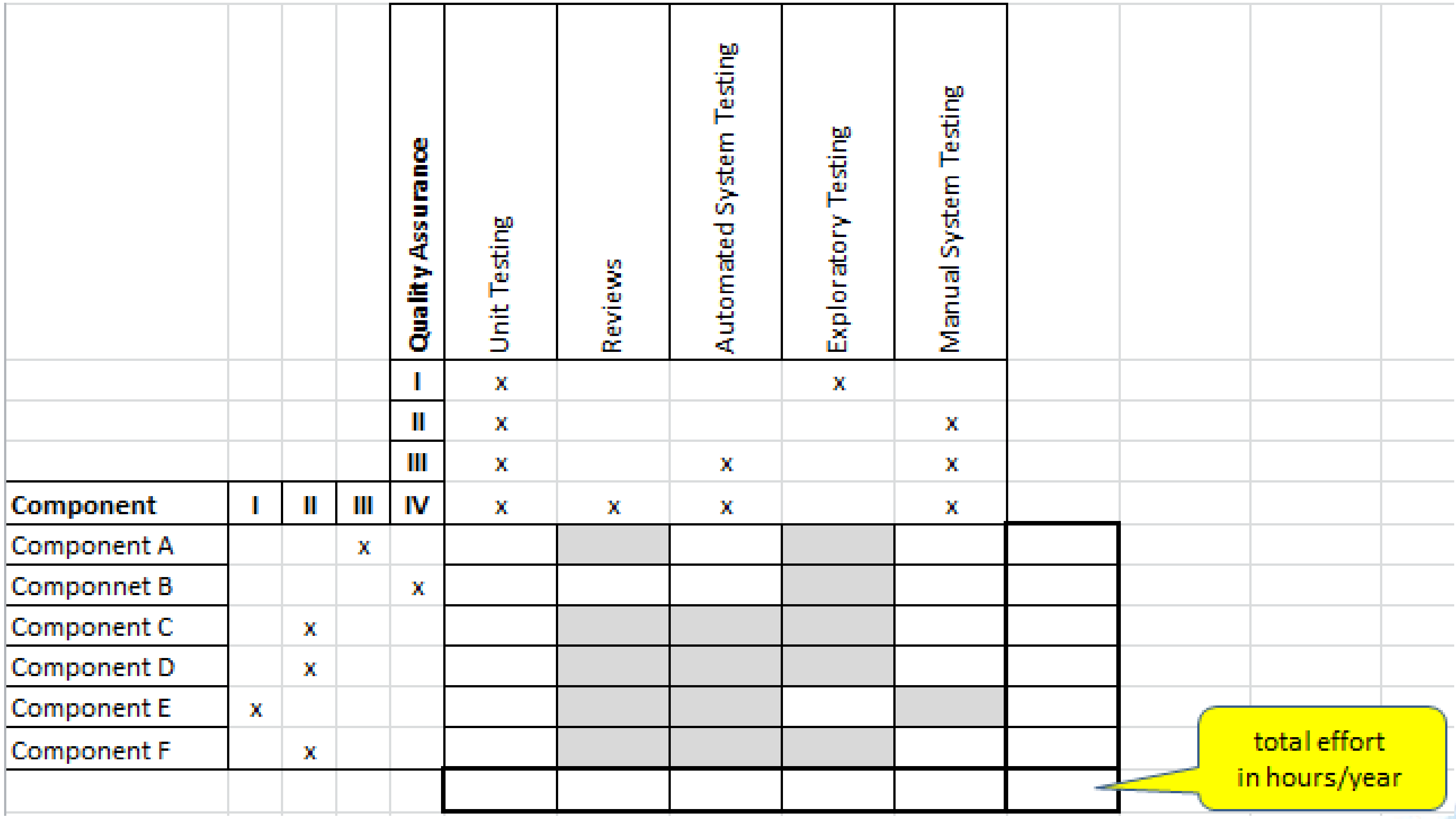
3. Impact Estimation
4. Computation of Risk Values
5. Determination of Risk Levels
Quality Management
Identification of QA/ Testing Techniques
6. Definition of Test Strategy
7. Refinement of Test Strategy

# 7. Refinement of Test Strategy

- Example using Excel template



| | | | | Quality Assurance | Unit Testing | Reviews | Automated System Testing | Exploratory Testing | Manual System Testing | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | I | x | | | x | | |
| | | | | II | x | | | | x | |
| | | | | III | x | | x | | x | |
| **Component** | **I** | **II** | **III** | **IV** | x | x | x | | x | |
| Component A | | | x | | | ▨ | | ▨ | | |
| Componnet B | | | | x | | | | ▨ | | |
| Component C | | x | | | | ▨ | ▨ | ▨ | | |
| Component D | | x | | | | ▨ | ▨ | ▨ | | |
| Component E | x | | | | | ▨ | ▨ | | ▨ | |
| Component F | | x | | | | ▨ | ▨ | ▨ | | |
| | | | | | | | | | | |

total effort in hours/year

# TED – Which steps do you take?

TED

- *“All testing is risk-based”* – James Bach
- What steps of Risk-Based Testing do you already do?

→ http://mfelderer.at/profes16rbt

- TED-7 Steps of the Risk-based Testing Process

# Overview of the Tutorial

- Introduction and Background
  - Software testing
  - Risk and Quality
  - Probability and Impact
- Benefits of Risk-Based Testing
- Risk-Based Testing Process
  - Estimation of Probability and Impact
  - Risk Value and Risk Levels
  - Test Strategy Development & Refinement
- Results and Lessons Learned

# Basic Publication

*Ramler, R., Felderer, M.:* A Process for Risk-Based Test Strategy Development and Its Industrial Evaluation. *16th International Conference on Product-Focused Software Process Improvement. Springer, 2015*

Profes 2015

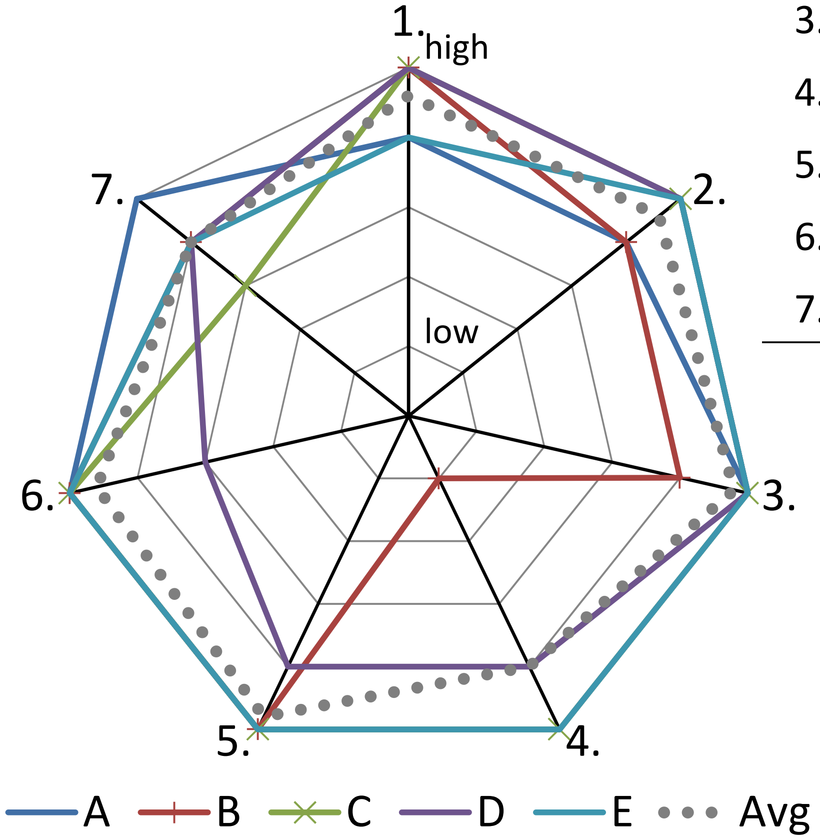
The 16th International Conference on

**Product-Focused Software Process Improvement**

# Evaluation: Case Companies

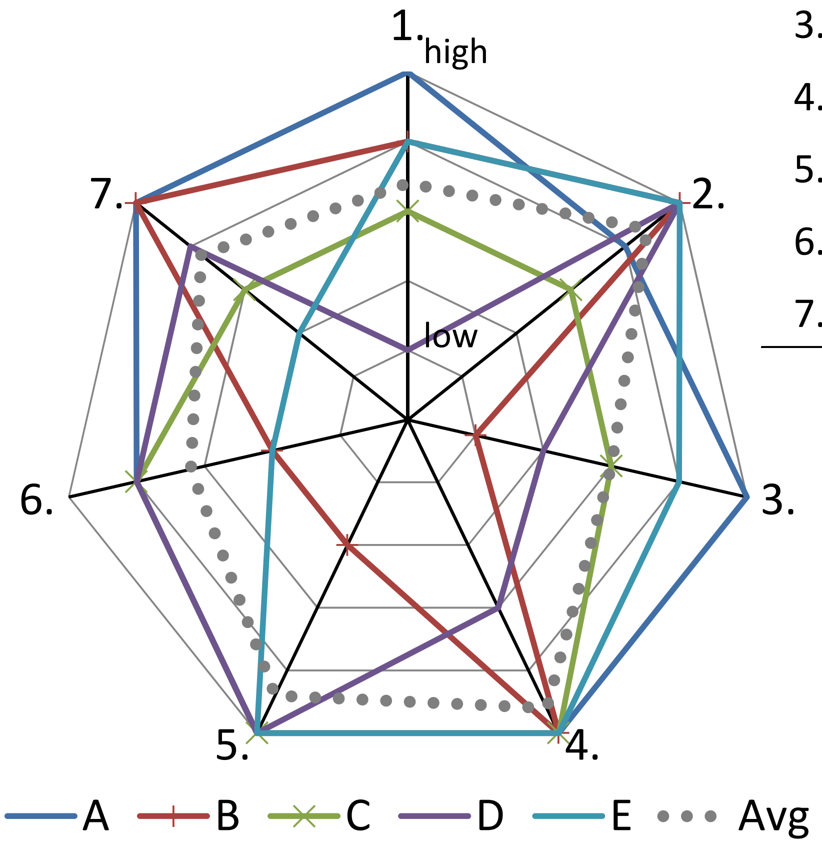
| | Case A | Case B | Case C | Case D | Case E |
|---|---|---|---|---|---|
| **Domain** | ERP software | Access systems | Document management | Training and recruitment | Payment systems |
| **Core business** | Software product and service | Hardware incl. embedded software | Software product and custom development | Service including software platform and operation | Solution development incl. software and hardware |
| **Employees** | 15 | 40 | 10 | 40 | 15 |
| **Software Releases** | 2 to 4 releases per year; service releases on demand | Adjusted to hardware product cycles (years) | New releases every one and four weeks | On demand | Delivery as custom projects |

# Evaluation: Perceived Usefulness



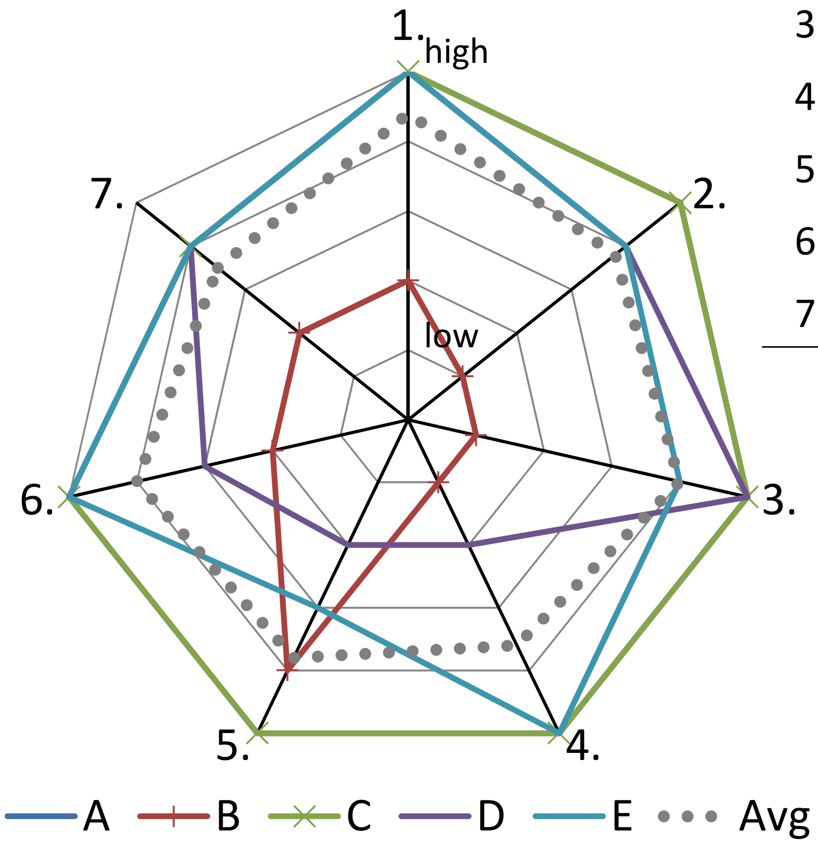
| Usefulness of ... | A | B | C | D | E | Avg | sdev |
|---|---|---|---|---|---|---|---|
| 1. Definition of Risk Items | 2 | 1 | 1 | 1 | 2 | **1.4** | 0.49 |
| 2. Probability Estimation | 2 | 2 | 1 | 1 | 1 | **1.4** | 0.49 |
| 3. Impact Estimation | 1 | 2 | 1 | 1 | 1 | **1.2** | 0.40 |
| 4. Computation of Risk Values | 1 | 5 | 1 | 2 | 1 | **2.0** | 1.55 |
| 5. Determination of Risk Levels | 1 | 1 | 1 | 2 | 1 | **1.2** | 0.40 |
| 6. Definition of Test Strategy | 1 | 1 | 1 | 3 | 1 | **1.4** | 0.80 |
| 7. Refinement of Test Strategy | 1 | 2 | 3 | 2 | 2 | **2.0** | 0.63 |

# Evaluation: Perceived Ease of Use



| Ease of Use of ... | A | B | C | D | E | Avg | sdev |
|---|---|---|---|---|---|---|---|
| 1. Definition of Risk Items | 1 | 2 | 3 | 5 | 2 | **2.6** | 1.36 |
| 2. Probability Estimation | 2 | 1 | 3 | 1 | 1 | **1.6** | 0.80 |
| 3. Impact Estimation | 1 | 5 | 3 | 4 | 2 | **3.0** | 1.41 |
| 4. Computation of Risk Values | 1 | 1 | 1 | 3 | 1 | **1.4** | 0.80 |
| 5. Determination of Risk Levels | 1 | 4 | 1 | 1 | 1 | **1.6** | 1.20 |
| 6. Definition of Test Strategy | 2 | 4 | 2 | 2 | 4 | **2.8** | 0.98 |
| 7. Refinement of Test Strategy | 1 | 1 | 3 | 2 | 4 | **2.2** | 1.17 |

# Evaluation: Perceived Representativeness



| Representativeness of ... | A | B | C | D | E | Avg | sdev |
|---|---|---|---|---|---|---|---|
| 1. Definition of Risk Items | 1 | 4 | 1 | 1 | 1 | **1.6** | 1.20 |
| 2. Probability Estimation | 1 | 5 | 1 | 2 | 2 | **2.2** | 1.47 |
| 3. Impact Estimation | 1 | 5 | 1 | 1 | 2 | **2.0** | 1.55 |
| 4. Computation of Risk Values | 1 | 5 | 1 | 4 | 1 | **2.4** | 1.74 |
| 5. Determination of Risk Levels | 1 | 2 | 1 | 4 | 3 | **2.2** | 1.17 |
| 6. Definition of Test Strategy | 1 | 4 | 1 | 3 | 1 | **2.0** | 1.26 |
| 7. Refinement of Test Strategy |  | 4 | 2 | 2 | 2 | **2.5** | 0.87 |

# Experiences from Application

1. Apply approach to a **representative amount of data** from the very beginning
2. **Definition of risk items is crucial** and should take available data and risk assessments into account
3. **Impact estimation more tricky** than probability estimation
4. **Refine** risk levels and assigned test strategies based on **expert and common knowledge**
5. Risk-based test strategy useful for graded application of arbitrary **software quality assurance techniques**
6. **Prioritization of test cases** and **motivation for enforcement of existing techniques** good starting points for implementation

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