Compositional Risk Assessment Combined with Automated Security Testing

The RACOMAT Method and Tool

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Overview

RACOMAT

Risk Assessment COMbined with Automated Testing

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Introduction
Importance of Risk Management for ICT-Systems

Basic observations

- Heterogeneous cross linked ICT-Systems of growing complexity are a key factor in modern industries and societies
- Security is crucial in various market sectors, including IT, health, aviation and aerospace.

Why Risk Management is required

- In the real world, perfect security often cannot be achieved
  - There are residual risks for any complex ICT-System
- Risk assessment und risk treatment can help to create trust by:
  - Communicating residual risks
  - Help to implement safeguards and treatments for to high risks in order to reduce the risks

Problems and Challenges

Risk Assessment and Security Testing

Risk assessment might be difficult and expensive

- Hard for large scale systems
- Is highly dependent on the skills and estimates of analysts

→ Make risk analysis more objective with testing

Security testing might be difficult and expensive, too

- Testing for unwanted behavior – there is no specification what to expect
- Even highly insecure system can produce lots of correct test verdicts if the “wrong” test cases have been created and executed
- Manual testing is error prone and infeasible for large scale systems

→ Automate risk assessment and security testing

State of the Art
Risk Assessment, RBST, TBSR

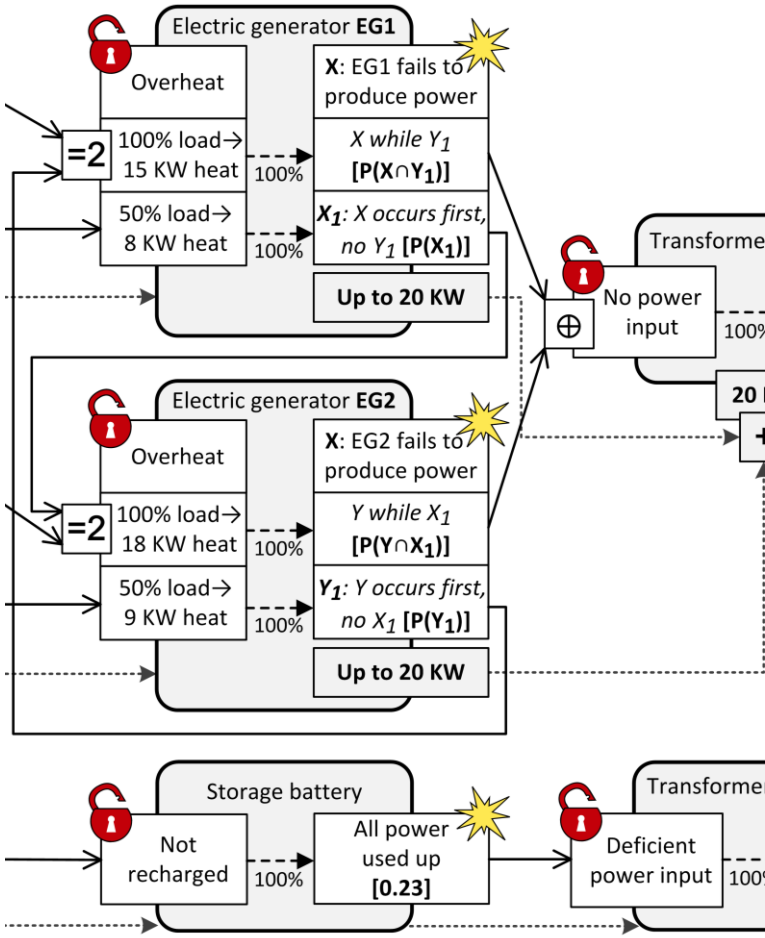
Methods for Risk Assessment

- FMEA/FMECA, FTA, ETA, CORAS …
- Compositional Risk Analysis
- Standard: ISO 31000

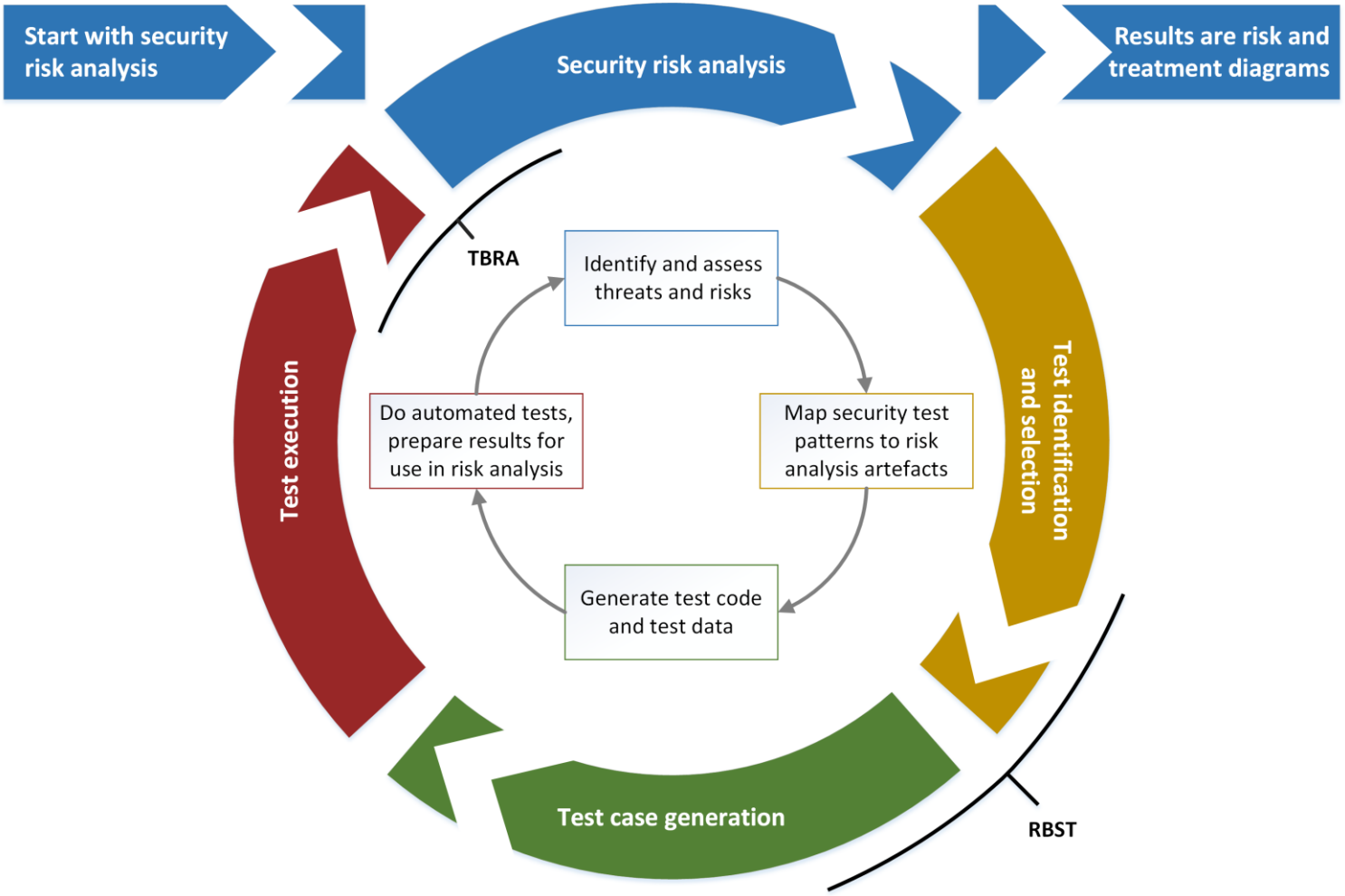
Combination of risk assessment und security testing

- Test-Based Risk Assessment (TBRA)
  - Improve risk assessment with results of security tests
- Risk-Based Security Testing (RBST)
  - Optimize security testing with results of risk assessment
- Combination of TBRA and RBST
  - No specific method established

→ The RACOMAT Method should close the gap



The RACOMAT Method
Iterative Process



The RACOMAT Method

Levels of Interaction Between Risk Assessment and Security Testing

1. Identification

What should be tested?

2. Prioritization

Spend how much effort for which tests?

3. Generation

Which test cases should be created?

4. Execution

How to stimulate and observe? Where to stimulate and observe?

5. Feedback

What do the test results mean for the overall risk picture?

The RACOMAT Method
Reusability and Automatization

- Component based, low level risk assessment
  - Reusable risk assessment artifacts
  - Compositional risk analysis
  - Connection with system components
- Security testing is a part of the RACOMAT Risk analysis
  - RBST, TBRA and automatization with the help of Security Test Pattern

    Security test pattern contain:
    - Strategies, models und code snippets for test case generation and test execution
    - Generic links between test pattern, risk analysis artifacts and system components
    - Information about testability and test effort
    - Metrics for test result aggregation and feedback to the risk picture

Security Test Pattern

Field	Description	Format
ID	Unique identifier	Number
Name	Meaningful identifier	Text
Description	Information for the user	Informal XHTML
Relations	E.g. to risk artefacts	{Catalog}, ID, semantics

The RACOMAT Method
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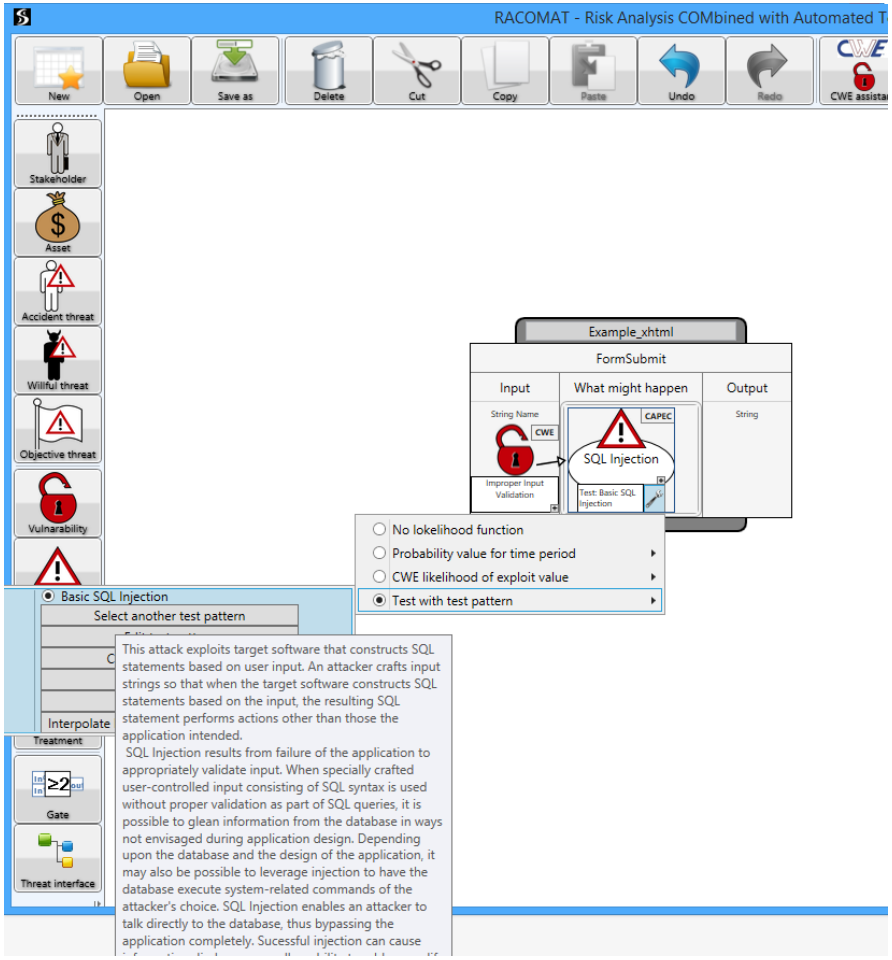
Evaluations	Assess generator, executer and metric combinations	Enumerations for effort and effectiveness
Feedback	User experiences	Rating, informal comments

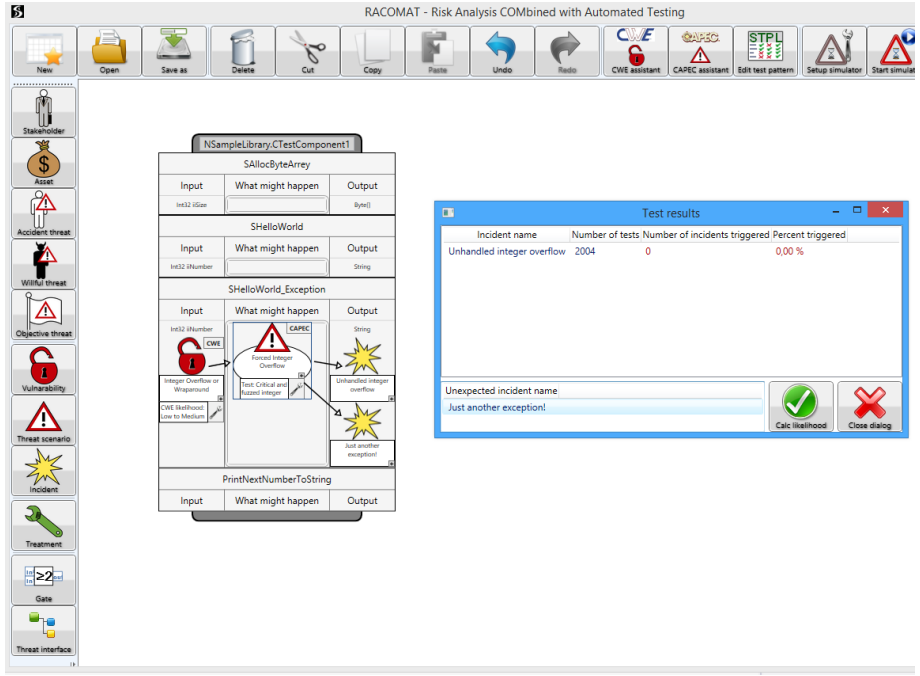
The RACOMAT Tool
Features and Workflow 1/2

- System analysis and risk assessment
  - Automatically creates interface models for programs, APIs, components, Web-Pages or Web-Services
  - Generates semi automatically initial fault trees or CORAS risk graphs
    - Uses risk catalogues (Mitre CWE / CAPEC, BSI IT-Grundschutz …)
  - Edit and compose per Drag and Drop
  - Calculates likelihoods for dependent incidents automatically
- Security Test Pattern instantiation
  - Suggests associations with identified threat scenarios and system components
  - Calculates, how much test effort should be spend



The RACOMAT Tool
Features and Workflow 2/2

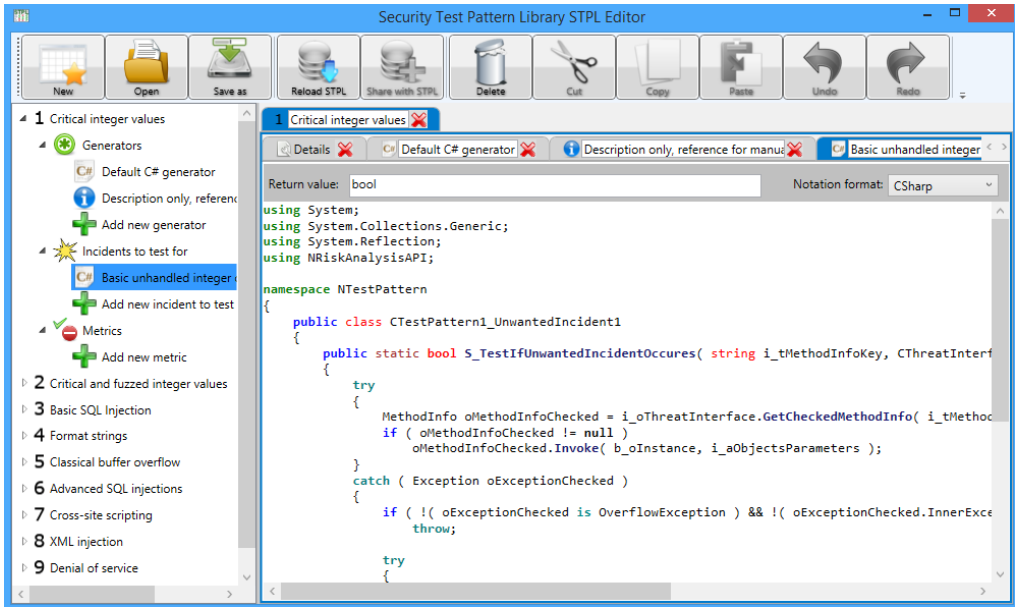
- Execution of tests
  - Once a test pattern is instantiated, generating, executing and evaluating tests woks at least semi automatically
    - Often no manual work is required at all, e. g. for overflows or (SQL-) Injections
- Updates the risk picture based upon the test results semi automatically
  - Makes suggestions using the metrics of the security test pattern
    - More precise likelihood values
    - Allows to add unexpected observations as new faults or unwanted incidents by dragging them to the risk graph



The RACOMAT Tool
Security Test Pattern Library STPL

Security Test Pattern Library STPL is a catalogue of security test pattern for the most common threat scenarios

- If there is no fitting test patterns, new test pattern can be created and edited using the RACOMAT Tool
- User can contribute feedback and they can suggest extensions for the open STPL
  - Quality management with ratings / comments of the users



The RACOMAT Tool – Demo

Case Studies
First experiences from praxis

- RACOMAT method and tool are tested in two case-studies for modular large scale systems
  - S-Network (Fraunhofer, H-C3 TU Berlin, http://surn.net)
  - Command Central (Software AG, EU-FP7 funded project RASEN, http://www.rasenproject.eu)

Positive experiences

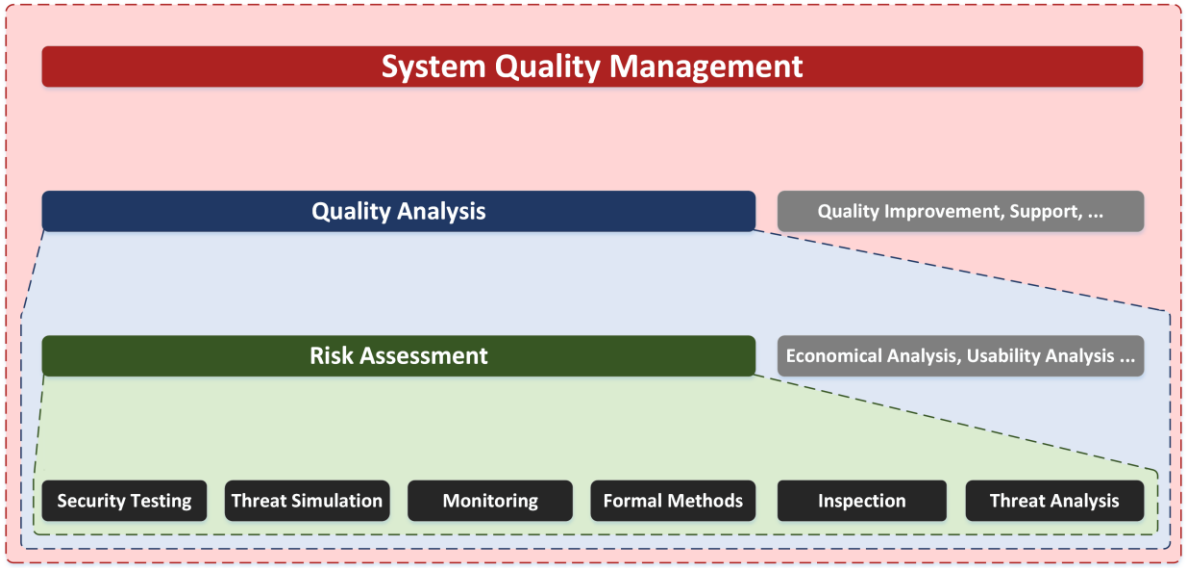
- The assistants and the libraries of predefined artifacts help to avoid that the analysts miss important aspects
  - Negative risk assessment: remove not relevant threats instead of looking for the relevant threats
- Reusing artifacts helps to reduce the need to reinvent the wheel each and every time – hence, it reduces the potential for analysts and testers to make errors

Problems

- There are currently only a few useable security test pattern
  - It is difficult to make sound estimates for the test quality, test effort and especially for generic test evaluation

Conclusion and Future Work

- RACOMAT method and tool already combine risk assessment with security tests tightly
  - Other analysis methods: Simulation, monitoring, verification, review …



  - Basic threat simulation (Monte Carlo simulation) already implemented into RACOMAT
- Assistance for analysis of external cloud services (outsourcing)
- Vision: Open Risk Assessment – Community Driven Risk Analysis

Questions, Remarks?

Thanks a lot for the attention!

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