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Impact of Forensic-Ready Information Systems on the Security Posture

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The Story …

SensitiveCloud and Forensic Readiness

- Platform for storage and processing of sensitive data
  - E.g., supporting life sciences researches
  - Strong need for information security
  - Build on Kubernetes (K8s), accessible by VPN

- Aspiring for ISO/IEC 27k certification

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The Story …

SensitiveCloud and Forensic Readiness

- Platform for storage and processing of sensitive data
  - E.g., supporting life sciences researches
  - Strong need for information security
  - Build on Kubernetes (K8s), accessible by VPN
- Aspiring for ISO/IEC 27k certification
- “I heard that you are doing some logging…”

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Forensic Readiness & Forensic-Ready Systems

- Proactive steps for potential (security) incident investigation
  - By-design, for the systems
  - Enhancement of security practices
- When security measures fail
  - Know: Why? Who? How? When? Where?
- Why should you care?
  - ISO/IEC 27001:2013 Annex A.12.4 (observability), Annex A.16.1 (incident response), ...
  - GDPR (quickly assess the scope of a data leak)
  - Local legal obligations (evidence release)

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Forensic-Ready Information Systems Security Risk Management

- Risk management is a standard practice in information security
  - Build on its results to assess the forensic readiness
- ISSRM (only security)
  - Risk, Asset, …
- FR-ISSRM (plus forensic readiness)
  - Evidence – information usable for investigation
  - Goal – purpose for implementation
  - Scenario – how is a Goal addressed, given a Risk

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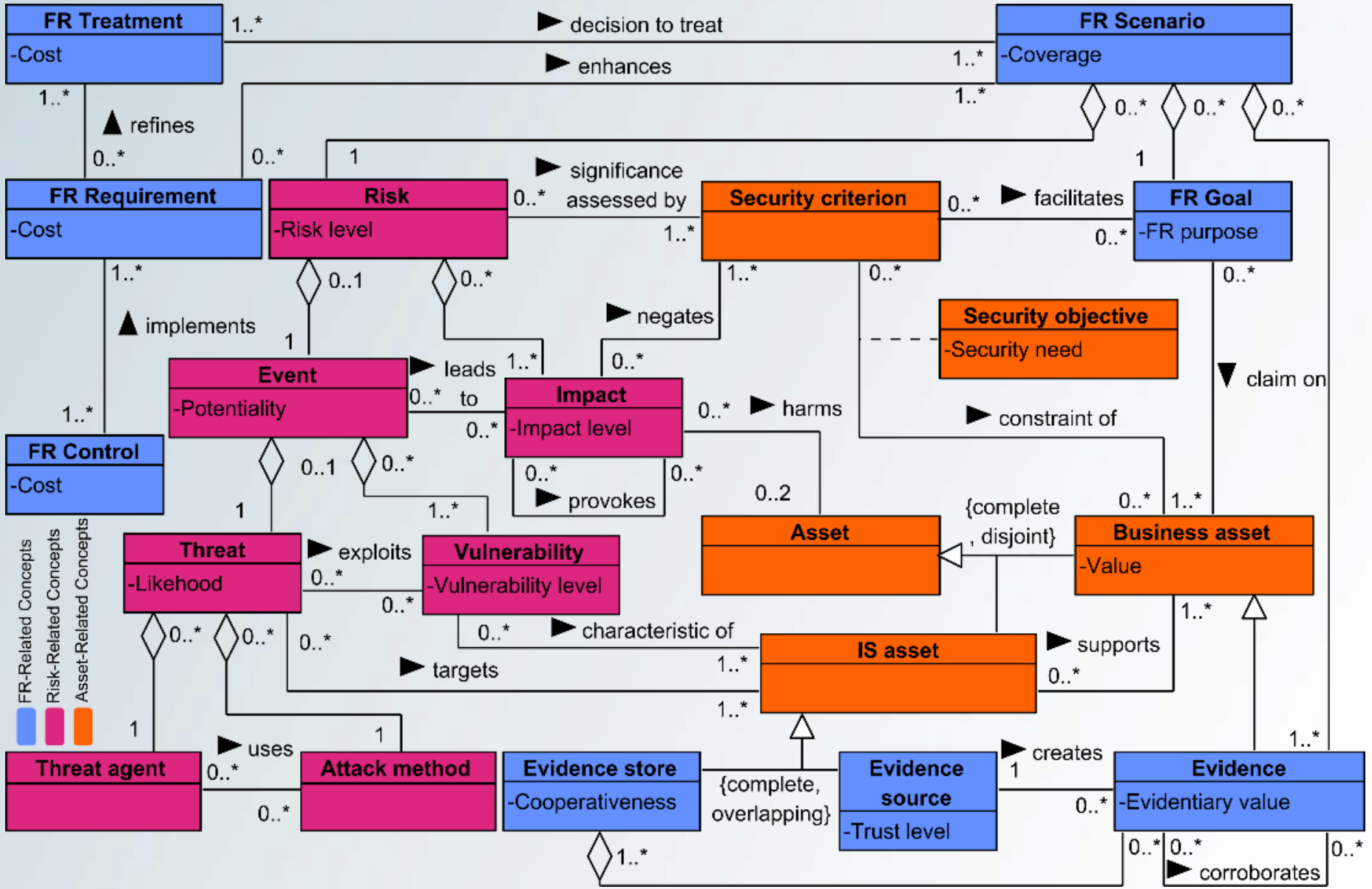

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Case Study: SensitiveCloud

Research questions

- RQ1: What data is needed to establish a forensic readiness model of an existing information system?
  - Artifacts? Enquiries? How to gather it in a real system?
- RQ2: How can the forensic readiness of a system be evaluated based on the established model and empirical knowledge?
  - How to evaluate the system? Establish its current state to (maybe) improve.
- RQ3: What are the effects of FR-ISSRM process execution and its artefacts on the security posture?
  - How did it help in security? Maybe in monitoring, incident handling, …

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Case Study: SensitiveCloud

Phases

- Mapping
  - Review security risk management documentation
  - Establish incentives for forensic readiness
  - Create model of the system
- Evaluation
  - Assess the readiness based on the model
  - Metrics
  - Simulated incident investigation
- Feedback
  - Process the results, interview participants
  - Propose requirements to enhance the system

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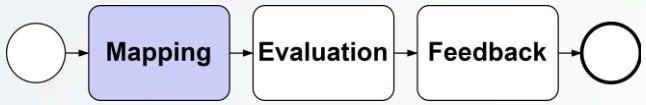
Mapping Phase

Security Risk Management Issues



- Focus on technical point of view
  - Only IS Assets / Supporting Assets were considered
  - Remedy: Business Assets / Primary Assets introduced
  - E.g.: VPN vs. logical perimeter

- Abstract formulation of risks
  - Catalogue-like entries
  - Risks instantiated using a description of nominal behavior and how risks can affect it
  - E.g.: *Wireguard VPN Connection* (Asset) can be affected by a *Leaked VPN key* (Impact) due to a *Physical theft of the admin's laptop* (Event)

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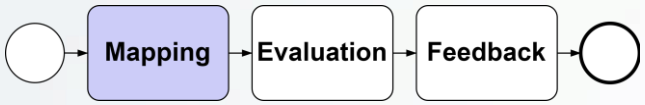
Mapping Phase

Forensic Readiness Goals



- Prove access to user data
  - E.g., to address disputes or impact
- Enable investigation of logical perimeter access process breach
  - Explain potential breaches
- Prove misuse of user identity
  - Track impersonations
- Enable evidence release of perimeter access process
  - Legal requirement

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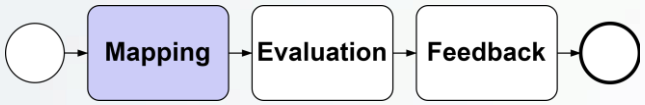
Mapping Phase

Forensic Readiness Scenarios



- Direct instantiation of goals was difficult on abstract risks
  - Asset-level descriptions and models mapped on the risks
- We identified initial potential evidence
  - Based on discussion with technical team
- We chose a high-risk scenario for further analysis
  - Leakage of data on user side
  - Impersonation and misuse of resources

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Evaluation Phase

Metrics and Simulation

- Forensic readiness metrics based on the model
  - Scenario coverage
  - Relative evidentiary value

- Simulated incident
  - Simulate a realistic attack
  - Let the team handle the incident

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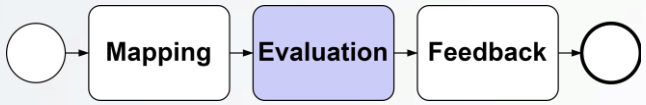
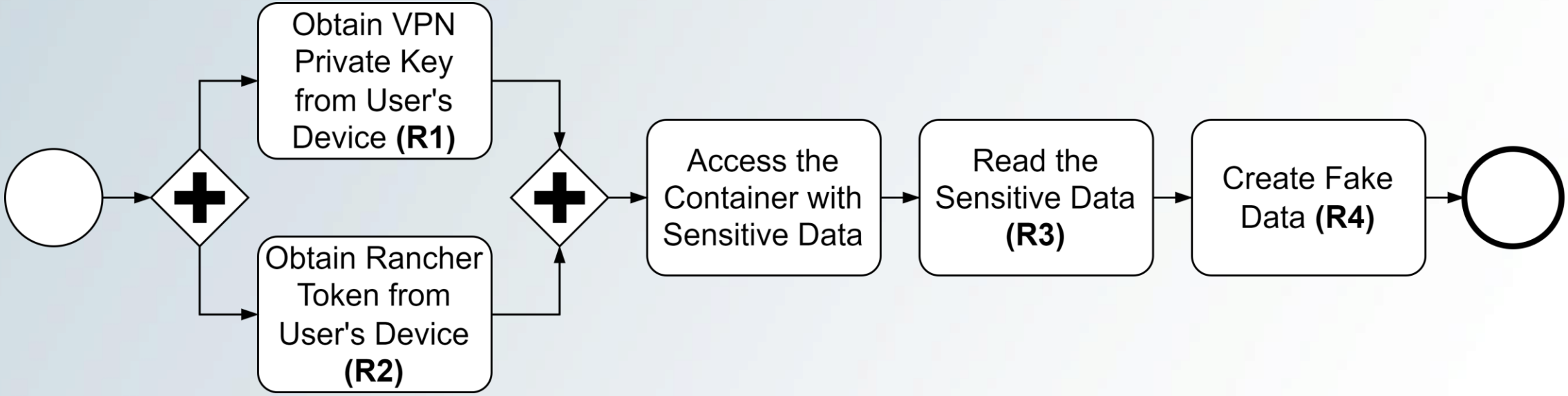
Evaluation Phase

Investigation



- Question:

  Which data was accessed, who accessed it and how?



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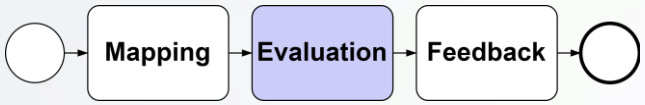
Evaluation Phase

Investigation



- Question:

  Which data was accessed, who accessed it and how?

- Problems
  - Mishandling of evidence led to its deletion
  - VPN handshakes not recorded
  - Audit log was misconfigured and missing critical data
  - Proxied IP did not allow tracing
  - Dependance on unreliable data

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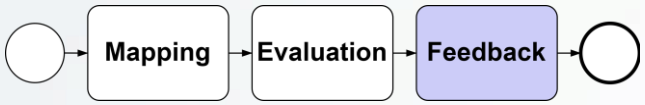
Feedback Phase

Requirements (in high-level)



- Independent copies of the important evidence
  - Wireguard Log
- Record the missing evidence
  - Wireguard Handshakes
  - Kube-API Audit
- Correlate with the proxied IP
- Reduce the possibility of evidence tampering
  - Store shell access log outside container

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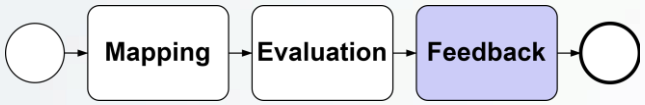
Feedback Phase

Incident Handling Shortcoming



- Incomplete documentation
  - Corruption of the evidence
- Single point of failure
  - Only a single person had the needed expertise
- Incident report handling
  - Establishing the eligibility of the reporter

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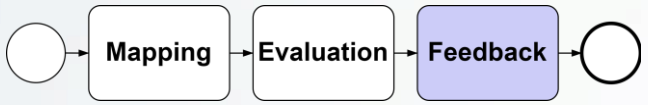
Feedback Phase

Interview Findings



- Simulation presented a hands-on learning opportunity
- Modeling motivated to look at the system from a different angle
  - Where is the evidence?
  - How does it actually work?
  - On the other hand, it was challenging for the technologically-oriented team
- Practical complement to ISO/IEC 27k certification
  - Iteration of an Information Security Management System
  - Forced people to start thinking about the business side of how to make the system secure

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Research Questions Answers

What data is needed to establish a forensic readiness model of an existing information system?

- Risks need to be described in detail
  - Asset-level scenarios helped in understanding how it can happen in the system
- Forensic readiness goals to steer the implementation
  - But the incentive is on the technical parts
  - Need to define high-level business drivers
- Modelling (BPMN process models) is challenging

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Research Questions Answers

How can the forensic readiness of a system be evaluated based on the established model and empirical knowledge?

- Metrics
  - Quick, but hard to compare between scenarios
  - Was able to point out issues

- Simulated incident
  - Costly to conduct but very insightful
  - Tests the availability and usefulness of modelled evidence
  - Identifies gaps in the evidence
  - Allows to observe and experience the cooperation during incident handling

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Research Questions Answers

What are the effects of FR-ISSRM process execution and its artefacts on the security posture?

- Supports incident handling and investigation process
  - Pre-prepared data pointing to the circumstances
- Security audit
  - Validation of configuration
  - Uncover weaknesses of the system
- Insights into the system
  - Inspection of systems' internal behavior
  - Documentation

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Lessons Learned

- Uncovered issues in the system
  - Blind spots, misconfiguration, unreliable data
- Contributed to the overall environment maturity
  - Understating of the system, incident handling
- Continuous evaluation proposed
  - Maintaining the readiness as system and environment changes

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