SoKNOS - Using Semantic Technologies in Emergency Management Software

Grigori Babitski, Simon Bergweiler, Olaf Grebner, Daniel Oberle, Heiko Paulheim, and Florian Probst

ESWC 2011

Agenda

Using Semantic Technologies in Emergency Management (Motivation)

- Introduction to the research project SoKNOS
- Ontologies developed during the project

Use Cases and Ontology-based Improvements

- Use Case 1: Simplified Database Integration
- Use Case 2: System Extensibility
- Use Case 3: Improved Search
- Use Case 4: Improved Discovery of External Sensor Observation Services
- Use Case 5: Plausibility Checks
- Use Case 6: Improved Information Visualization

Lessons Learned

SoKNOS

The Next Generation of Emergency Management Systems

Current Situation in Managing Large Incidents

- Incomplete Emergency & Disaster Picture
- Ineffective resource/ asset management
- Disjointed coordination and capabilities of stakeholders
- Recovery and reconstruction delays

EMERGENCIES & DISASTERS

Challenges in Crisis Situations - SoKNOS Motivation and Goal

Police

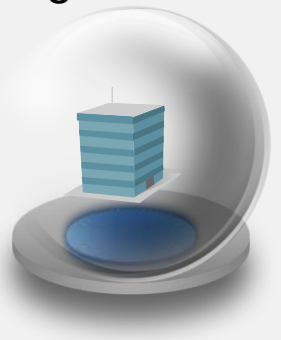
- ➔ Shortening the chaos-phase.
- ➔ Getting continuously comprehensive information from all kinds of information sources.
- ➔ Support the seemless **collaboration** between all actors and organisations involved in fighting the incident.

Rescue

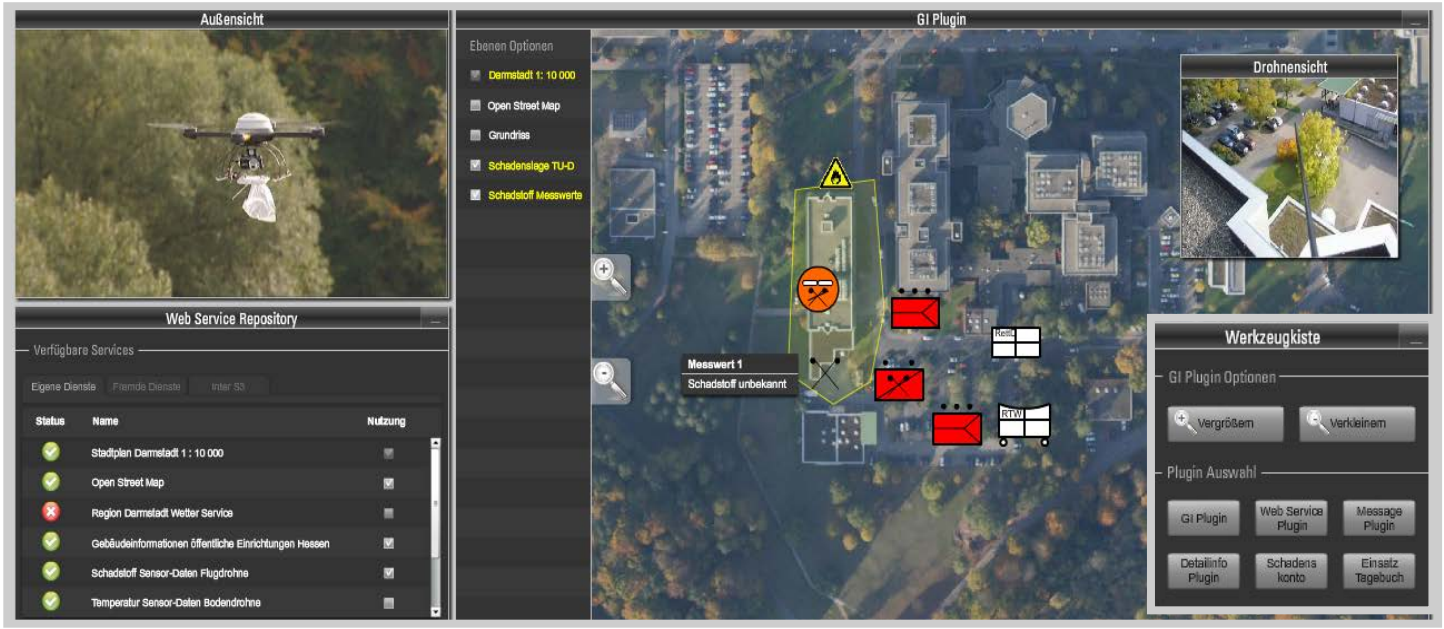
Fire Brigade

Technical Relieve Agency

Agencies



SoKNOS Partner



SoKNOS

GEFÖRDERT VOM

Bundesministerium für Bildung und Forschung

SAP

B2M SOFTWARE AG

ESRI

ESRI Geoinformatik GmbH

itelligence

Berliner Feuerwehr

Stadt Köln

Berufsfeuerwehr Köln

Deutsche Hochschule der Polizei

Deutsches Forschungszentrum für Künstliche Intelligenz GmbH

FhG

Fraunhofer Gesellschaft

ifgi

Institut für Geoinformatik

Universität Münster

TECHNISCHE UNIVERSITÄT DARMSTADT

TECHNISCHE UNIVERSITÄT DRESDEN

RUTGERS

THE STATE UNIVERSITY OF NEW JERSEY

SoKNOS – User-centric Approach

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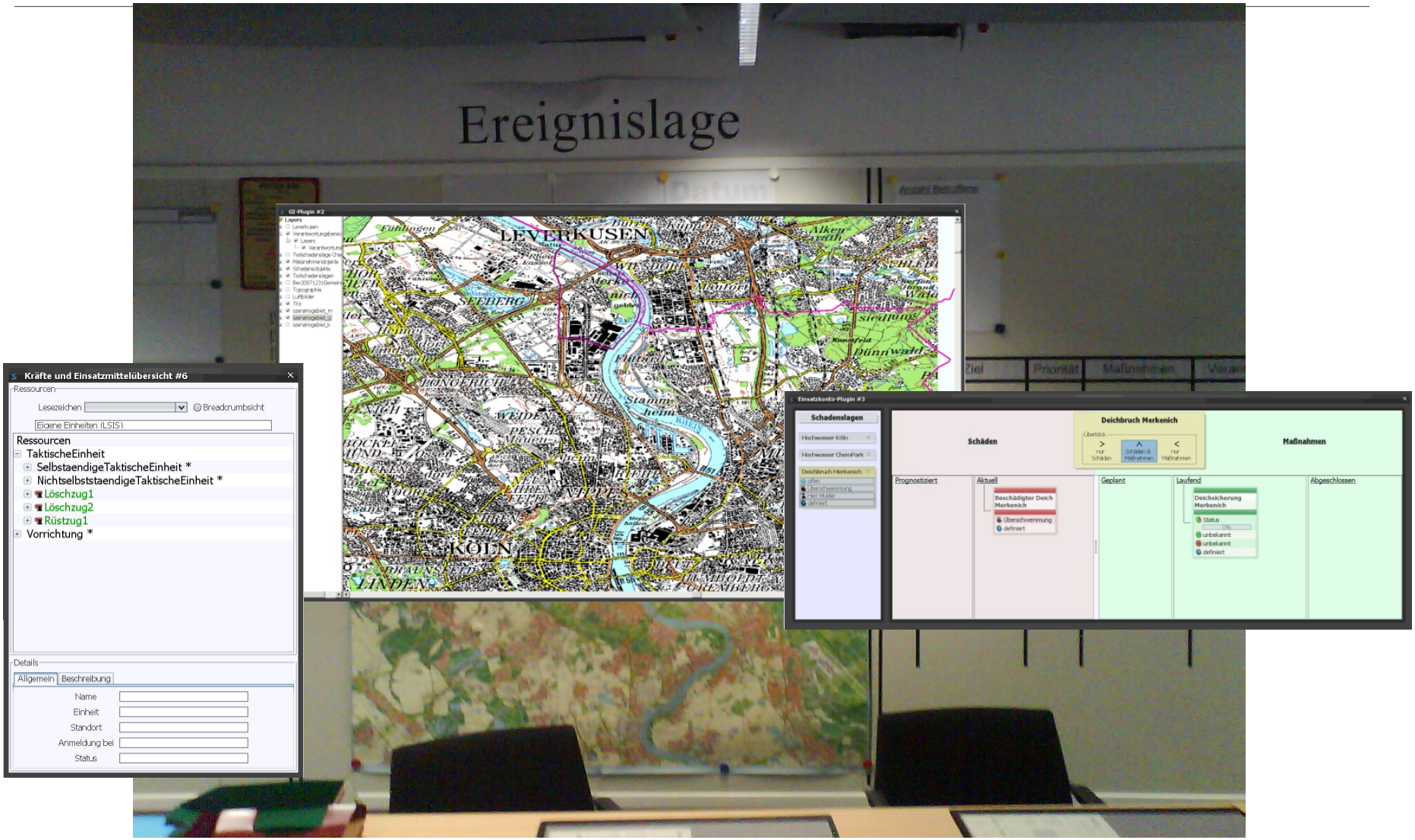
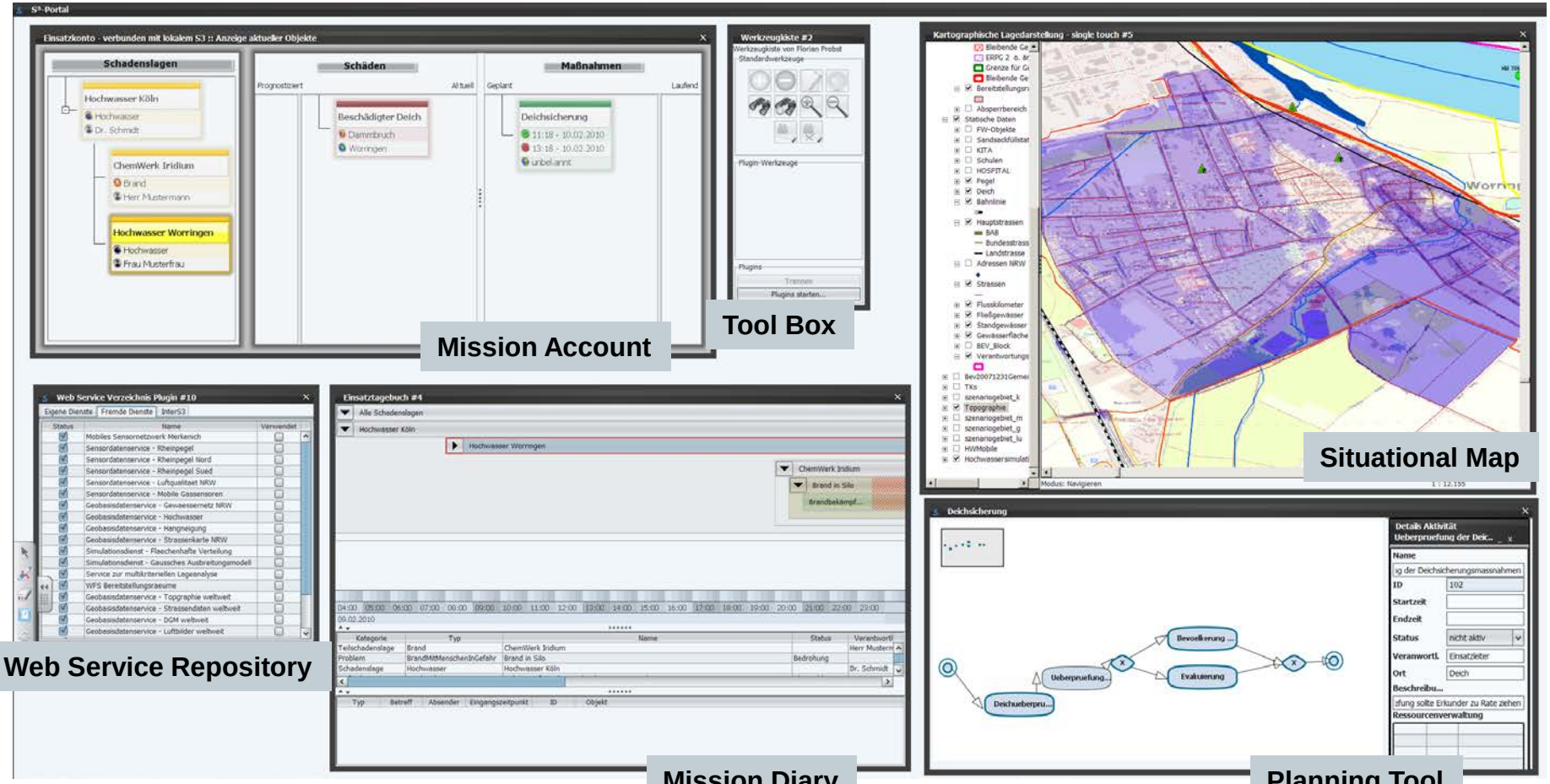
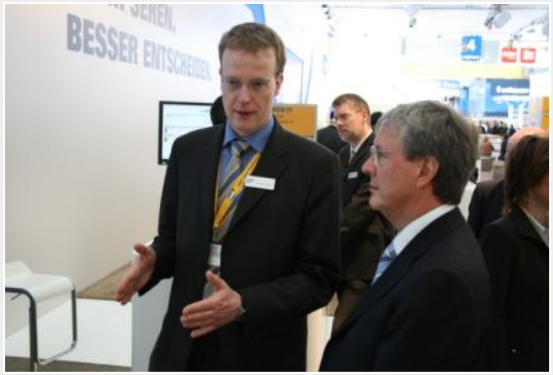


Highly Flexible, Service-based System. Adjustable to the Needs of the Current Situation



New Generation of Emergency Management Systems: SoKNOS Prototype

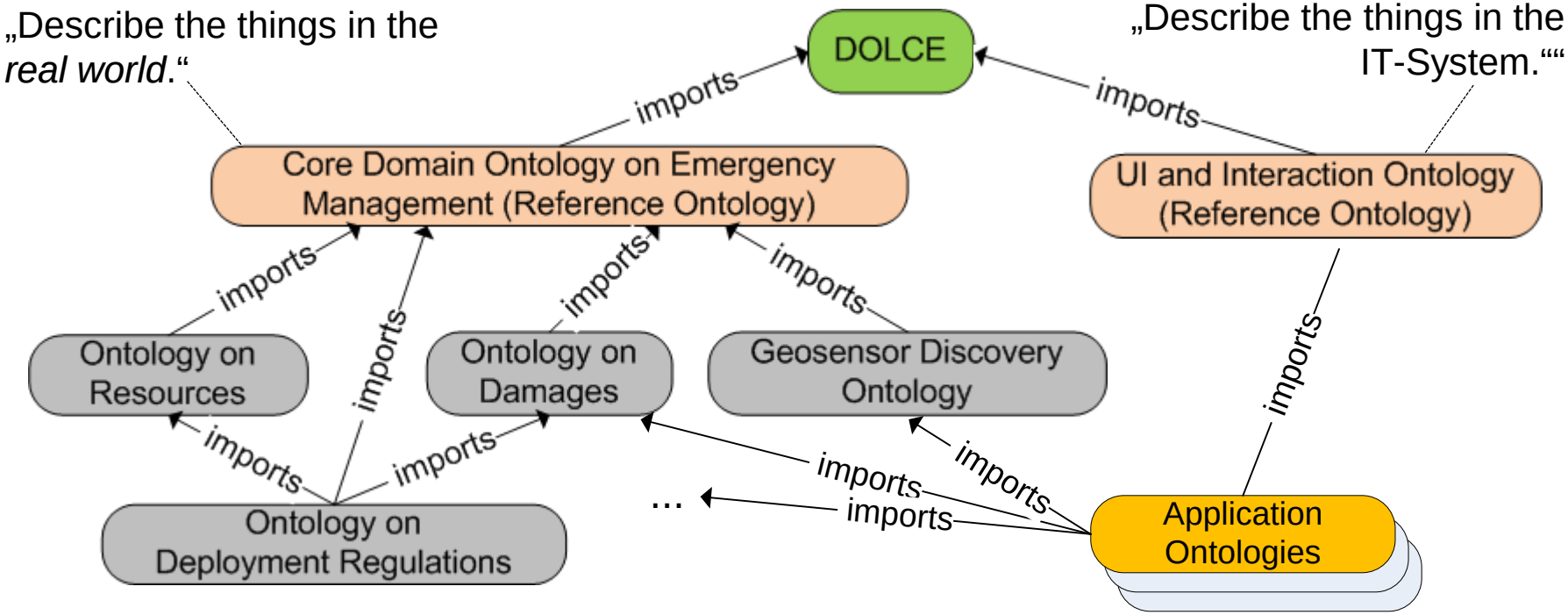
Kanzlerin Dr. A. Merkel und Gouverneur A. Schwarzenegger



David Skellern, CEO NICTA

Ontologies

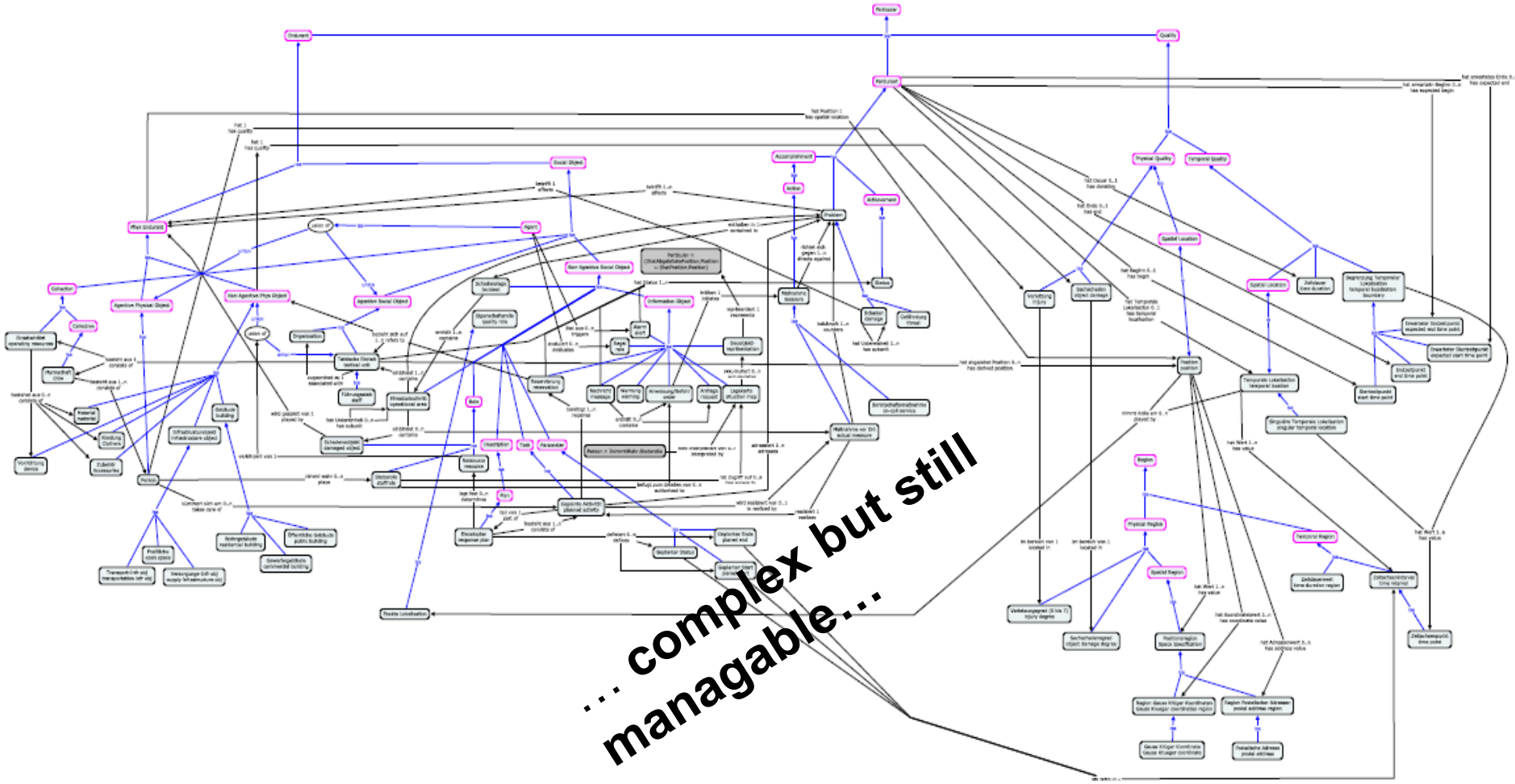
Ontology Stack



The top-level ontology DOLCE constraints the domain and application ontologies.

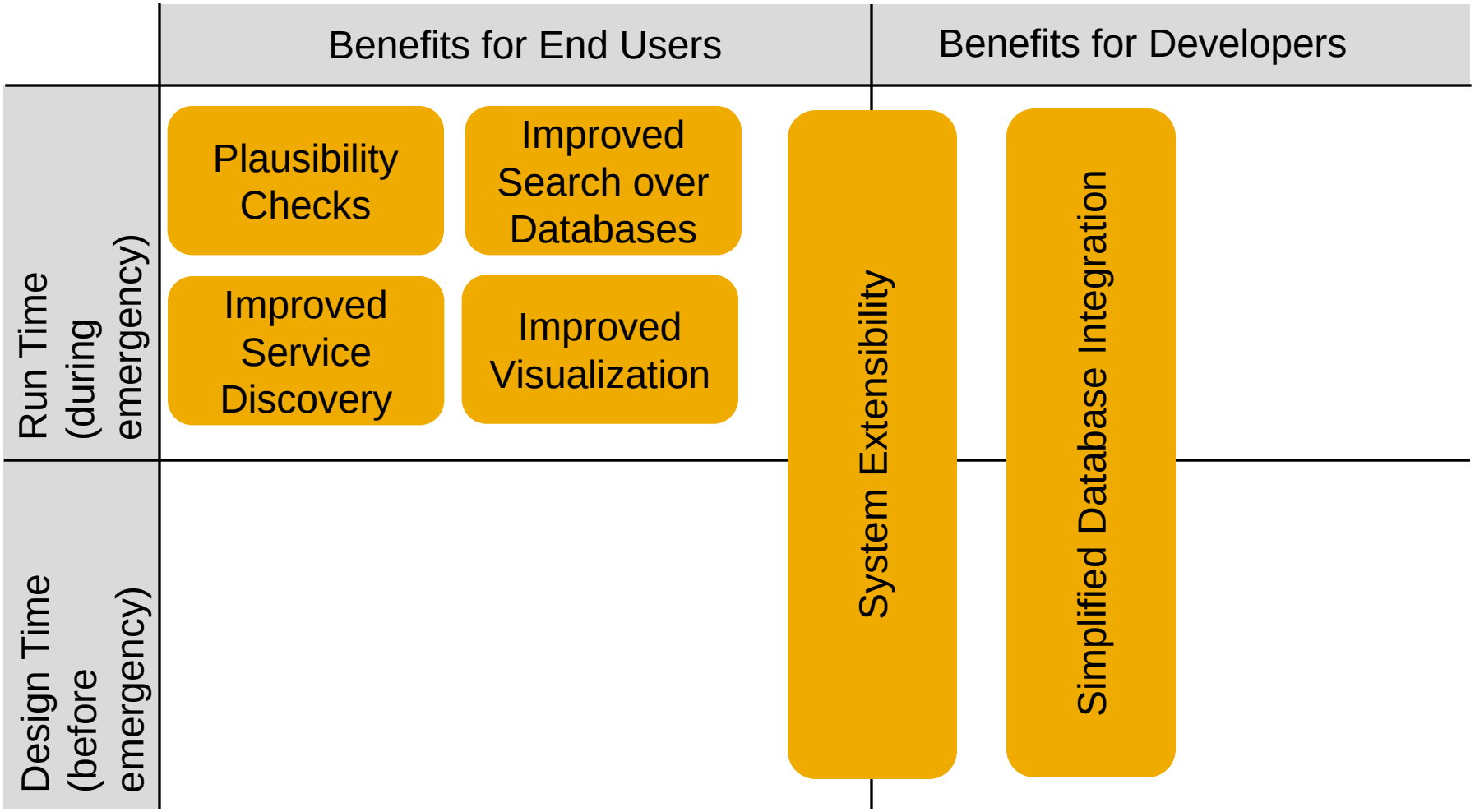
→ Result: High conceptual flexibility on lower levels while maintaining comparability of concepts.

Reference Ontology for Emergency Management



Overview Use Cases

Central Use Cases for IT-Systems in Emergency Management



Use Case 1: Simplified Database Integration

Use Case 2: System Extensibility

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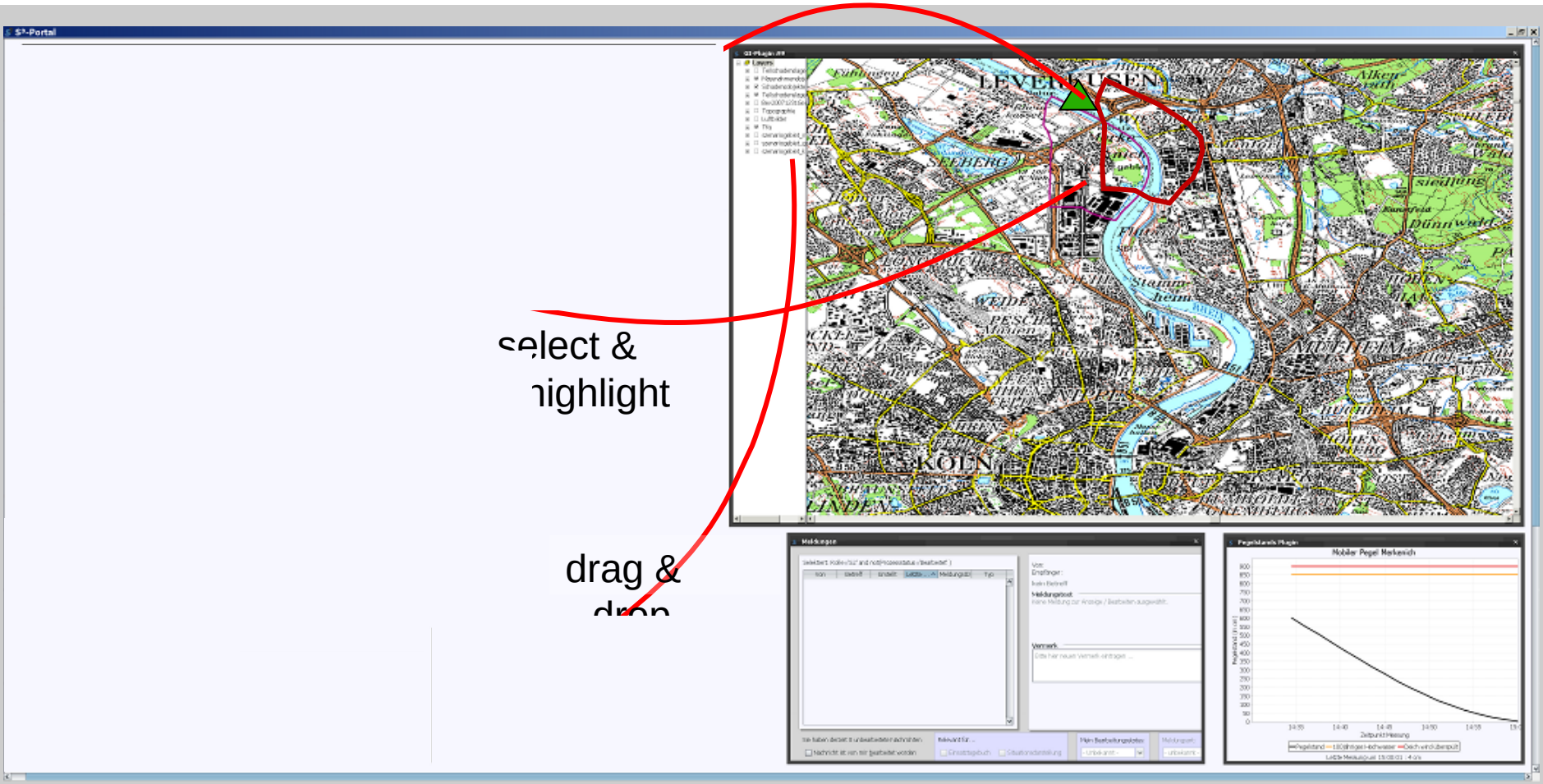
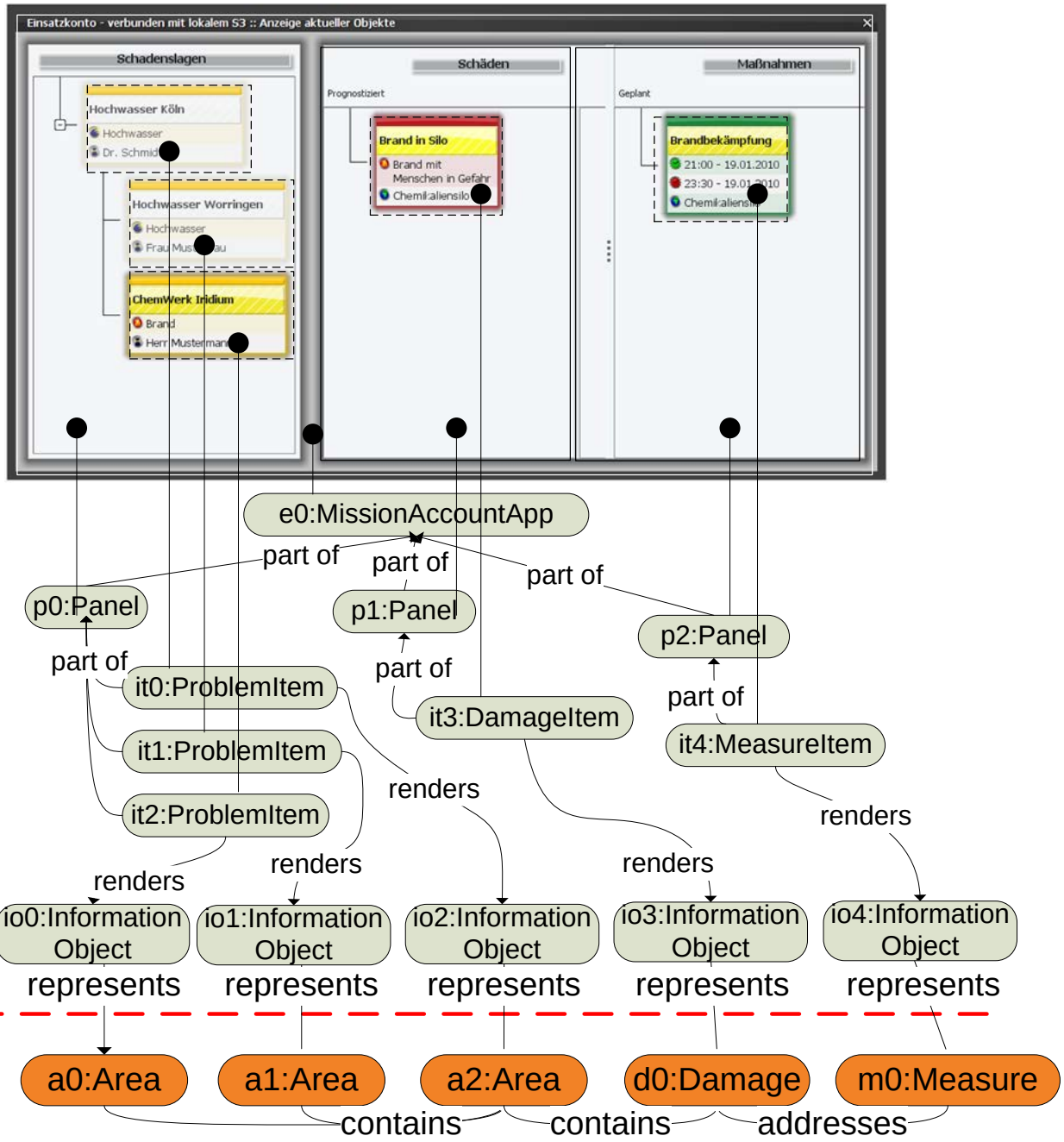
Semantics-based Integration of System Modules in SoKNOS

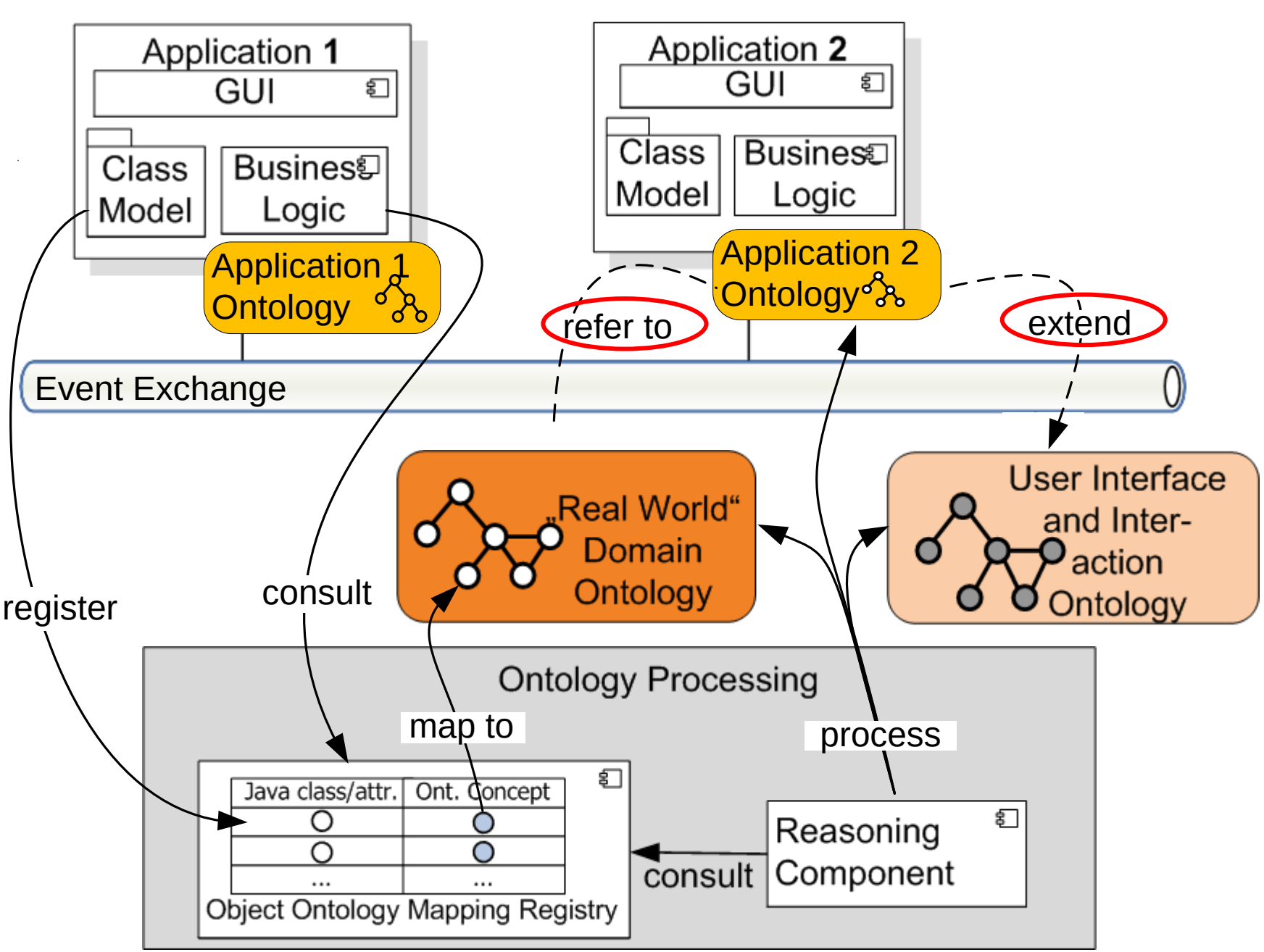


Information exchange between (really!) independent modules
→ Quick configuration of the system.

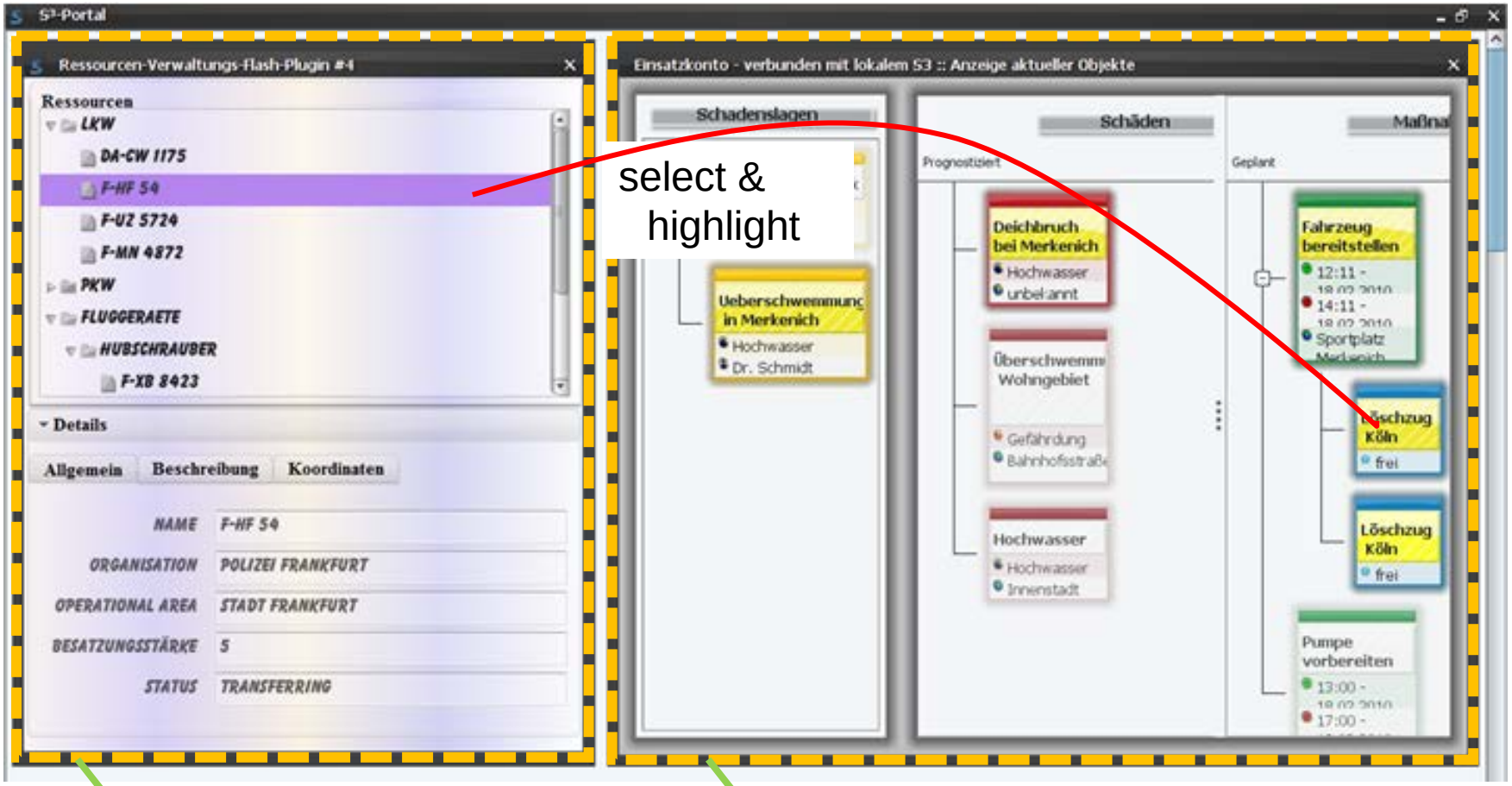


User Interface & Interaction Domain Ontology

Real World Domain Ontology



Integrating Applications developed in Flex resp. Java



Flash Application for Ressource Management

Java Application „Mission Management Tool“

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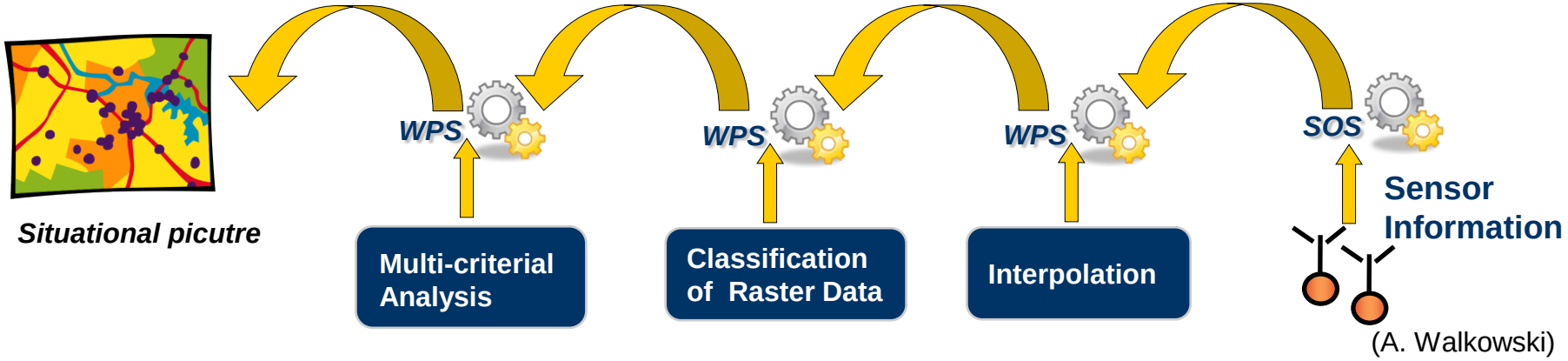
Use Case 4: Improved Discovery of External Sensor Observation Services

Motivation:

- An accurate picture of the crisis situation is essential.
- Sensor Services can deliver this information, but finding them under time pressure is difficult.
- Enable the crisis management team to find sensor observation data fast and reliable.

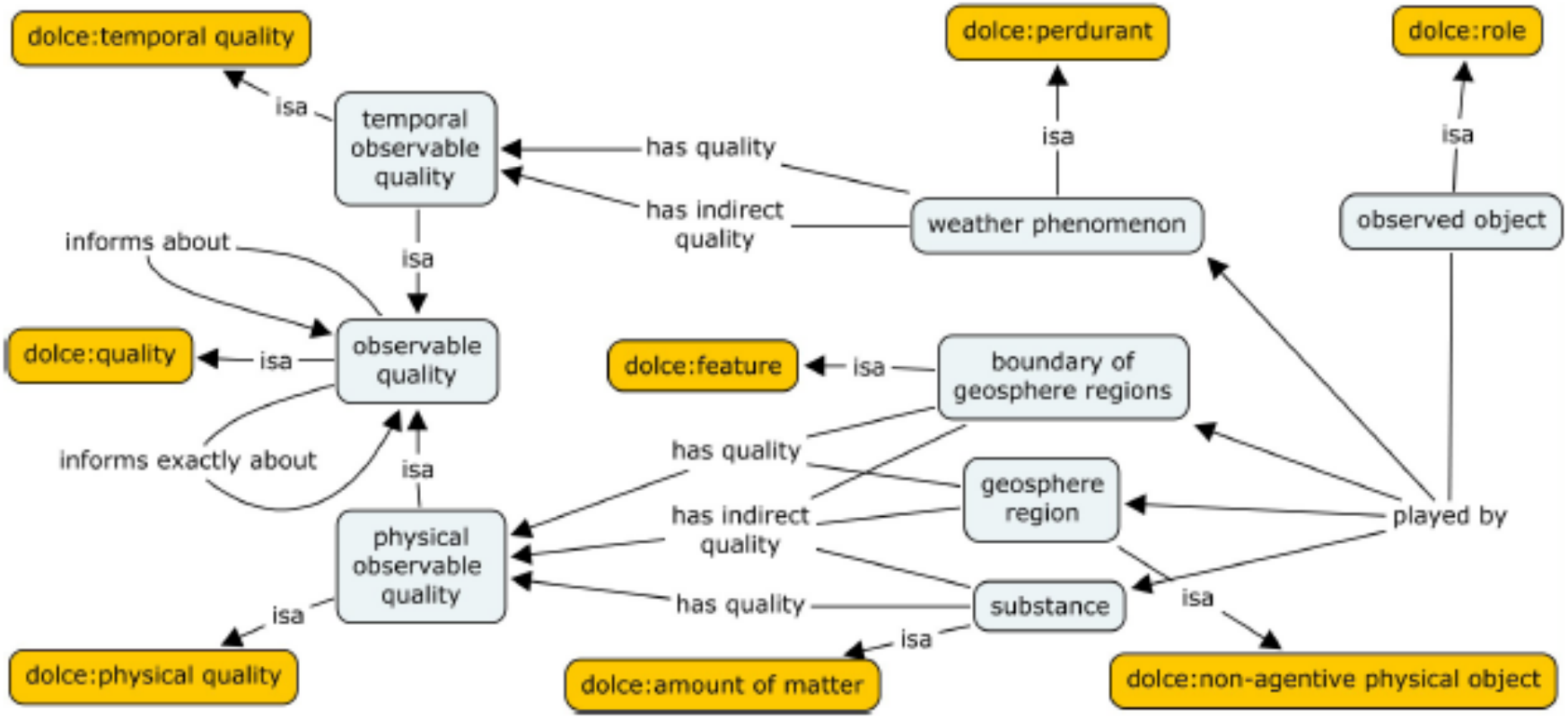
Solution:

- Semantic annotation of Web Services designed according to the SOS specification (OGC).



(A. Walkowski)

Ontology for Sensor Observation Services



The ontology is based on the OGC specification for sensor observation services.

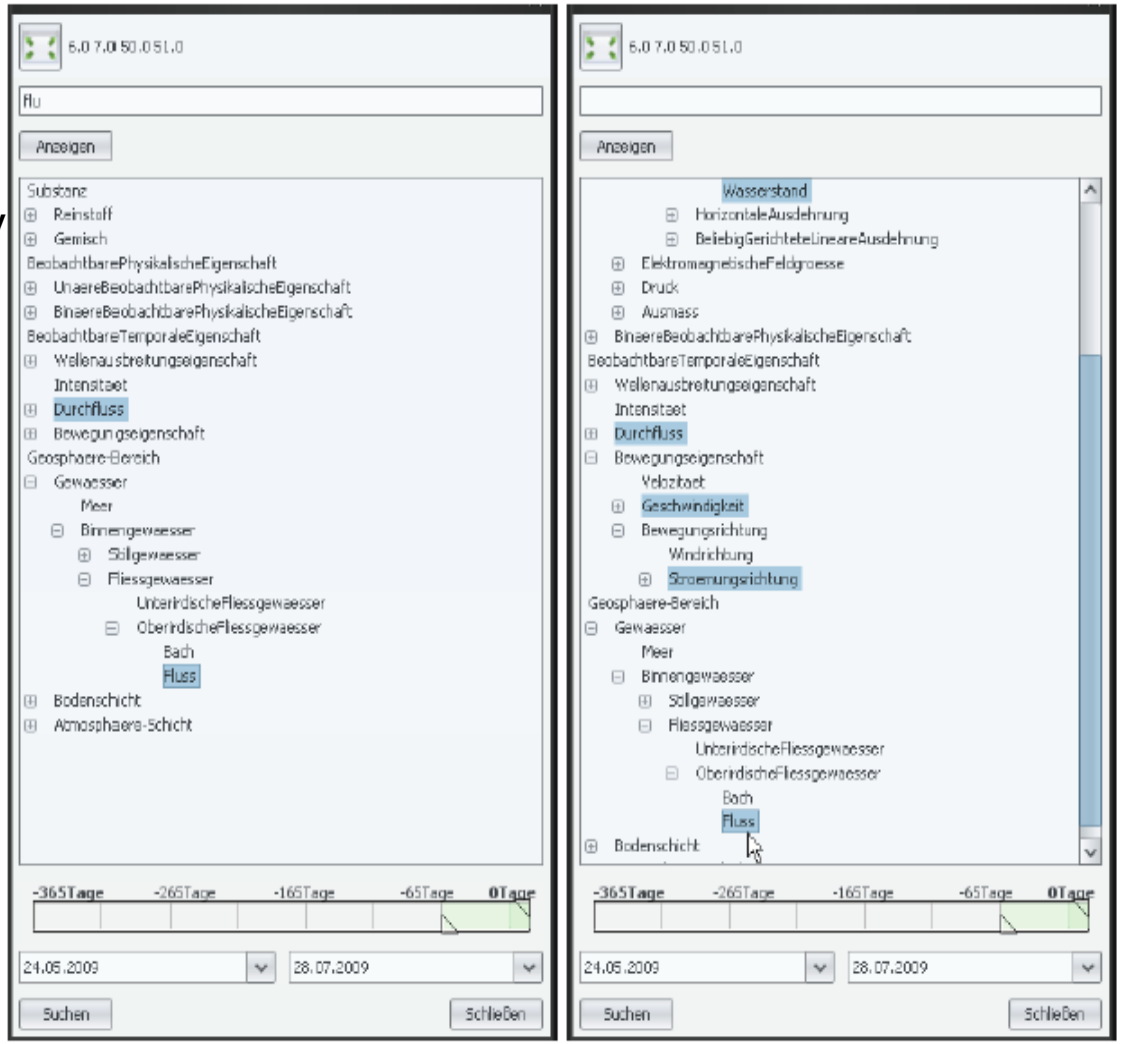
Ontology-based Search for Sensor Observation Services

User specifies via the ontology:

- Feature (entity) of interest entity (e.g. wind, water body,)
- Observed quality of that entity (e.g. speed, direction, depth, concentration of x)

The approach extends existing OGC standards.

Goal: Semantic support for catalog services



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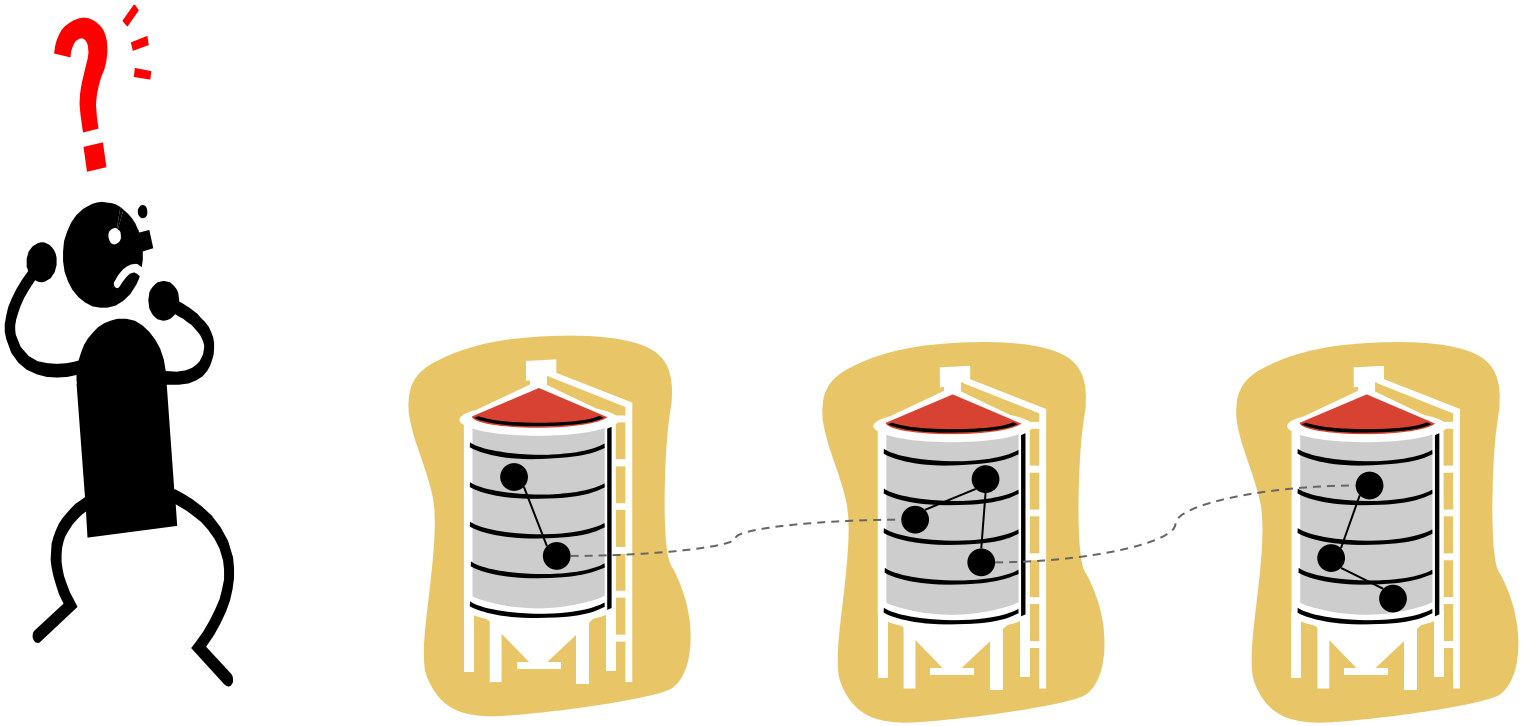
Motivation

- Information contained in “silos” (aka IT systems)
  - hard to grasp interrelations (especially for end users across organization boundaries)
  - deriving information from data is a hard task

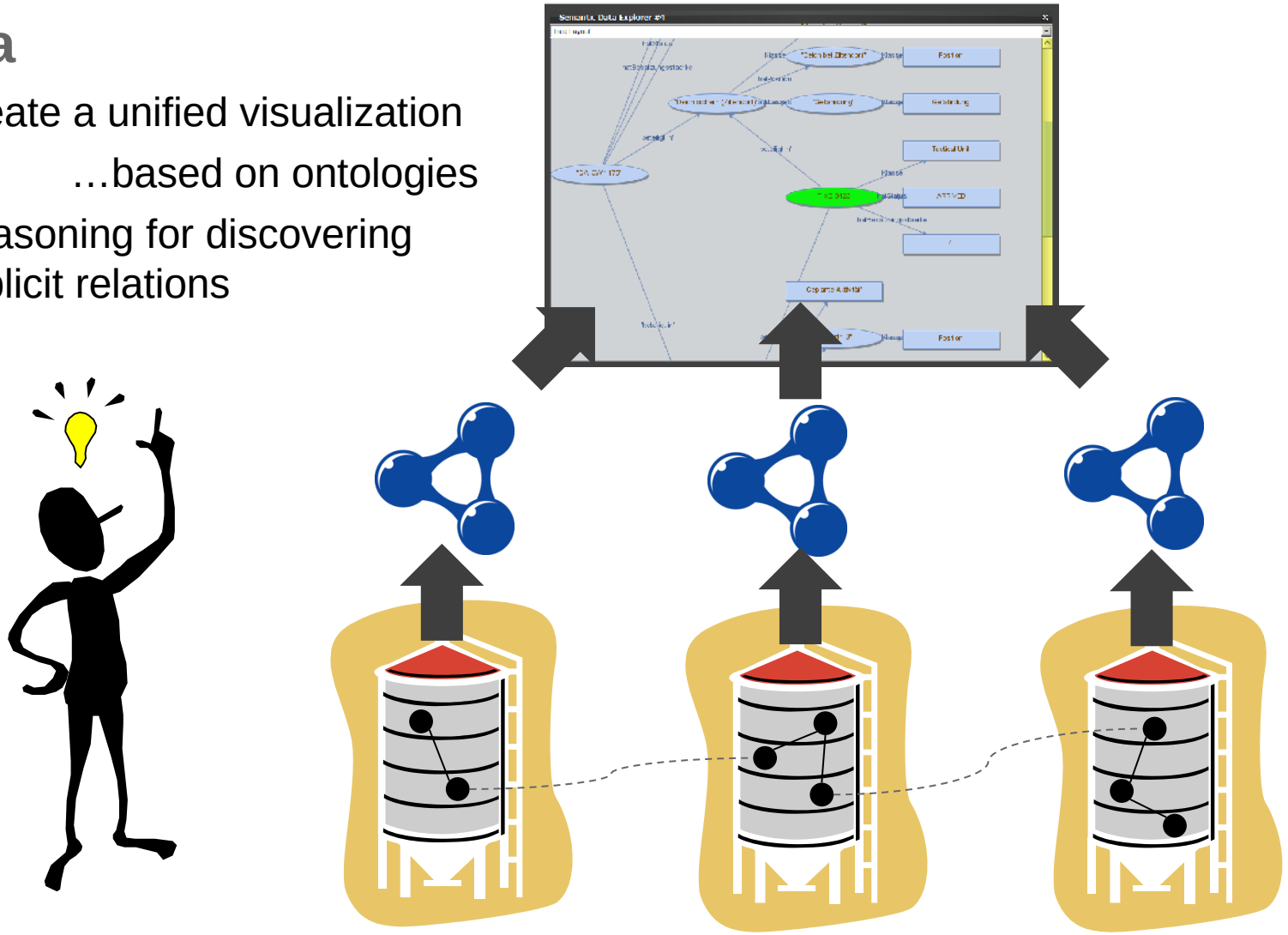


Use Case 6: Improved Information Visualization (cont.)

Idea

- Create a unified visualization

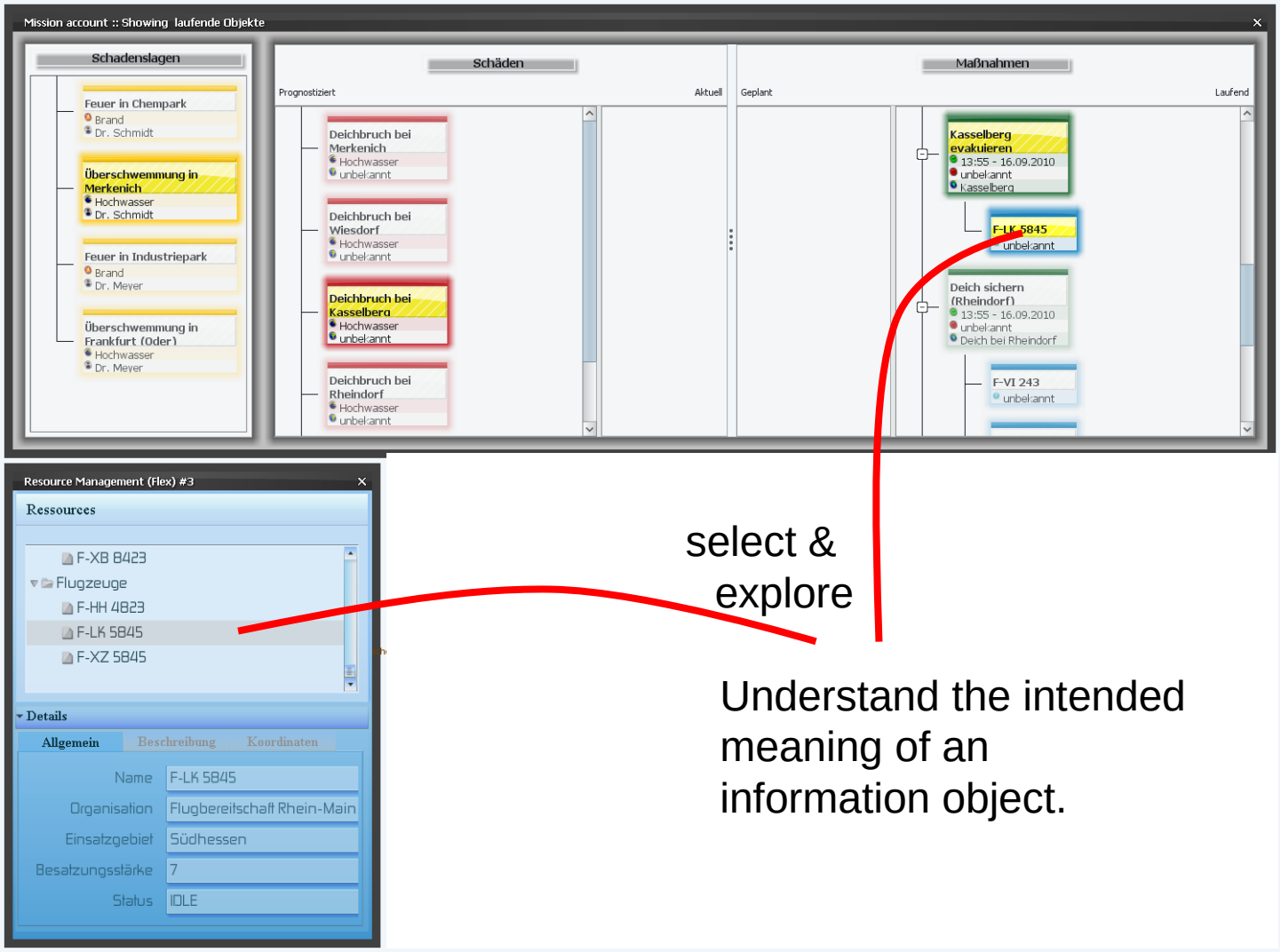
  …based on ontologies
- Reasoning for discovering implicit relations



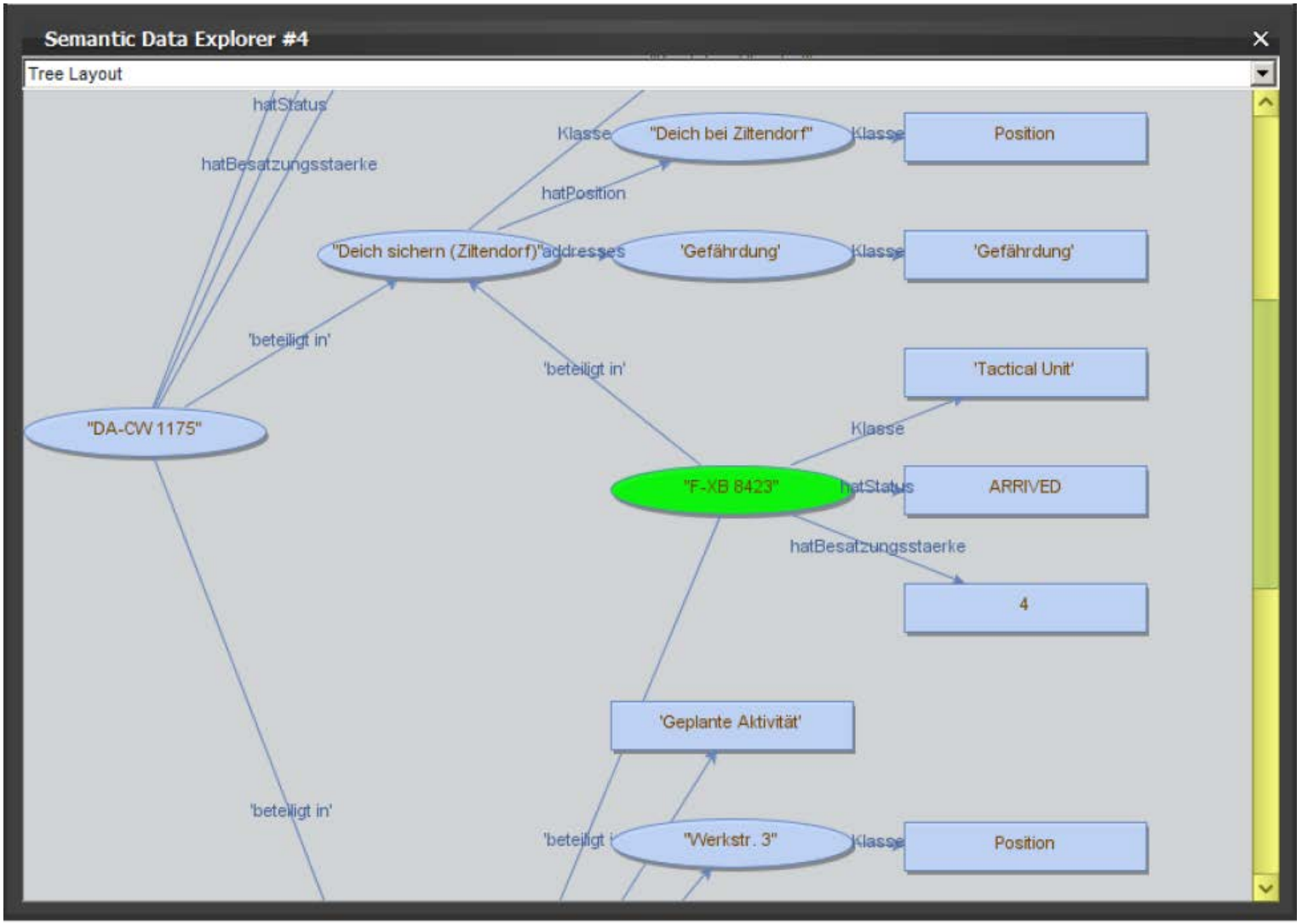
Interaction

- Visualizing objects
  - by dragging and dropping them onto the canvas
- Navigating
  - by opening nodes (double clicking)
- Hybrid visualization
  - selected objects in the graph are highlighted in original application
  - and vice versa

Setup



Screenshot Semantic Data Explorer



Lessons Learned

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Ontology Engineering Process

- Involving the end user (rather obvious)
- Establishing the role of an ontology engineer (in analogy to master courses in software engineering).
- Ontology editors need improvement in their browsing mechanisms, help systems and visualization metaphors." [Garca-Barriocanal], A statement from 2005 which unfortunately still holds true.

Software Engineering Process and Ontologies

- Developing new mechanisms for semantic annotations.

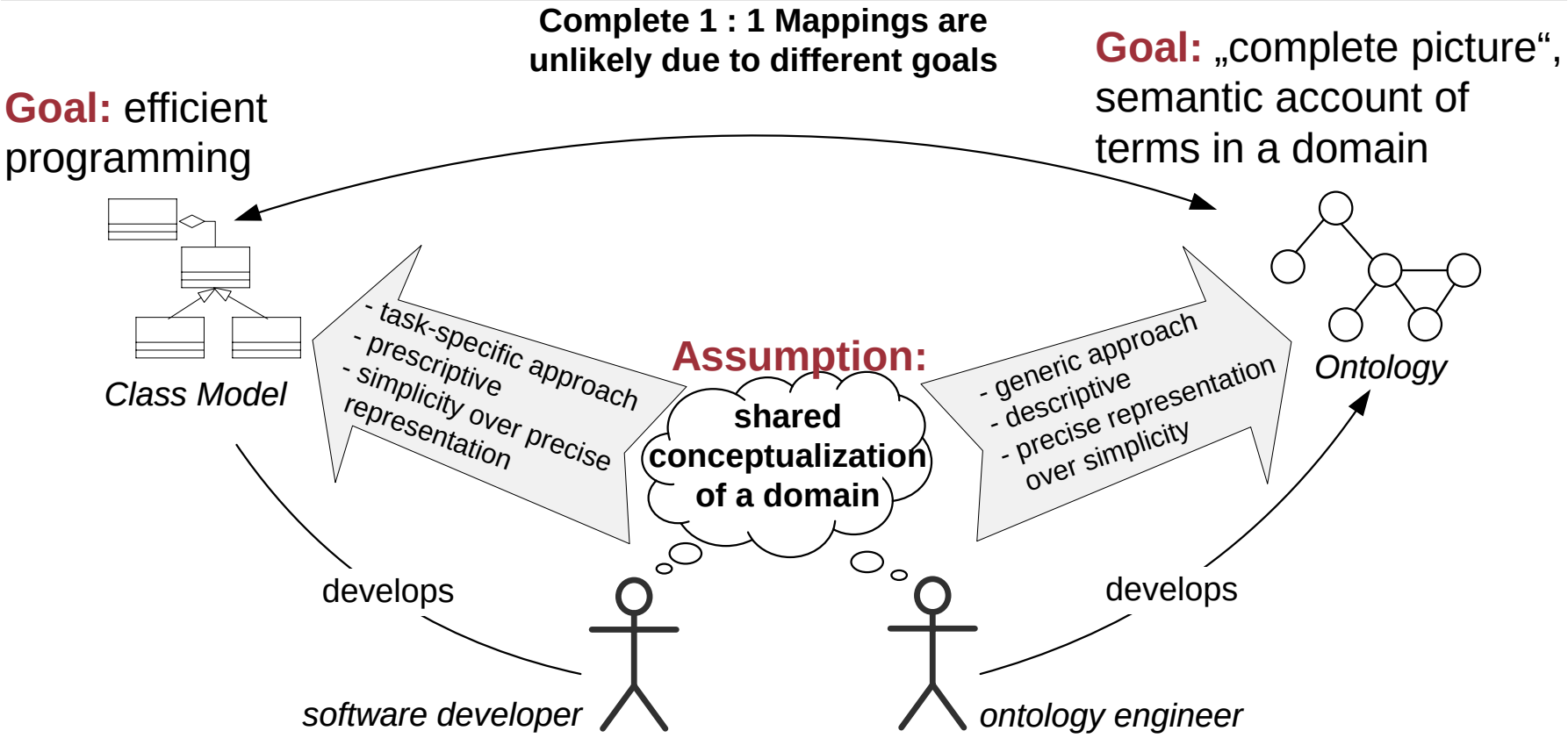
  → non-intrusive annotation of instances during run-time
- Addressing performance.

Lessons Learned

Ontology Usage and Suitability

- Finding the right modeling granularity.
- Domain experts were not used to concepts needed to create a formally correct ontology (DOLCE)
- End users were irritated by modeled domain terminology that was not part of their colloquial language.
- Finding the right visualization depth.

Lessons Learned: Data Models and Ontologies Serve Differente Purposes → 1:1 Mappings are not Helpful



Good software requires both:

1. Efficient code (fast, reliable, easy to maintain)
2. Sound and formal semantics of the exchanged information items

→ Both requirements need to be fulfilld without hapering the other.

Thank You!

Contact information:

Dr. Florian Probst
f.probst@sap.com