# LINKED DATA IN ASSET MANAGEMENT

## TWO CASES

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LDAC 2021
Luxembourg

TAXONIC

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**Ontologist | CEO**
Taxonic

TAXONIC

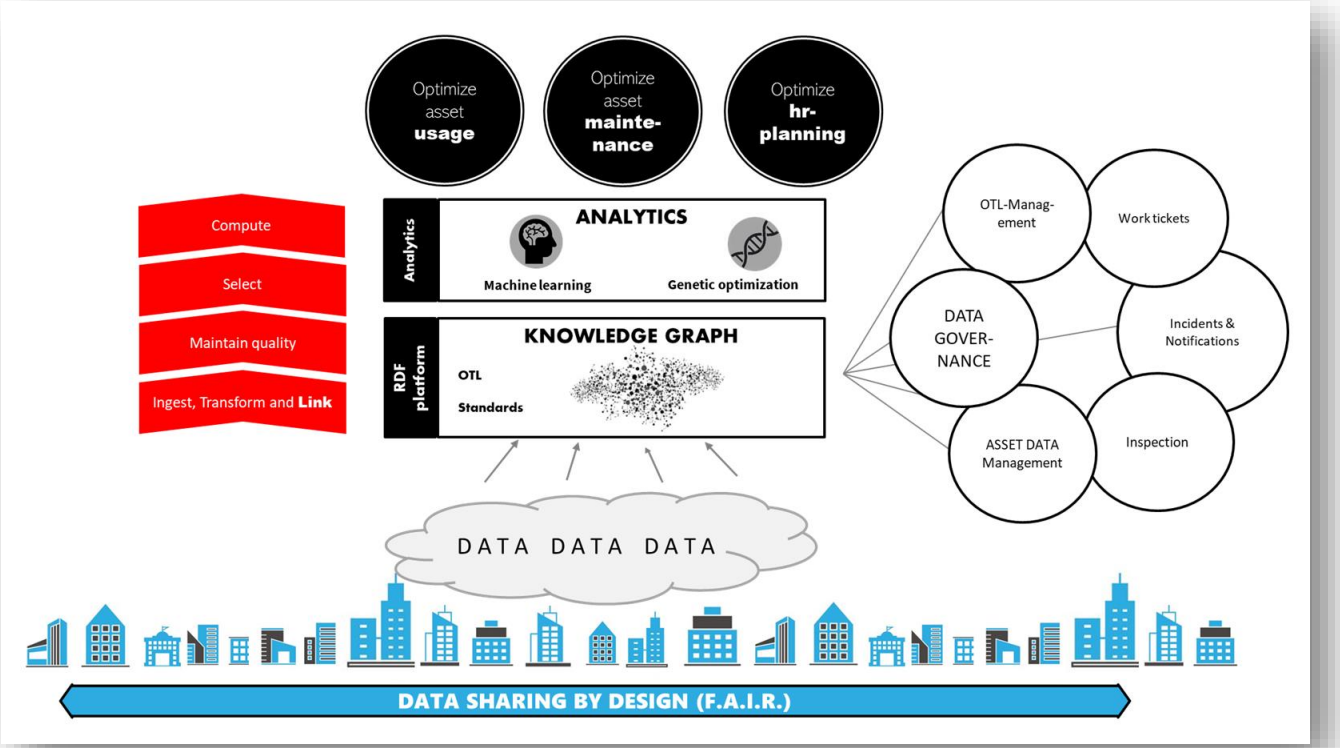
Founded in 2012 as a Dutch consultancy specializing in knowledge engineering

Practical application of knowledge graphs

Reseller and implementation partner TopQuadrant's TopBraid suite for local customers

# STRATEGIC GOAL

## Leveraging knowledge




# CASE 1

## COOPERATING IN THE UNDERGROUND


# Public sector Partners

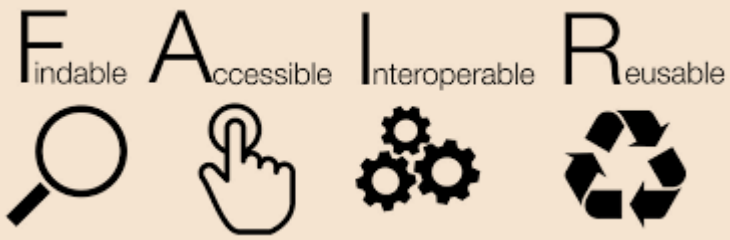
- National government (ministerie I&W, RWS)
- Union of waterboards (UvW)
- Federation of water companies (Vewin)
- Federation of Dutch municipalities (VNG)
- Provinces (IPO)

**COVENANT**

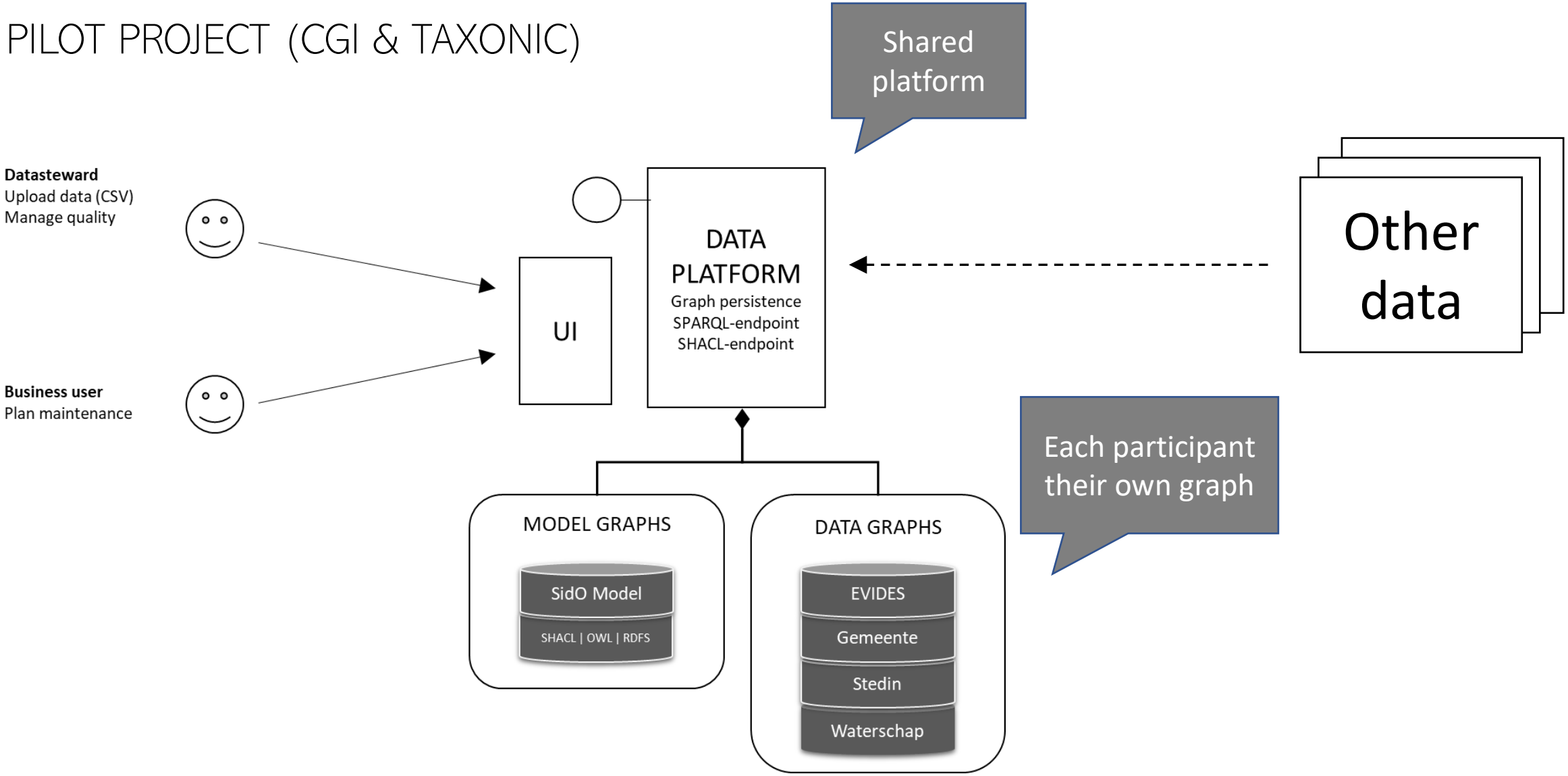
OPTIMIZATION THROUGH COOPERATION

**SIDO**

COOPERATION IN THE UNDERGROUND


Findable
Accessible
Interoperable
Reusable

# PILOT PROJECT (CGI & TAXONIC)



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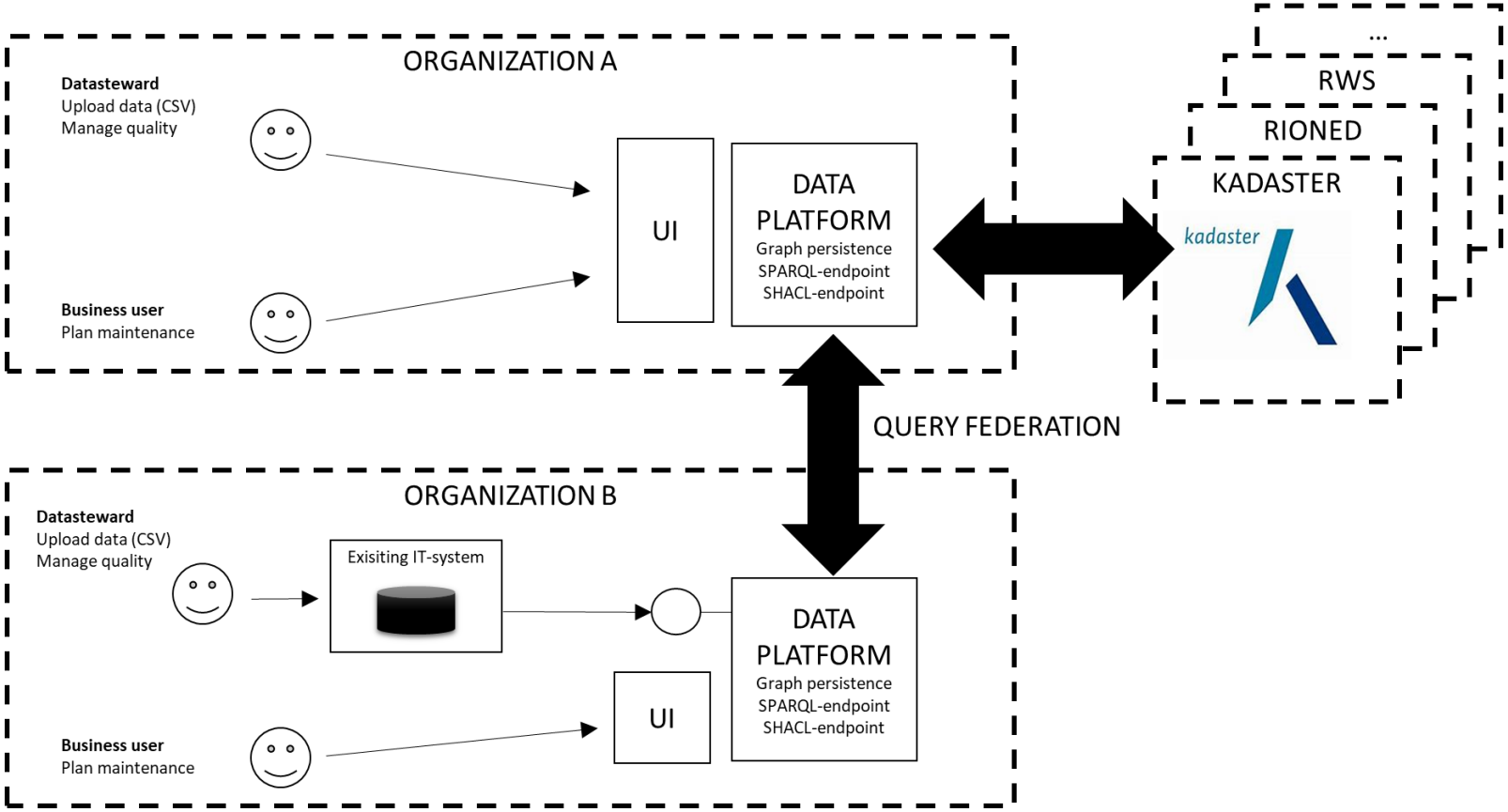
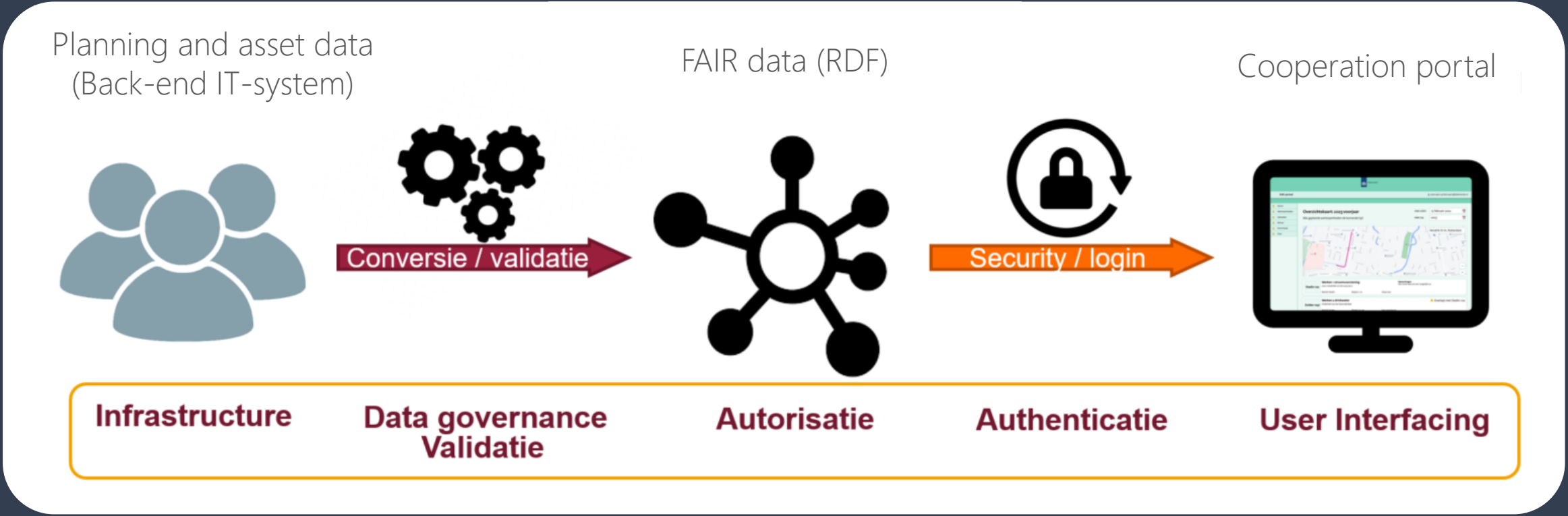


# WORK PROCESS
## FROM BACKEND TO PLATFORM



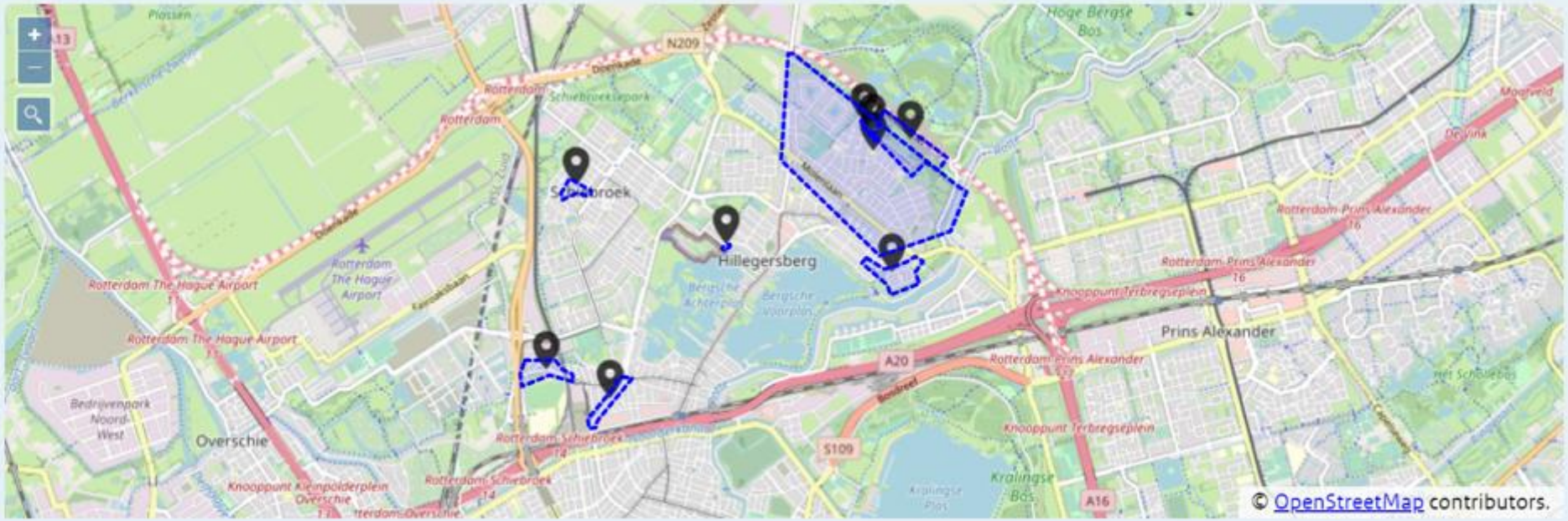
Rijksoverheid

Ministerie van Infrastructuur en Waterstaat > SidO Portaal

admin@cgi.com

- Home
- Dashboard
- FAIR evaluator
- Upload Dataset
- Kaart
- Beheer
- Over

Filter



# CASE 2

## CONTRACTOR'S PERSPECTIVE ON OTL

# Datafication
## FROM DOCUMENTS TO DATA

**Documents still rule**
Large infra projects use up to 10M documents

**Manual processes**
Computers offer tremendous potential

**Move towards data**
Computers understand data, not text

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# BIM | ASSET MANAGEMENT

EACH OBJECT A DIGITAL TWIN

INFORMATION REUSE

OPTIMIZED PROCESSES

SEAMLESS EXCHANGE

PREDICTIVE MAINTENANCE

**DIGITAL TWINS ARE NOT OPTIONAL**

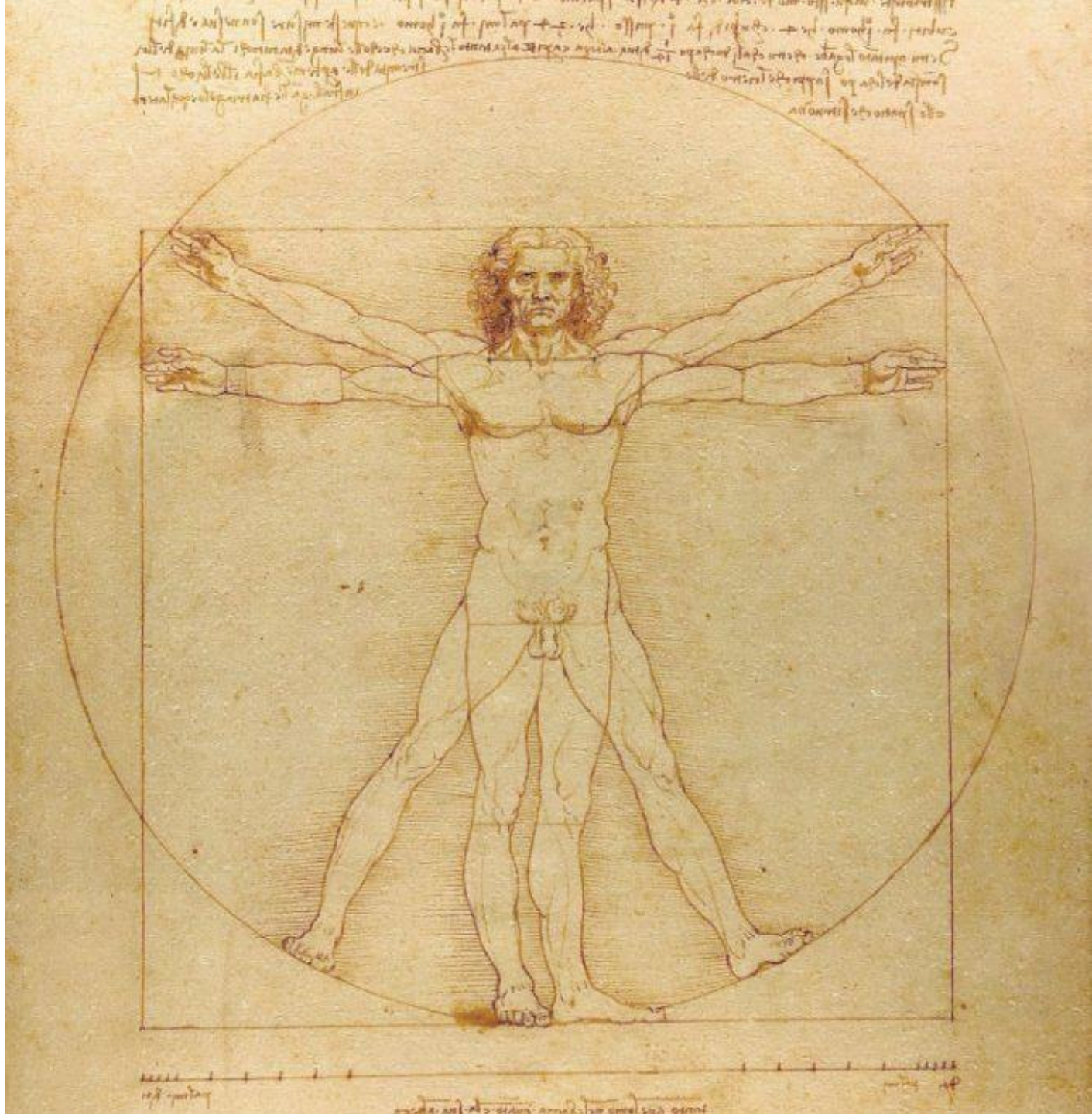
# Datafication

## EASIER SAID THAN DONE

**Black hole**
Data without data model are unusable

**Data models hard-coded**
Data models cannot be exchanged

**Knowledge graphs**
Knowledge graphs represent data **and** data model

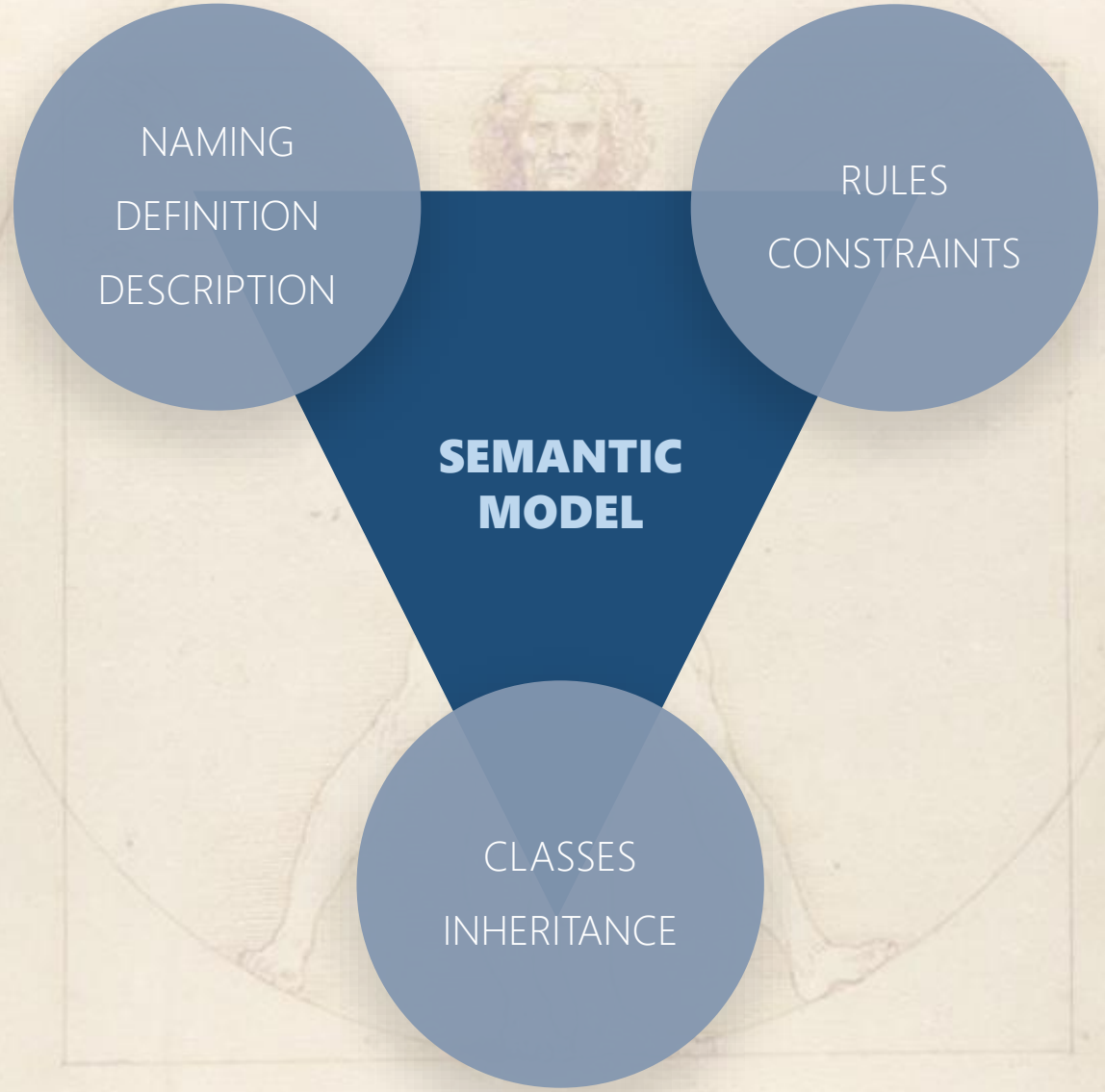


# RDF

## Exchanging data models

**Importance of data models**
Data models provide semantics so that computers “understand” data

**Semantic triangle**
Class hierarchy, definition, constraints



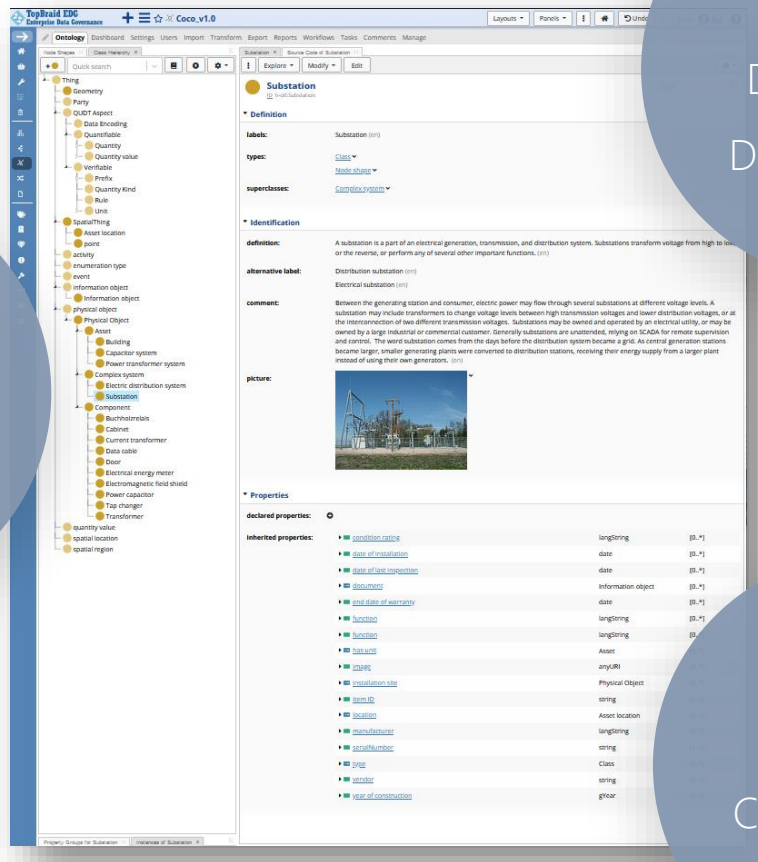
NAMING

DEFINITION

DESCRIPTION

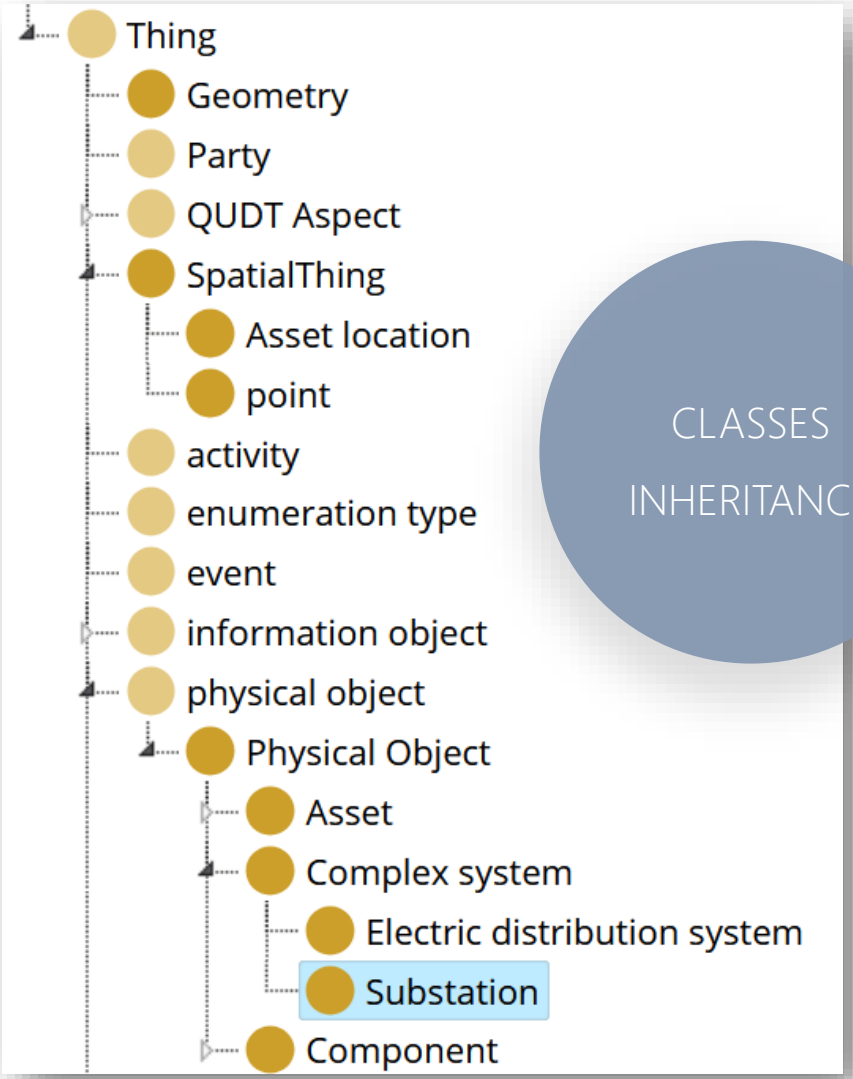
CLASSES

INHERITANCE




RULES

CONSTRAINTS



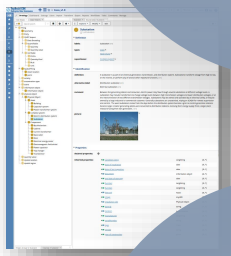

CLASSES

INHERITANCE

NAMING

DEFINITION

DESCRIPTION



RULES

CONSTRAINTS

## Substation

ID h-otl:Substation

Class

### Definition

**labels:** Substation (en)

**types:** Class

Node shape

**superclasses:** Complex system

NAMING

DEFINITION

DESCRIPTION

### Identification

**definition:** A substation is a part of an electrical generation, transmission, and distribution system. Substations transform voltage from high to low, or the reverse, or perform any of several other important functions. (en)

**alternative label:** Distribution substation (en)

Electrical substation (en)

**description:** Between the generating station and consumer, electric power may flow through several substations at different voltage levels. A substation may include transformers to change voltage levels between high transmission voltages and lower distribution voltages, or at the interconnection of two different transmission voltages. Substations may be owned and operated by an electrical utility, or may be owned by a large industrial or commercial customer. Generally substations are unattended, relying on SCADA for remote supervision and control. The word substation comes from the days before the distribution system became a grid. As central generation stations became larger, smaller generating plants were converted to distribution stations, receiving their energy supply from a larger plant instead of using their own generators. (en)

**picture:**

SES

ANCE

RULES

CONSTRAINTS

## Properties

**declared properties:**

**inherited properties:**

| | | |
|---|---|---|
| condition rating | langString | [0..*] |
| date of installation | date | [0..*] |
| date of last inspection | date | [0..*] |
| document | Information object | [0..*] |
| end date of warranty | date | [0..*] |
| function | langString | [0..*] |
| function | langString | [0..*] |
| has unit | Asset | [0..*] |
| image | anyURI | [0..*] |
| installation site | Physical Object | [0..*] |
| item ID | string | [1..1] |
| location | Asset location | [0..*] |
| manufacturer | langString | [0..*] |
| serialNumber | string | [1..1] |
| type | Class | [0..*] |
| vendor | string | [0..*] |
| year of construction | gYear | [0..1] |

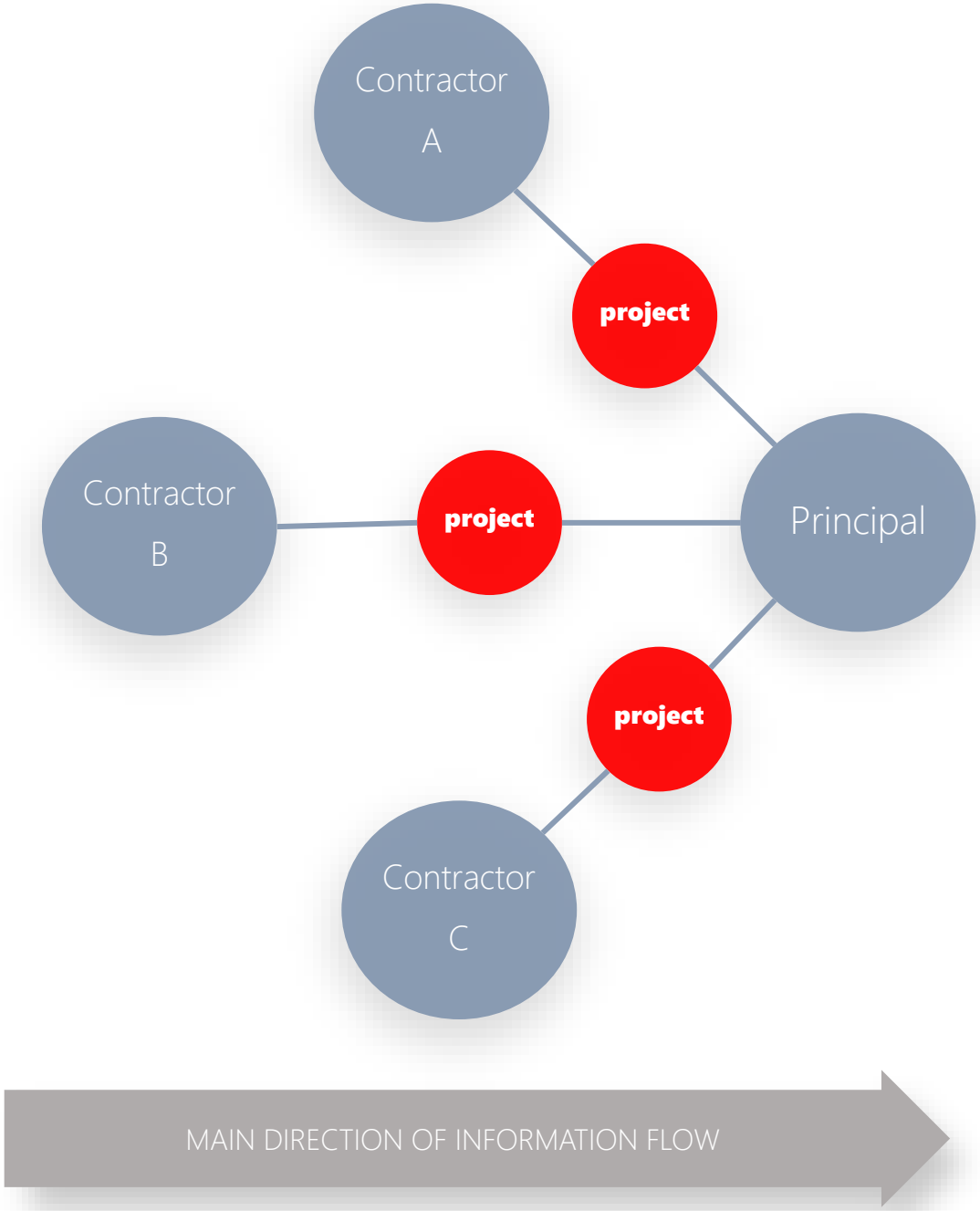
RULES
CONSTRAINTS

CLASSES
INHERITANCE

NAMING
DEFINITION
DESCRIPTION

# USING GRAPHS

## The principal's perspective

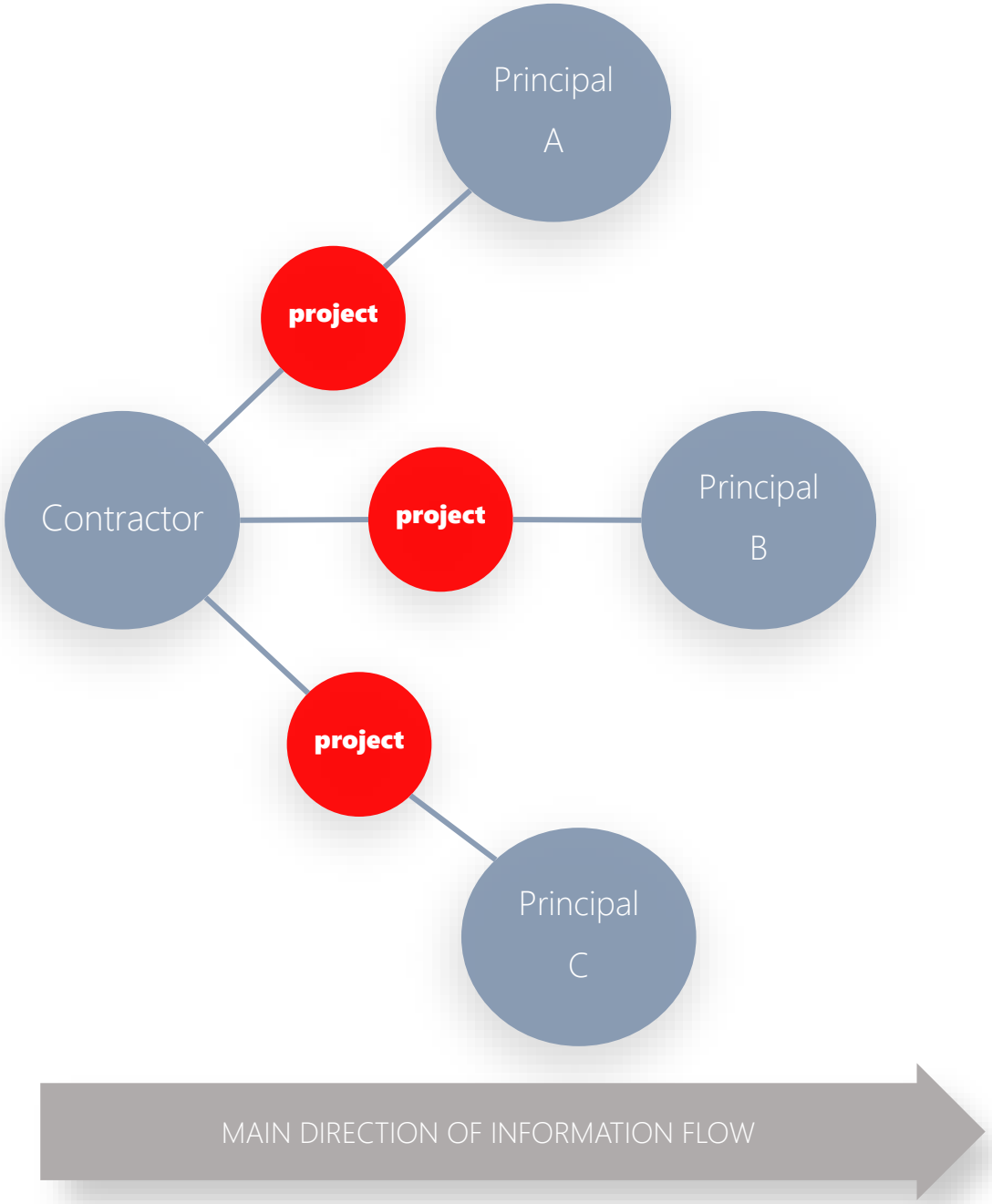



**Exchangeable models**
Object Type Library
Engineering Class Library
Reference Data Library
Ontology

**Many examples**
Schiphol AIM project

# USING GRAPHS

## The contractor's perspective




**Many exchangeable models**
Each project a different OTL

**Integration with IT-systems**
Knowledge graphs solve this problem

# Graph coalescence

## Combining graphs

TopBraid EDG Enterprise Data Governance

Concom2GridCo

Layouts | Panels | Undo | Hello, Administrator

Mappings | Dashboard | Settings | Users | Import | Transform | Export | Reports | Workflows | Tasks | Comments | Manage

Concom2GridCo Crosswalk | Mappings for Concom2GridCo | Source Code of Concom2GridCo

Free Text | Generate Mappings | Concom-OTL | GridCo-OTL

18 rows

| Class (Concom-OTL) | Class (GridCo-OTL) |
|---|---|
| Electromagnetic field shield | |
| Door | |
| Building | • housing system |
| Power capacitor | • power capacitor |
| Power transformer system | • power transformer system |
| Substation | • substation |
| Tap changer | • tap-changer |
| Transformer | • transformer |

Concom classes

GridCo classes

Problems and Suggestions

8 results

**Capacitor system (crosswalk:closeMatch)**
**Unmapped term "Capacitor system"**
*Suggestion:* Map to capacitor system (Confidence: 100) Preview Apply

**Component (crosswalk:closeMatch)**
**Unmapped term "Component"**
*Suggestion:* Map to component system (Confidence: 56) Preview Apply

**Current transformer (crosswalk:closeMatch)**
**Unmapped term "Current transformer"**
*Suggestion:* Map to current transformer (Confidence: 100) Preview Apply

**Door (crosswalk:closeMatch)**
**Unmapped term "Door"**
*Suggestion:* Map to door (Confidence: 100) Preview Apply

**Electric distribution system (crosswalk:closeMatch)**
**Unmapped term "Electric distribution system"**
*Suggestion:* Map to electric distribution system (Confidence: 100) Preview Apply

**Electromagnetic field shield (crosswalk:closeMatch)**
**Unmapped term "Electromagnetic field shield"**
*Suggestion:* Map to electromagnetic field shield (Confidence: 100) Preview Apply

**Nothing (crosswalk:closeMatch)**
**Unmapped term "Nothing"**
*Suggestion:* Map to Thing (Confidence: 71) Preview Apply

**Thing (crosswalk:closeMatch)**
**Unmapped term "Thing"**
*Suggestion:* Map to thin film photovoltaic module (Confidence: 13) Preview Apply

Download as JSON Download as TSV Apply all top suggestions

Auto-generated suggestions

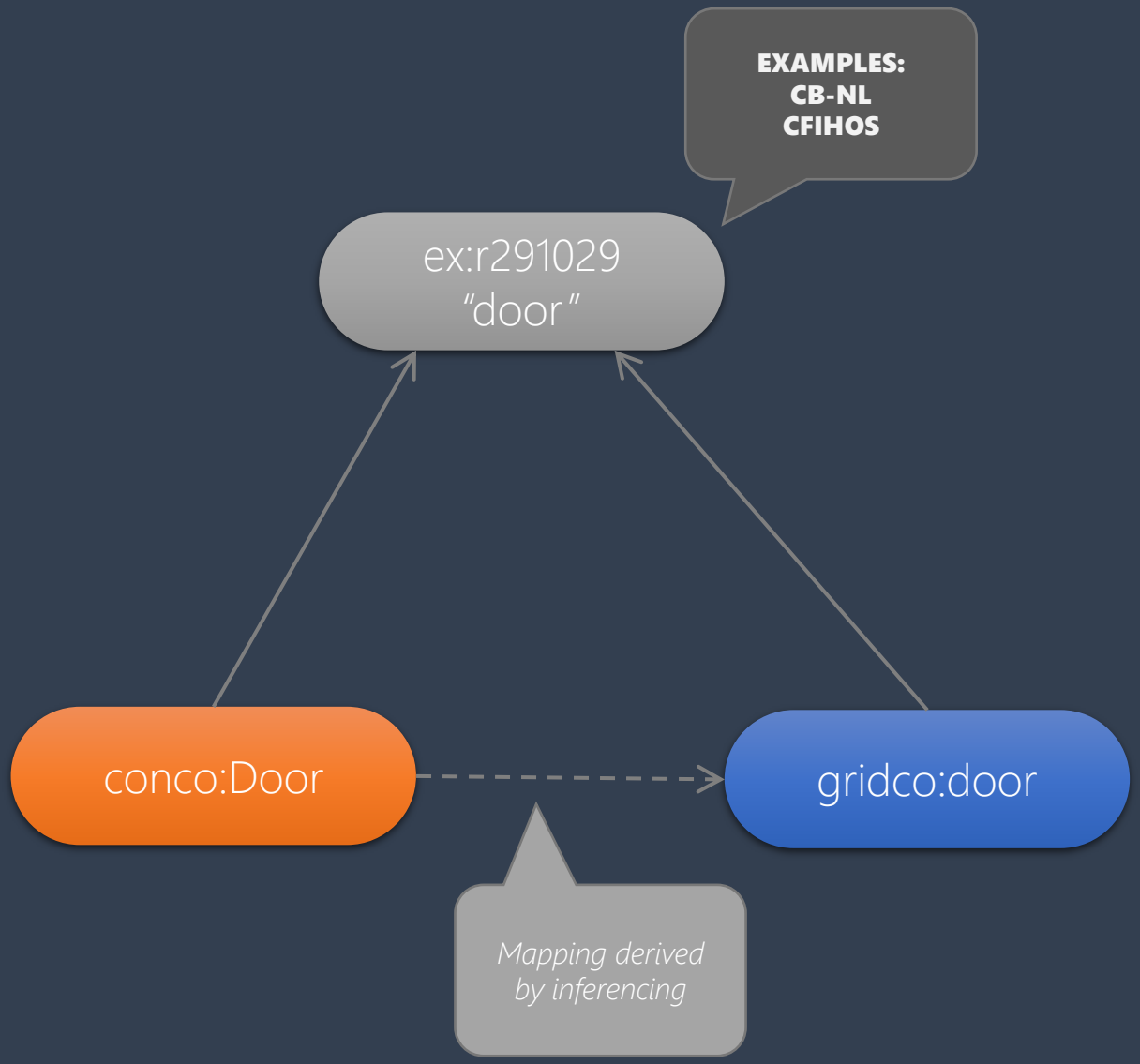
# MAPPING RULES

## HOW MAPPINGS ARE GENERATED

**Simple similarity of labels**
This is used in the demo

**Adding more labels**
More matches (also false positives)

**Third party taxonomies**
Transitive closure

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# Unified approach

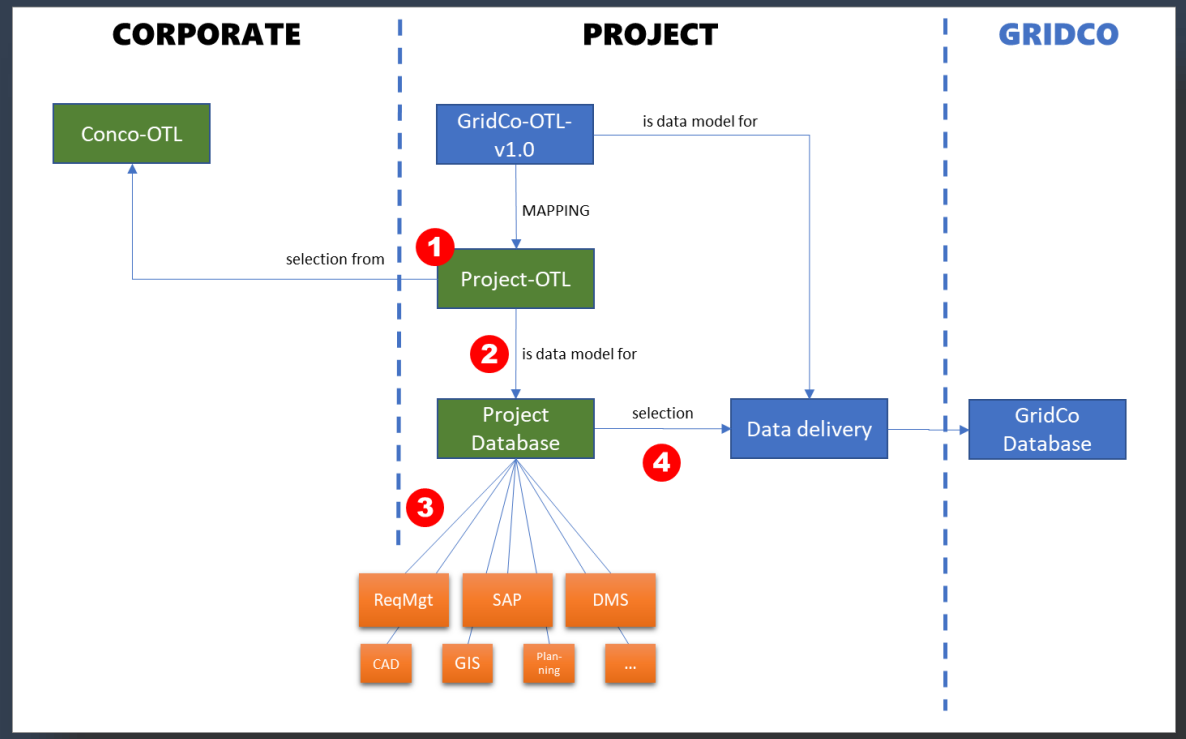
## Combining graphs

1. **Project OTL**
   Combining two OTLs and mappings

2. **Project database**
   Concom-OTL is the leading model

3. **Integration with back-end IT**
   Interfaces reusable across projects

4. **Data delivery**
   Reusable SHACL Rules for executing the mapping rules



# THANK YOU!

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