Ontology-based Data Governance and Enterprise Data Modelling

Standards, AI Readiness and Governance Processes for PLM Data Management, a "Data Town Plan" Approach.

Mikkel H. Brynildsen. Chief Data Scientist, Data&AI, Grundfos.



PLM Road Map™ & PDT EMEA 2026

AI in PLM: A Disruptive Opportunity and Challenge

Turning AI disruption into enterprise value:
Strategic insights for the PLM professional

4-5 November 2026

CIMdata®

www.CIMdata.com

Water Systems

Grundfos is a leading pump manufacturer



"Alpha2" Circulator pump



KPL Flood control pump

2070 liters / second

Who am I

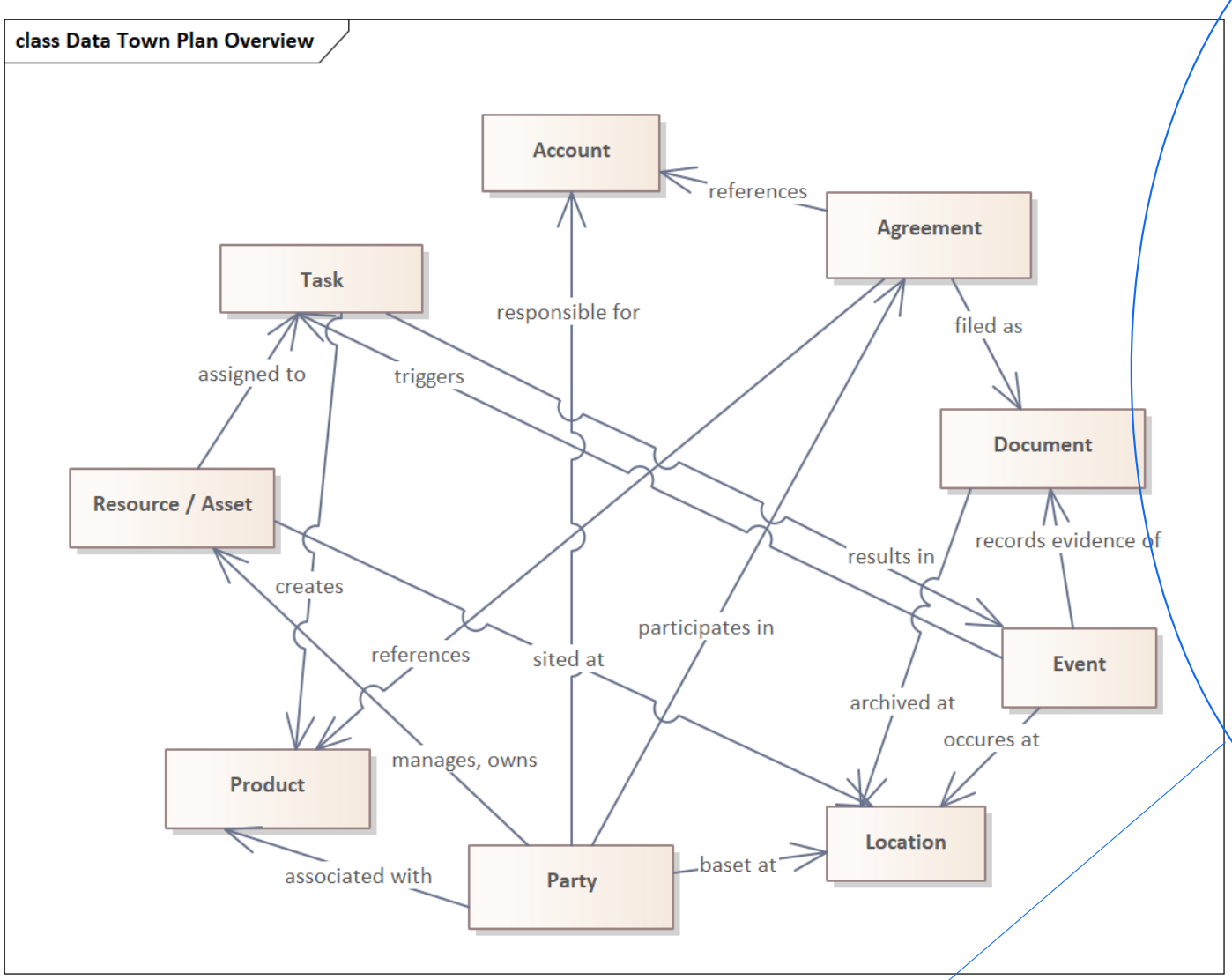
- Chief Data Scientist at Grundfos “Data&AI”.
  - Data Governance
  - AI
- PhD Mathematical Physics.
- Danish representative to ISO 23726 standards development (ontology-based interoperability). Project leader for ISO 23726-2.





Industrial Scale Knowledge Graphs

Data Town Plan Approach:
Start with a high-level conceptual data model



An **Account** is a company, organization or individual acting as a legal/financial entity with whom a financial relationship exists or has the potential to exist.
An **Agreement** is an arrangement (typically one which is legally binding) made between two or more parties and agreed by mutual consent. Also: a document or instrument embodying this.

A **Document** is something written, inscribed, etc., which furnishes evidence or information upon any subject. Can be a collection of data in digital form that is considered a single item and typically has a unique filename by which it can be stored, retrieved, or transmitted (as a file, a spreadsheet, or a graphic).

An **Event** is Something that happens or takes place.

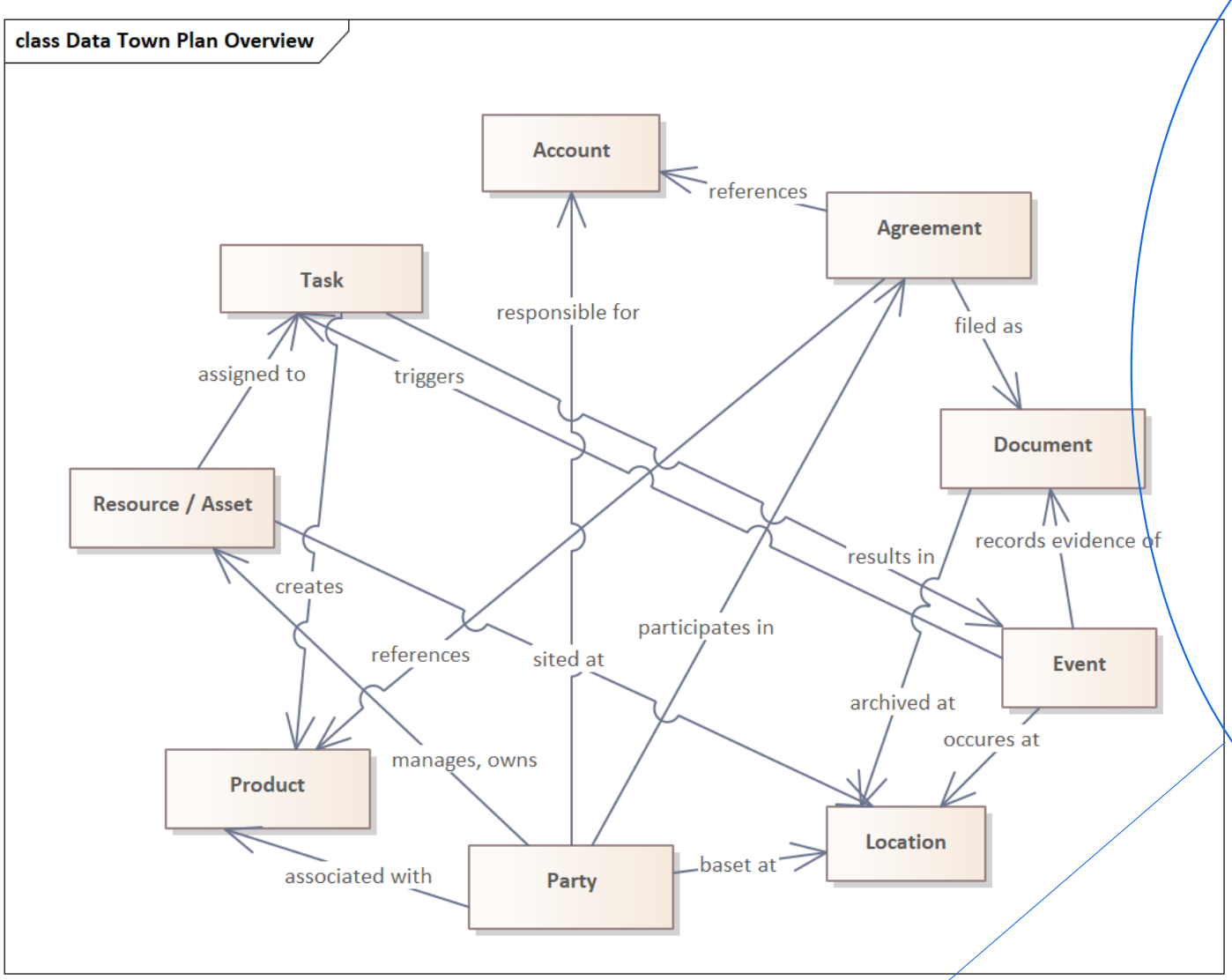
A **Location** is the particular place or position occupied by a person or thing or precise situation.
A **Party** is a person or organization (group of persons).
A **Product** is an artifact that is intended to be sold or has been sold.

Resources are Stocks or reserves of money, materials, or some other asset, which can be drawn on when necessary.

A **Task** is a piece of work. A task can define an overall profile of Tasks that occur frequently.
Sources: Oxford English Dictionary, IDO

Source: John Giles: “Elephant In the Fridge”

Each class in the Town Plan Conceptual Model unfolds to a proven data warehouse (Data Vault 2.0) Design Pattern.



An **Account** is a company, organization or individual acting as a legal/financial entity with whom a financial relationship exists or has the potential to exist.
An **Agreement** is an arrangement (typically one which is legally binding) made between two or more parties and agreed by mutual consent. Also: a document or instrument embodying this.

A **Document** is something written, inscribed, etc., which furnishes evidence or information upon any subject. Can be a collection of data in digital form that is considered a single item and typically has a unique filename by which it can be stored, retrieved, or transmitted (as a file, a spreadsheet, or a graphic).

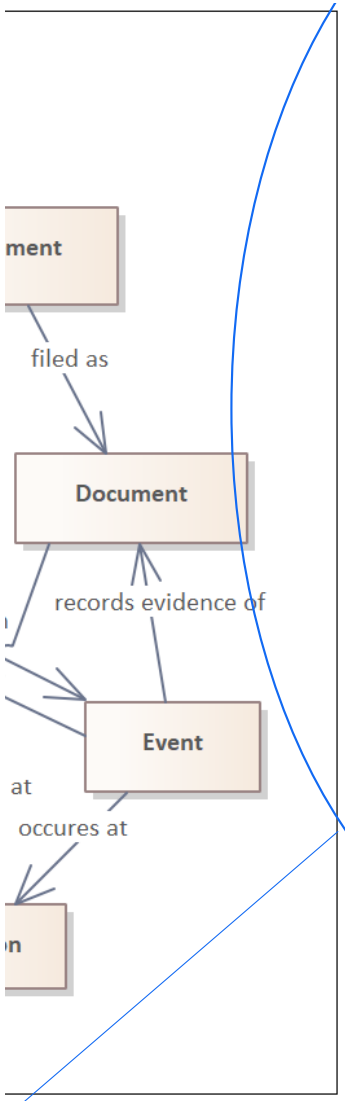
An **Event** is Something that happens or takes place.

A **Location** is the particular place or position occupied by a person or thing or precise situation.
A **Party** is a person or organization (group of persons).
A **Product** is an artifact that is intended to be sold or has been sold.

Resources are Stocks or reserves of money, materials, or some other asset, which can be drawn on when necessary.

A **Task** is a piece of work. A task can define an overall profile of Tasks that occur frequently.
Sources: Oxford English Dictionary, IDO

Source: John Giles: “Elephant In the Fridge”



e: John Giles: “Elephant In the Fridge”

An **Account** is a company, organization or individual acting as a legal/financial entity with whom a financial relationship exists or has the potential to exist.
An **Agreement** is an arrangement (typically one which is legally binding) made between two or more parties and agreed by mutual consent. Also: a document or instrument embodying this.

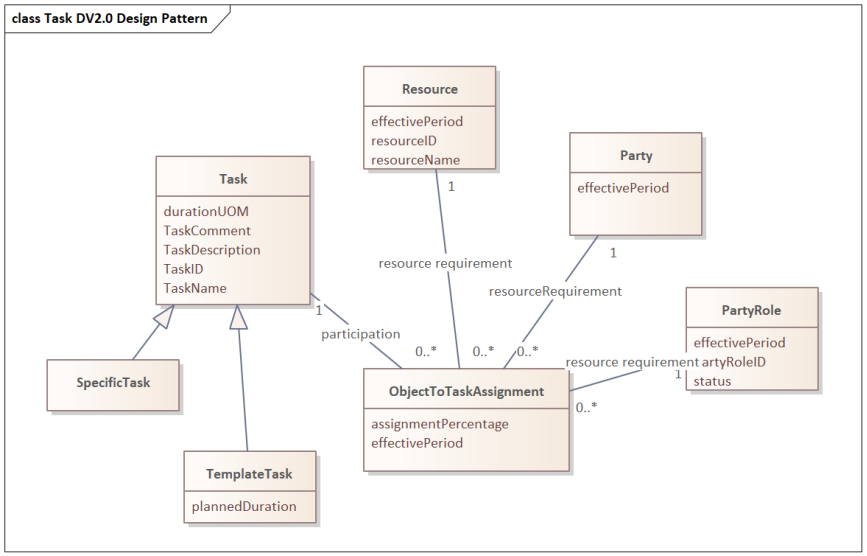
A **Document** is something written, inscribed, etc., which furnishes evidence or information upon any subject. Can be a collection of data in digital form that is considered a single item and typically has a unique filename by which it can be stored, retrieved, or transmitted (as a file, a spreadsheet, or a graphic).

An **Event** is Something that happens or takes place.

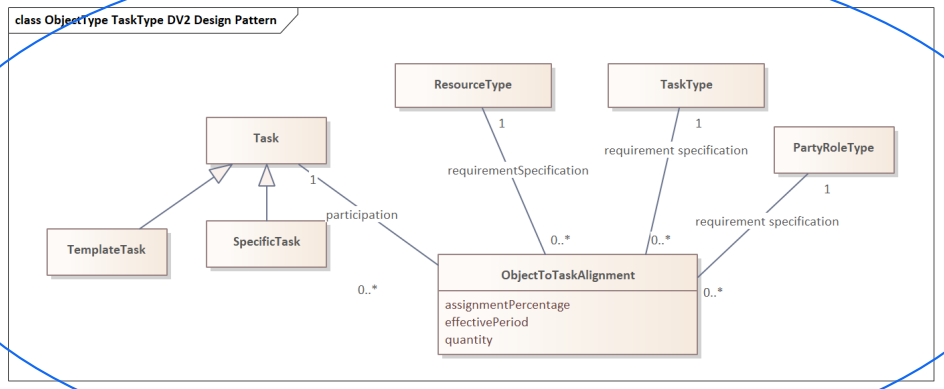
A **Location** is the particular place or position occupied by a person or thing or precise situation.
A **Party** is a person or organization (group of persons).
A **Product** is an artifact that is intended to be sold or has been sold.

Resources are Stocks or reserves of money, materials, or some other asset, which can be drawn on when necessary.

A **Task** is a piece of work. A task can define an overall profile of Tasks that occur frequently.
Sources: Oxford English Dictionary, IDO



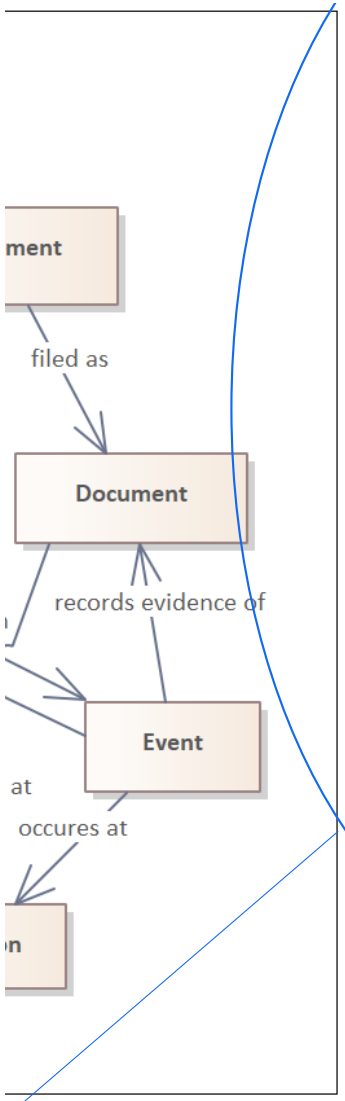
Source: John Giles: “Elephant In the Fridge”



Source: John Giles: “Elephant In the Fridge”

The classes are defined by Business Data Experts, in the context of the company data governance framework.

Data Managers are trained in Ontological approach to what constitutes a good definition.



e: John Giles: “Elephant In the Fridge”

An **Account** is a company, organization or individual acting as a legal/financial entity with whom a financial relationship exists or has the potential to exist.
An **Agreement** is an arrangement (typically one which is legally binding) made between two or more parties and agreed by mutual consent. Also: a document or instrument embodying this.

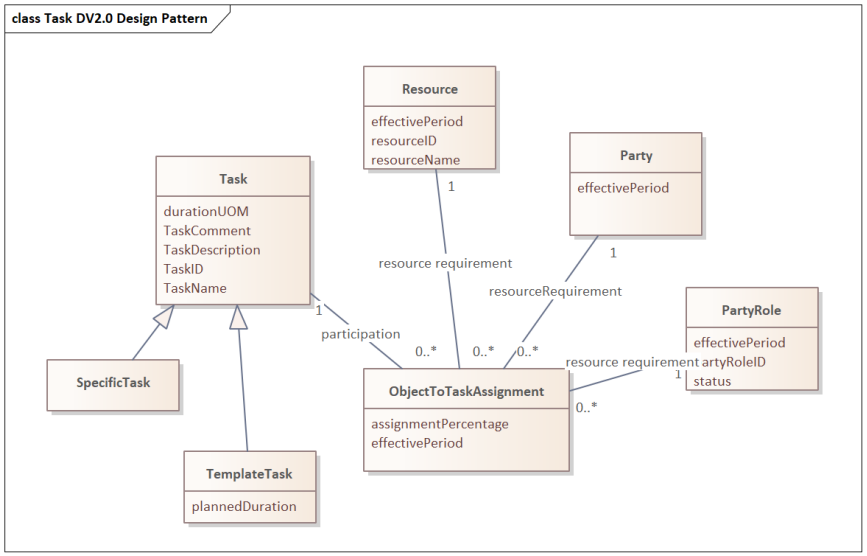
A **Document** is something written, inscribed, etc., which furnishes evidence or information upon any subject. Can be a collection of data in digital form that is considered a single item and typically has a unique filename by which it can be stored, retrieved, or transmitted (as a file, a spreadsheet, or a graphic).

An **Event** is Something that happens or takes place.

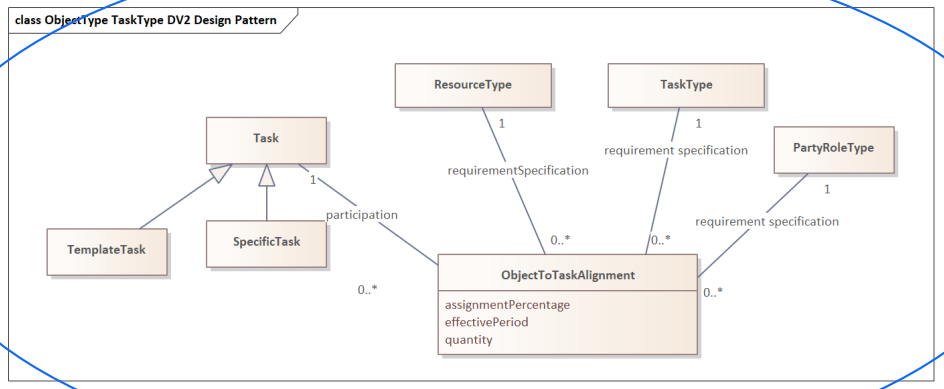
A **Location** is the particular place or position occupied by a person or thing or precise situation.
A **Party** is a person or organization (group of persons).
A **Product** is an artifact that is intended to be sold or has been sold.

Resources are Stocks or reserves of money, materials, or some other asset, which can be drawn on when necessary.

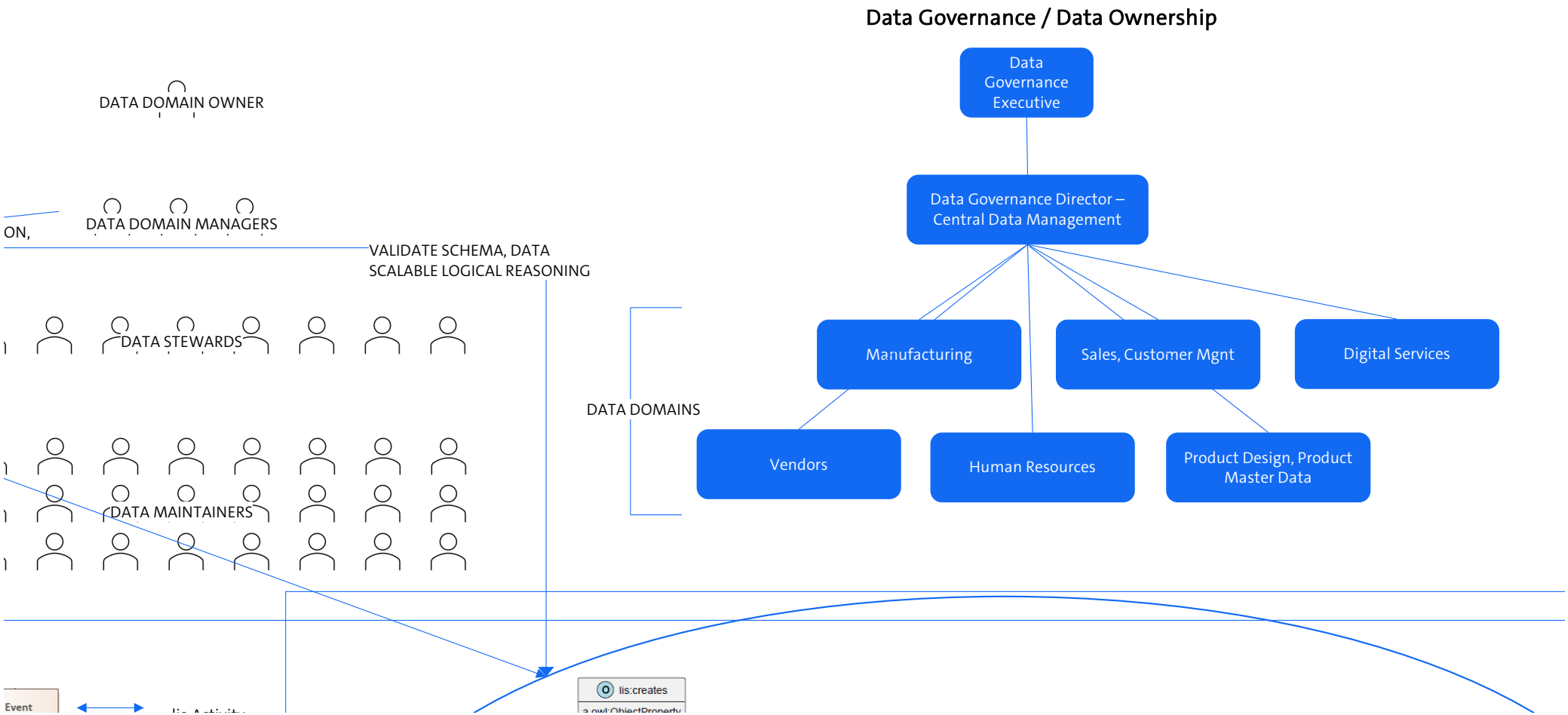
A **Task** is a piece of work. A task can define an overall profile of Tasks that occur frequently.
Sources: Oxford English Dictionary, IDO



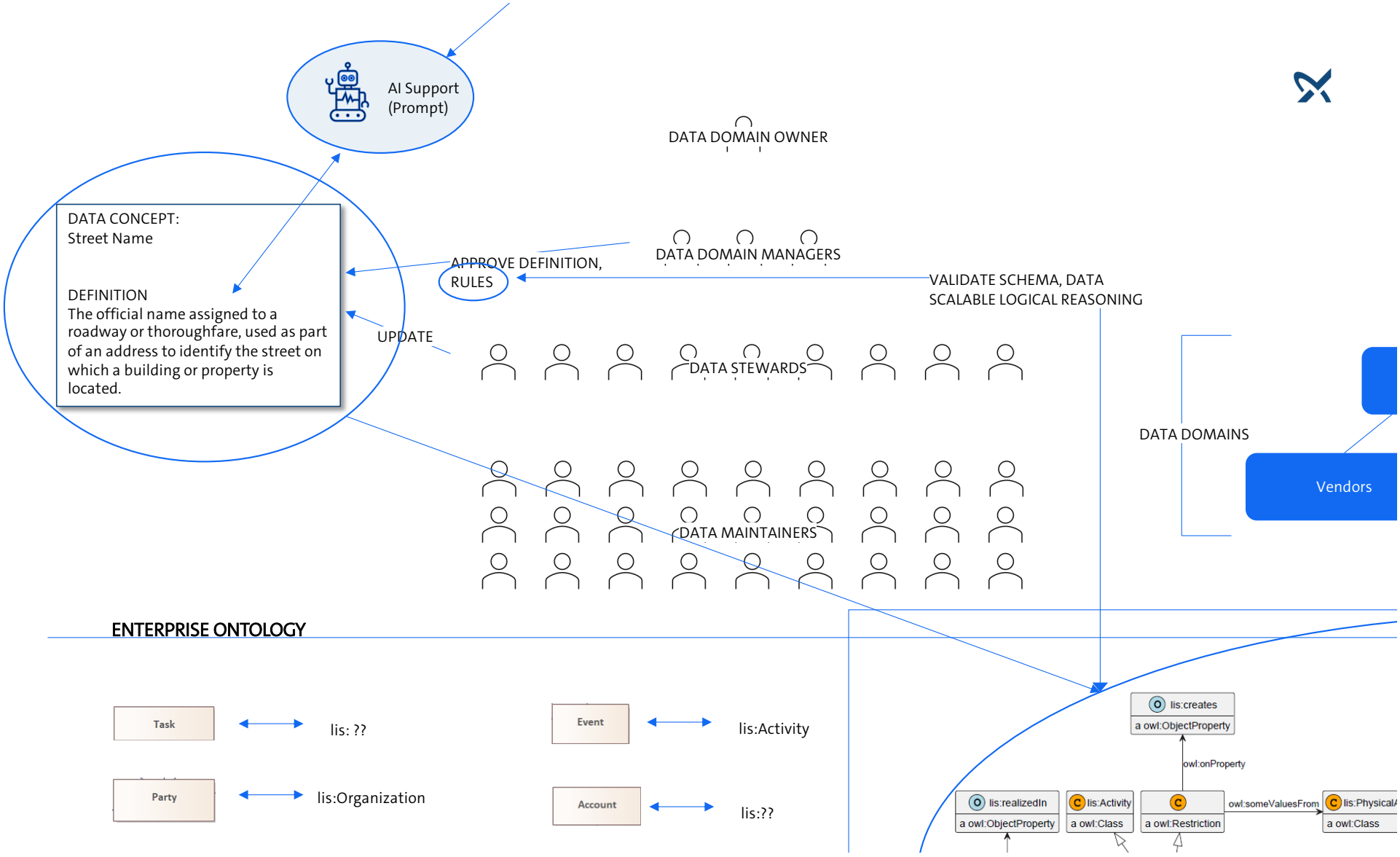
Source: John Giles: “Elephant In the Fridge”



Source: John Giles: “Elephant In the Fridge”



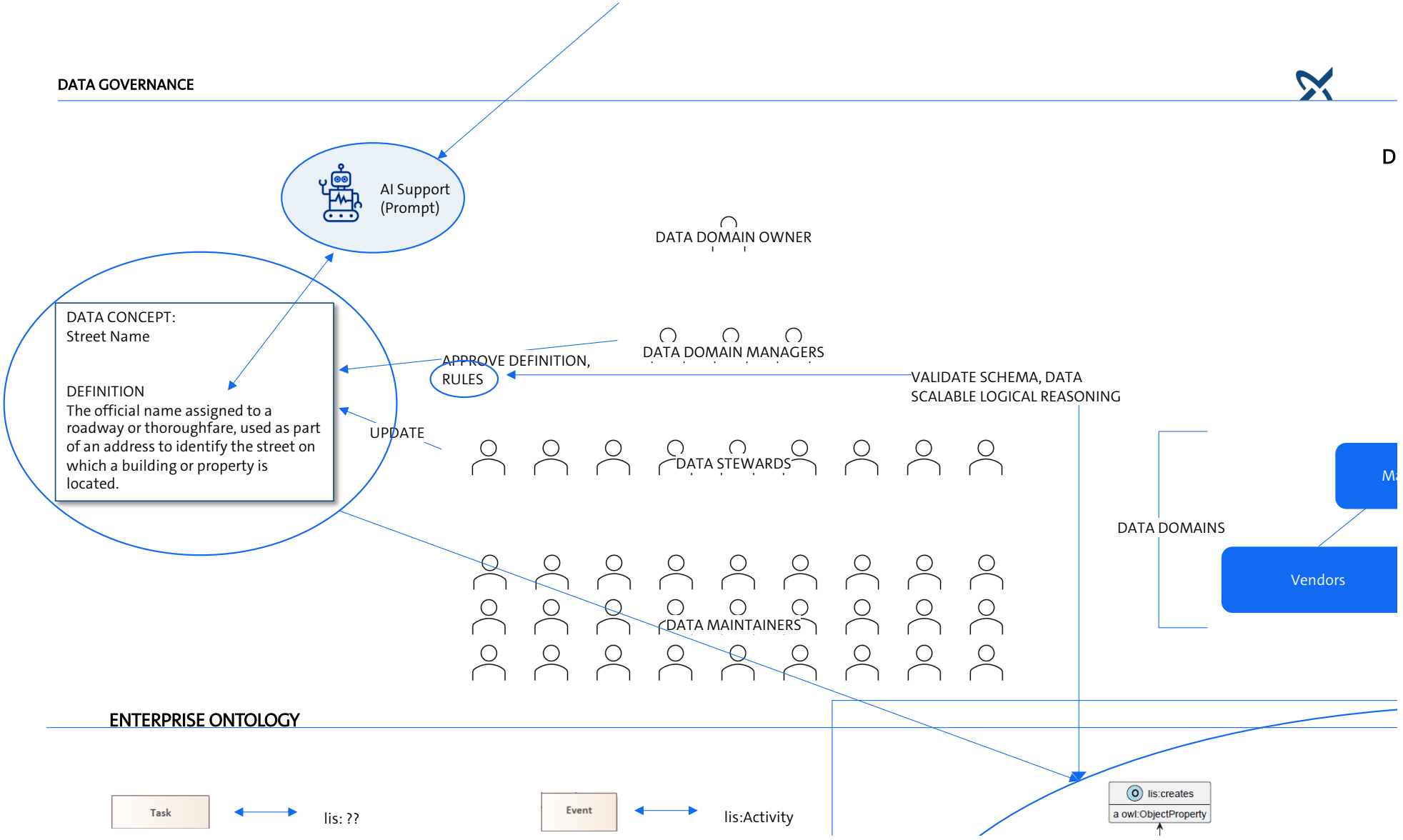
Data Governance / Data Ownership

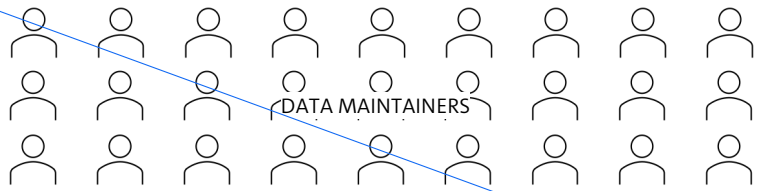

AI Support
(Prompt)
DATA DOMAIN OWNER
DATA CONCEPT:
Street Name
DEFINITION
The official name assigned to a roadway or thoroughfare, used as part of an address to identify the street on which a building or property is located.
APPROVE DEFINITION, RULES
DATA DOMAIN MANAGERS
VALIDATE SCHEMA, DATA
SCALABLE LOGICAL REASONING
UPDATE
DATA STEWARDS
DATA DOMAINS
Vendors
DATA MAINTAINERS
ENTERPRISE ONTOLOGY
Task
lis: ??
Party
lis:Organization
Event
lis:Activity
Account
lis:??
lis:creates
a owl:ObjectProperty
owl:onProperty
lis:realizedIn
a owl:ObjectProperty
lis:Activity
a owl:Class
a owl:Restriction
owl:someValuesFrom
a owl:Class

The subject matter experts specify rules that the data should satisfy.

RDF reasoning (OWL/Datalog) can check some of the more complicated (engineering based) rules.

Efficient patterns has been developed in the community around IDO.


DATA GOVERNANCE
AI Support
(Prompt)
DATA DOMAIN OWNER
DATA CONCEPT:
Street Name
DEFINITION
The official name assigned to a roadway or thoroughfare, used as part of an address to identify the street on which a building or property is located.
APPROVE DEFINITION, RULES
DATA DOMAIN MANAGERS
VALIDATE SCHEMA, DATA
SCALABLE LOGICAL REASONING
UPDATE
DATA STEWARDS
DATA DOMAINS
Vendors
DATA MAINTAINERS
ENTERPRISE ONTOLOGY
Task
lis: ??
Event
lis:Activity
lis:creates
a owl:ObjectProperty



DATA MAINTAINERS

Vendors

ENTERPRISE ONTOLOGY

Task	↔	lis: ??
Party	↔	lis:Organization
Location	↔	lis: Location
Document	↔	lis:InformationObject, lis:PhysicalObject
Event	↔	lis:Activity
Account	↔	lis:??
Product	↔	lis:Role / lis:PhysicalArtefact / lis:InformationObject (Software System? Service?)
Agreement	↔	lis:??
Resource / Asset	↔	lis:Role / lis:PhysicalArtefact / lis:PhysicalObject

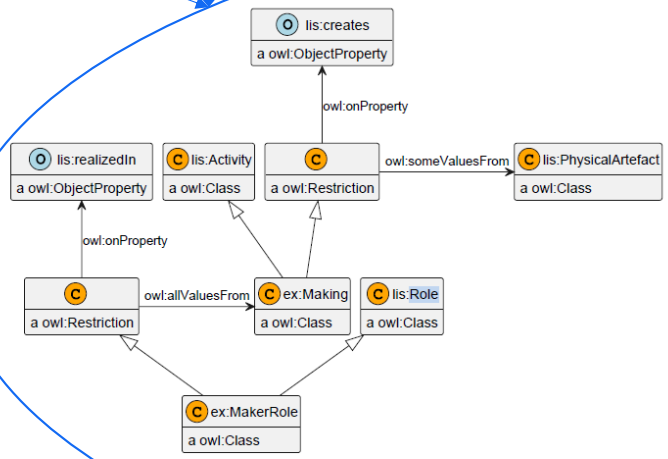


Figure 5.9: 'role' example, 'maker role'

Source: IDO, rds.posccaesar.org

AI Contexts

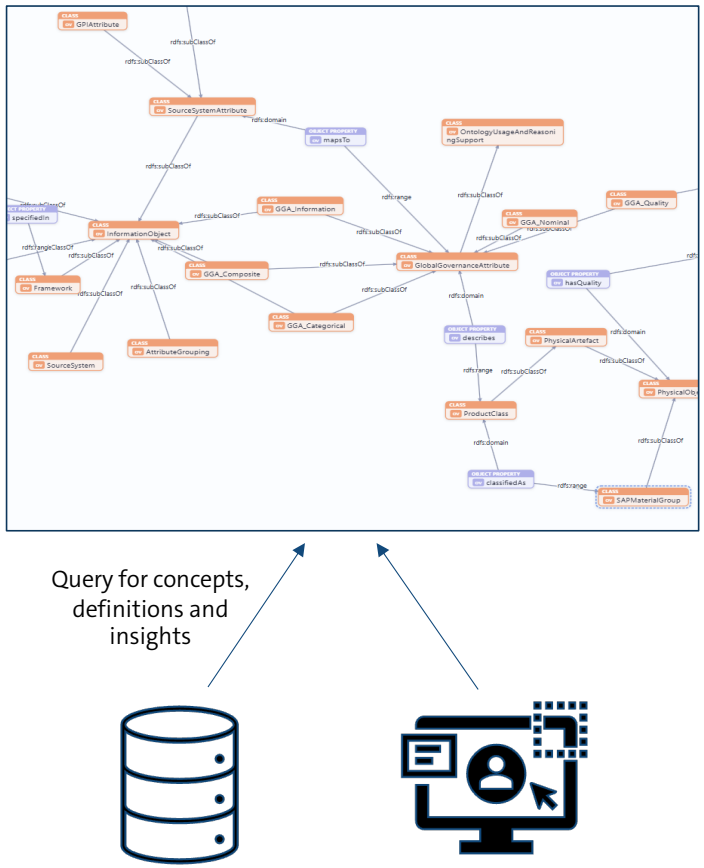
multi-hop relationship traversal, reasoning, often only current state

The knowledge graph

The product model sits in an **RDF Triplestore** as a graph

The **knowledge graph validates itself** with rules and reasoning (a feature of semantic web)

The KG (as is) can be **queried** so that its concepts, definitions and insights can be mapped to data within the dv2.0 data warehouse and used in applications.



Important Notes:

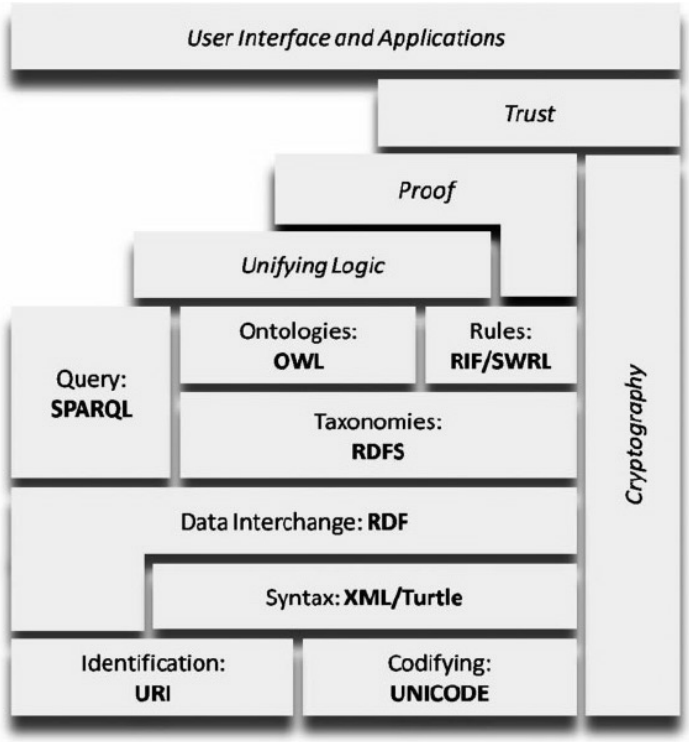
The knowledge graph is, naturally, in a state of evolution and improving every day. The best way to make a perfect KG is to do it together (IT and Business).

Source: Caitlin Woods

Using the Semantic Web Toolbox

- Semantics
- Graph
- Ontology (OWL2)
- Taxonomies
- Constraints
- Rules / Axioms
- RDF
- Triple stores
- SPARQL

Semantic Web Framework



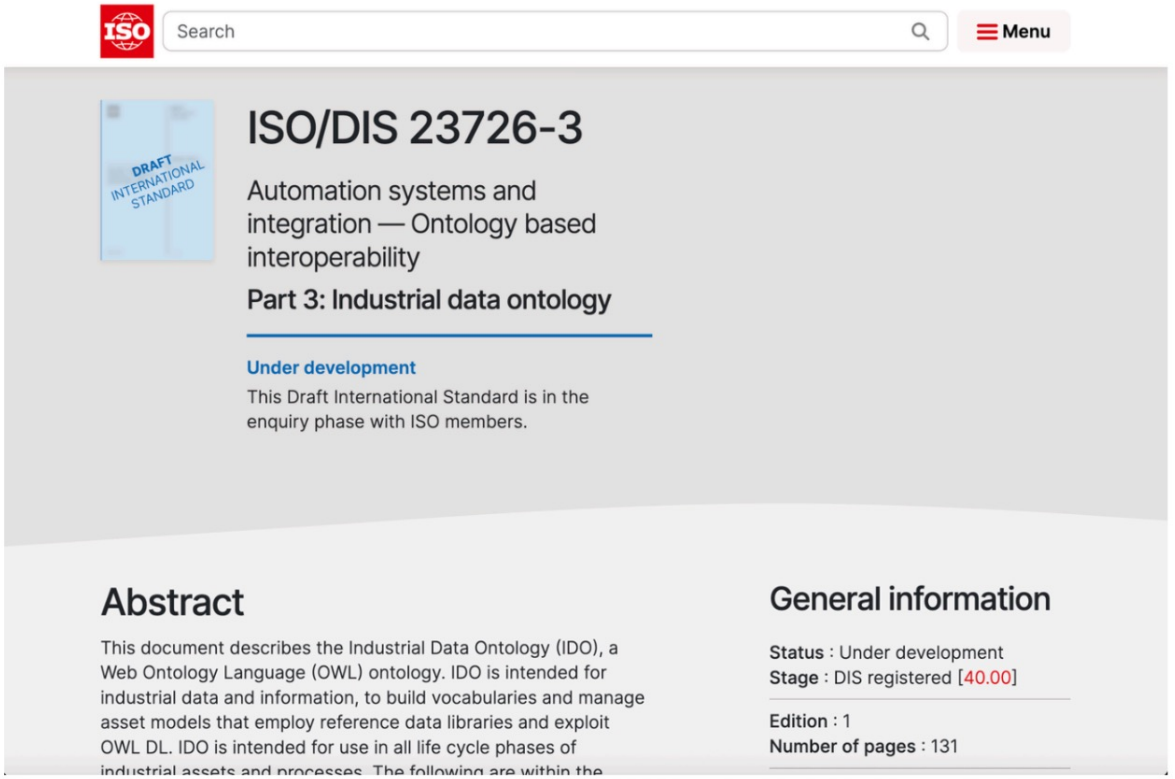
These are open data standards and are tool independent.

Outcome: Lots of built-in data capability, and no vendor lock-in in our enterprise modelling

Source: Caitlin Woods

Standardization with and between organizations

- Standard, upper-level schema for modelling industrial data
- Ensures consistent terminology **across** and within industries
- Part of the new ISO 23726 series
- Builds on its successful use in oil & gas



Source: Caitlin Woods

Why have we done things this way?

AI works better with structured data

- Larger context downgrades AI performance

- Understanding data and the connections between it helps us to create shared, reusable contexts with correct data.

Standardizing data focuses the community

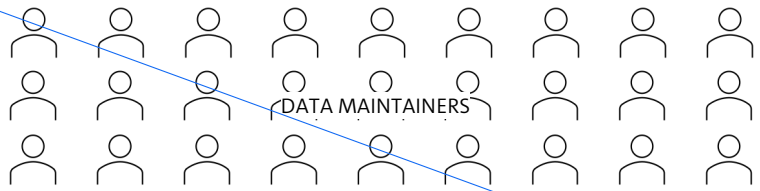
- By structuring our data according to standards, we encourage the company to work towards the same data efforts (by re-using parts of the model and contributing to extensions).

Open data standards

- Grundfos data models (ontologies) use open data standards from the W3C, meaning that the data that we have is vendor / tool independent.

Source: Caitlin Woods

The Data Vault 2.0 Warehouse and the Knowledge graph complement each other, different tools for different tasks.



DATA MAINTAINERS

Vendors

ENTERPRISE ONTOLOGY

Task	↔	lis: ??
Party	↔	lis:Organization
Location	↔	lis: Location
Document	↔	lis:InformationObject, lis:PhysicalObject
Event	↔	lis:Activity
Account	↔	lis:??
Product	↔	lis:Role / lis:PhysicalArtefact / lis:InformationObject (Software System? Service?)
Agreement	↔	lis:??
Resource / Asset	↔	lis:Role / lis:PhysicalArtefact / lis:PhysicalObject

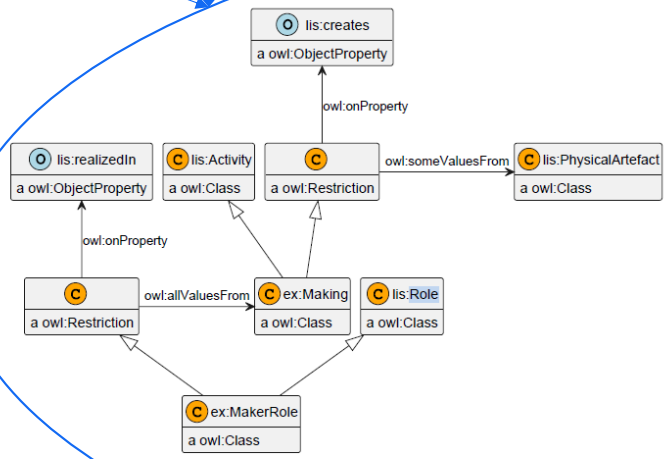
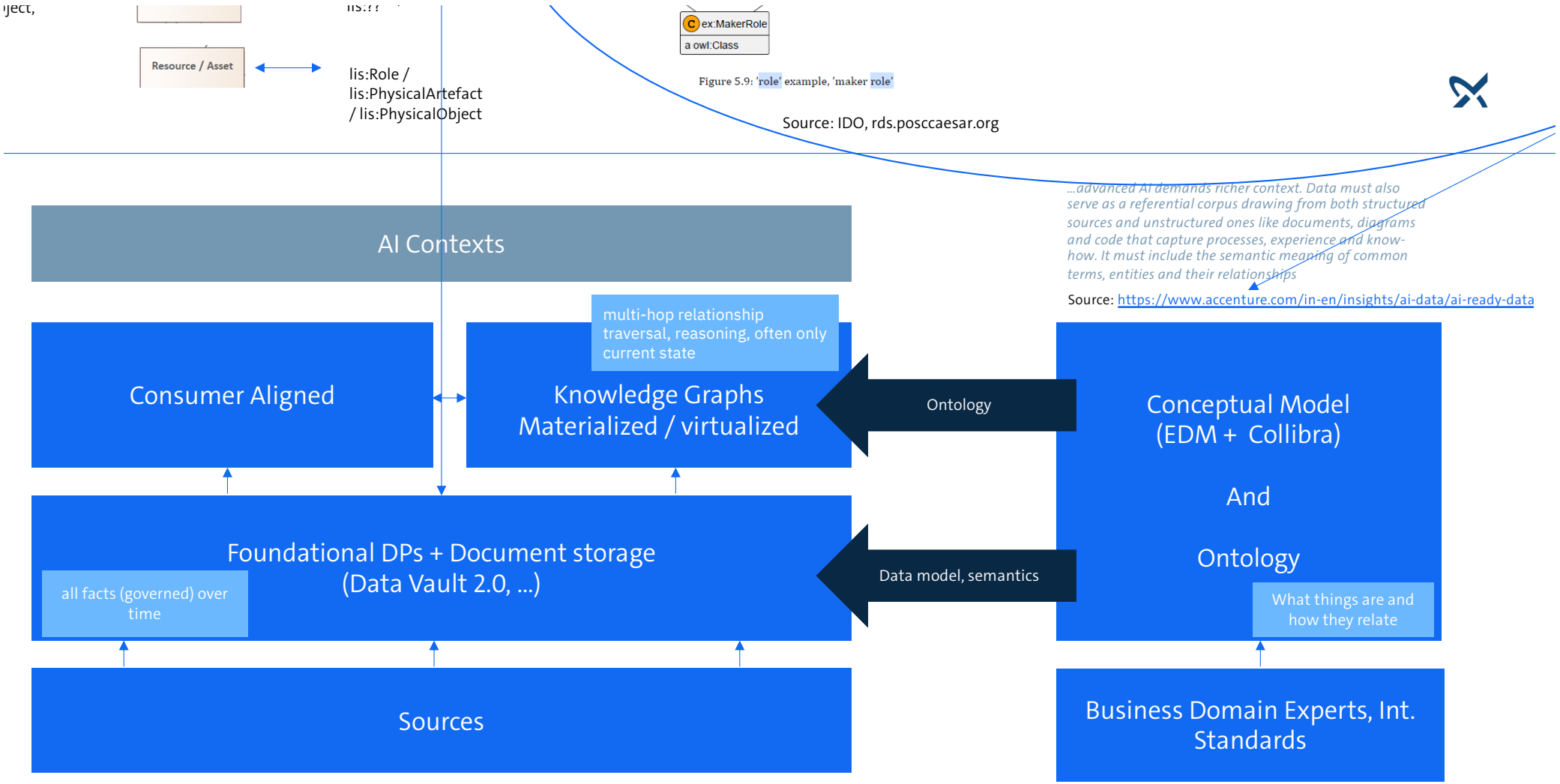


Figure 5.9: 'role' example, 'maker role'

Source: IDO, rds.posccaesar.org

AI Contexts

multi-hop relationship traversal, reasoning, often only current state


Resource / Asset
lis:Role /
lis:PhysicalArtefact
/ lis:PhysicalObject
ex:MakerRole
a owl:Class
Figure 5.9: 'role' example, 'maker role'
Source: IDO, rds.posccaesar.org
...advanced AI demands richer context. Data must also serve as a referential corpus drawing from both structured sources and unstructured ones like documents, diagrams and code that capture processes, experience and know-how. It must include the semantic meaning of common terms, entities and their relationships
Source: https://www.accenture.com/in-en/insights/ai-data/ai-ready-data
AI Contexts
Consumer Aligned
multi-hop relationship traversal, reasoning, often only current state
Knowledge Graphs
Materialized / virtualized
Ontology
Conceptual Model
(EDM + Collibra)
And
Ontology
What things are and how they relate
Foundational DPs + Document storage
(Data Vault 2.0, ...)
all facts (governed) over time
Data model, semantics
Sources
Business Domain Experts, Int. Standards

The Big Picture

Data Town Plan
“North star data model”

Business centric taxonomies,
Support definitions
(ontology methods)

Synchronized Data Products
and Knowledge Graphs, Contexts
For AI.



Data Vault 2.0
modelling patterns

Ontology + Knowledge Graph
Reasoning (validate before merge)