



Matching Requirements and Solutions,
Industrial Scale Knowledge Graphs.

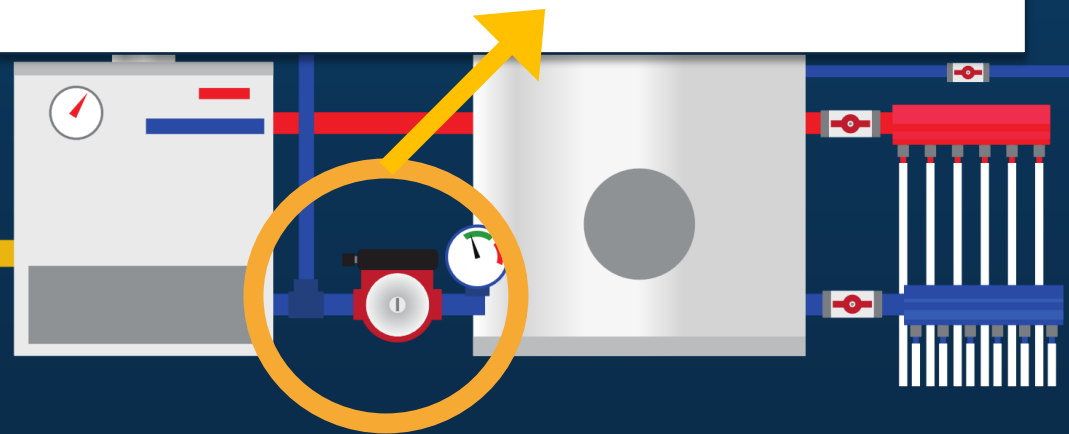
Mikkel H. Brynildsen, Grundfos

Water Systems

Grundfos is a leading pump manufacturer



“Alpha2” Circulator pump





KPL Flood control pump

2070 liters / second

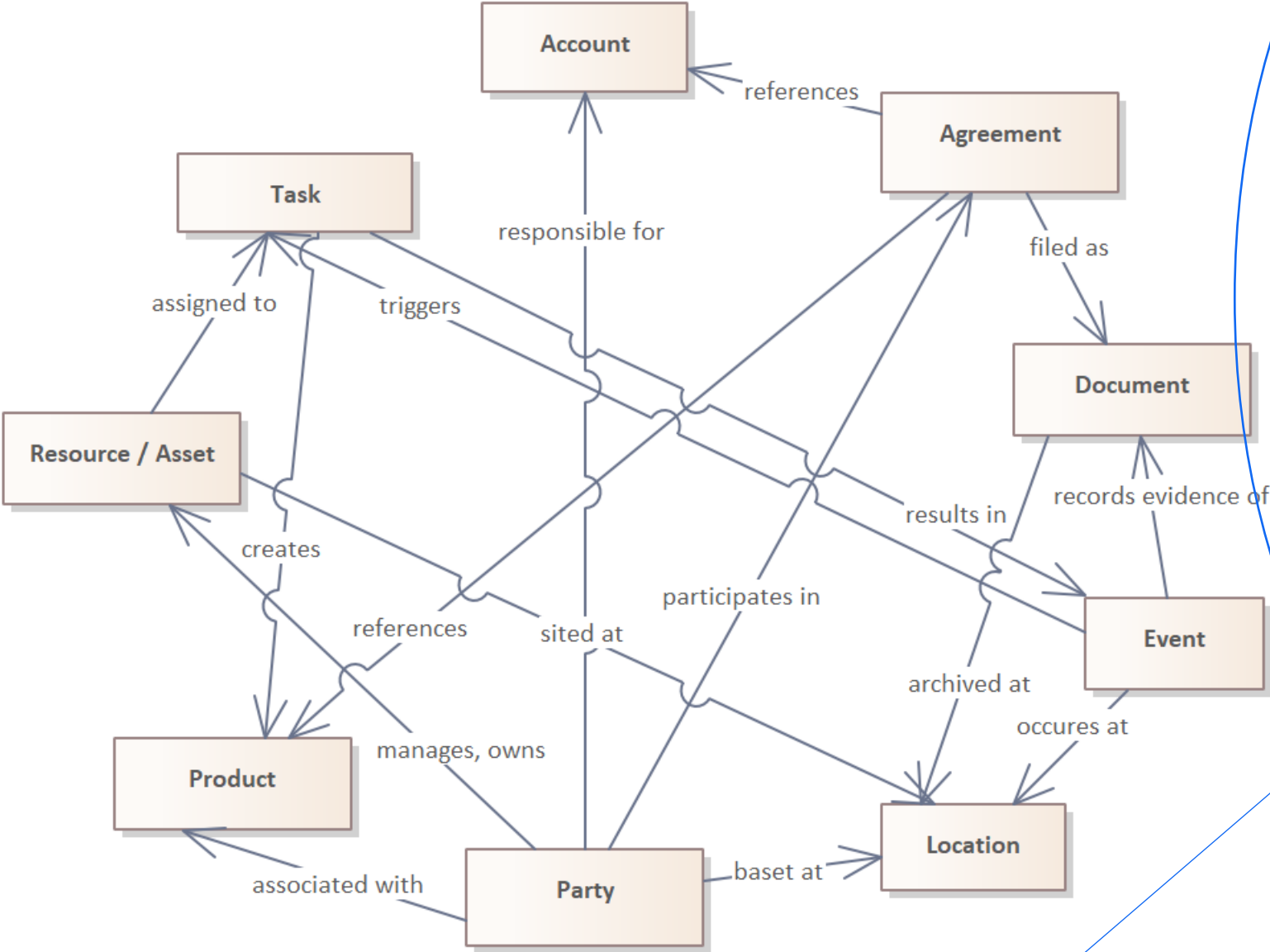
- Based in Denmark
- 20,818 Employees.
- Facilities in more than 60 countries.
- DKK 33,2bn revenue in 2024
- 15,000,000 units produced every year
- ~500,000 categories of “product items”, ~4,500,000 material numbers in scope.
- ~1000 new material numbers (types of products, materials, components) generated each day.
(most generated by smart “Configurators”)
- Digital offerings



Industrial Scale Knowledge Graphs

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

class Data Town Plan Overview



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.

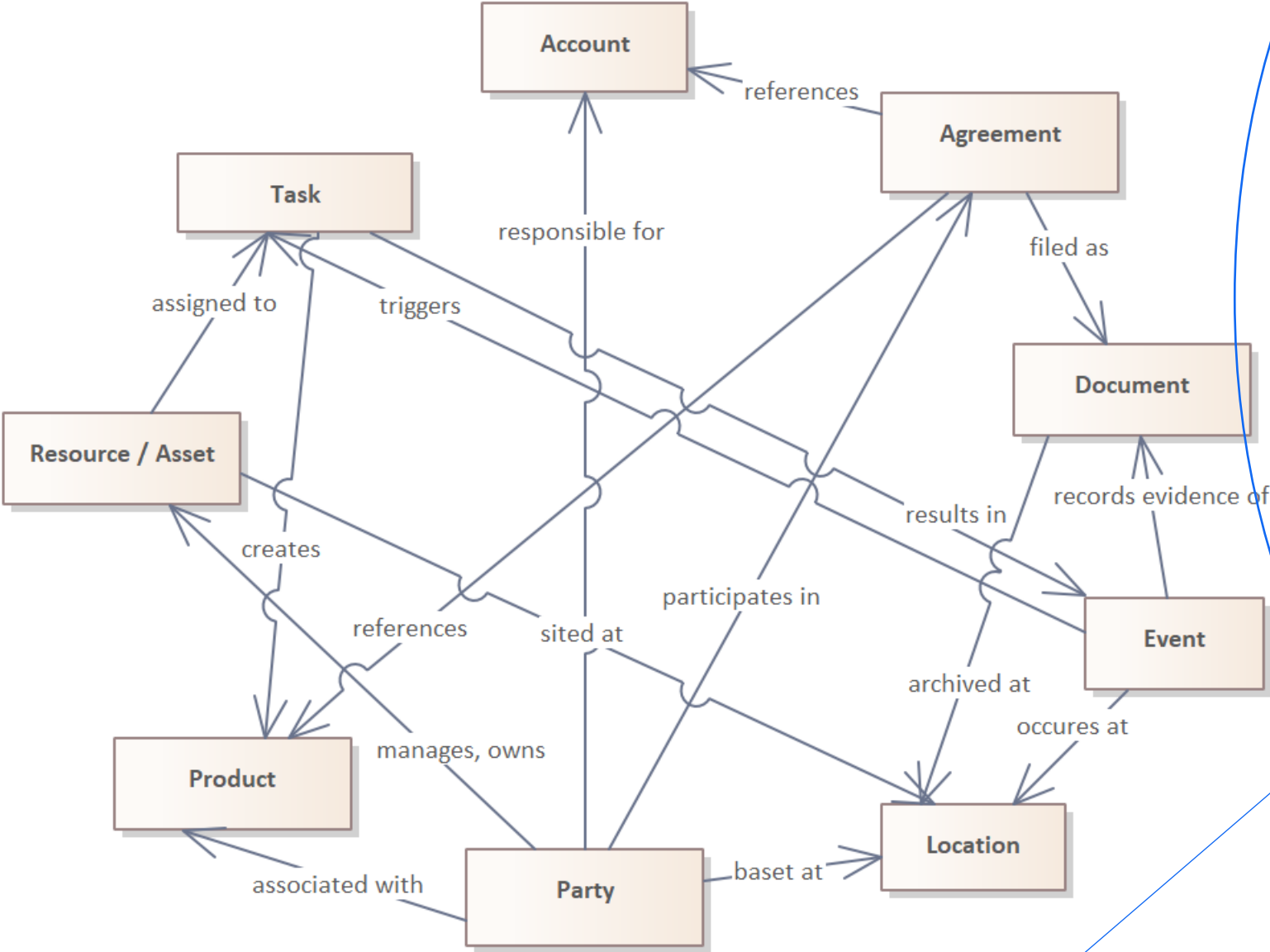
A **Task** is a piece of work. A task can define an overall profile of Tasks that occur frequently.

Sources: Oxford English Dictionary, IDO



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

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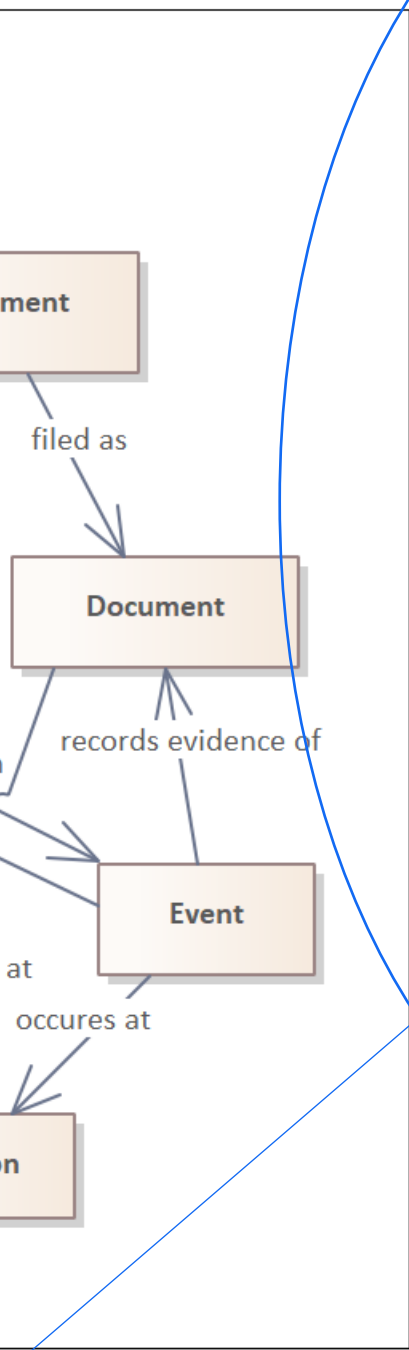
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class Task DV

Sp

class ObjectType TaskType

TemplateTask



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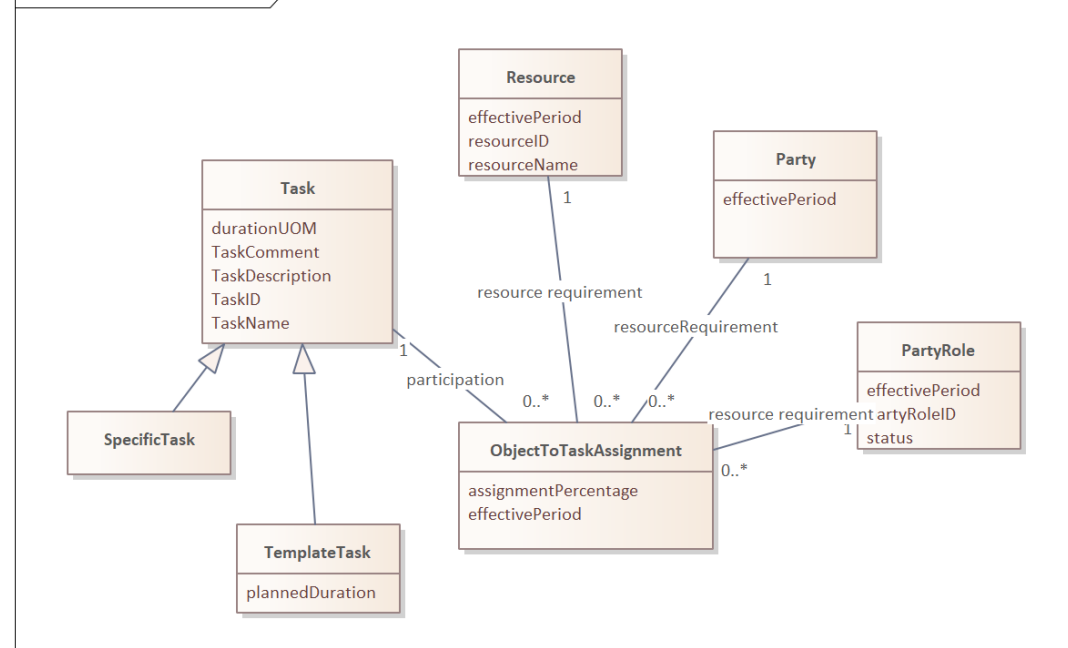
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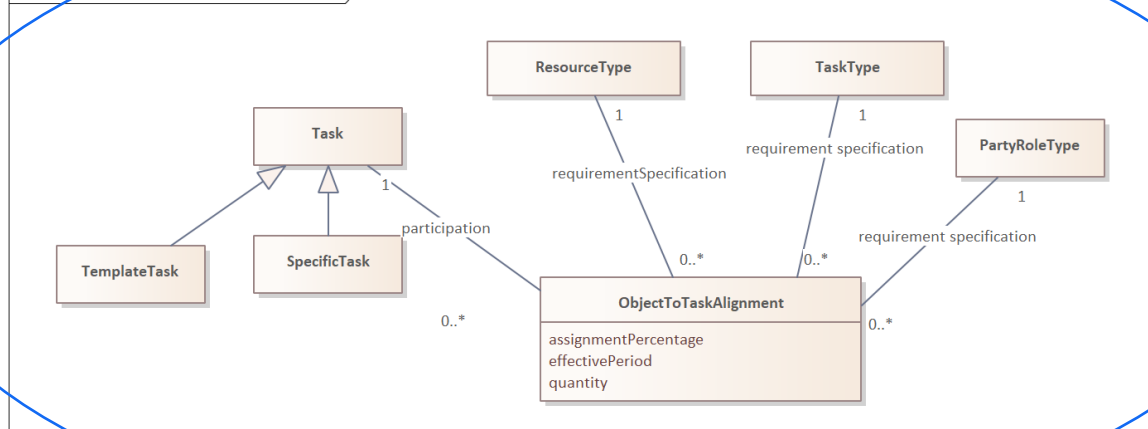
Sources: Oxford English Dictionary, IDO

class Task DV2.0 Design Pattern



Source: John Giles: "Elephant In the Fridge"

class ObjectType TaskType DV2 Design Pattern

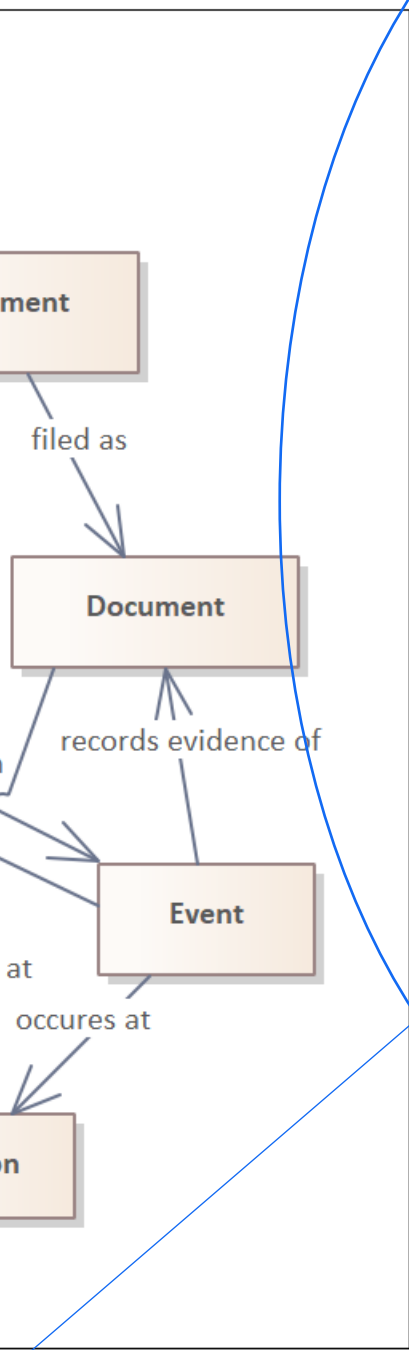


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The classes are defined by Business Data Experts, in the context of the company data governance framework.

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



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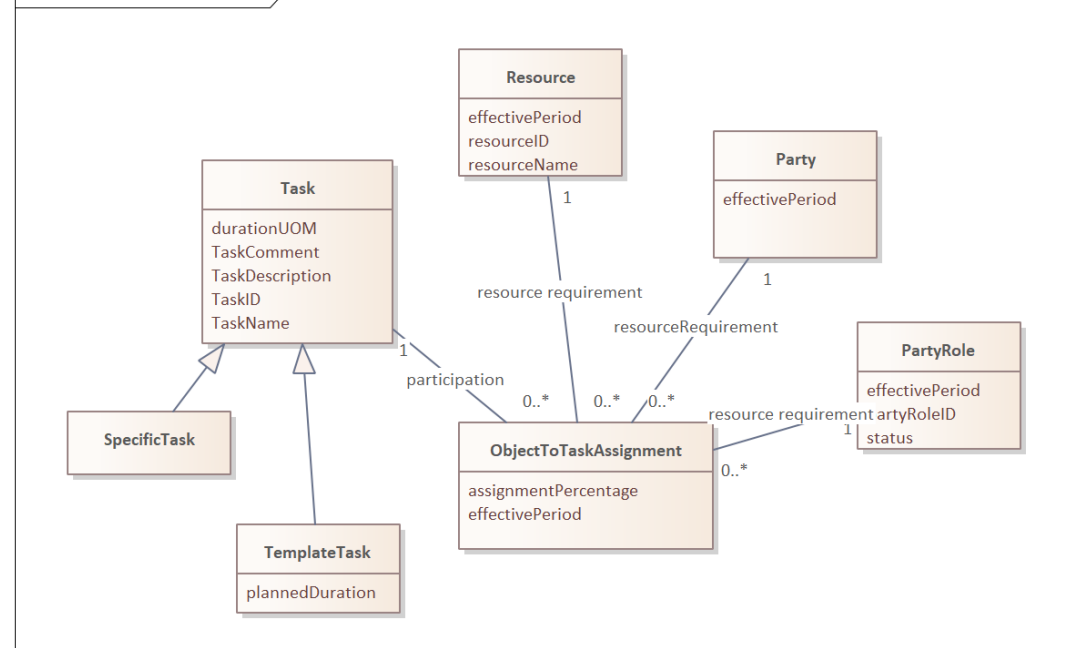
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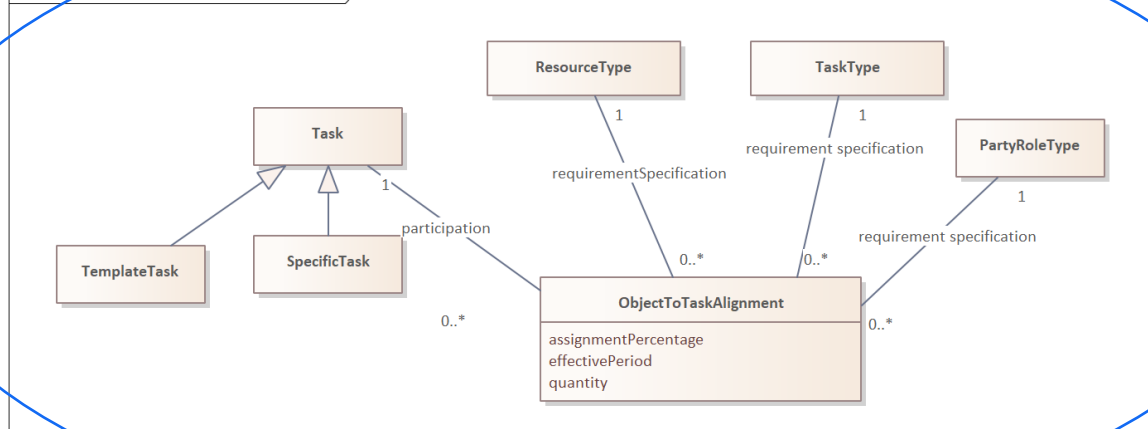
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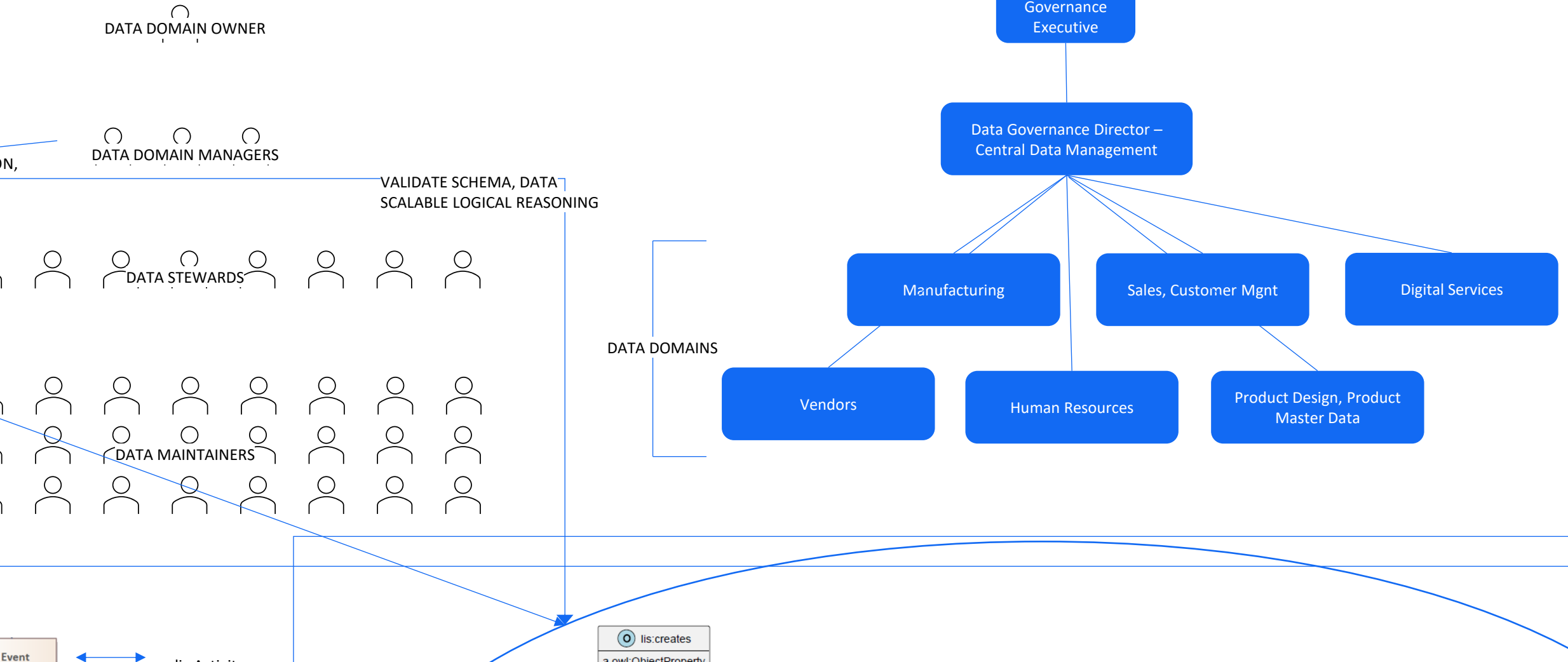
class ObjectType TaskType DV2 Design Pattern



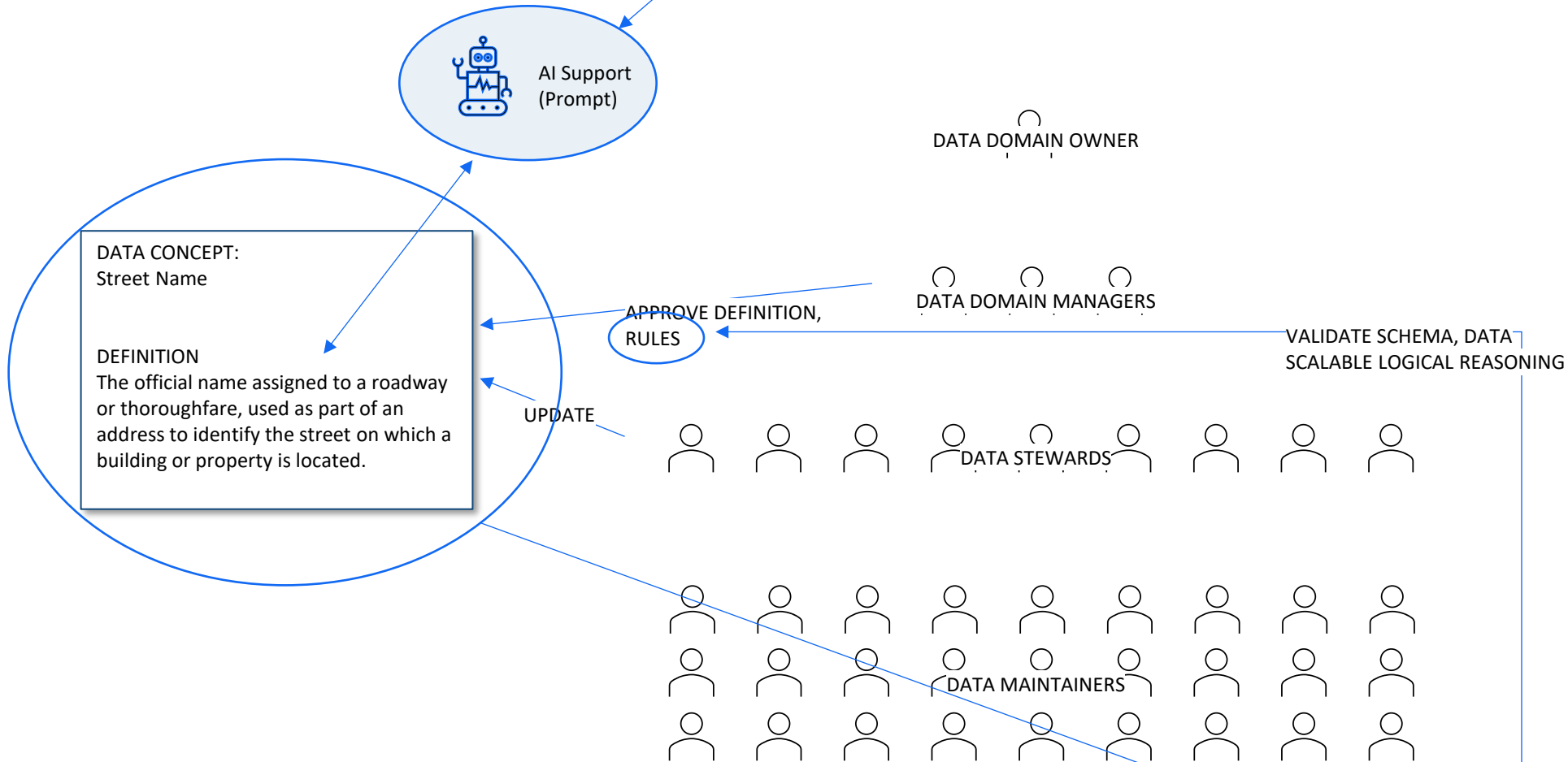
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Data Governance / Data Ownership



DATA GOVERNANCE



ENTERPRISE ONTOLOGY



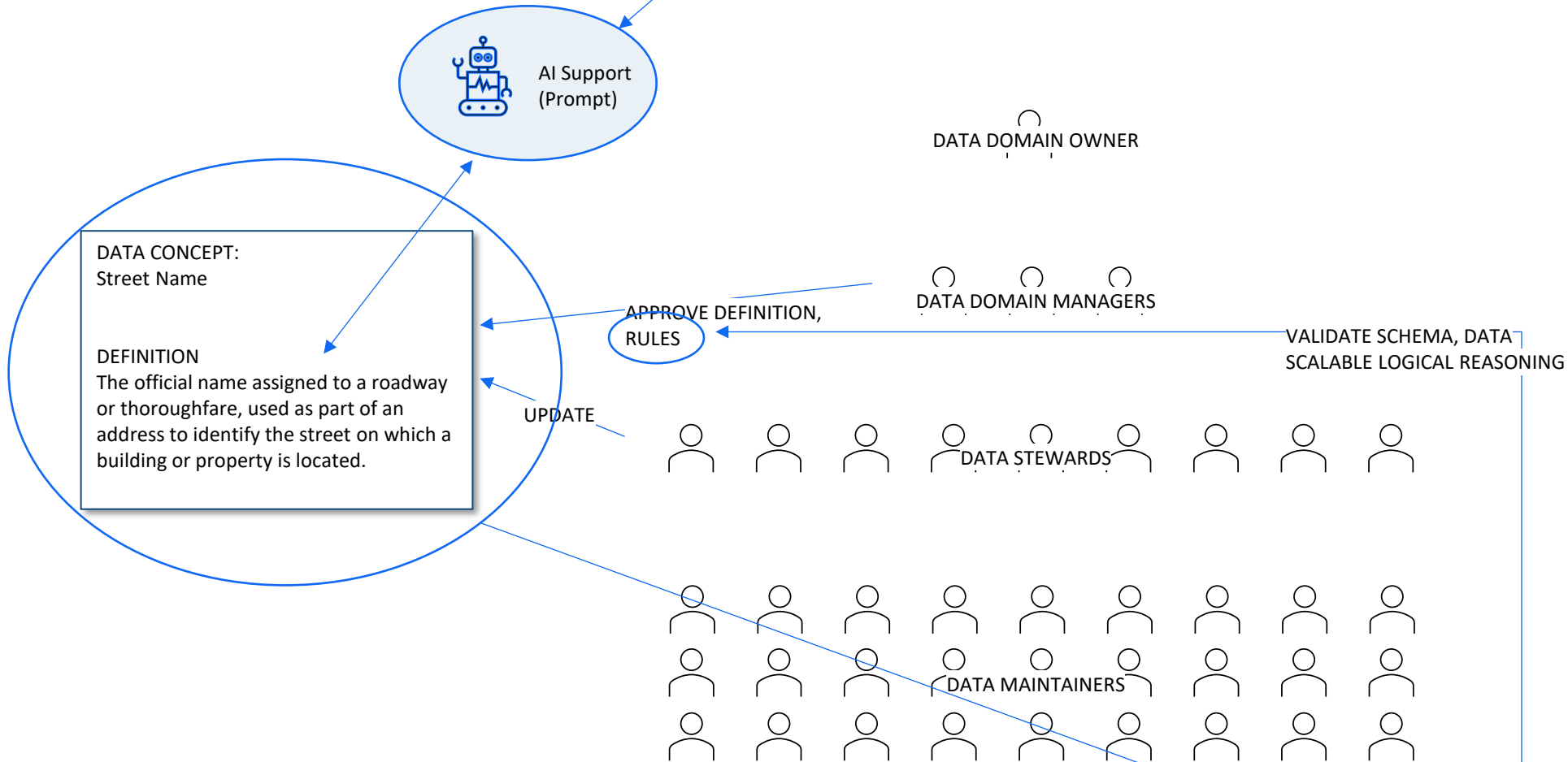


The subject matter experts specify rules that the data should satisfy.

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

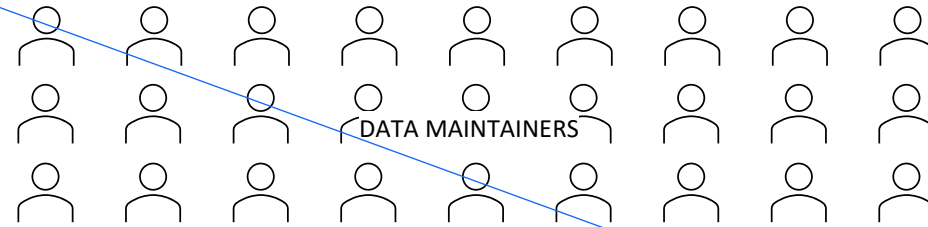


DATA DOMAINS

Vendors

ENTERPRISE ONTOLOGY

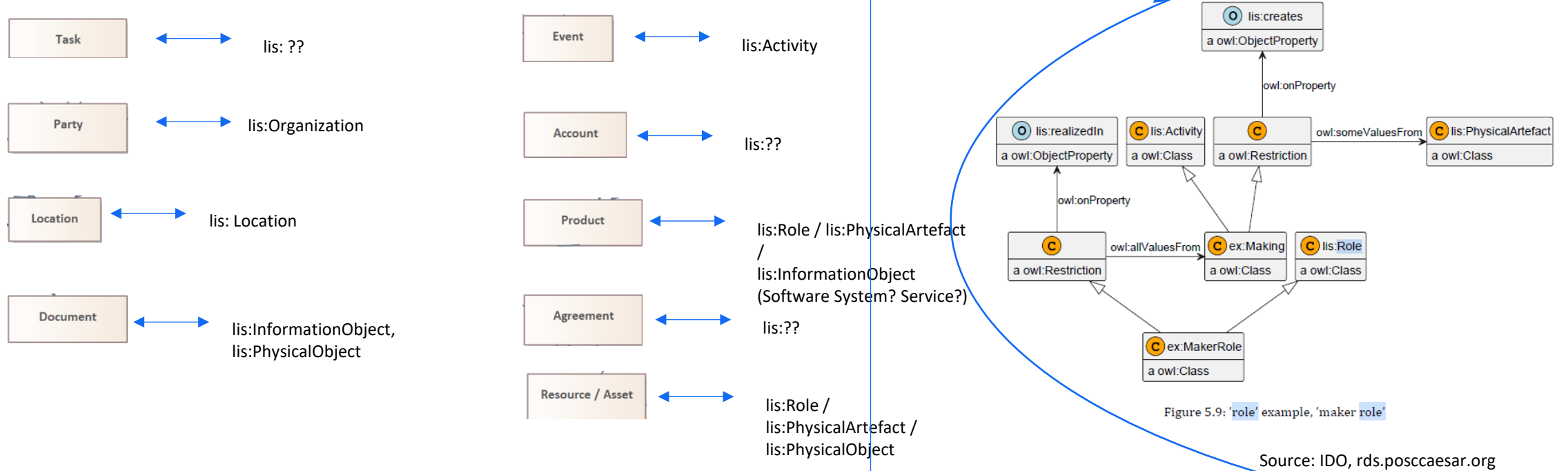




Vendors



ENTERPRISE ONTOLOGY



AI Contexts

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

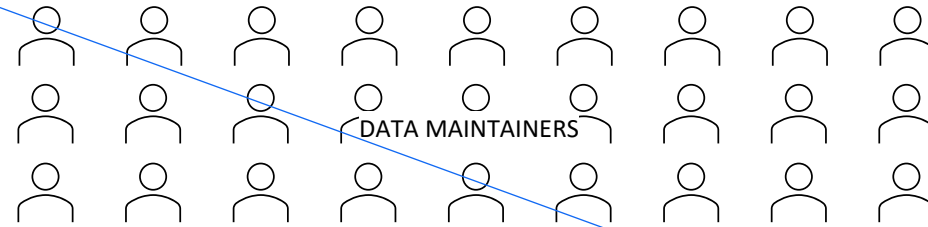
...advan
as a ref
and uns
that cap
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This setup helps the enterprise serve quality information to the AI contexts being developed.

Ontology-backed Knowledge graphs have three main benefits:

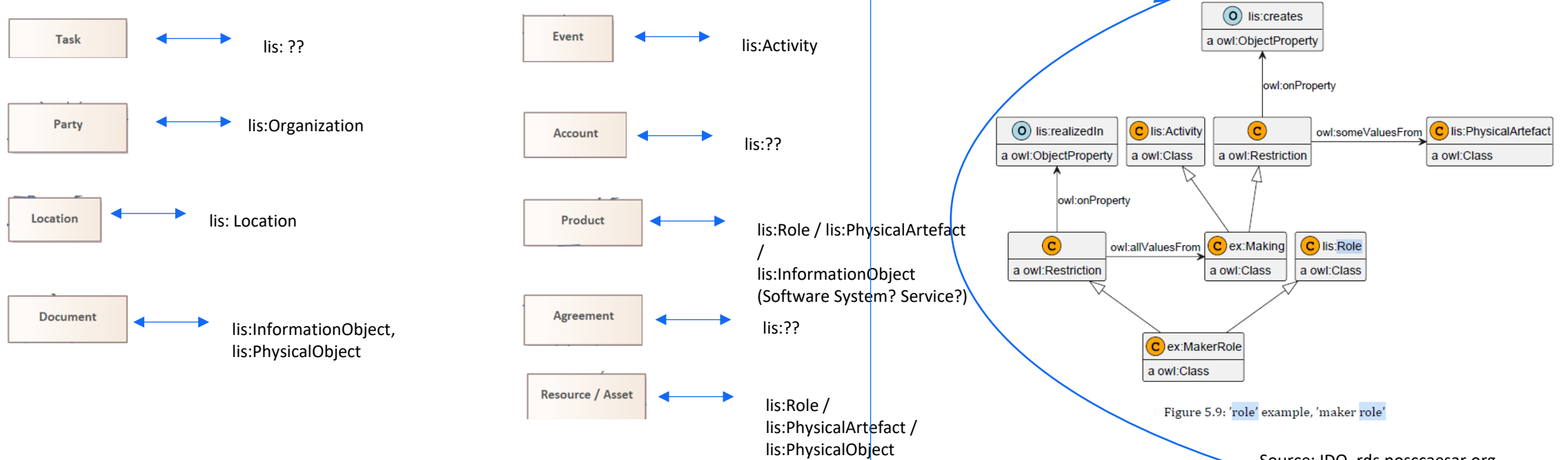
1. Logic based Reasoning can surface new insights – with full traceability.
2. A knowledge graph is suited for queries that needs multi-hop relationship traversal. (vs. expensive/complex SQL joins.)
3. A knowledge graph can provide current, up-to-date information where big document repositories are stale and too big for AI context.



Vendors



ENTERPRISE ONTOLOGY



AI Contexts

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traversal, reasoning, often only
current state

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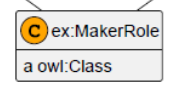
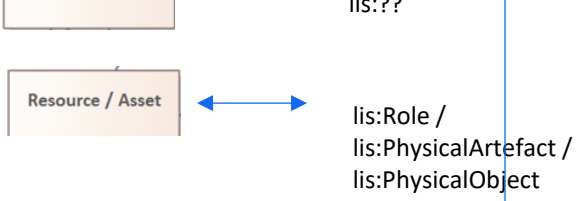


Figure 5.9: 'role' example, 'maker role'

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

Data model, semantics

Foundational DPs + Document storage
(Data Vault 2.0, ...)

all facts (governed) over time

Ontology

What things are and how they relate

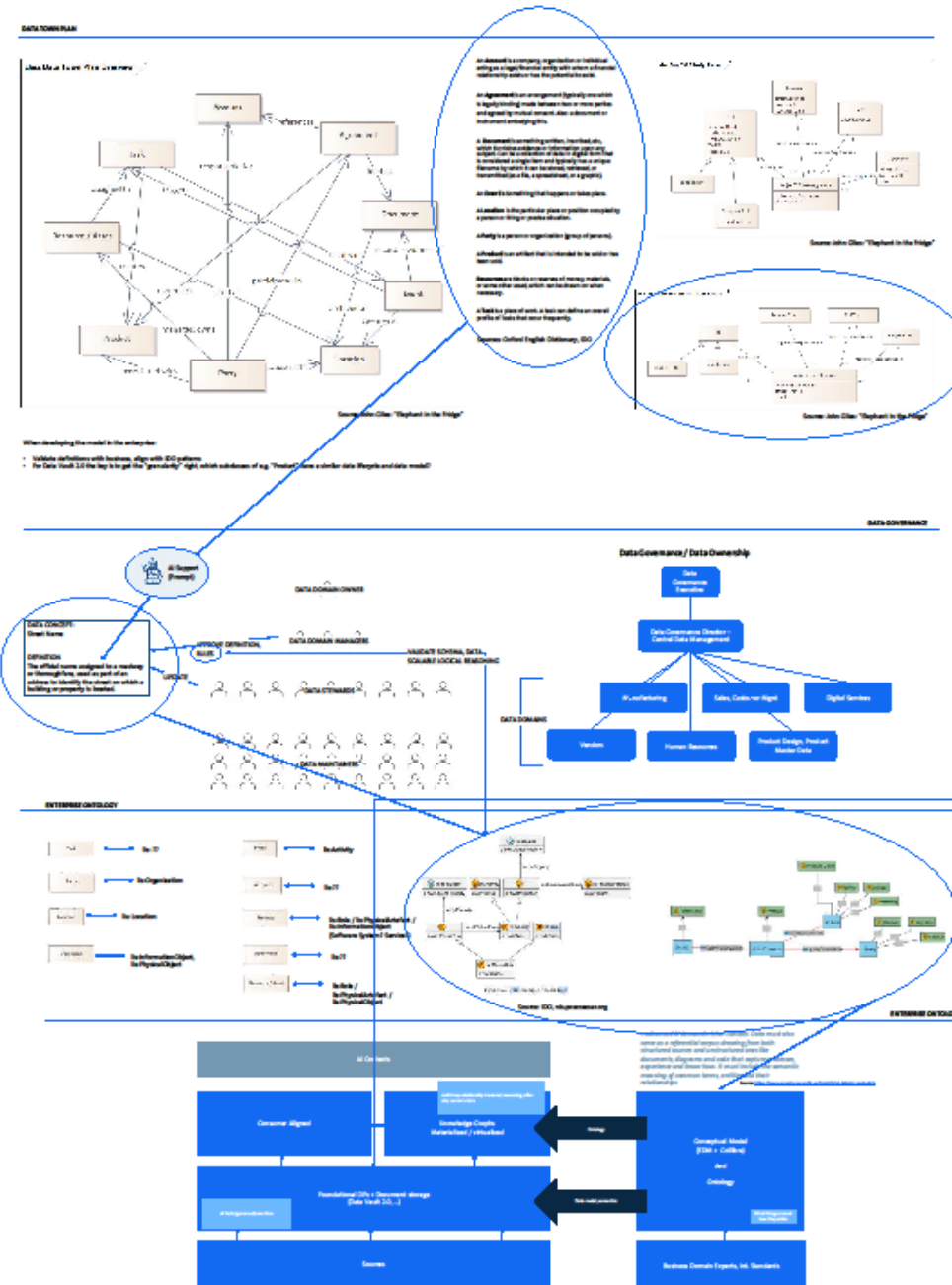
Sources

Business Domain Experts, Int. Standards

Data Town Plan
“North star data model”

Business centric taxonomies,
Support definitions
(ontology methods)

Synchronized Data Products
and Knowledge Graphs



Data Vault 2.0
modelling patterns

Ontology + Knowledge Graph
Reasoning (validate before merge)