A standards-based portal for integrated land administration information

A case study of the Netherlands

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External Supervisor: Dr. ir. L. Rowland
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1. Introduction
2. Literature and contexual review
3. Design of prototype
4. Results
5. Conclusion

1

Introduction

Problem statement, main research question and objective

Problem statement

BAG

BRP

BRK

For a given address, who is the owner of the building and the parcel and are there any spatial plans to which the building plan needs to apply and are there public law restrictions to which the plan should comply?

Ruimtelijke Plannen

BRK-PB

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Main research question

What are the benefits and drawbacks of a linked data portal based on the Land Administration Domain Model (LADM) Edition II concepts?

This study examines the benefits and drawbacks of a linked data portal based on the Land Administration Domain Model (LADM) Edition II concepts.

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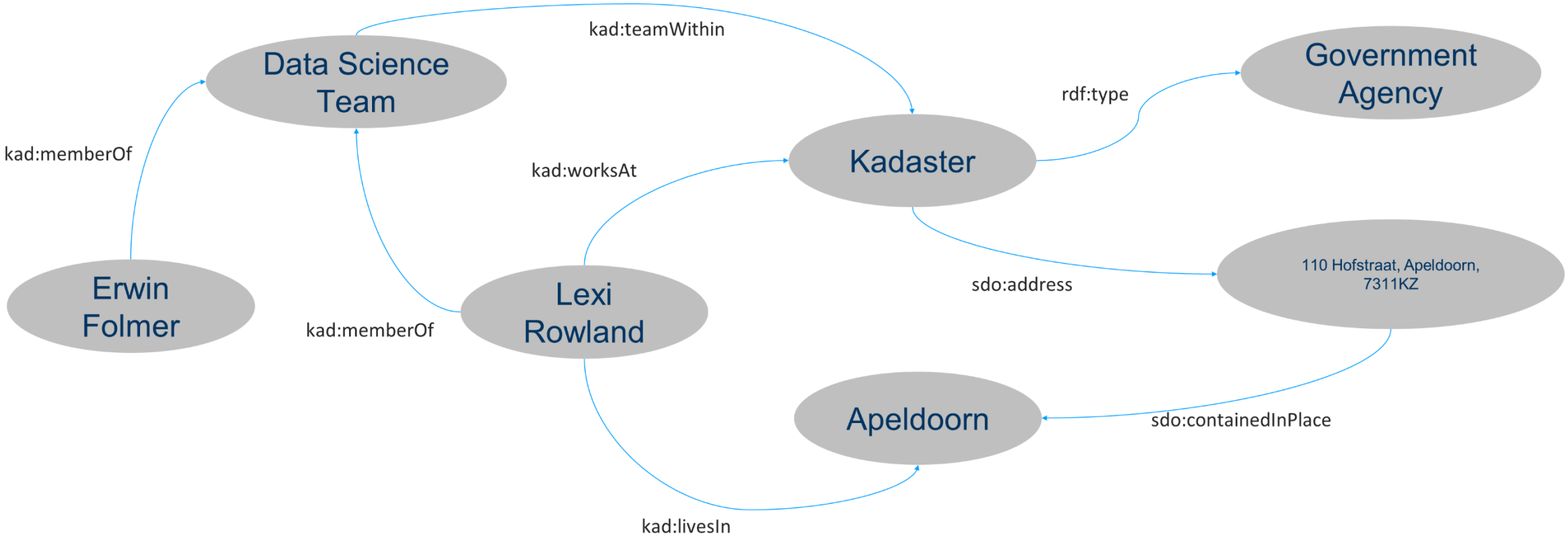
This study examines the benefits and drawbacks of a **linked data** portal based on the Land Administration Domain Model (LADM) Edition II concepts.

Linked data


Data Science Team
kad:teamWithin
Government Agency
rdf:type
kad:memberOf
kad:worksAt
Kadaster
Erwin Folmer
kad:memberOf
Lexi Rowland
sdo:address
110 Hofstraat, Apeldoorn, 7311KZ
Apeldoorn
sdo:containedInPlace
kad:livesIn

This study examines the benefits and drawbacks of a linked data **portal** based on the Land Administration Domain Model (LADM) Edition II concepts.

Portal

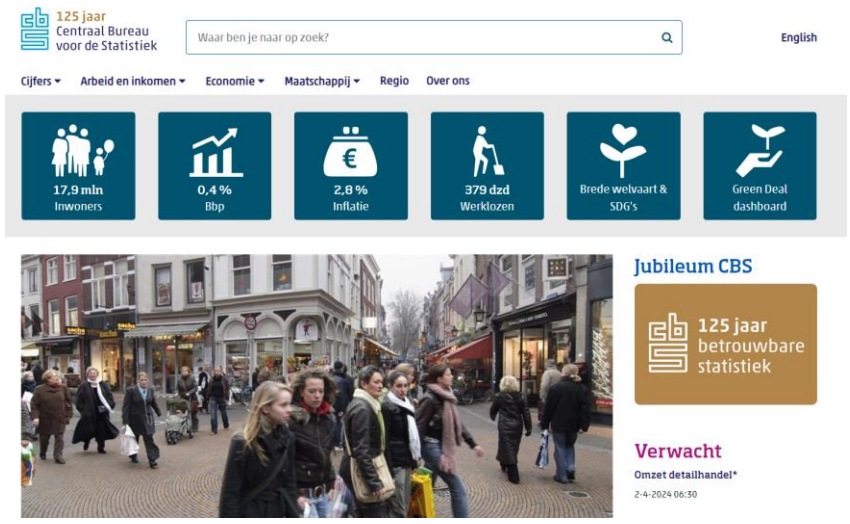


Figure. CBS portal
(Centraal Bureau voor de Statistiek, 2024)

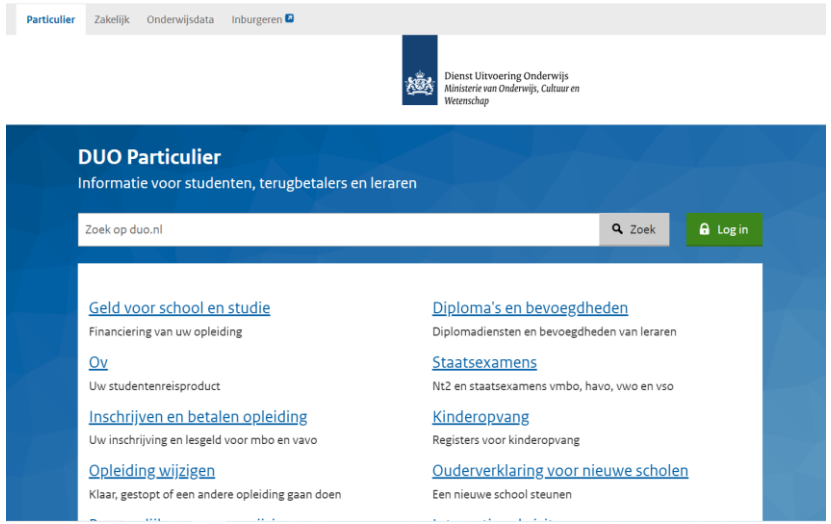


Figure. DUO portal
(DUO - Particulier, n.d.)

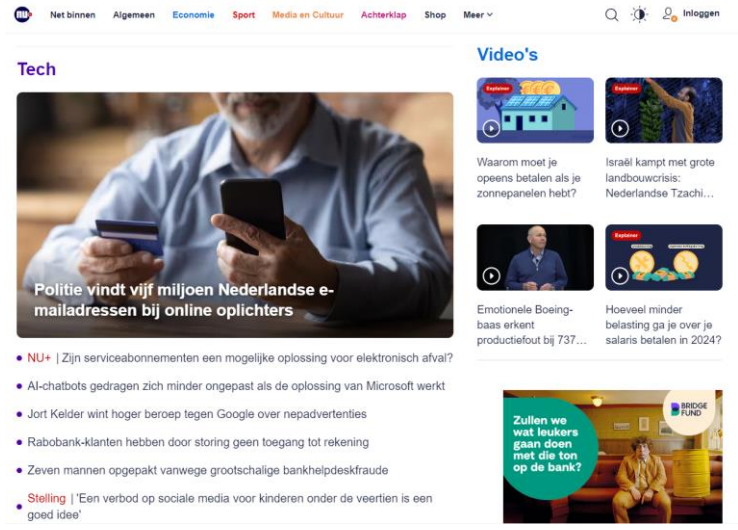


Figure. Nu.nl portal
(DPG Media Privacy Gate, 2024)

This study examines the benefits and drawbacks of a linked data portal based on the Land Administration Domain Model (LADM) Edition II concepts.

The Land Administration Domain Model (LADM)

- Land administration is the process of establishing and maintaining information about land.
- Conceptual model
- International Organization for Standardization

- Land ownership
- Land use
- Land rights

- Unified Modeling Language (UML)
- Adaptable to different contexts

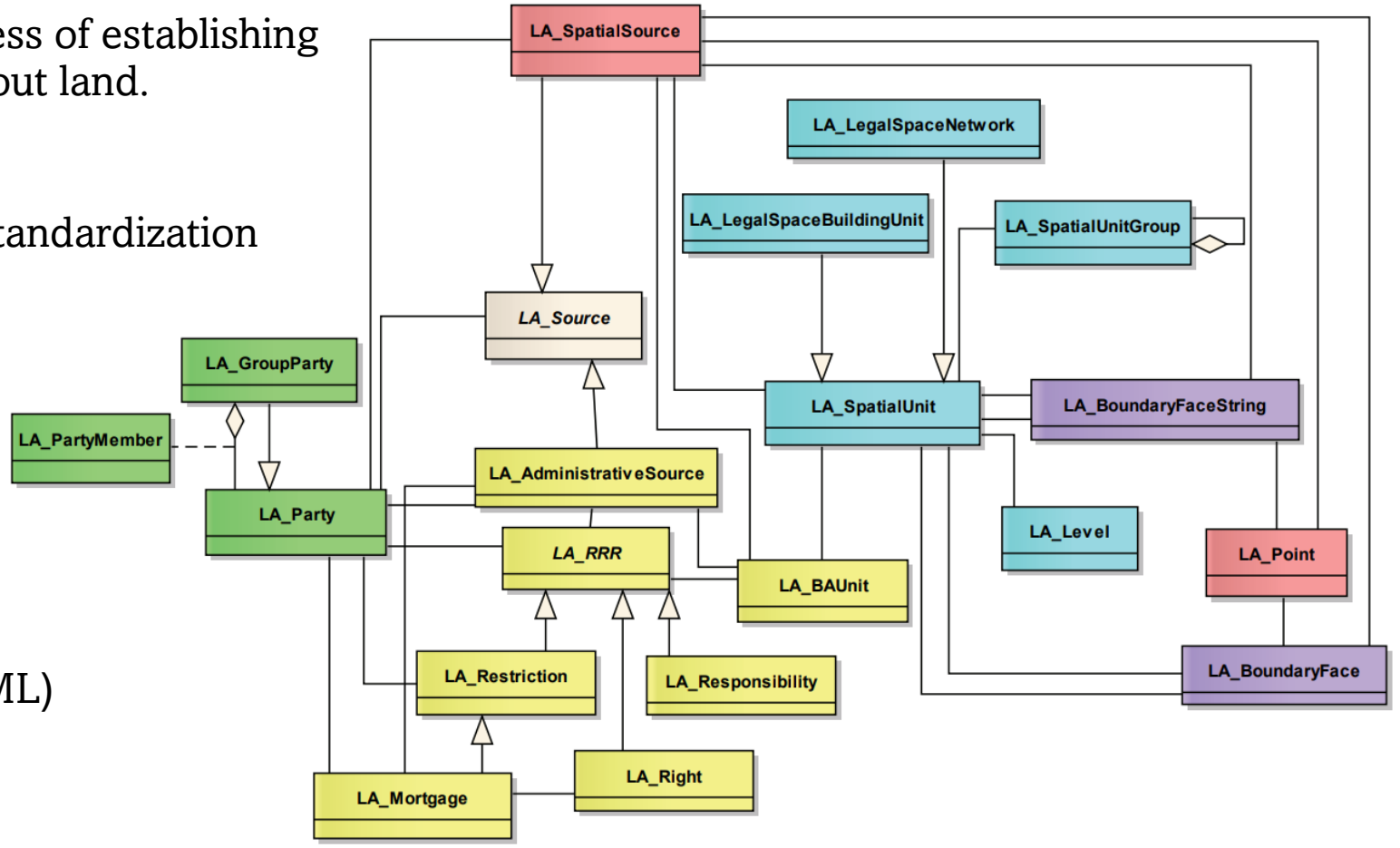
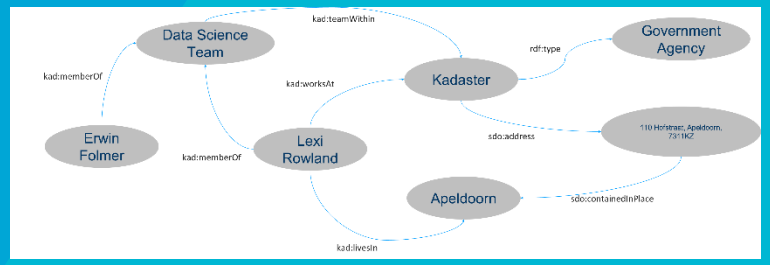
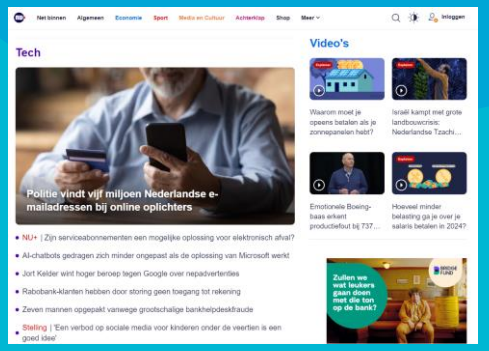
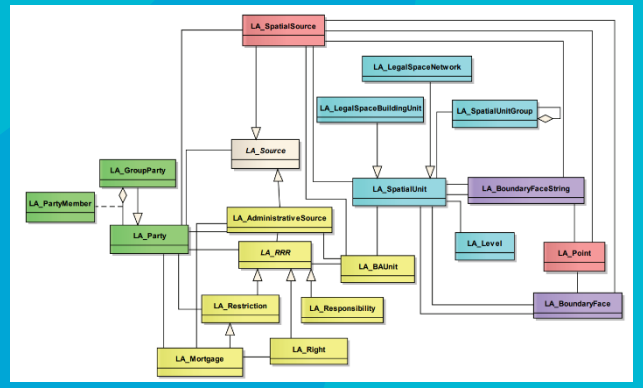


Figure. Overview of the Land Administration Domain Model (ISO, 2012)





This study examines the benefits and drawbacks of a **linked data portal** based on the **Land Administration Domain Model (LADM)** Edition II concepts.



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Literature and contextual review

Land Administration Domain Model Edition II

Core LADM

- Part 1 – Generic Conceptual Model (approved)
- Part 2 – Land registration

- Part 4 – Valuation information
- Part 5 – Spatial plan information

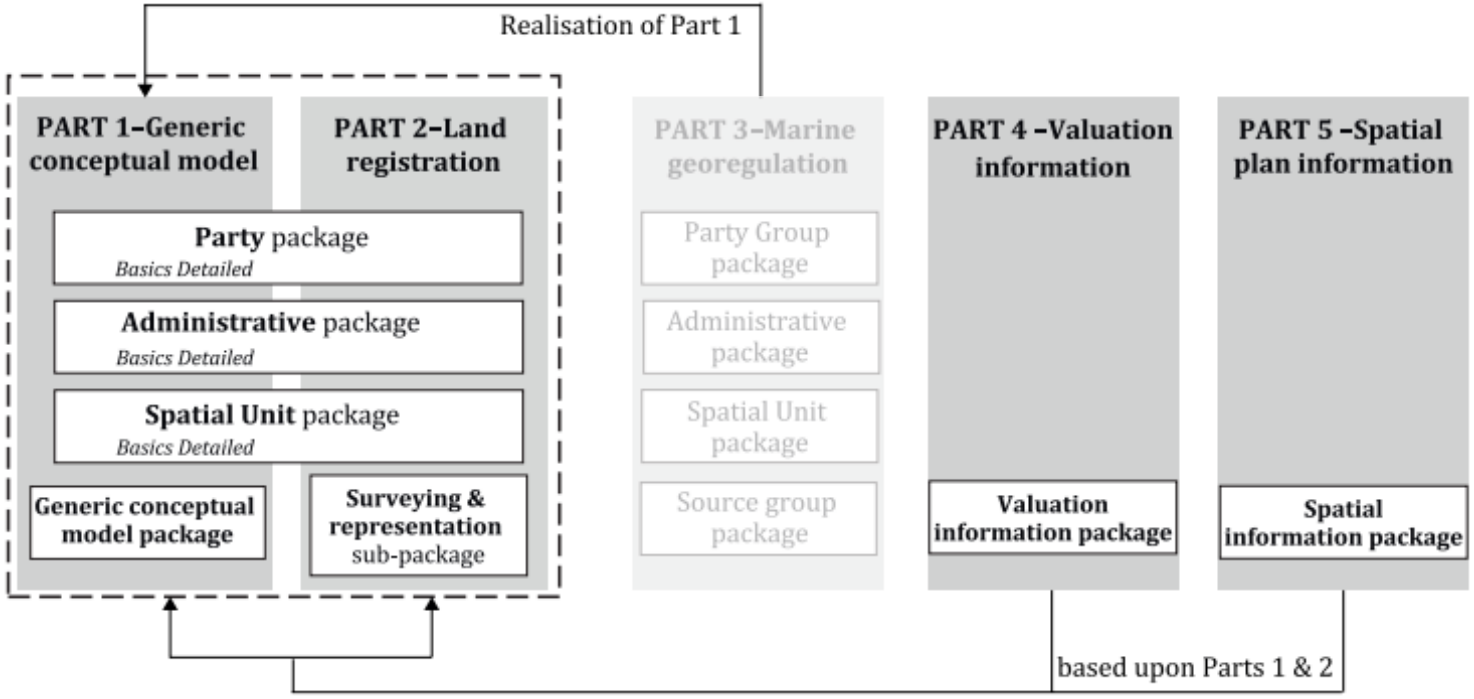

Figure. Overview of the Land Administration Domain Model (ISO, 2023)

Land Administration Domain Model Edition II

Core LADM

- Part 1 – Generic Conceptual Model (approved)
- Part 2 – Land registration

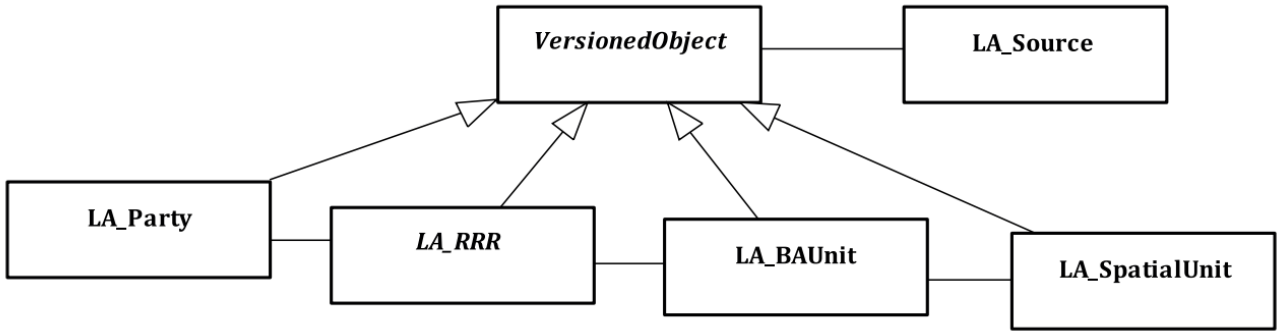

Figure. Basic classes of core LADM
(Kara et al., 2024)

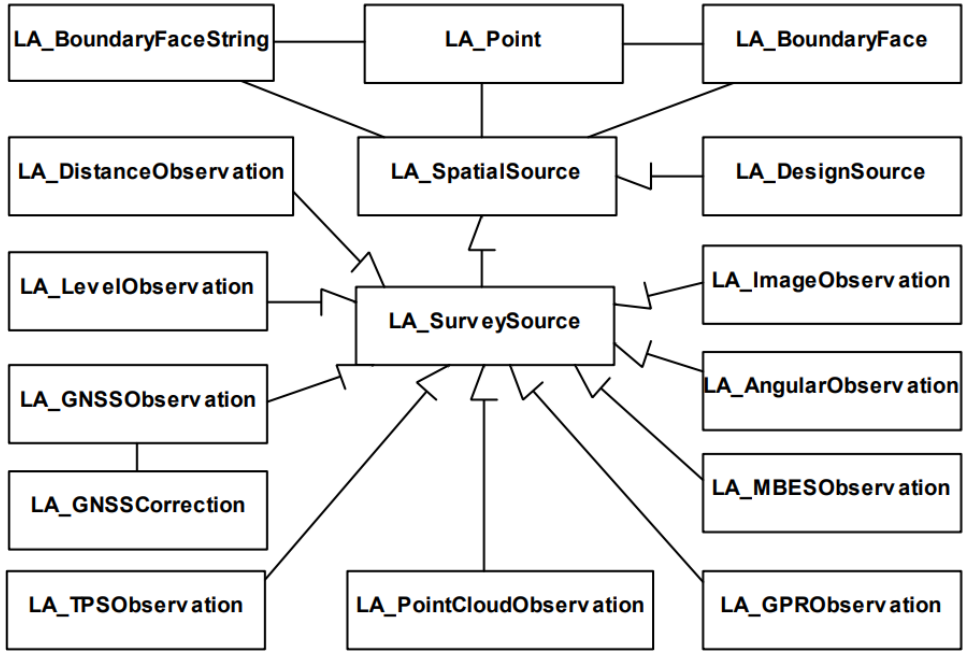

Figure. Classes of the Surveying and Representation package
(Kara et al., 2024)

Land Administration Domain Model Edition II

- Part 4 – Valuation information
- Facilitates all stages of administrative property valuation

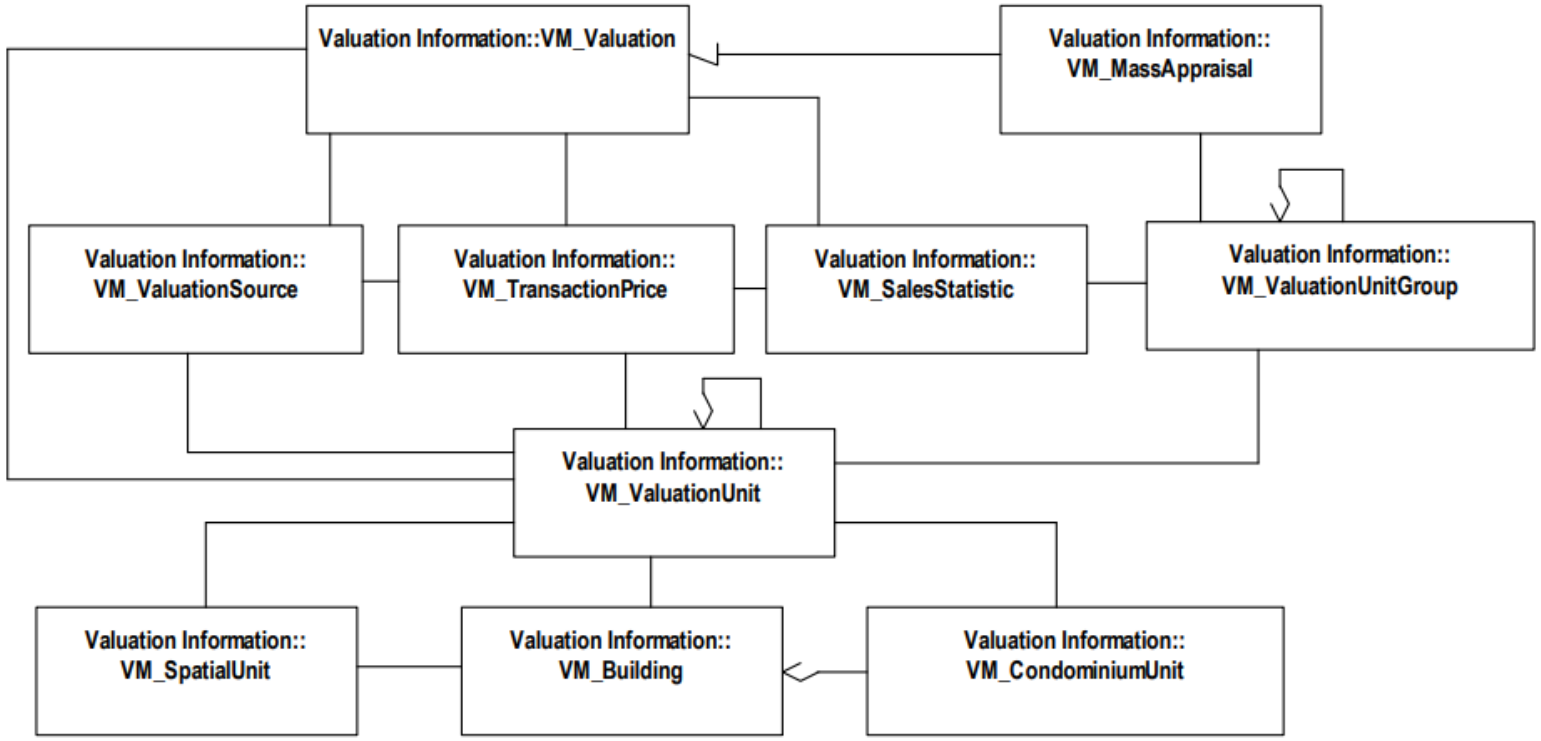

Figure. Basic classes of valuation information
(Kara et al., 2024)

Land Administration Domain Model Edition II

- Part 5 – Spatial plan information
- Defines how expected land use converted into rights, restrictions and responsibilities

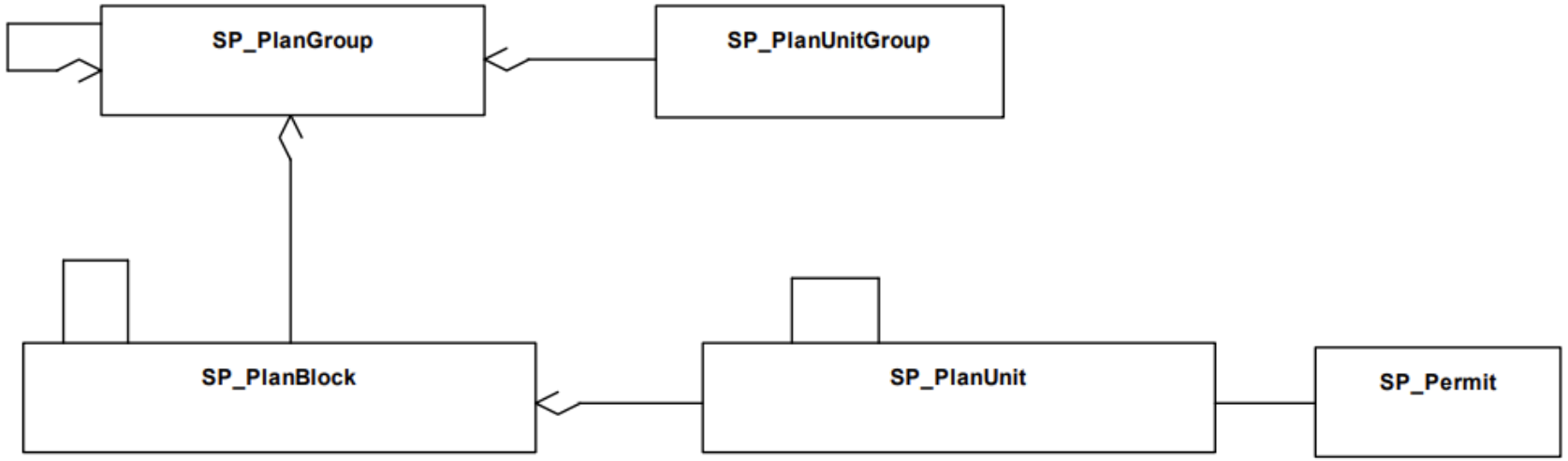

Figure. Basic classes of spatial plan information
(Kara et al., 2024)

Land administration in the Netherlands

- Land registration
- Valuation information
- Spatial plan information

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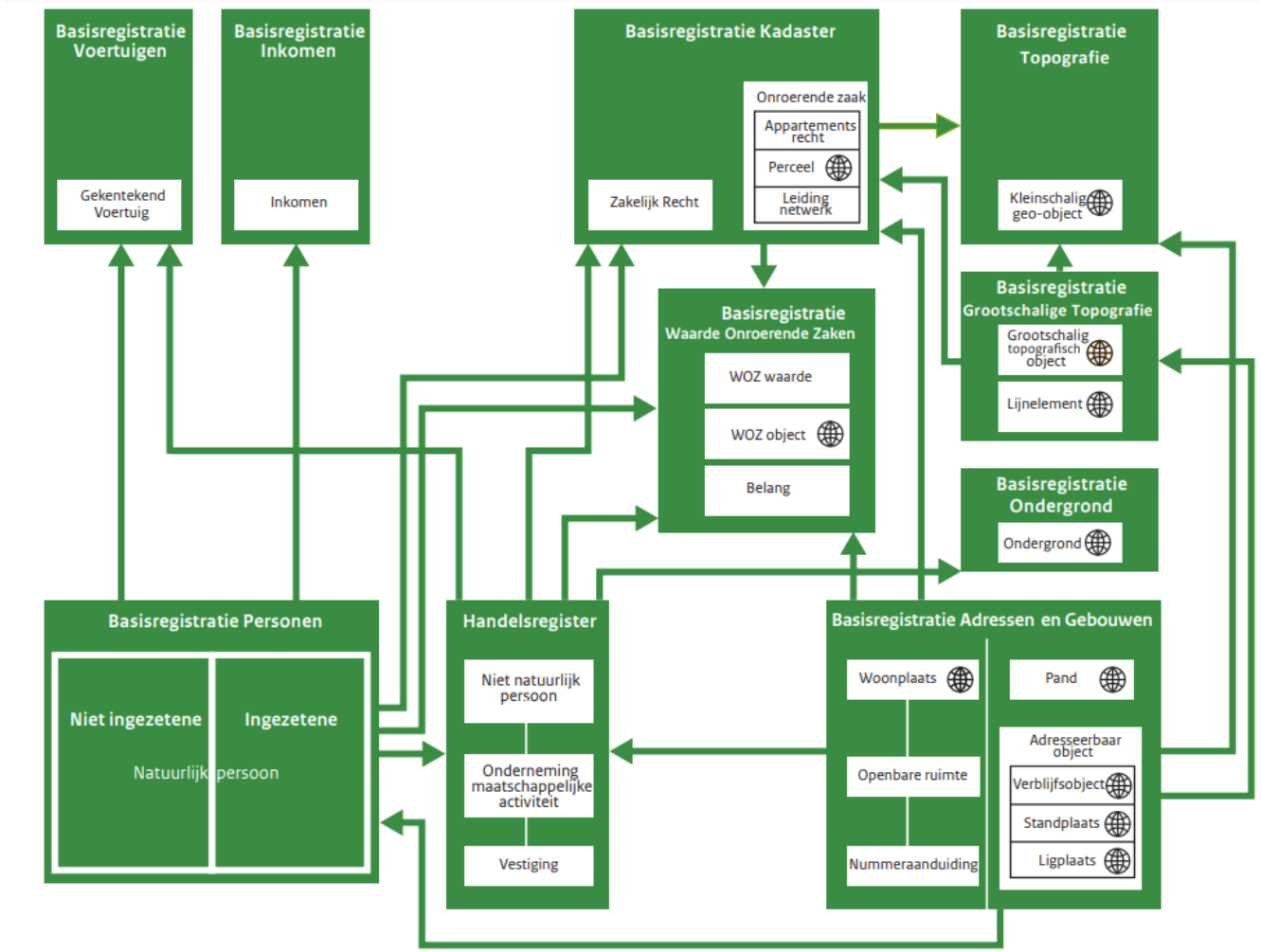

Figure. Base registers in the Netherlands (Overheid, 2020)

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Land administration in the Netherlands

- Land registration
- Valuation information
- Spatial plan information

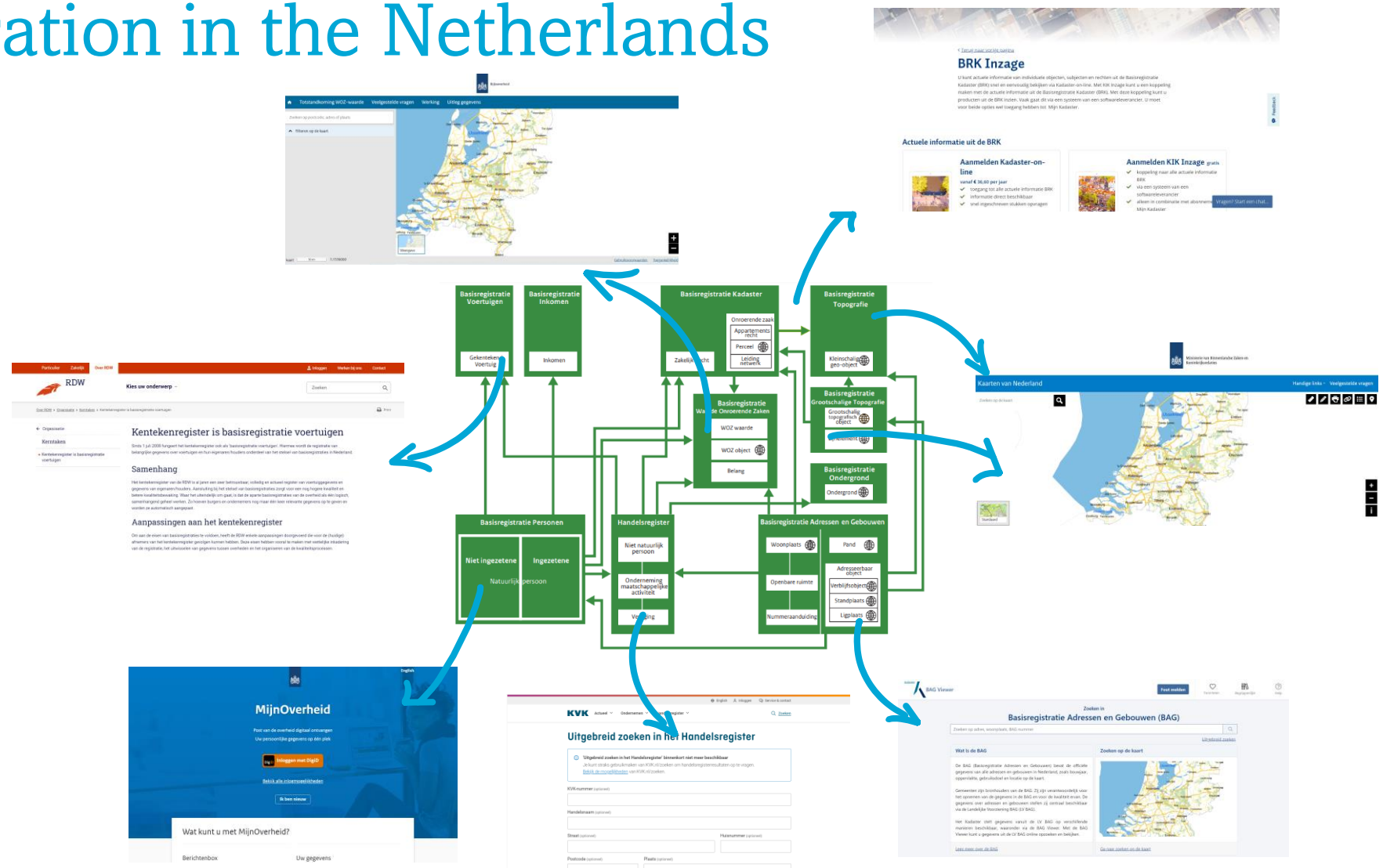

Figure. Base registers in the Netherlands (Overheid, 2020)

Land administration in the Netherlands

- Land registration
- Valuation information
- Spatial plan information

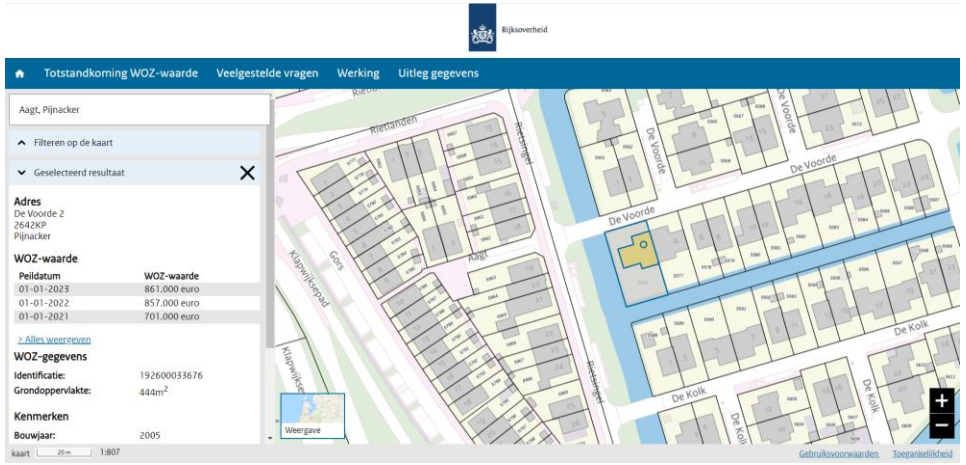

Figure. Wozwaardeloket portal (WOZ-waardeloket, n.d.)

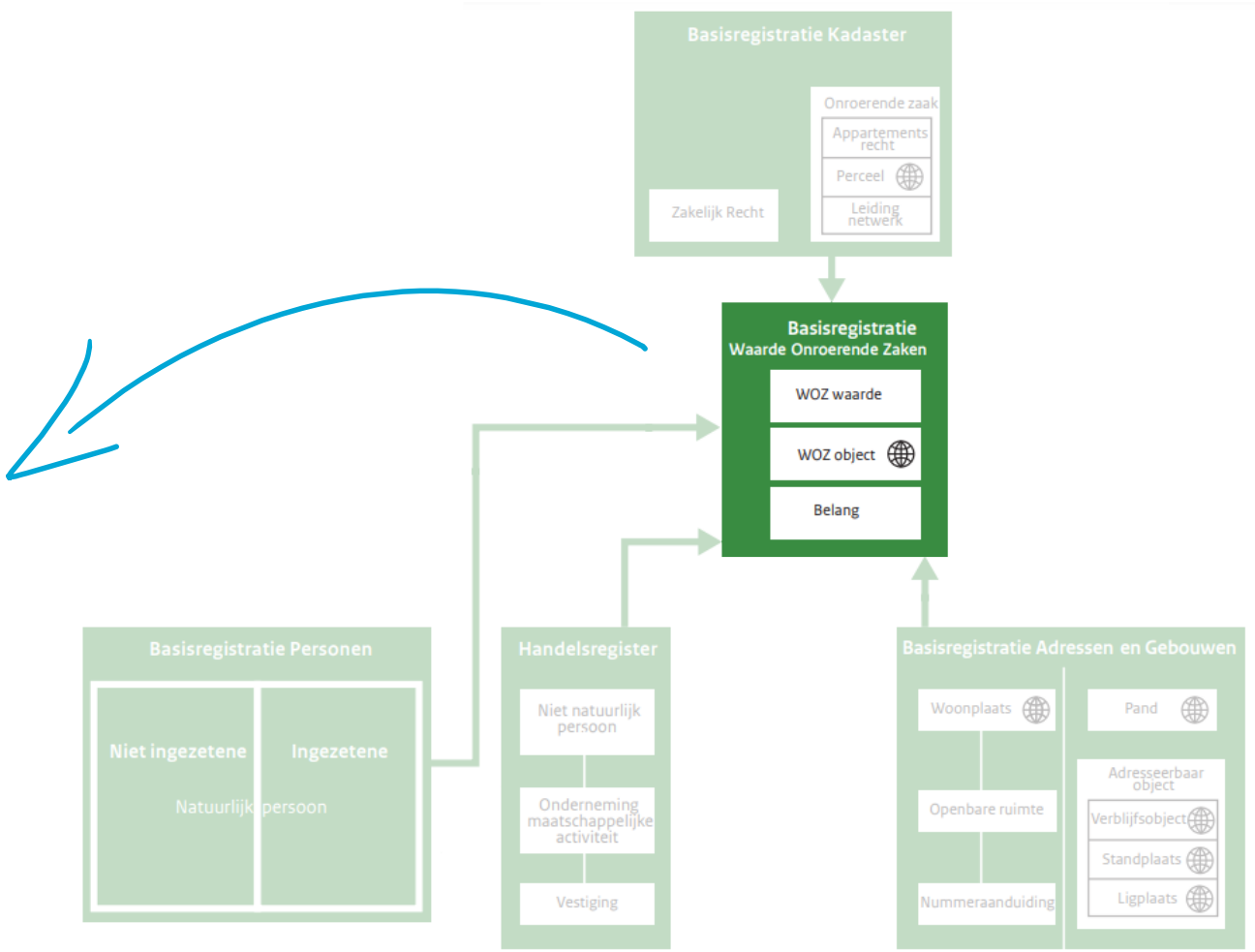

Figure. Base registers in the Netherlands (Overheid, 2020)

Land administration in the Netherlands

- Land registration
- Valuation information
- Spatial plan information

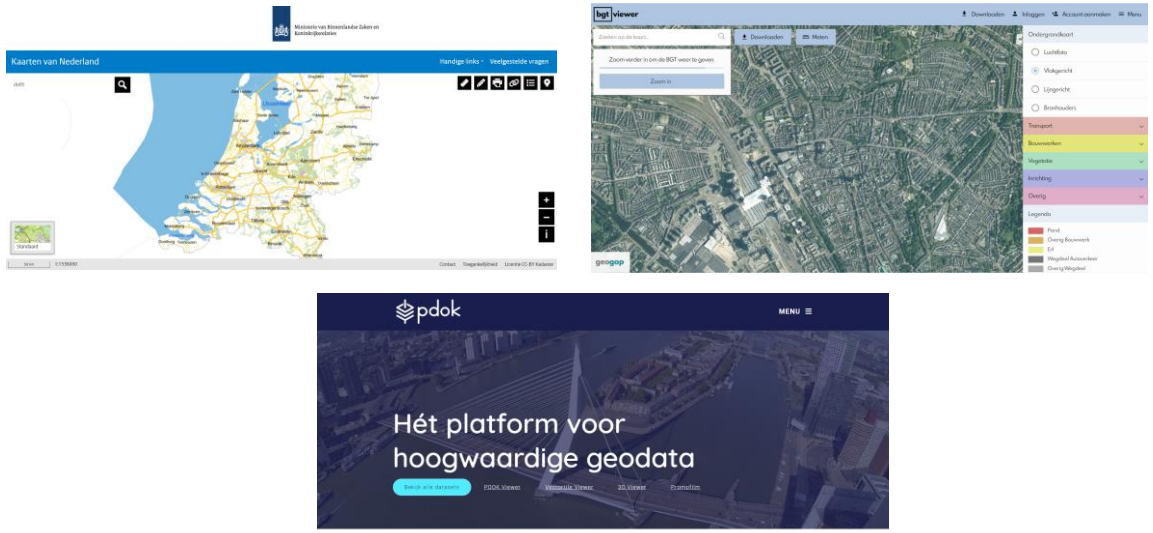

Figure. Ruimtelijkeplannen, BGTviewer and PDOK portals (Ruimtelijkeplannen, n.d.) (BGTviewer, n.d.) (PDOK, n.d.)

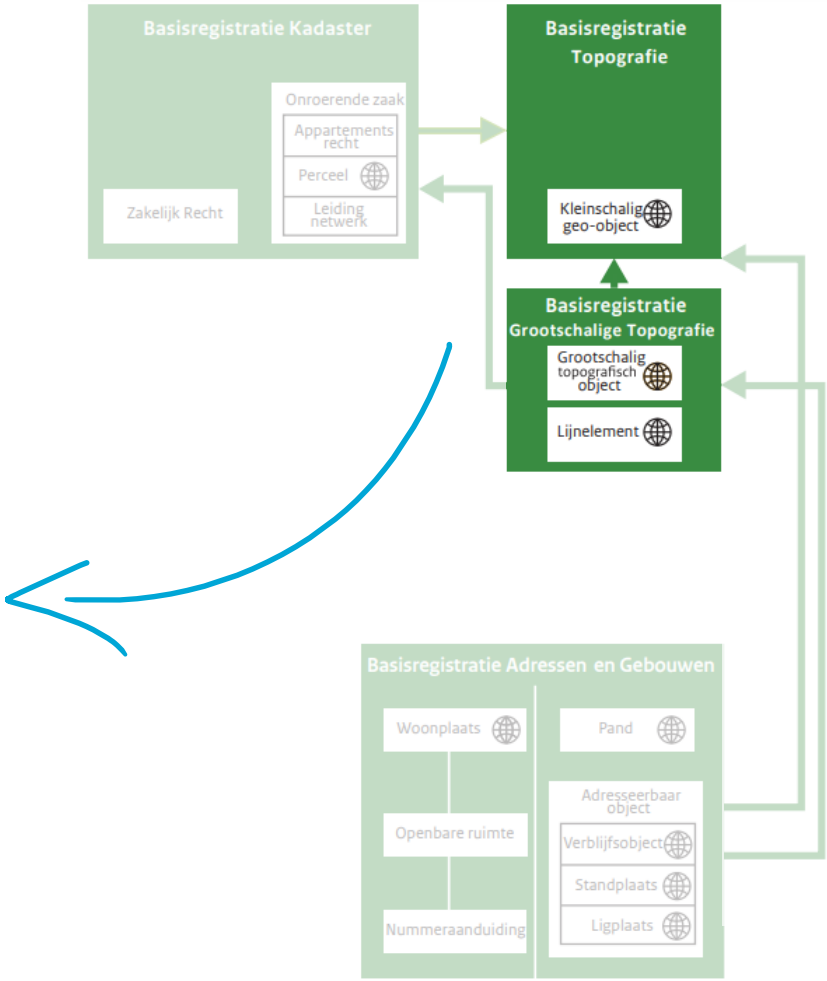

Figure. Base registers in the Netherlands (Overheid, 2020)

Linked data

- SPARQL language
- Triples (subject, predicate, object)
- Uniform Resource Identifiers (URIs)

- The Kadaster Knowledge Graph

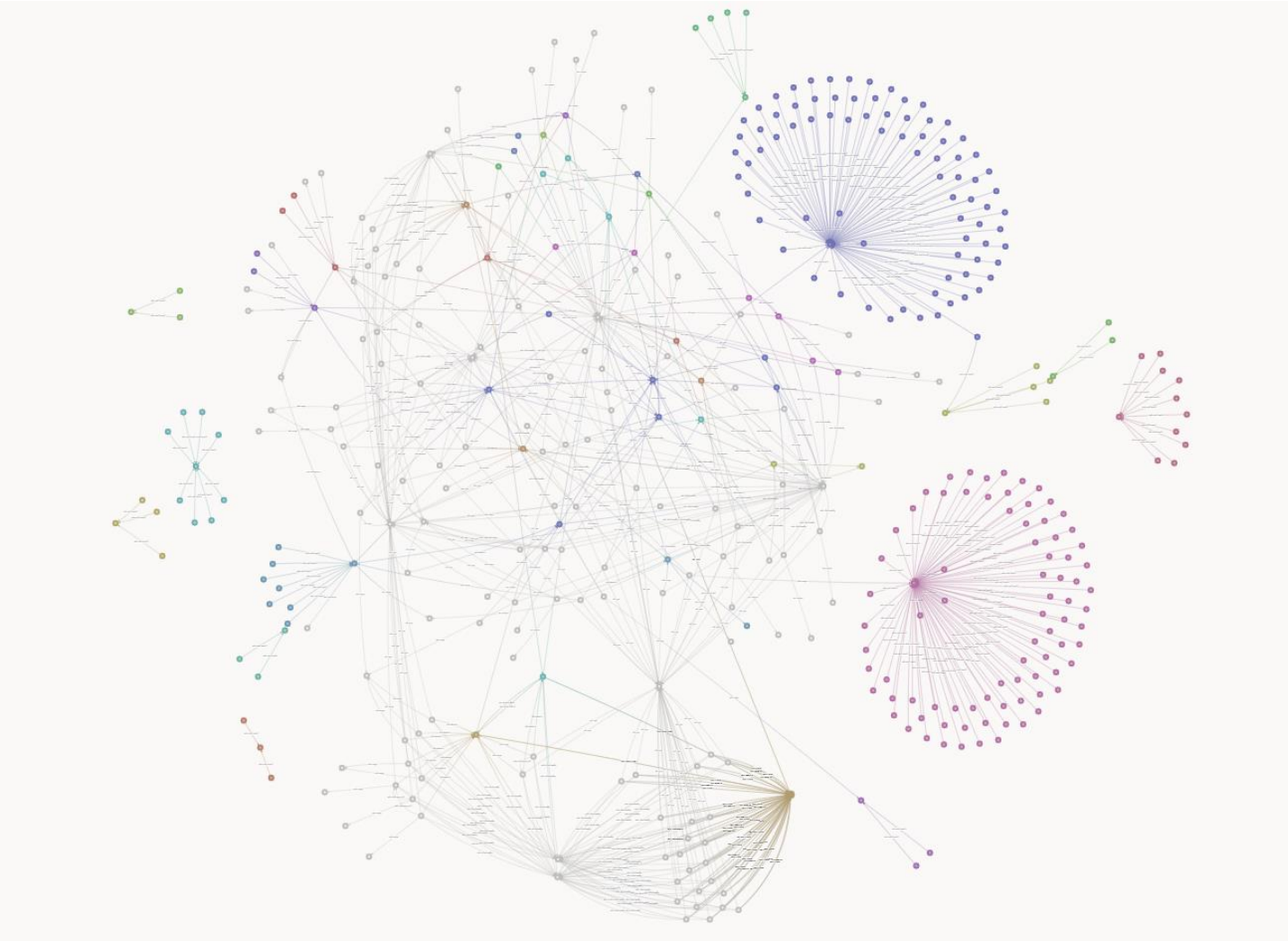

Figure. Kadaster Knowledge Graph

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Design of Prototype

Methodology

Methodology

- Design Science Research (DSR)

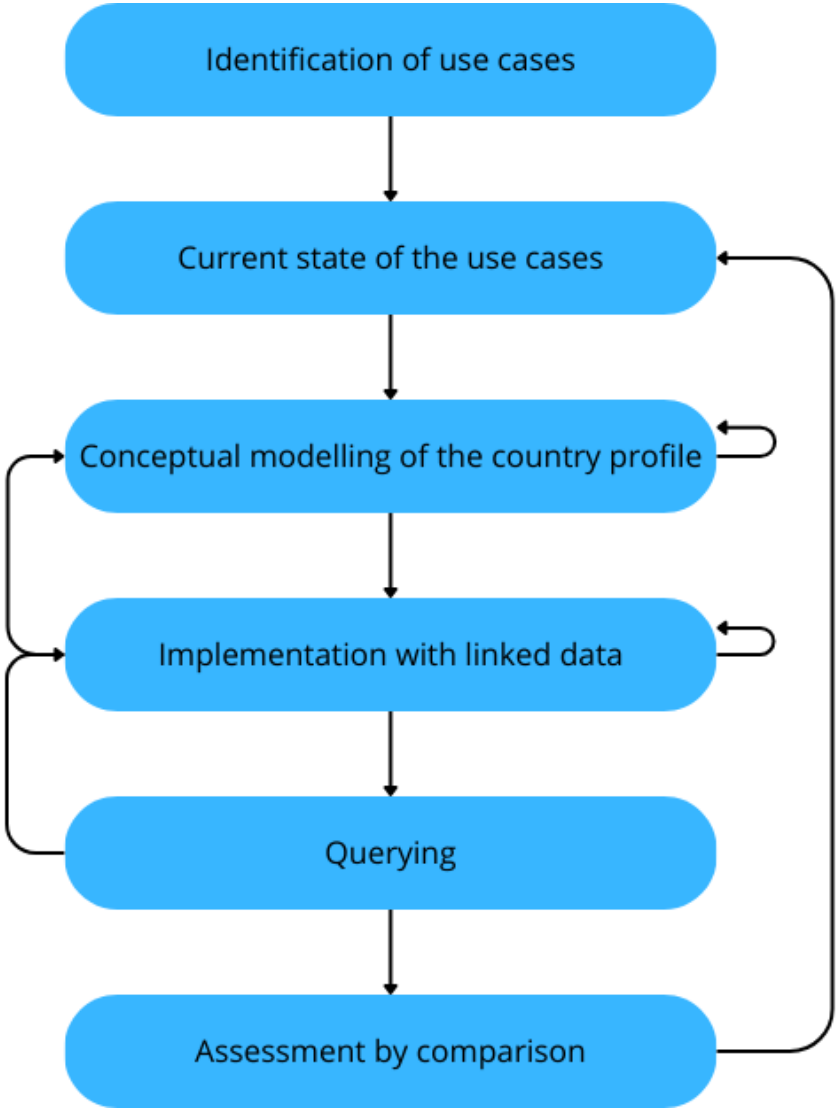


Figure. Methodology of this thesis

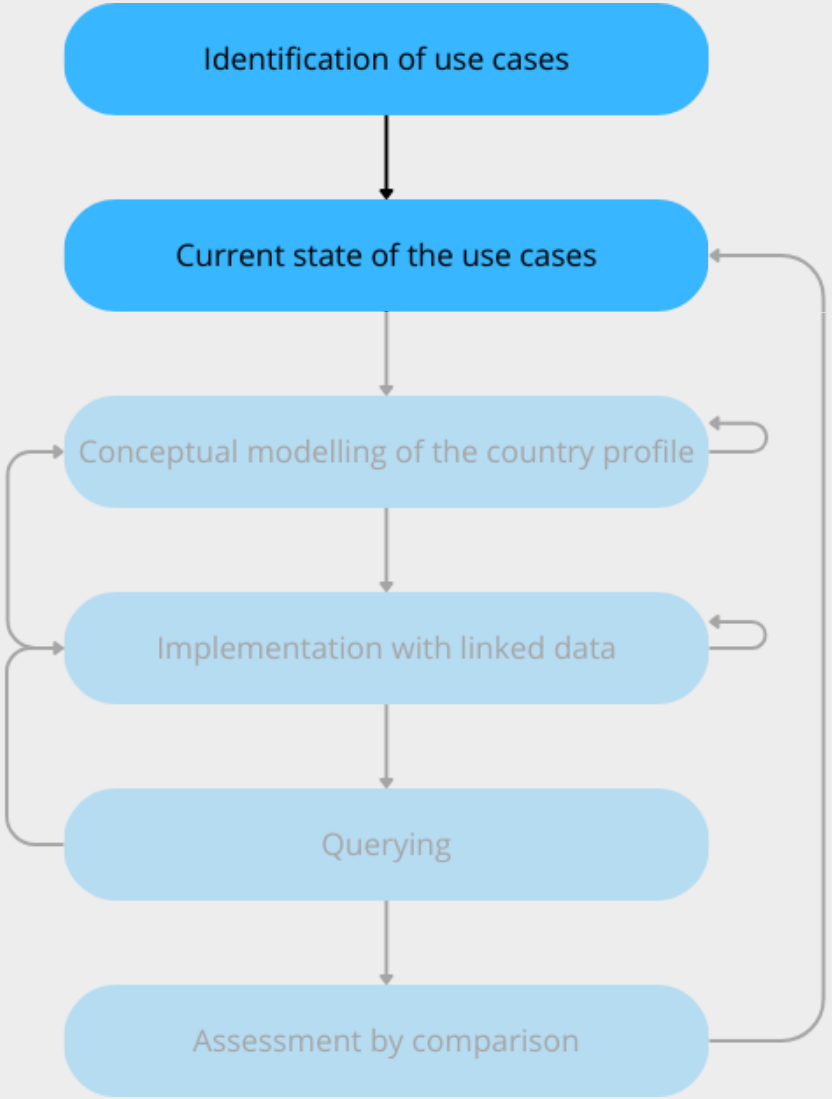
4

Results

Use cases

Two use cases are identified to assess the impact of the implementation of LADM in the Netherlands.

Current state of the use cases is modelled as process models.



Real estate transaction

- The preliminary phase: Information sources in real estate exploration.

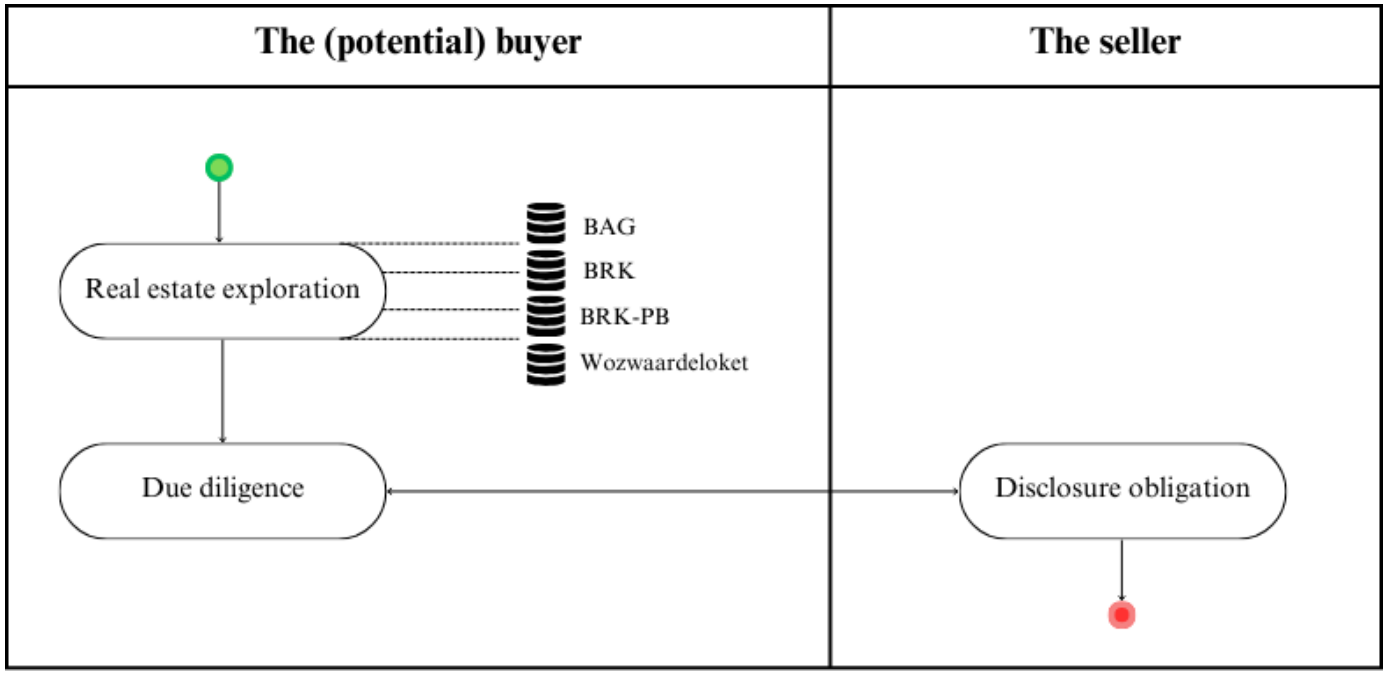


Figure. Process model real estate transaction – Preliminary phase

Real estate transaction

- The sequential phase: Sale and transfer of the real estate.

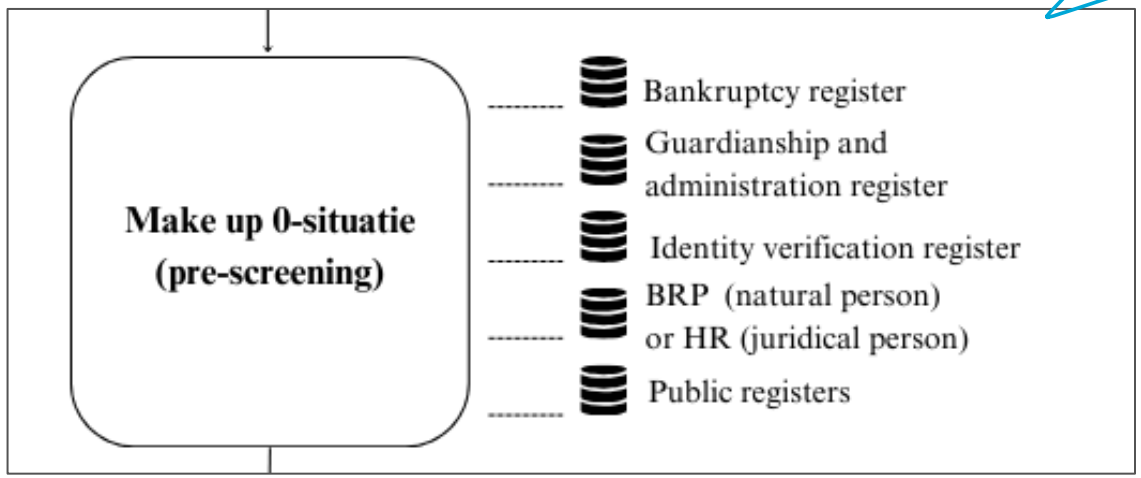
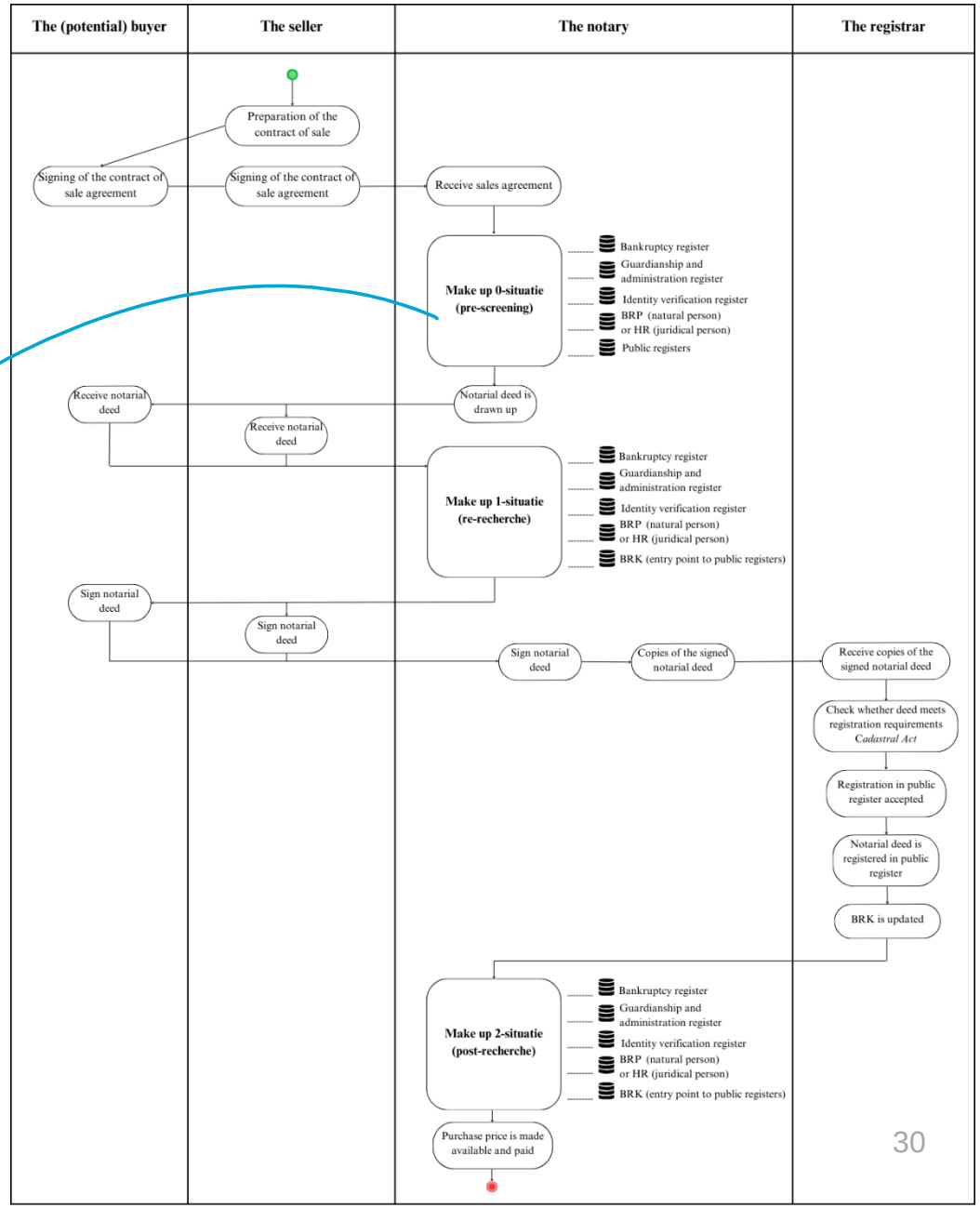


Figure. Process model real estate transaction – Sequential phase



Building permit

- Preliminary phase: Information sources in preparation of a building plan and the application for a building permit.

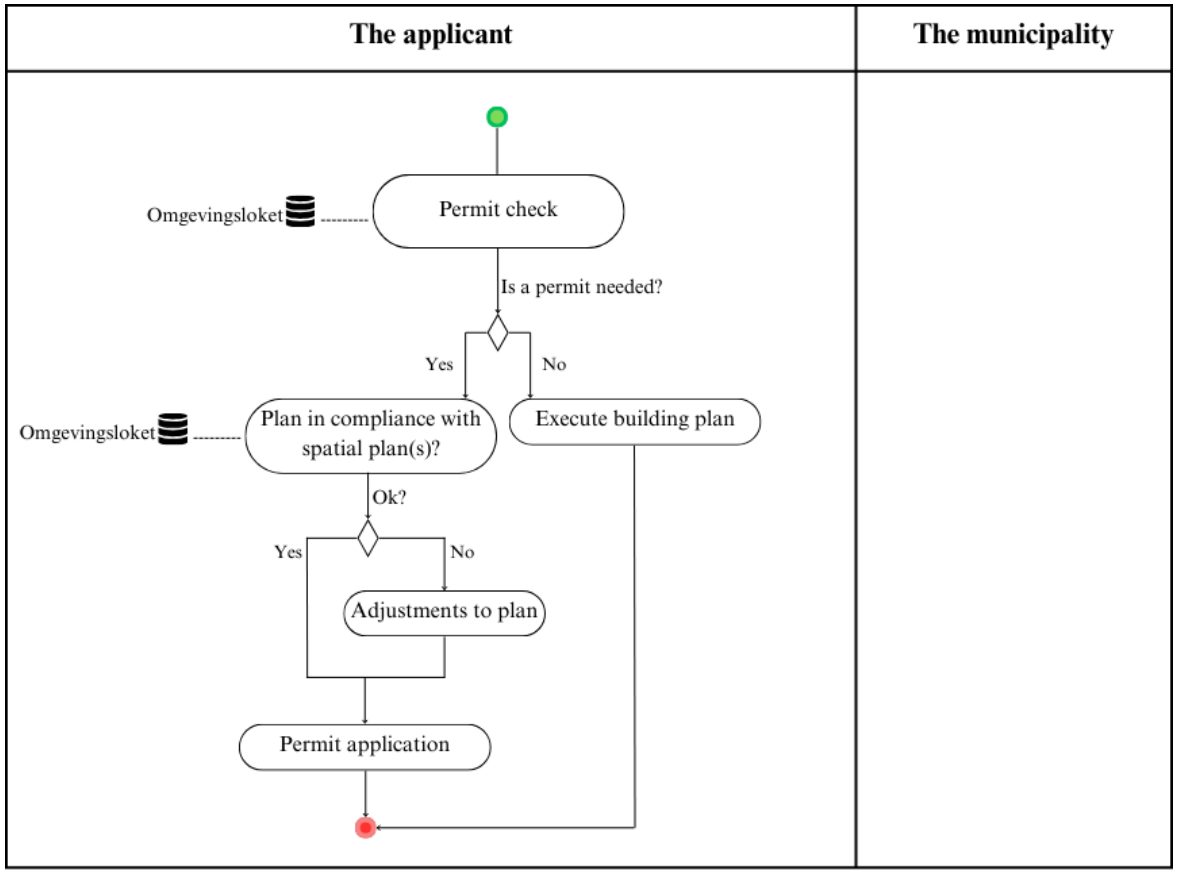


Figure. Process model building permit – Preliminary phase

Building permit

- Sequential phase: Application for a building permit.

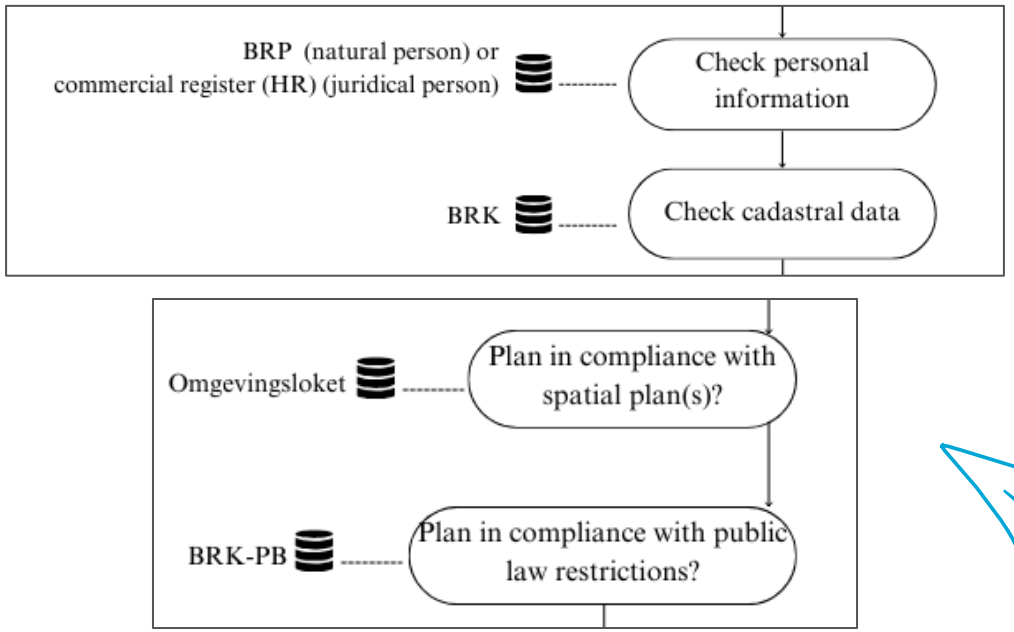
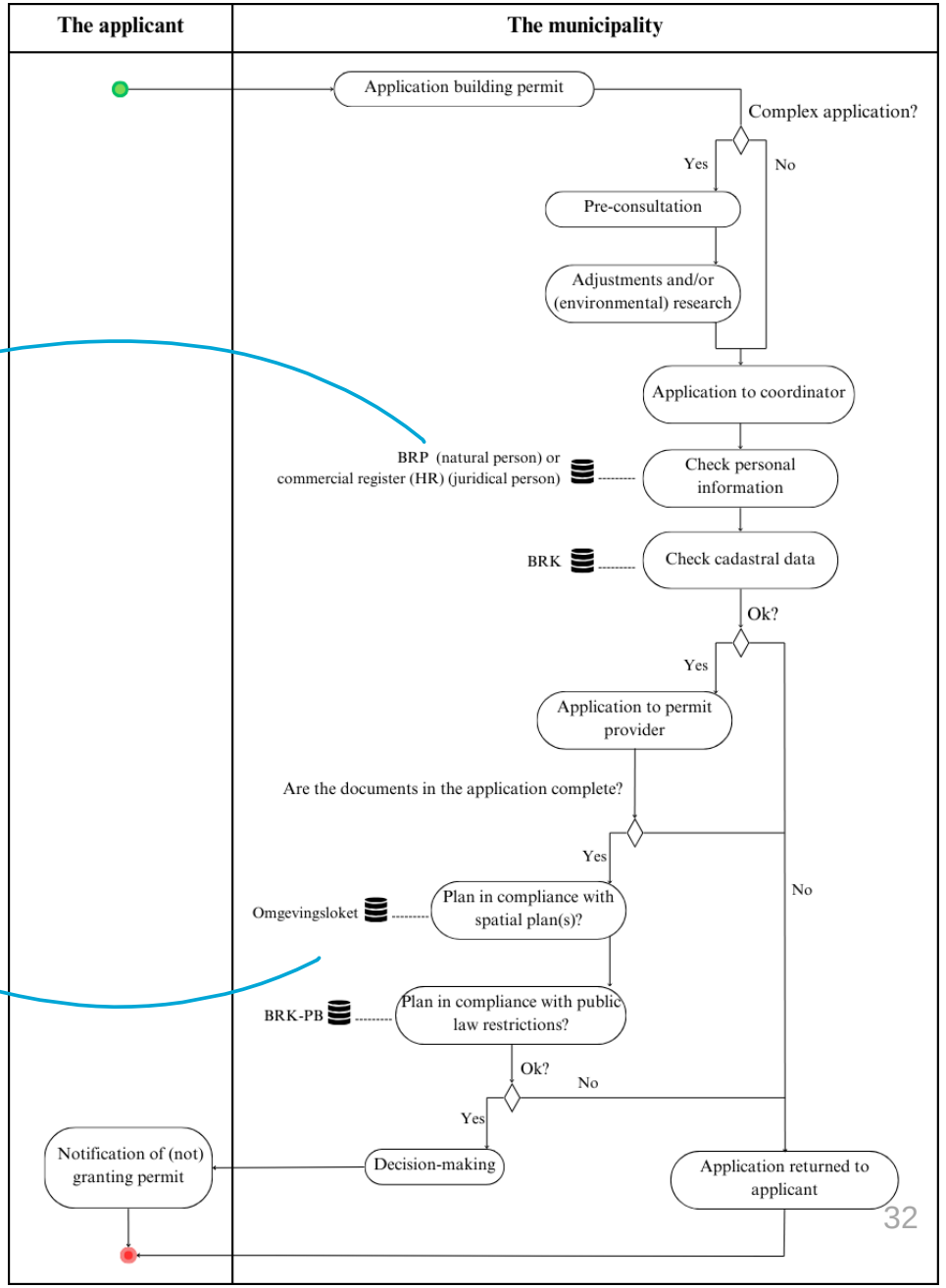
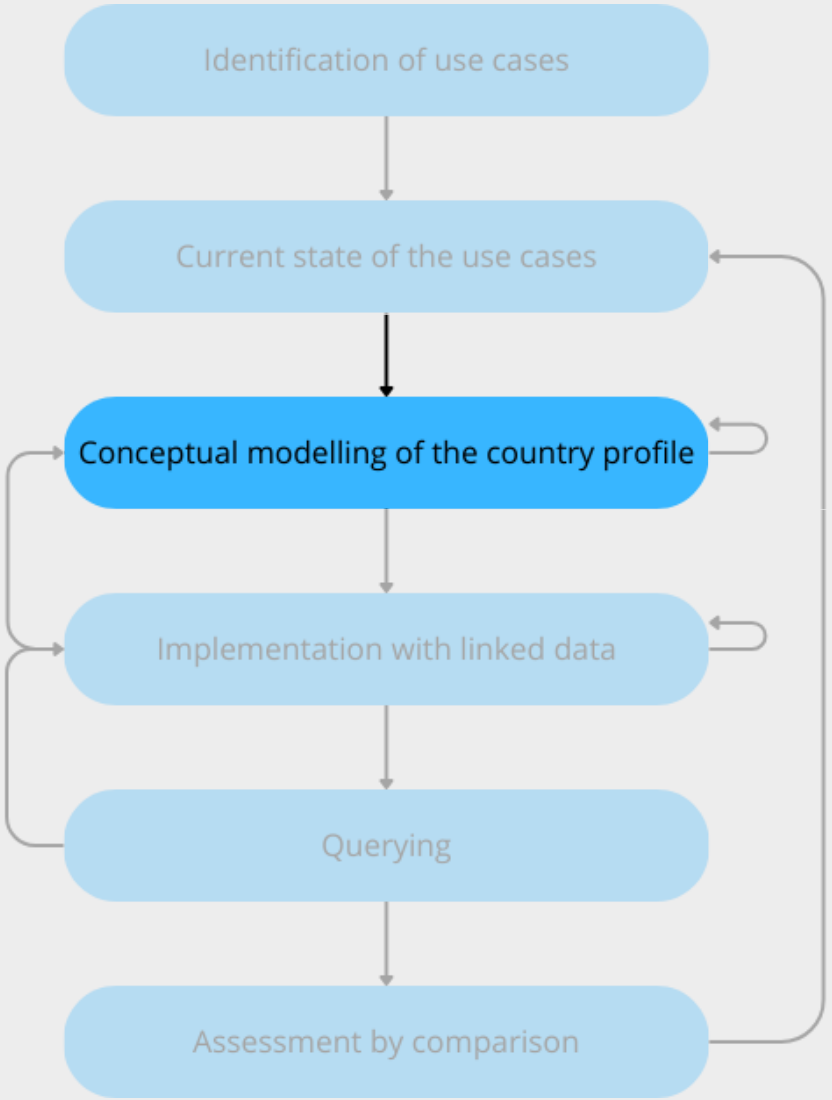


Figure. Process model building permit – Sequential phase



Country profile of the Netherlands

To adapt the LADM to the country-specific needs of the Netherlands.



Core LADM

- Part 1 – Generic Conceptual Model
- Part 2 – Land registration

Adjustments:

- Required relationship on LA_RRR
- Merging of the classes LA_BAUnit and LA_SpatialUnit
- LA_Mortgage as a subclass of LA_RRR

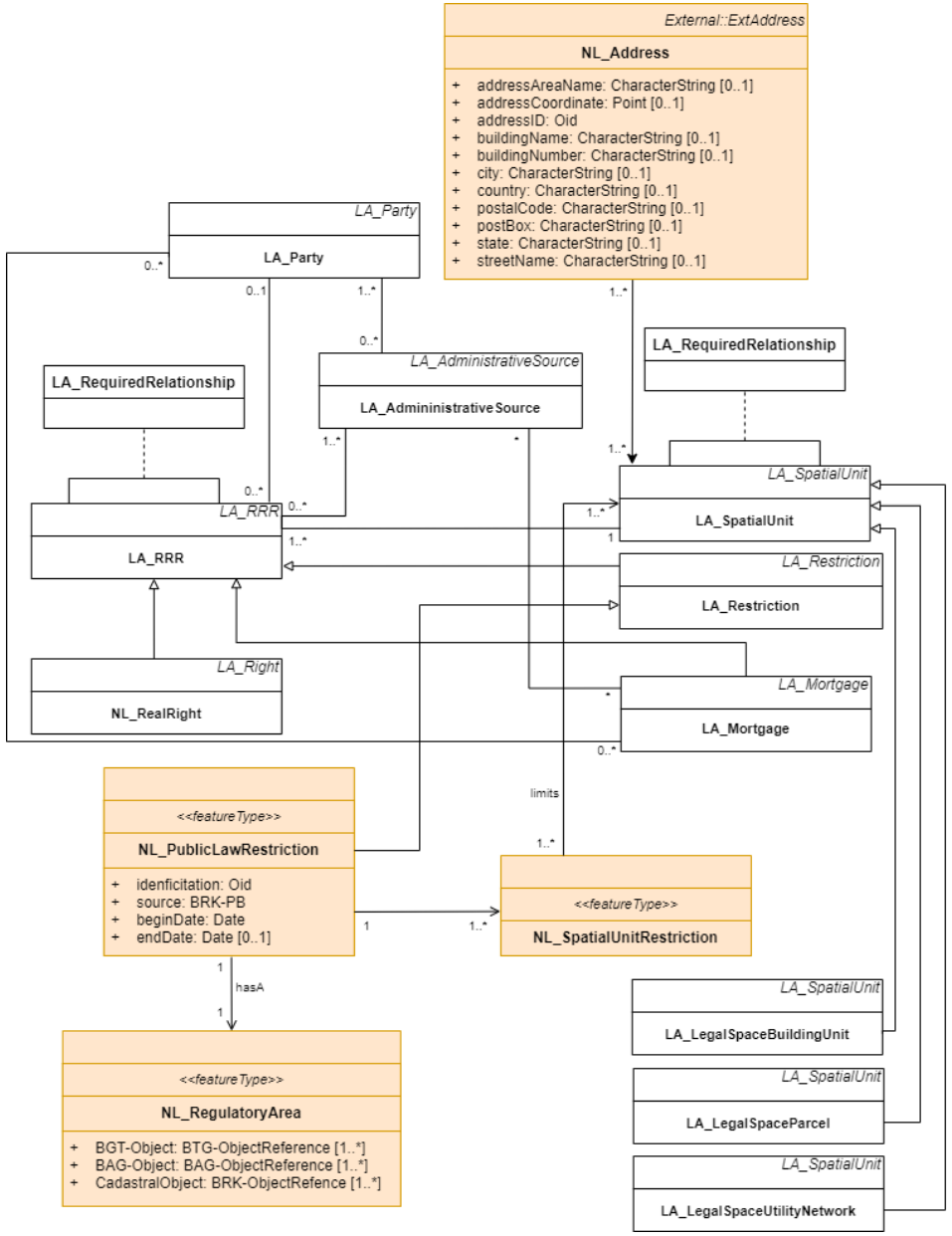
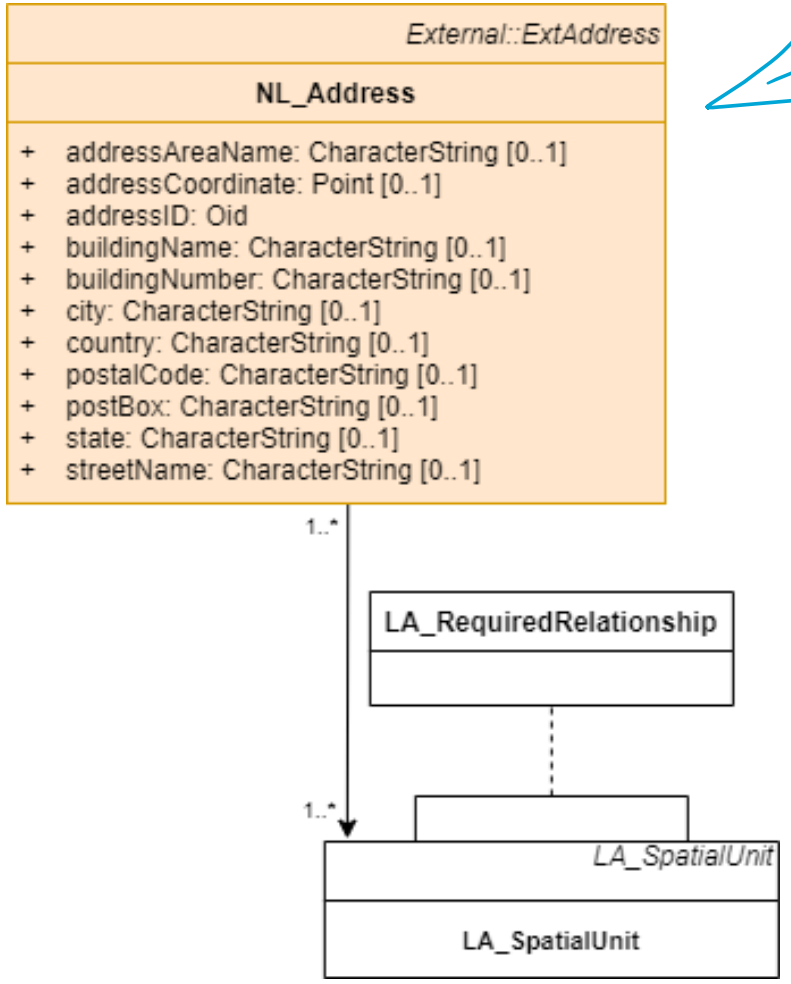


Figure. Country profile of the Netherlands for core LADM

Core LADM

Added class:

- NL_Address



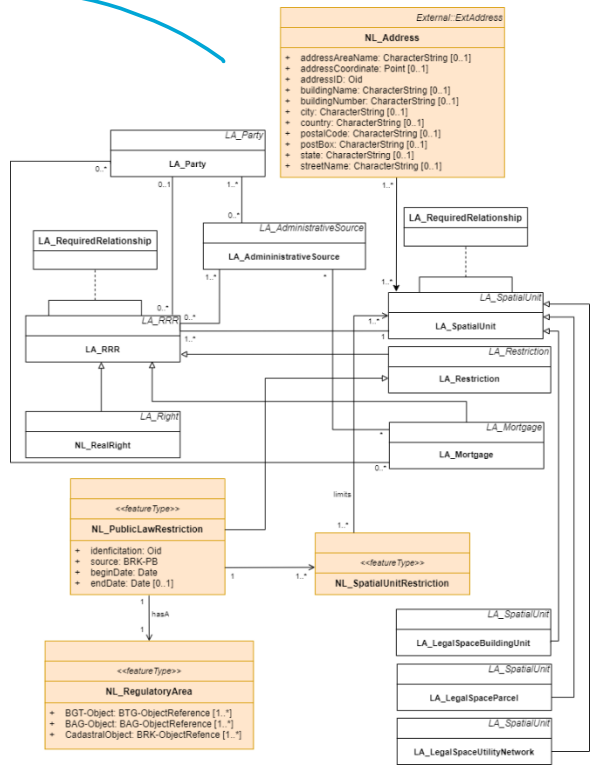


Figure. Country profile of the Netherlands for core LADM

Core LADM

Added classes:

- NL_PublicLawRestriction
- NL_SpatialUnitRestriction
- NL_RegulatoryArea

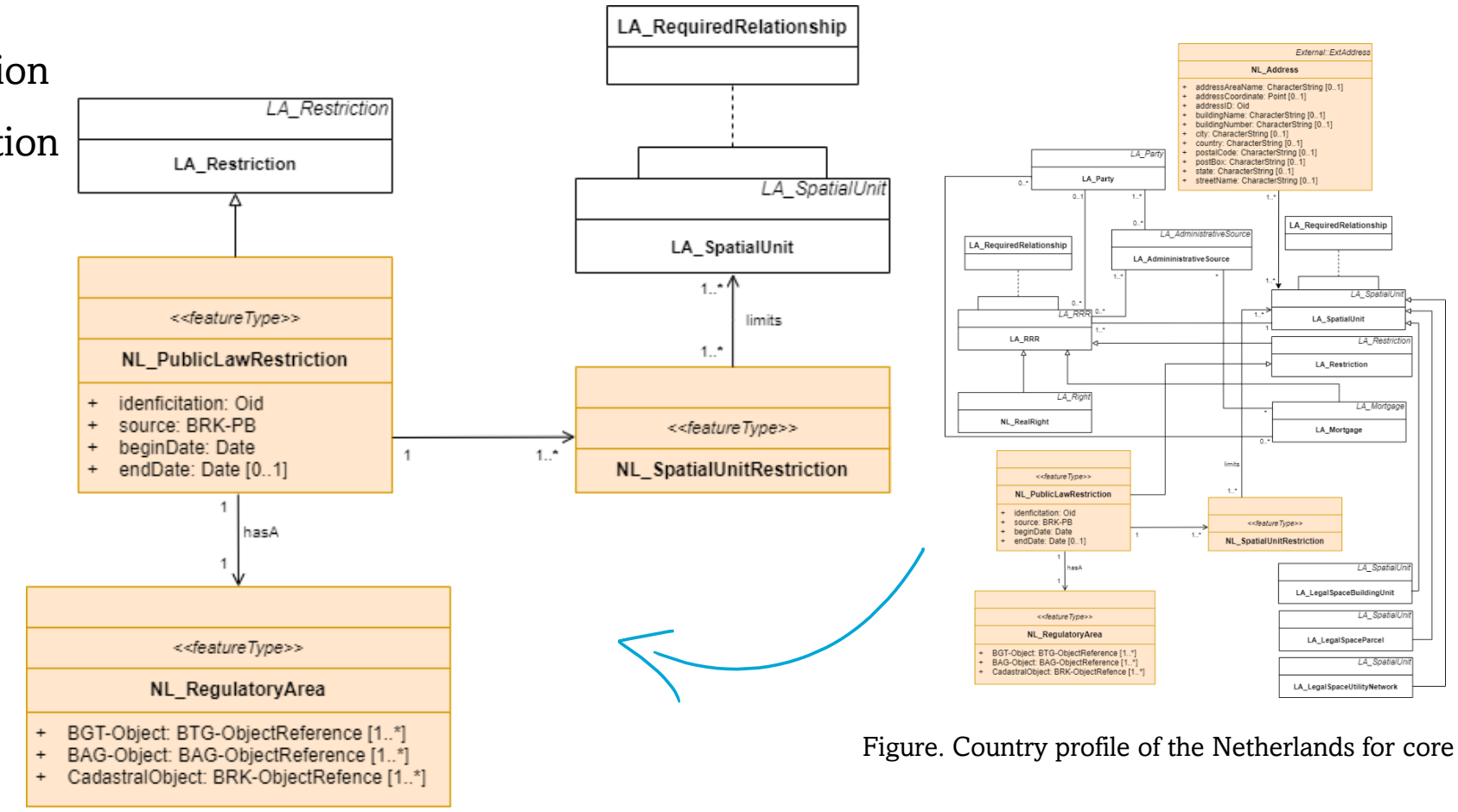


Figure. Country profile of the Netherlands for core LADM

Valuation information

- Part 4 – Valuation information

Adjustments:

- Removal of relationships on itself on the class LA_SpatialUnit
- Removal of the relationship on itself on the class LA_SpatialUnitGroup
- Addition of a relationship between the classes LA_SpatialUnitGroup and LA_SpatialUnit
- Addition of class VM_Valuationsource and its relationships with VM_ValuationUnit, VM_Transactionprice, VM_Valuation and LA_Party

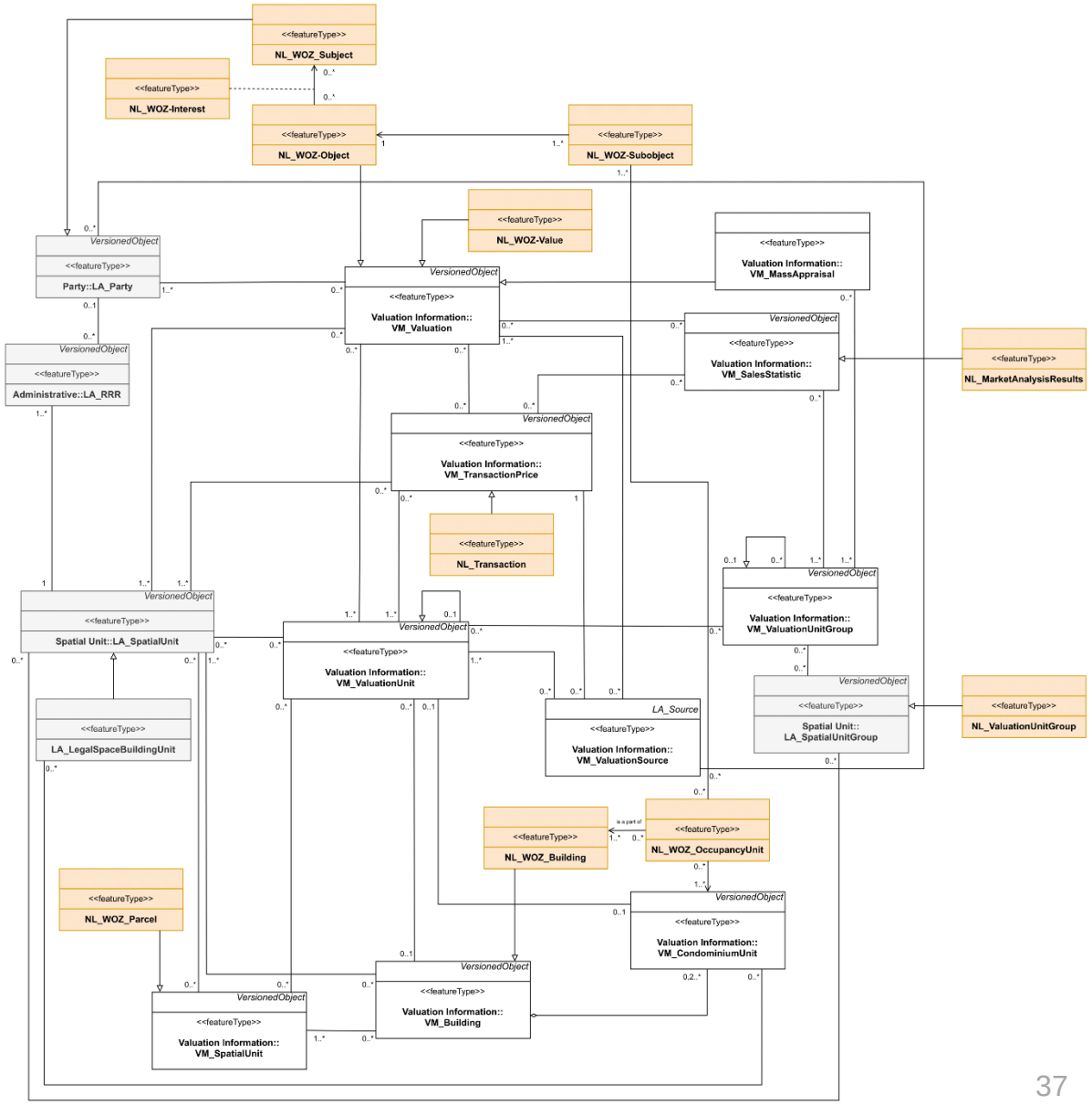
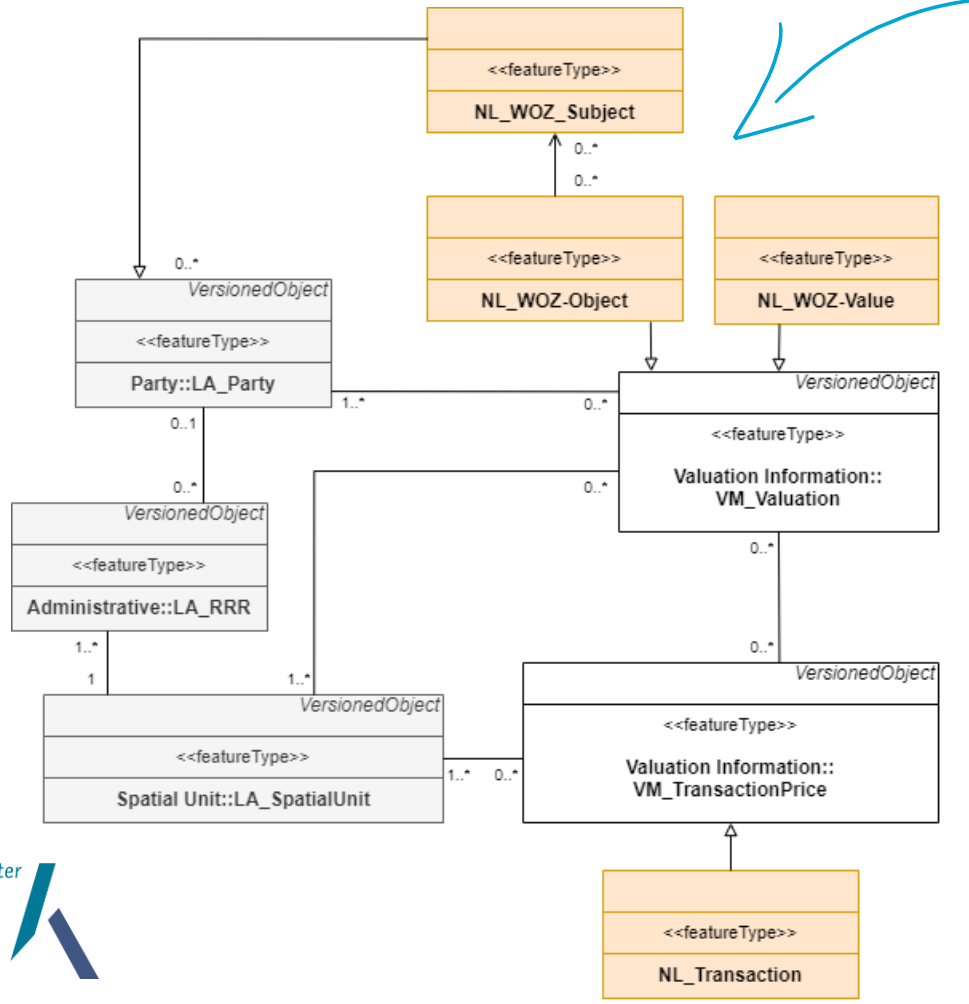


Figure. Country profile of the Netherlands for valuation information

Valuation information

- Part 4 – Valuation information



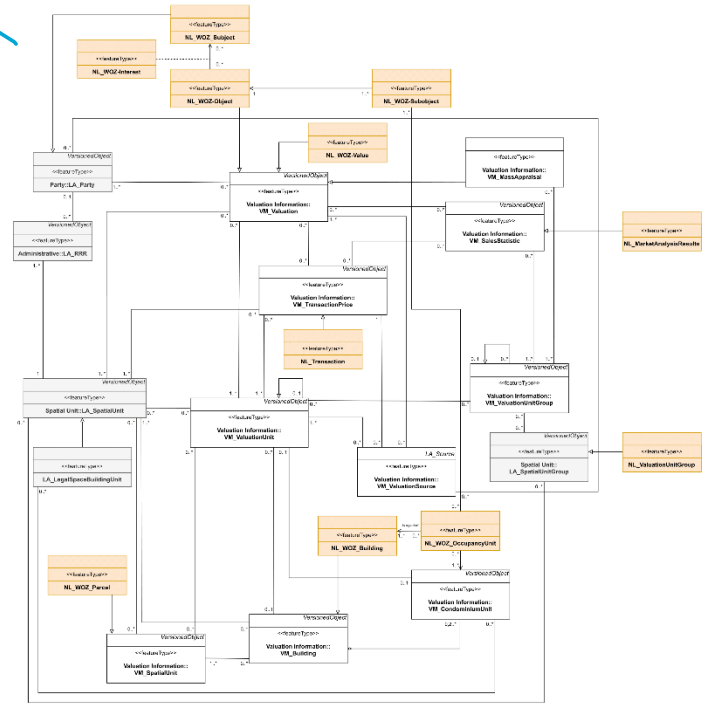


Figure. Country profile of the Netherlands for valuation information

Spatial plan information

- Part 5 – Spatial plan information

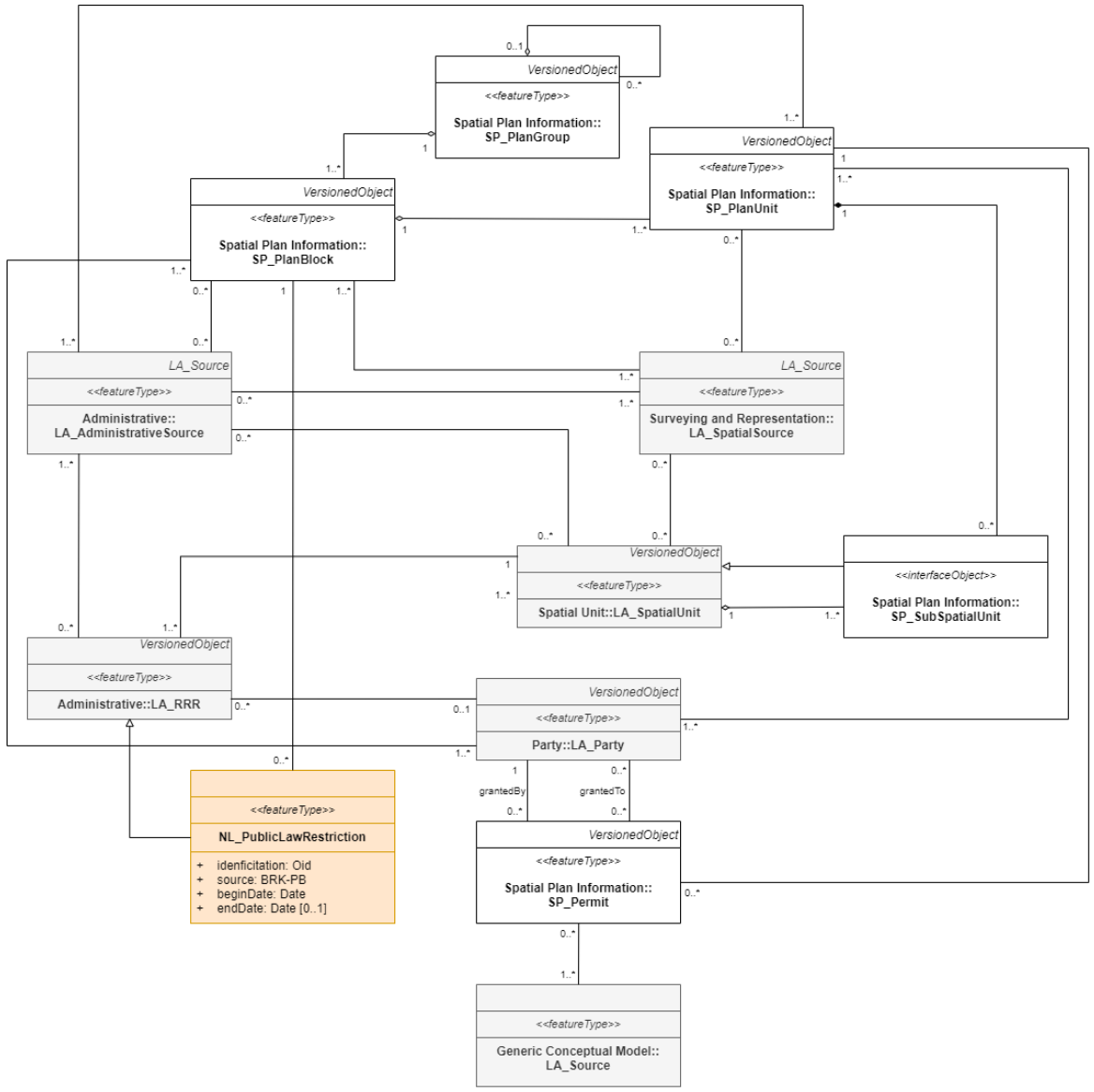
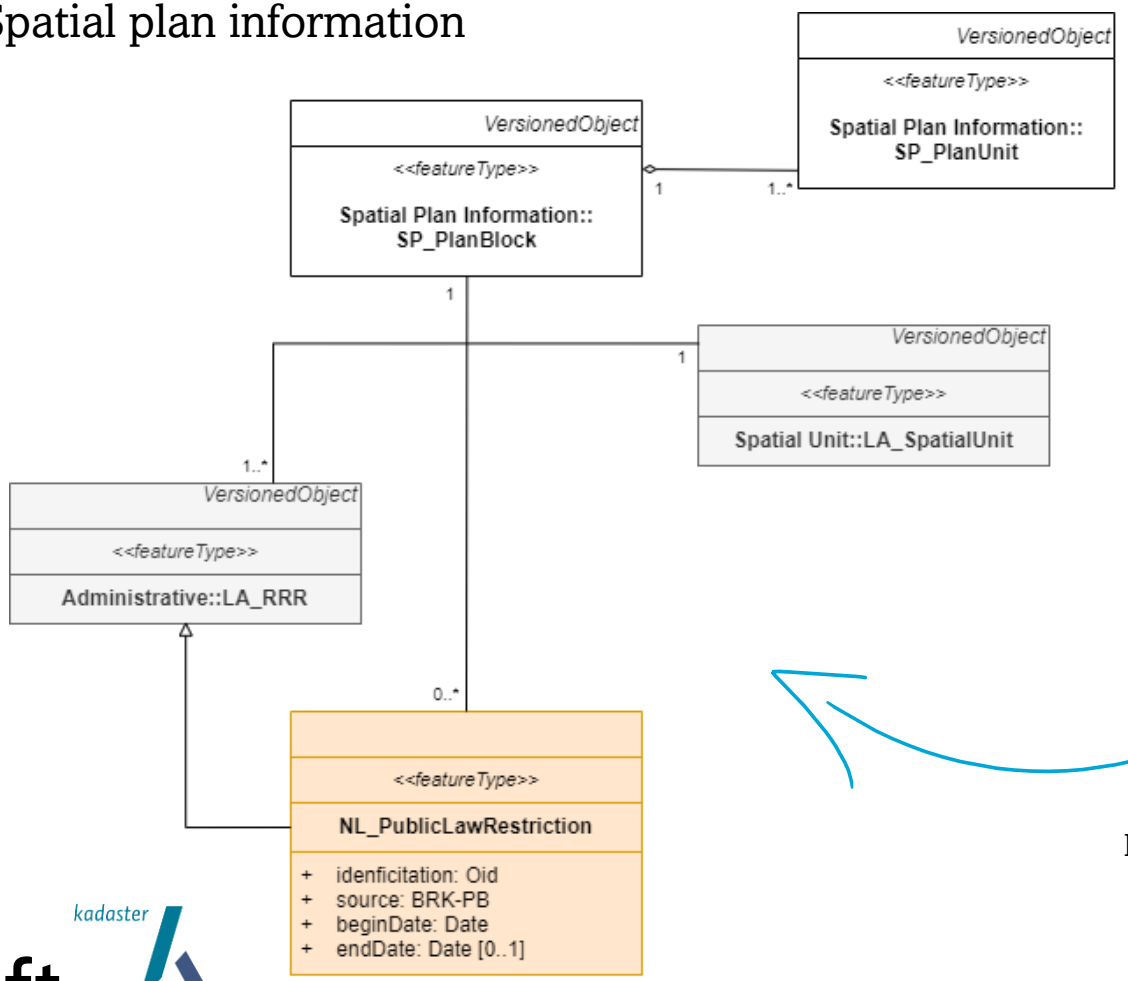


Figure. Country profile of the Netherlands for spatial plan information

Spatial plan information

- Part 5 – Spatial plan information



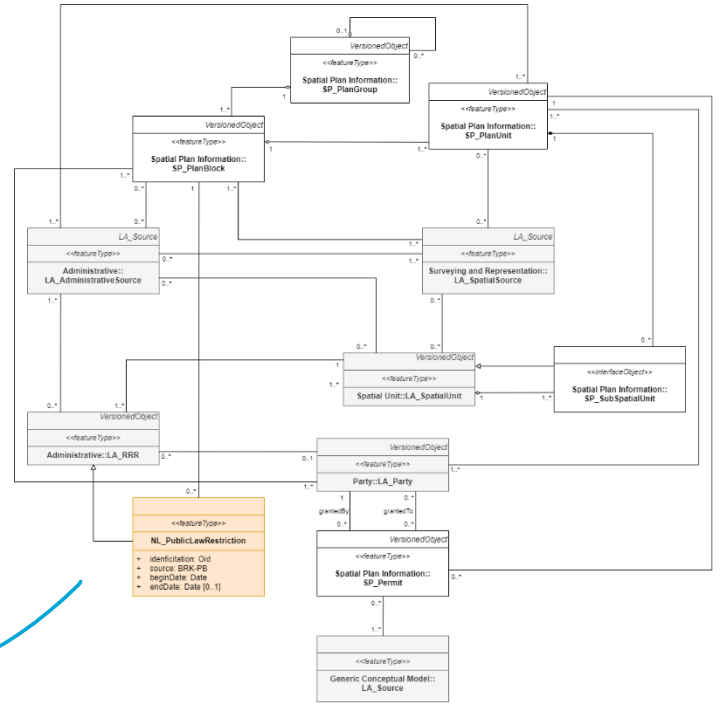
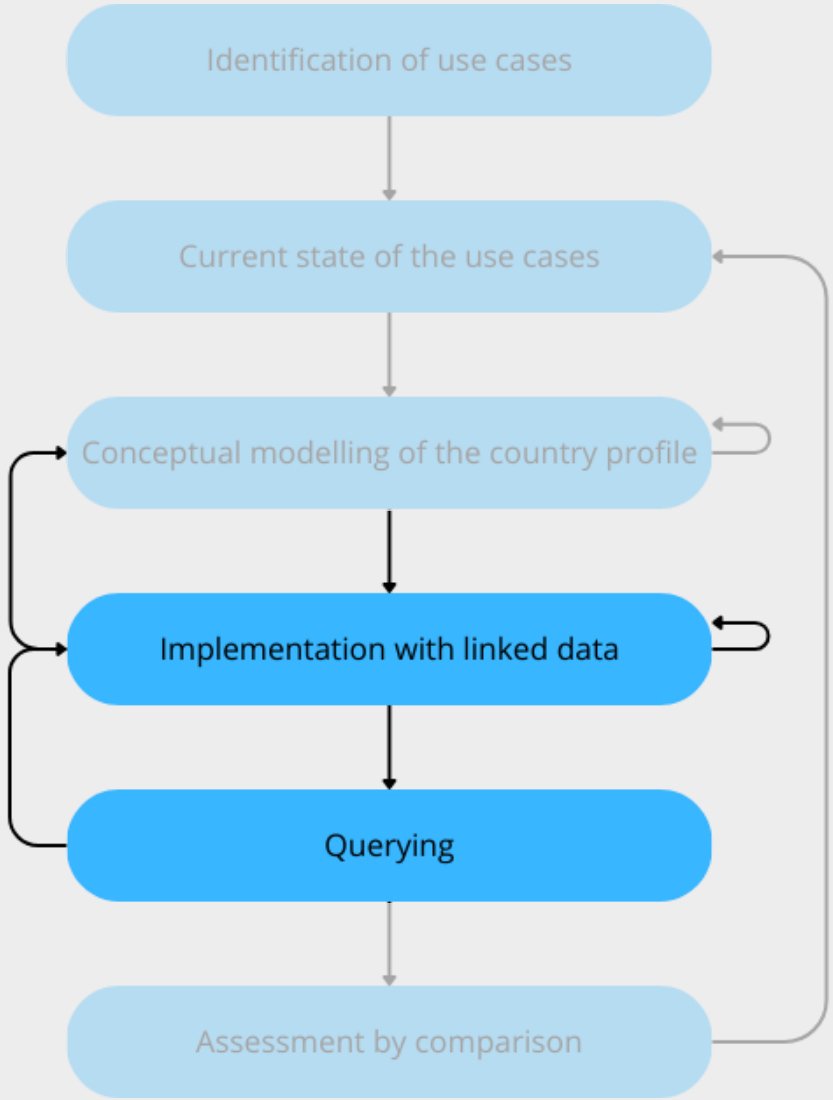


Figure. Country profile of the Netherlands for spatial plan information

Implementation with linked data

To develop a prototype that demonstrates the implementation of LADM in the Netherlands, by querying the use cases.



Ontology

- Ontologies are a way to formally model a system's structure by representing its relevant entities and their relationships.
- Web Ontology Language (OWL)

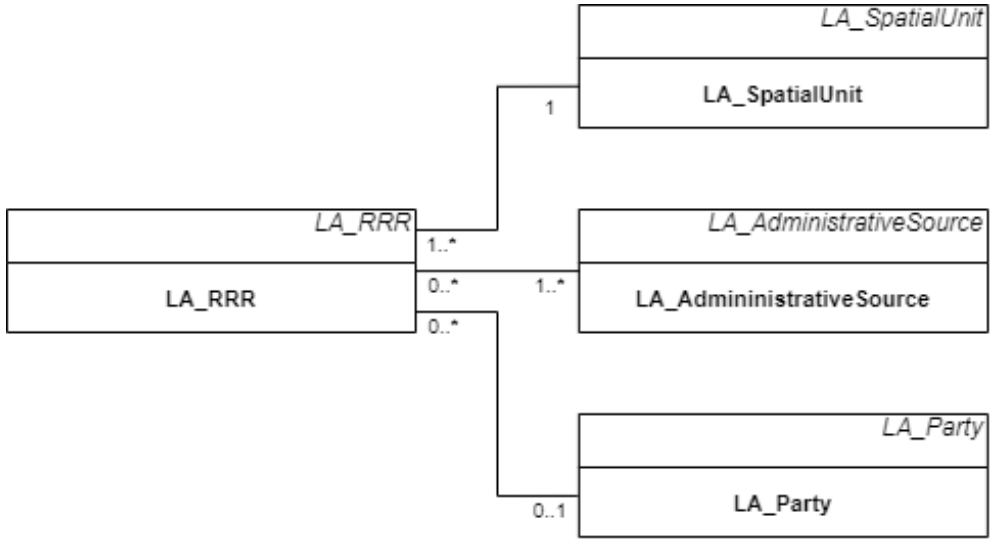


Figure. LA_RRR and its relationships as UML model

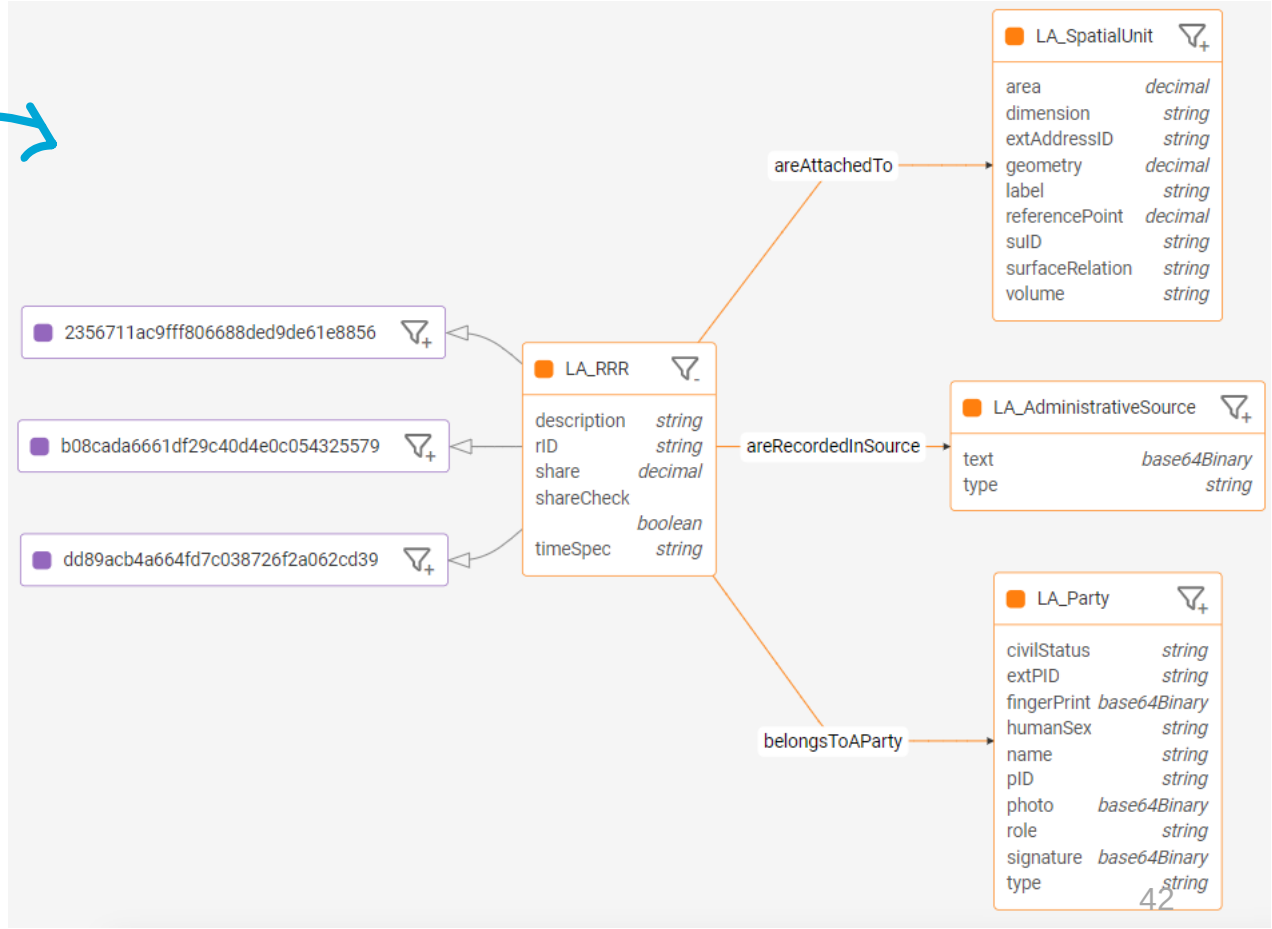


Figure. LA_RRR and its attributes and relationships as OWL model

Ontology

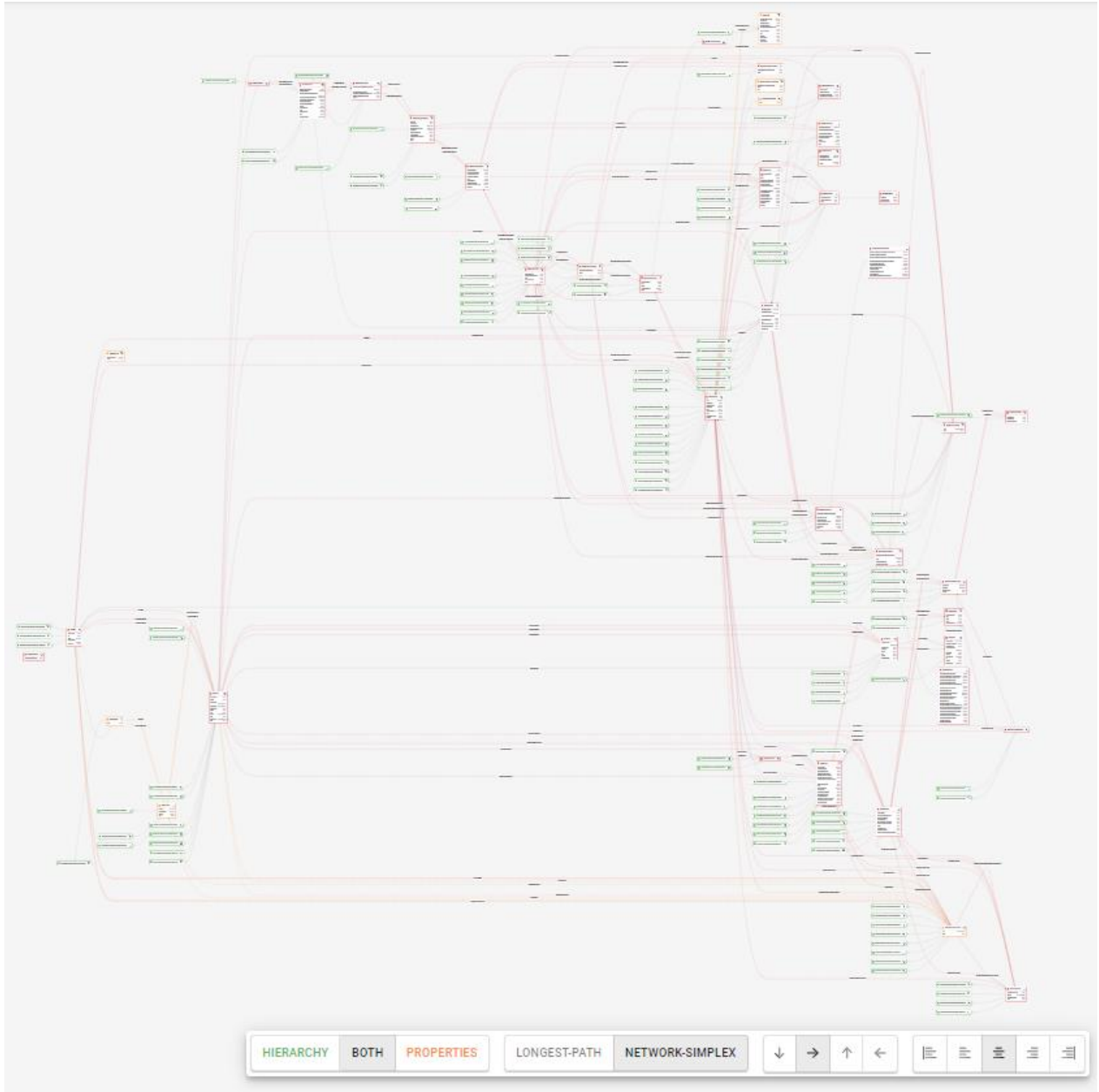


Figure. Resulting OWL ontology model

SPARQL construct queries

- Mismatch between the classes with attributes in the Dutch registers and classes with attributes in the ontology.
- Create new datasets conform the ontology.
- SPARQL construct queries.

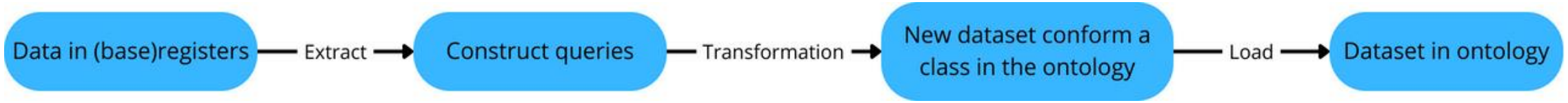


Figure. ETL approach

SPARQL construct queries

- Mismatch between the classes with attributes defined by LADM and classes with attributes in the Dutch registers.

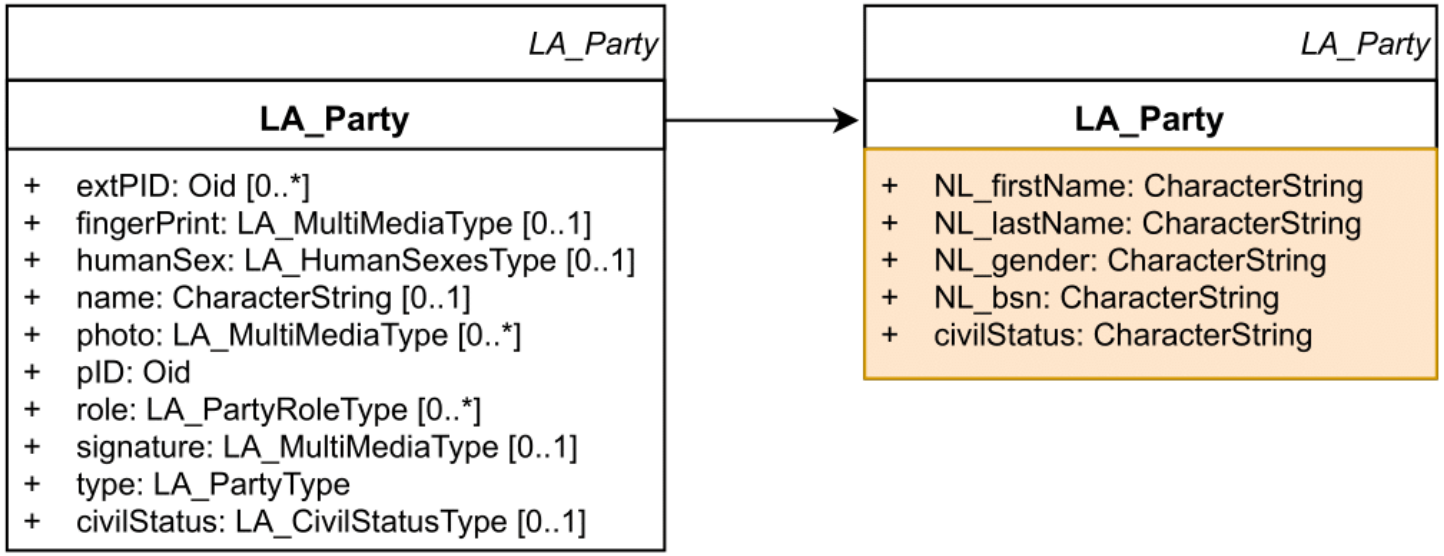


Figure. Attribute list conform Dutch registers

SPARQL queries

- Querying the data for the use cases.
- Seeking for patterns in the triples.

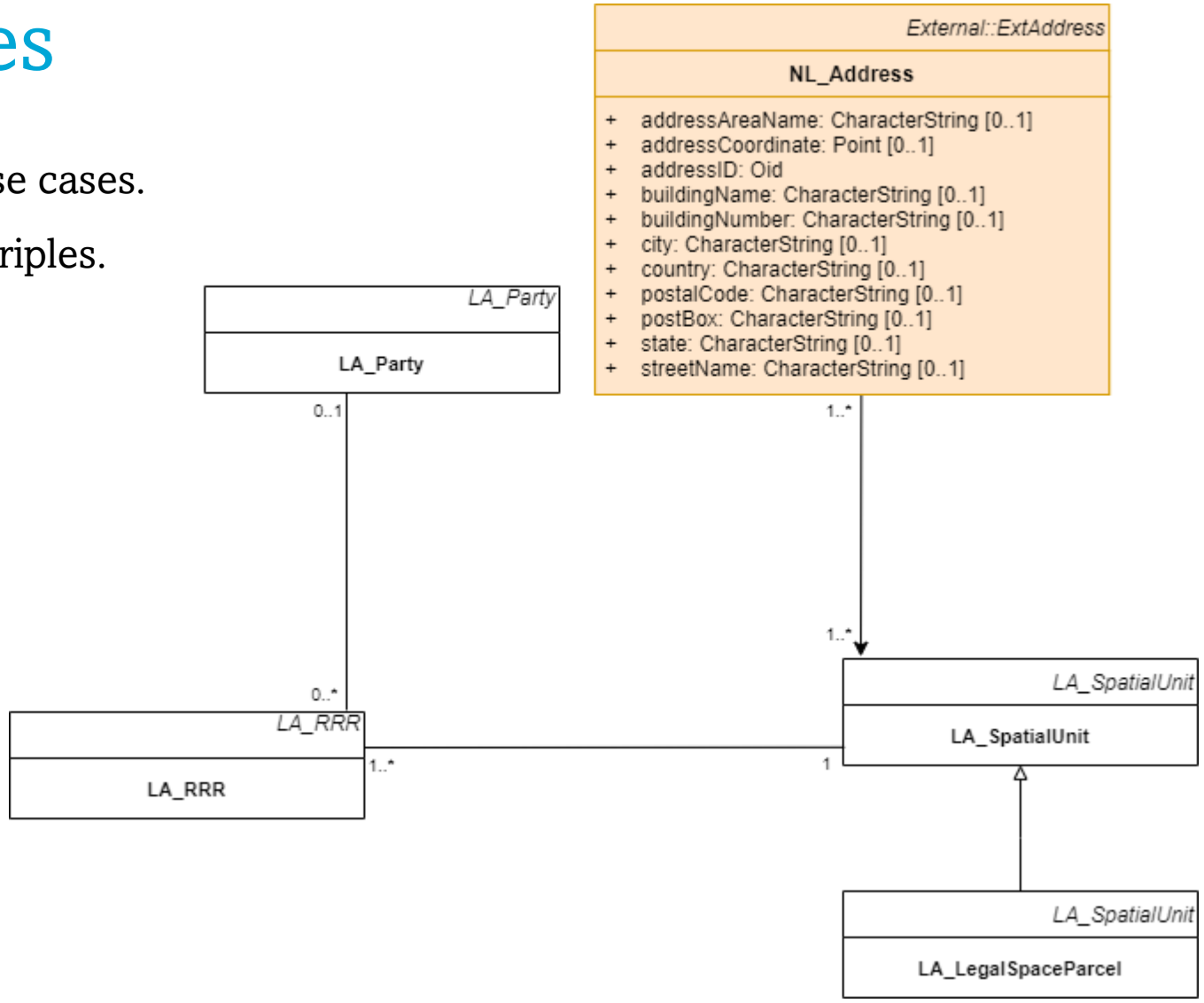


Figure. Attribute list conform Dutch registers

SPARQL queries

- Seeking for patterns in the triples.

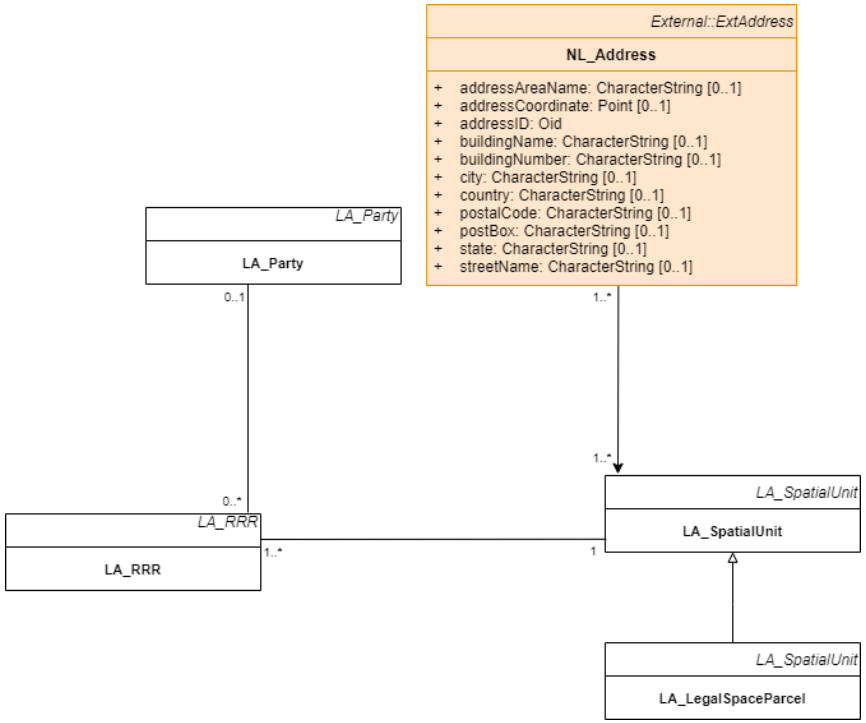
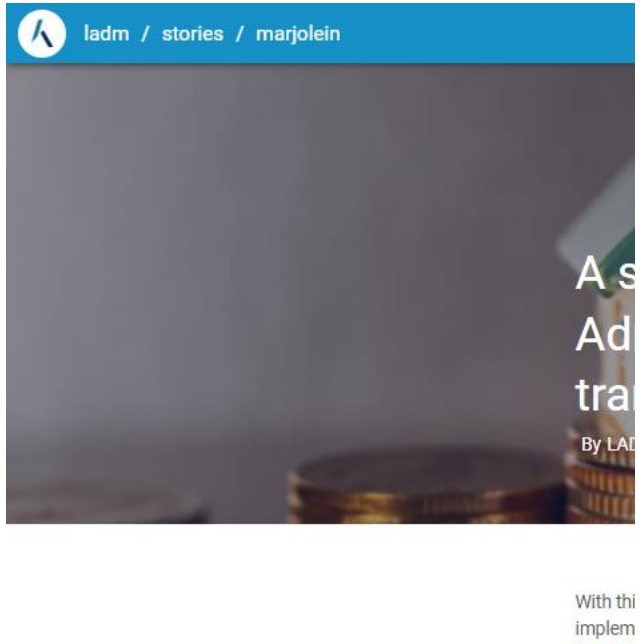


Figure. Attribute list conform Dutch registers

```
PREFIX graph: <https://data.labs.kadaster.nl/ladm/ladm-test/graphs/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX skos: <http://www.w3.org/2004/02/skos/core#>
PREFIX sor: <https://data.kkg.kadaster.nl/sor/model/def/>
PREFIX nen3610: <https://data.kkg.kadaster.nl/nen3610/model/def/>
PREFIX ladm: <https://data.labs.kadaster.nl/2024/ladm#>

SELECT distinct ?addressDetails ?bsn ?firstname ?lastname ?civilstatus
where {
  {
    ?adres
      ladm:NL_belongsToSpatialUnit ?buildingunit ;
      ladm:postalCode ?postcode ;
      ladm:streetName ?streetname ;
      ladm:cityName ?cityName ;
      ladm:houseNumber ?houseNumber .
    optional { ?adres ladm:NL_addressLetter ?houseletter }
    optional { ?adres ladm:NL_addressNumberAddition ?housenumberaddition }
  }

  ?buildingunit ladm:NL_belongsToSpatialUnit ?building .
  ?parcel ladm:NL_isAssociatedWith ?building .

  ?rrr
    ladm:NL_belongsToAParty ?party ;
    ladm:NL_areAttachedTo ?parcel .

  ?party
    a ladm:LA_Party ;
    ladm:NL_bsn ?bsn ;
    ladm:NL_firstName ?firstname ;
    ladm:NL_lastName ?lastname ;
    ladm:NL_gender ?gender ;
    ladm:civilStatus ?civilstatus .

  bind(concat(str(?streetname),' ',str(?houseNumber),
      if(bound(?houseletter), str(?houseletter), ''),
      if(bound(?housenumberaddition), concat('-', str(?housenumberaddition)), '
    '),
      ', ',str(?postcode),', ',str(?cityName)) as ?addressDetails )

}
  limit 5
```

Data story

- Real estate transaction.
- Building permit.



The following query shows parcel information on a map, as geometry. The input parameter allows the user to query address information within a, postal code.

Note that this query uses an API variable, namely, "postalcode". It is possible to configure such API variables on top of a SPARQL query. The postal code entered by a user is automatically inserted and executed by the SPARQL engine in the query. This makes it possible to modify the SPARQL query in certain parts without requiring detailed knowledge of the SPARQL query language. Just try entering a value yourself, and then click the "Run query" button to retrieve information for this destination.

Go to dataset Try this query yourself

postalcode *
3891AP

Reset ▶ RUN QUERY

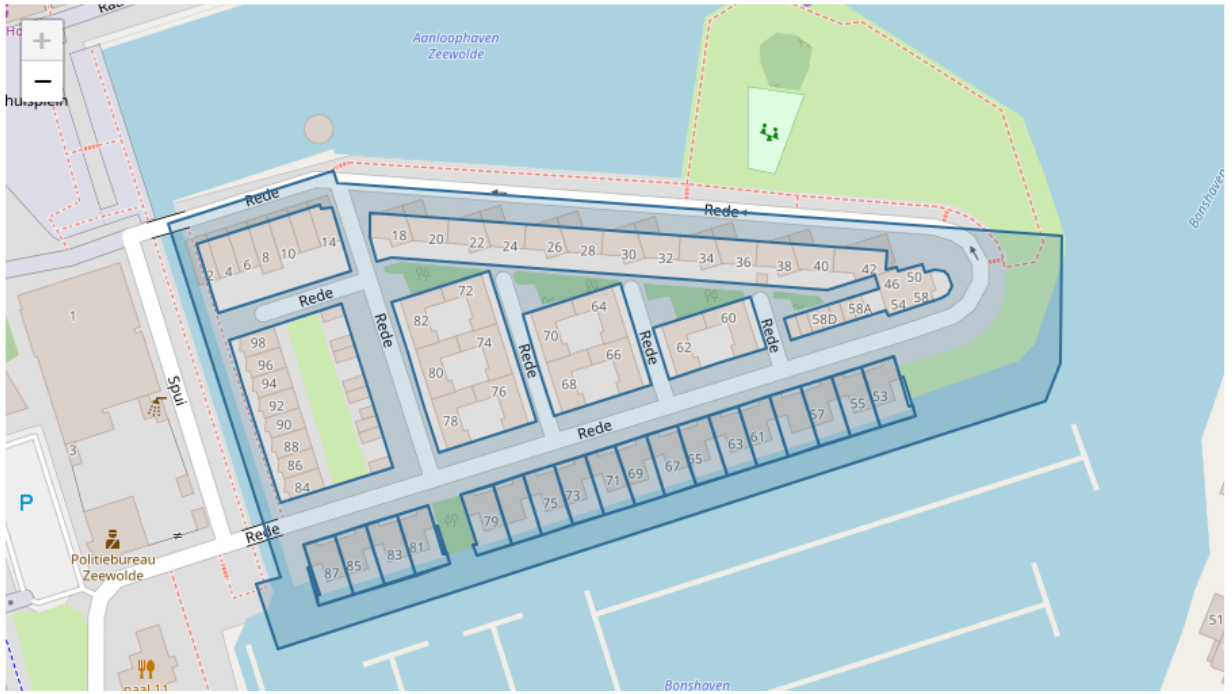
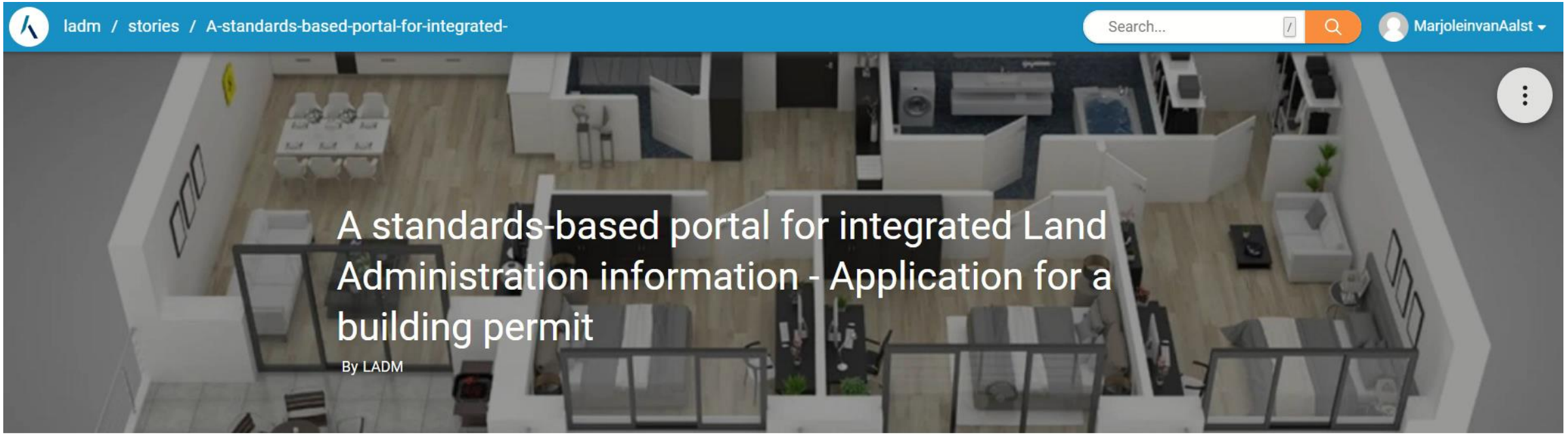


Figure. Example result query

Data story - Demo

- Spatial plans attached to a specific address and its spatial area.
- Personal information.



With this data story we would like to demonstrate the retrieval of data sourced from multiple registers through integration, based on the implementation of LADM. This demonstration is based on a use case.

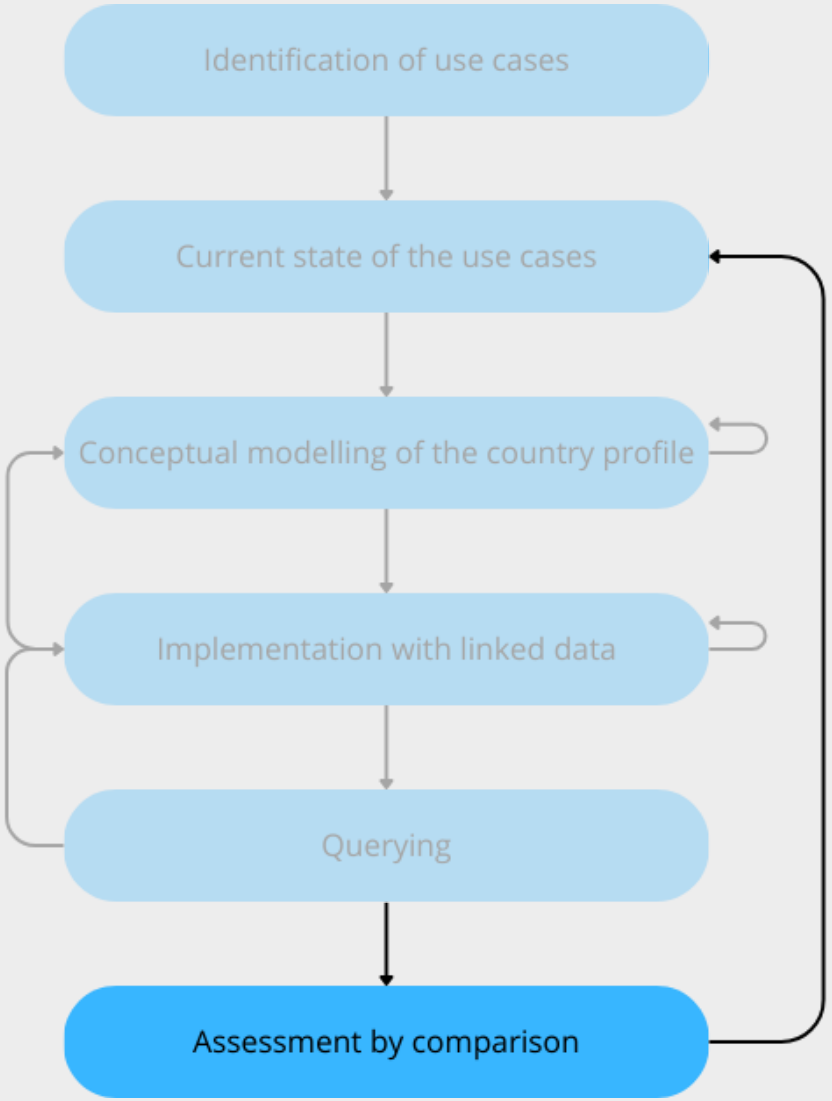
Preliminary phase

Spatial plan information

The following query returns address information and spatial plan information. The input parameter allows the user to query address

Assessment and evaluation

To assess the linked data portal prototype in the form of a data story.



Assessment metrics

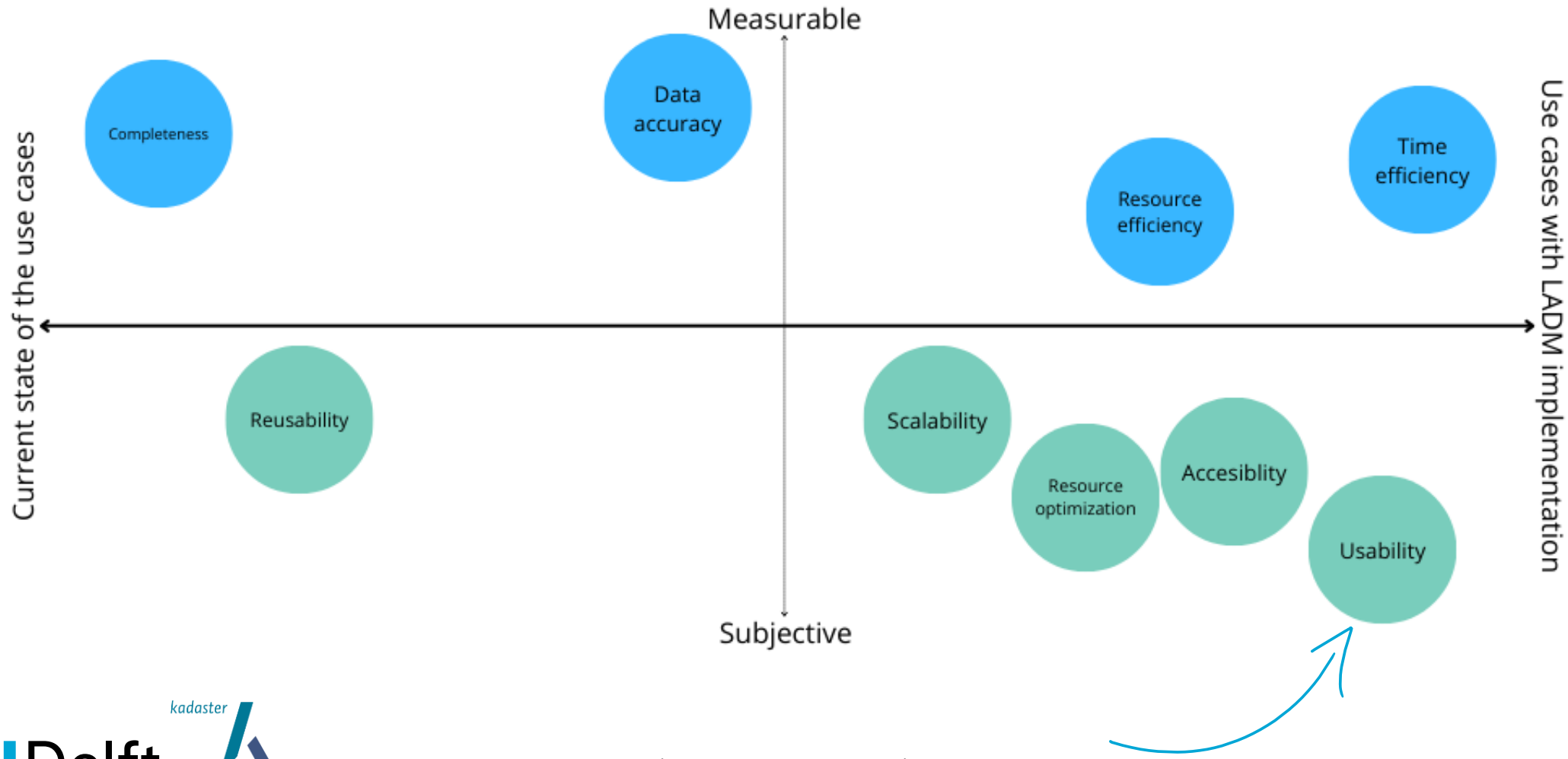


Figure. Assessment metrics

Usability test

To evaluate the usability of the prototype.

Goals:

- The prototype should guide the user in retrieving information efficiently.
- The prototype should provide information that is clear to the user.
- The prototype should be easy to use and/or there should be a learning curve.
- The prototype must give the user certainty about the information retrieved.
- The prototype should not create limitations and/or frustration for the user.

Usability test

The usability test has shown that:

- Users can query the information for the use cases.
- Users appreciate all information in one web environment.
- Information retrieval is dependent on clear headings.
- Standard language is better understood.
- Users become more proficient in using the prototype.

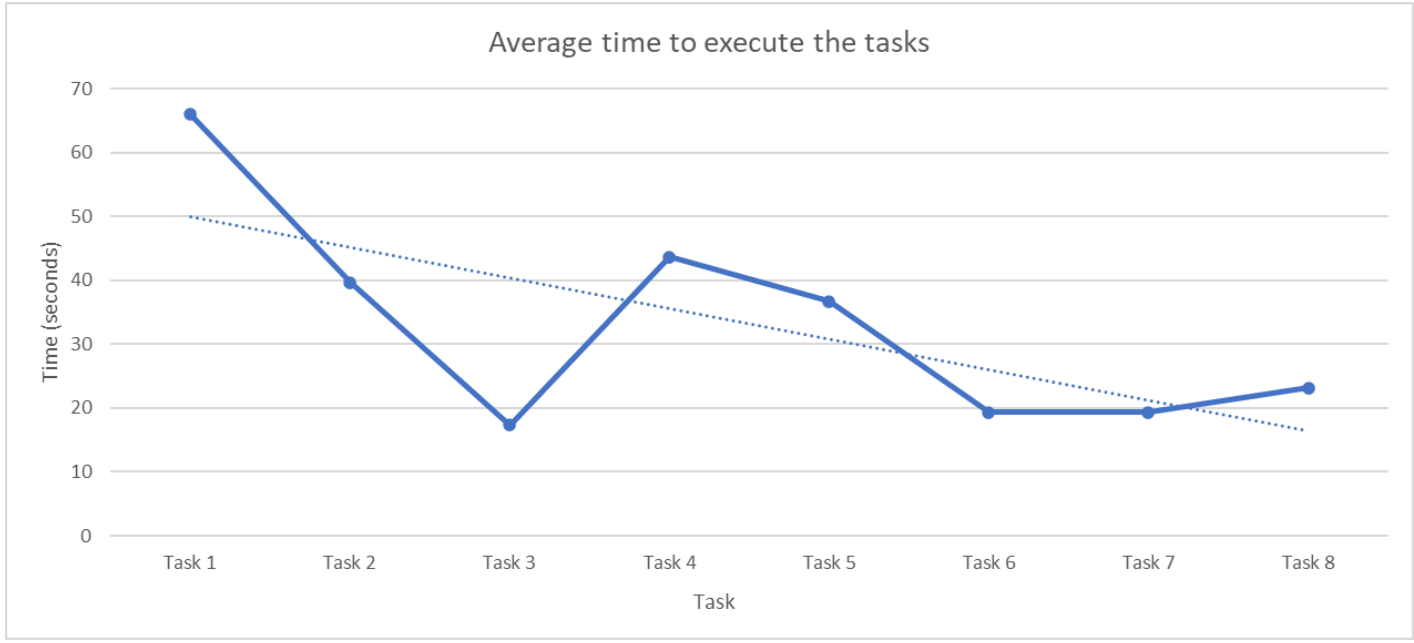


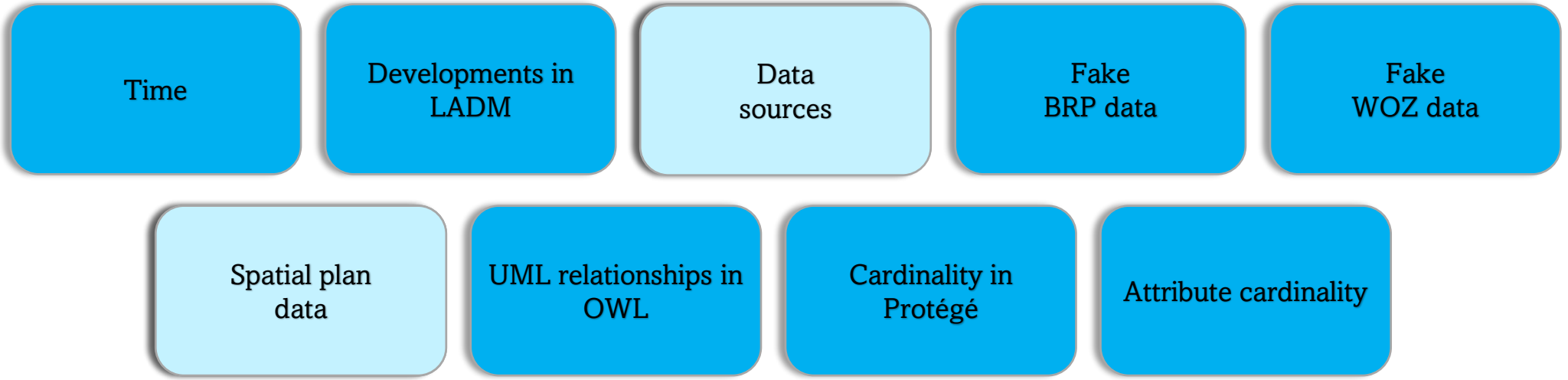
Figure. Average task completion time

5

Conclusion

Limitations, conclusion and future research

Limitations

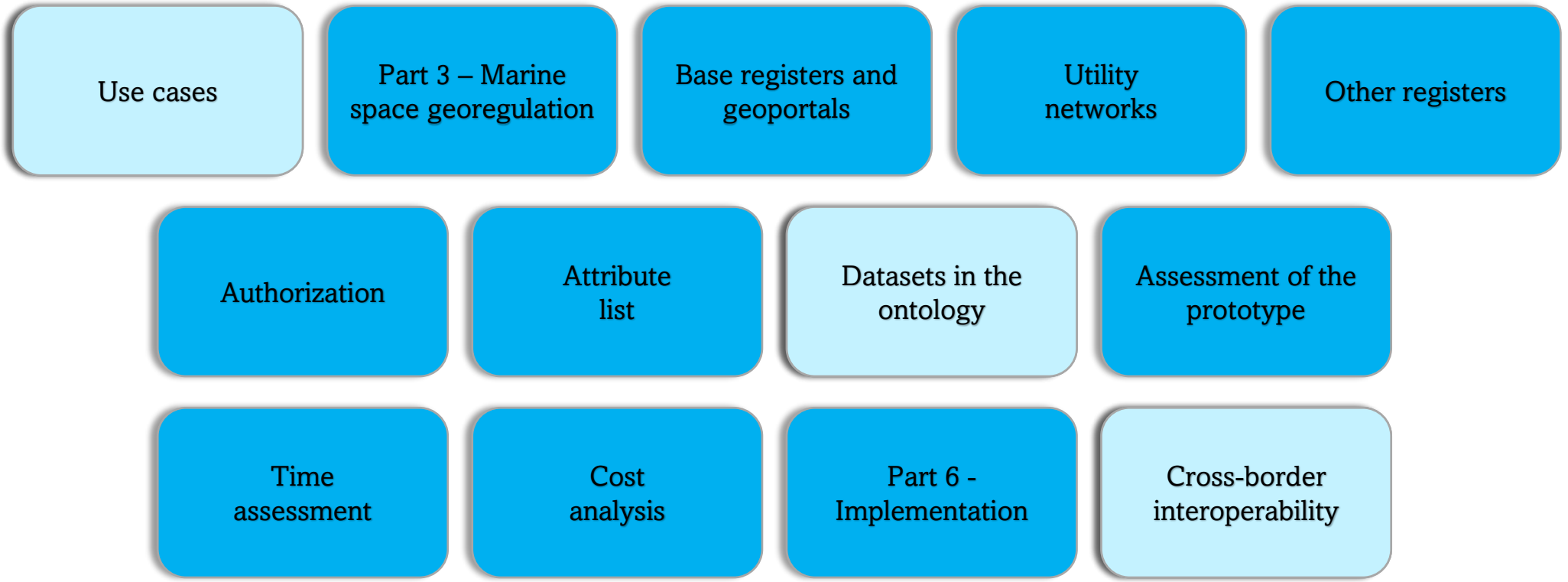


Conclusion

What are the benefits and drawbacks of a linked data portal based on the Land Administration Domain Model (LADM) Edition II concepts?

Benefits	*Drawbacks*
• Time efficiency • Resource efficiency • Usability • Enables Kadaster to develop, implement and maintain land administration systems more efficiently • Enables users to access information in a way that is clear and understandable to locals, foreigners and machines	• Validation of the country profile • Creation of datasets conform the ontology • Verification of the attribute lists • Data must be in linked data format • Only data that is accessible and publicly available can be included • Writing of SPARQL queries for querying of the data

Future research



Thank you for your attention

TU Delft

kadaster