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The Kadaster Data Platform & Knowledge Graph

Ronzhin, S.; Folmer, E.; Maria, P.; Brattinga, M.; Beek, W.; Lemmens, R.; van't Veer, R. Kadaster Knowledge Graph: Beyond the Fifth Star of Open Data. *Information* **2019**, *10*, 310. https://www.mdpi.com/548974

Rowland, A.; Folmer, E.; Beek, W.; Wenneker, R. Interoperability and Integration: An Updated Approach to Linked Data Publication at the Dutch Land Registry. ISPRS Int. J. Geo-Inf. 2022, 11, 51. https://doi.org/10.3390/ijgi11010051

Erwin Folmer 30-5-2022
Erwin.Folmer@kadaster.nl

The Journey

- Context
- Why Kadaster Data Platform (KDP)
- Phase 1 – KDP
- Phase 2 – Knowledge Graphs Experiment
- Phase 3 – Building Knowledge Graph – IGO
- Phase 4 – Building Kadaster Knowledge Graph – Production
- Final Thoughts

Dr.ir. Erwin Folmer

Data Science Team Lead @ Kadaster
Research Associate on Interoperabilty & Standards @ University of Twente
Board Member @ Platform Linked Data Netherlands

Kadaster Labs

labs.kadaster.nl

Use Case

Loki voor GEO Informatieverstrekking

Loki is een chatbot voor Locatie-gebaseerde Kadaster Informatieverstrekking. Vraag Loki en krijg eenvoudig antwoord van Kadaster.

Use Case

3DMaptable

Bekijk hoe we middels Augmented Reality een 3D overzicht geven over uw buurt!

Use Case

Routering Landbouwverkeer

Hoe rijdt een boer van zijn boerderij naar zijn perceel, zonder daarbij water of ander onbegaanbaar gebied te trotseren.

Use Case

Grondmarkt

Voer live SPARQL queries uit op een combinatie van basisregistraties en kom tot meer inzicht in de eigenschappen van kadastrale percelen.

Use Case

+ab|eau

Live data in een BI Toepassing

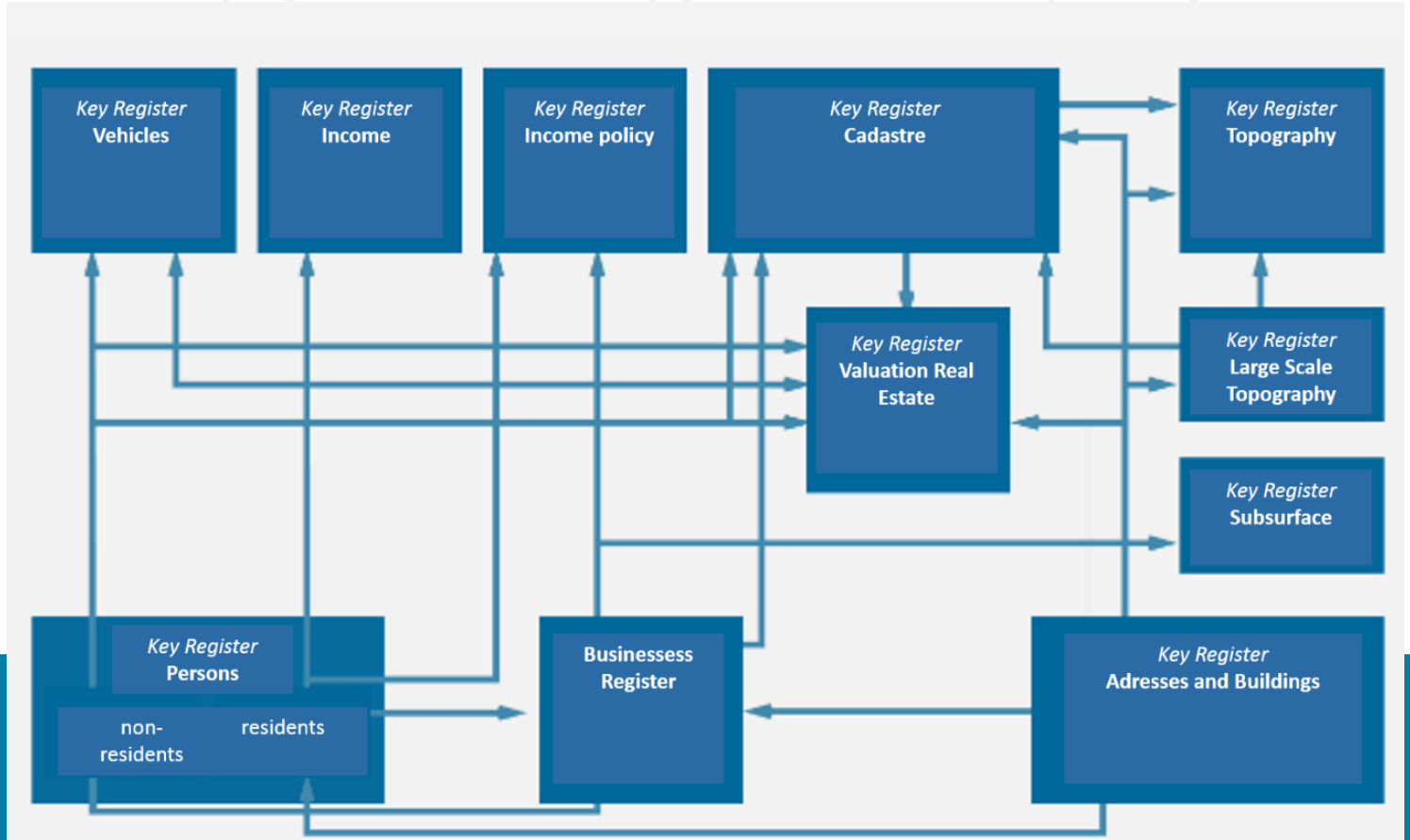
Hoe we een API aanspreken als bron in een standaard BI toepassing.

Use Case

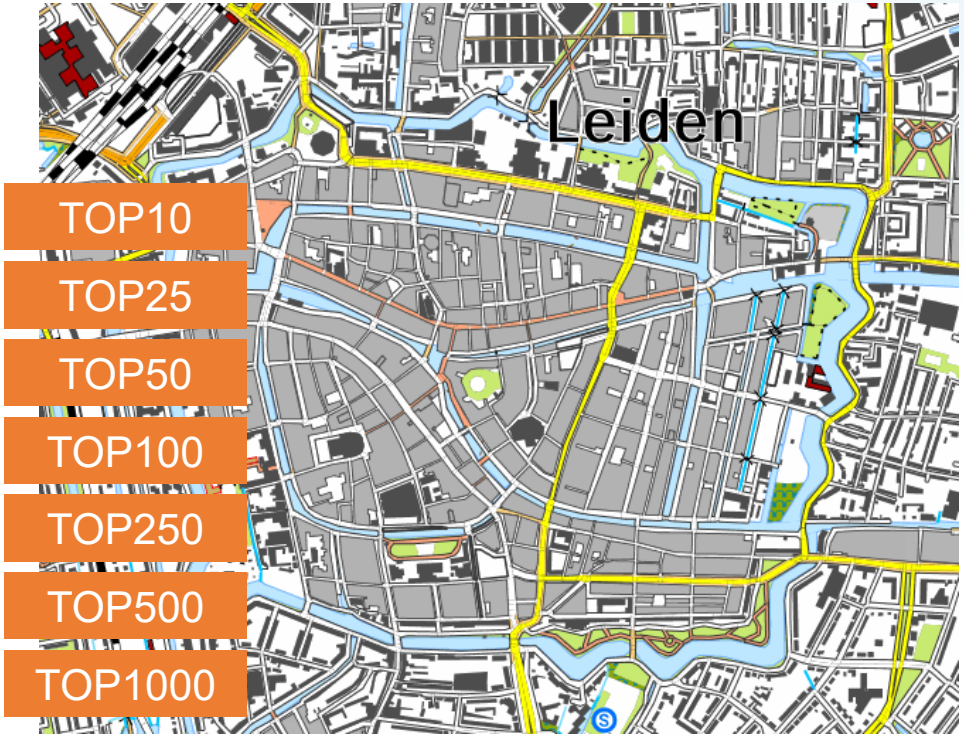
Missende waarden voorspellen in de BAG

In deze use case bekijken we hoe met het Machine Learning missende waarden uit de BAG kunnen voorspellen.

Dutch system of Key Registers



BRT Topography



Key Register Topography

Produced by Kadaster

Data and raster maps, 3D and Linked data

Fully updated yearly in 5 releases with uniform quality

Automatically generalised

BGT - Large Scale Topography

Key Register Large Scale Topography

Produced by local, regional and national authorities (418)

Initial completion mid 2017

Phase of quality improvement until 2020

Daily updated

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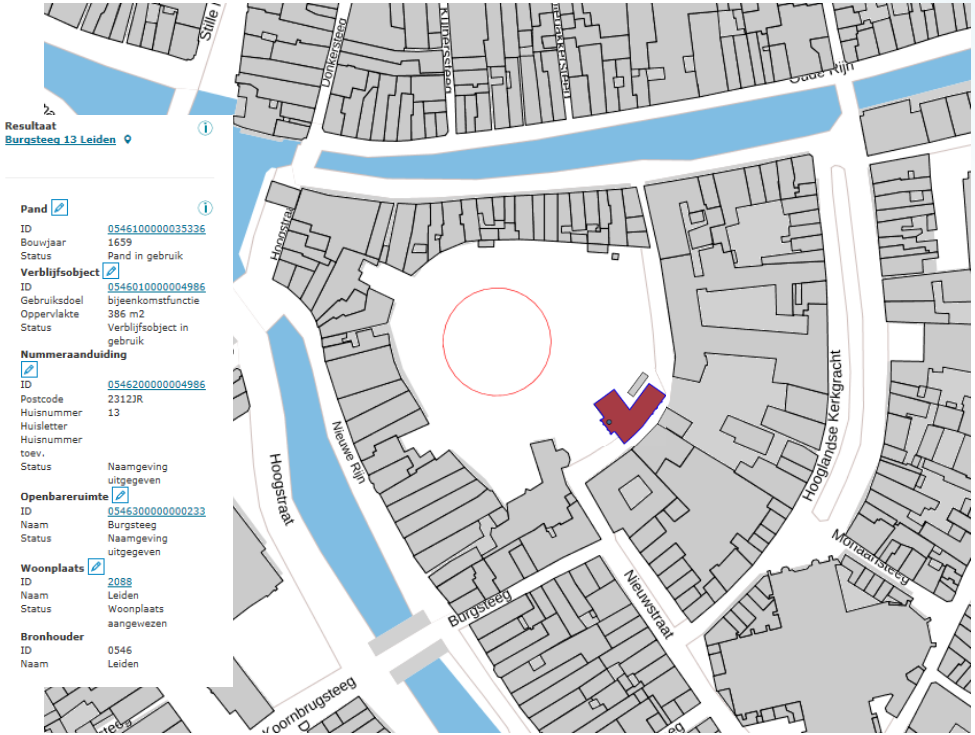
BAG - Addresses and Buildings



Key Register Addresses and Buildings

Unique objects with address, area, contour and purpose

Produced by municipalities (380)

Daily updated

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pdok
Labs
Actueel
Over PDOK
Voor aanbieders
Contact
Datasets
PDOK Viewer
Inspiratie
Community
Support
PDOK Next
NGR
Hét platform voor hoogwaardige geodata
Bekijk alle datasets
Ontdek de PDOK Viewer
Bekijk de PDOK promofilm
Bij PDOK vind je open datasets van de overheid met actuele geo-informatie. Deze datasets zijn benaderbaar via geo webservices, RESTful API's en beschikbaar als downloads en linked data. Daarnaast vind je hier inspirerende cases over de mogelijkheden van deze geo datasets. Meer info over PDOK.
158
hoogwaardige datasets
5 JAAR PDOK
29 miljoen
data calls per dag
Er is op dit moment 1 storing.
Klik hier voor storingen
Nieuws
Nieuws

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Kadaster Data Platform

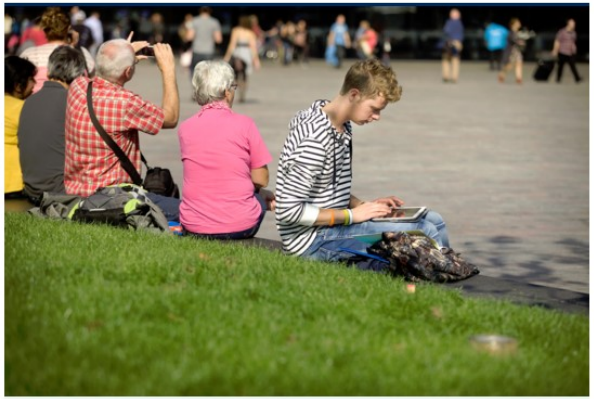
The development of the Spatial Data Platform of the Future

Why?

Erwin Folmer (Kadaster & University of Twente)

Kadaster's Ambitions

Providing certainty of ownership and use of anything above and below the surface



Offering a platform for anyone to handle spatial information anywhere and anytime

Supporting society in using spatial information to solve issues that matter

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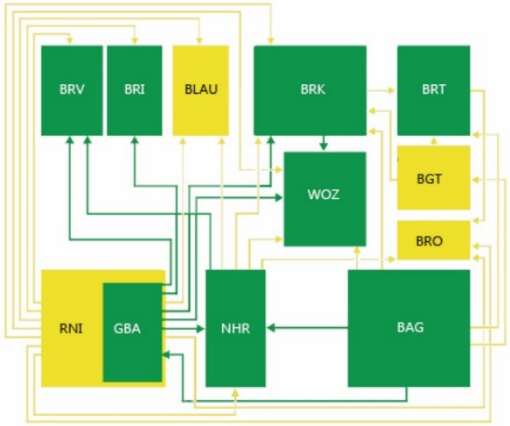
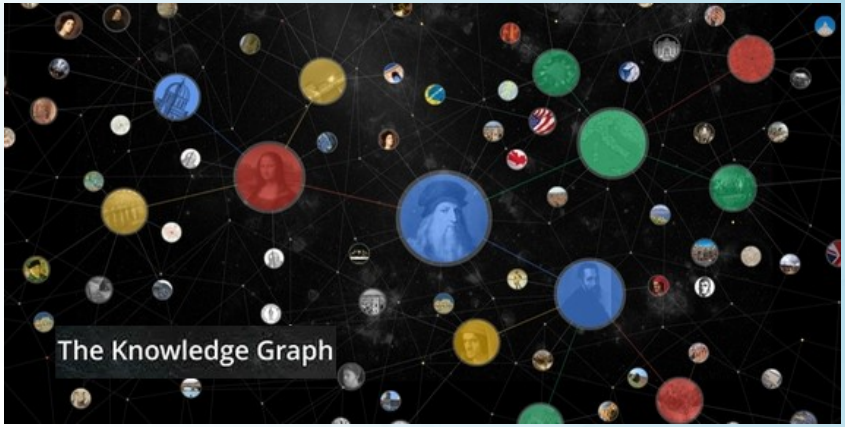
Not only intrinsic quality

- The leaflet (metadata) is essential

- Semantics
- Provenance

From data silo's to connected information





closed

open

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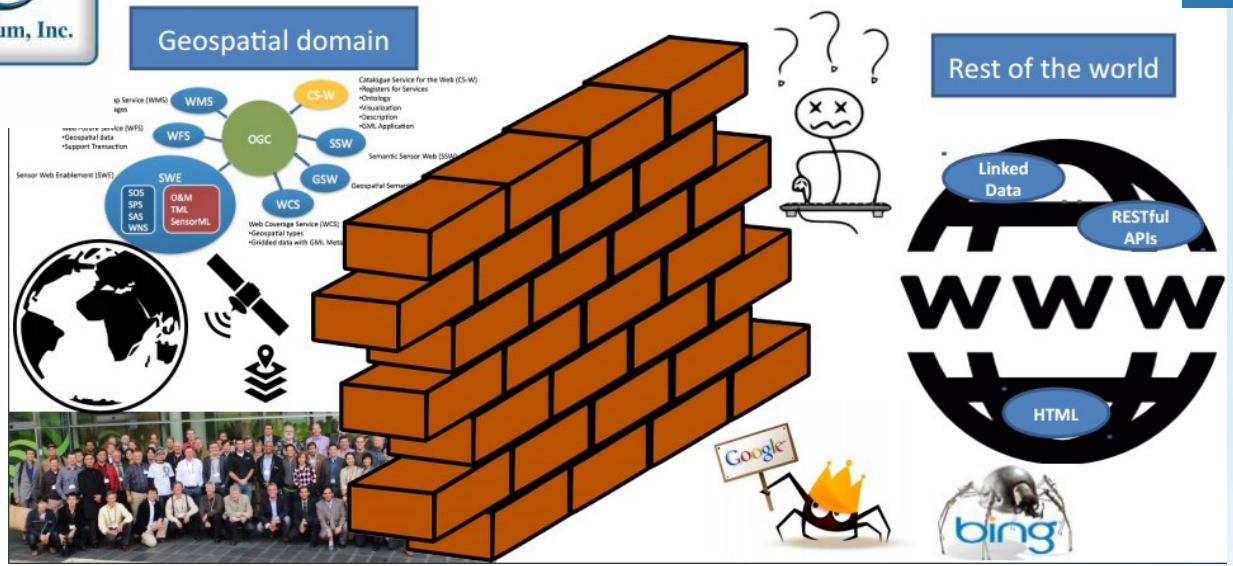
GEONOVUM

OGC®
Open Geospatial Consortium, Inc.

W3C

Spatial data: to the web

Reaching more people with spatial data



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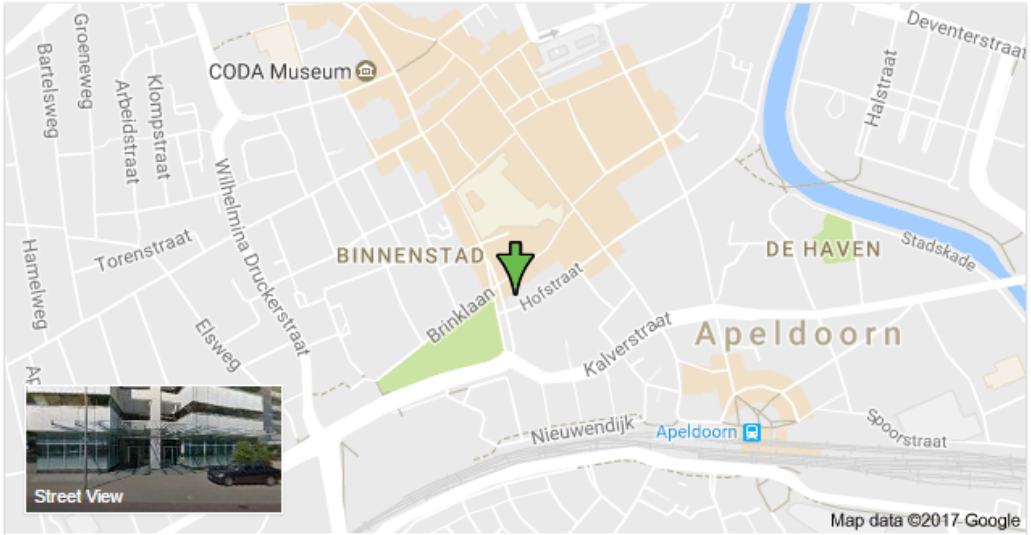
Google

hofstraat 110

Press F11 to exit full screen

All Maps Images Shopping Videos More Settings Tools

About 1.230.000 results (0,71 seconds)



Hofstraat 110, 7311 KZ Apeldoorn Get directions

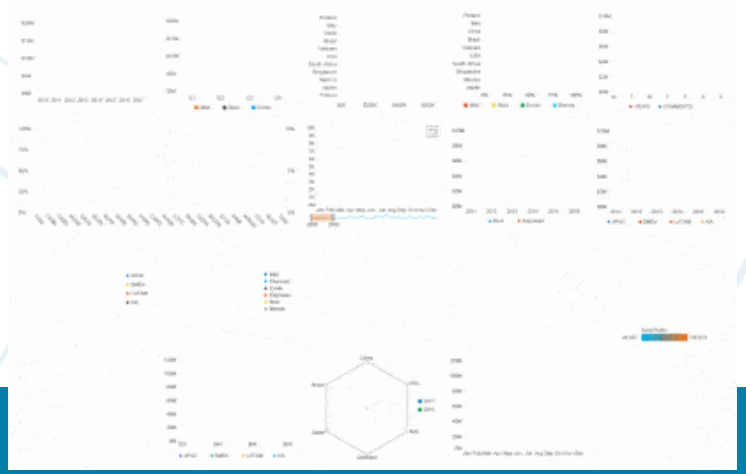
Kadasterkantoren

https://www.kadaster.nl/kadasterkantoren ▾ Translate this page

Hofstraat 110 7311 KZ Apeldoorn Telefoon receptie: 088-183 20 00. Routebeschrijving kantoor de Grift. Particulier; Woningwaarde · Eigendom · Grenzen ...

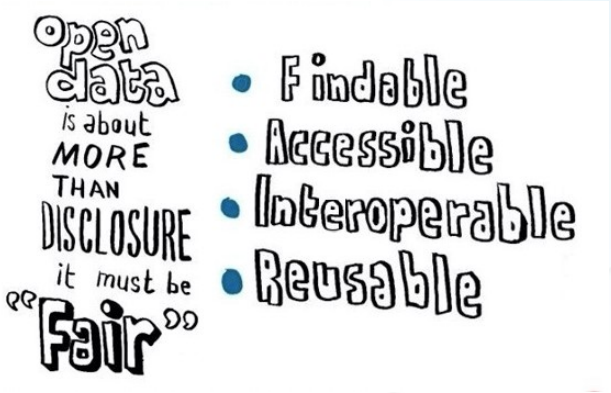
The dream:
Self Service GIS

- Citizen (non GIS professional)
- Data at the Source – Data Ecosystem
- Semantics (Transparancy, Reproducability)
- The Web (only a browser)
- Map integration – GIS functionality
- (integration with more advanced tools)



In summary the ingredients

- Interlinked data
- Data conform W3C standards
- “Approach” URI’s, Semantics, Provenance in line with W3C best practices
- Findable (indexed) through search engines (schema.org)
- Self-Service GIS: GeoSparql Endpoint & SPARQL Query Designer



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Kadaster Data Platform

The development of the Spatial Data Platform of the Future

Phase 0-1 - KDP

Erwin Folmer (Kadaster & University of Twente)

Phase 0 – Before...

Basisregistratie Adressen en Gebouwen (BAG)

Opnieuw beginnen | Terugmelding | Gebruik viewer | Wat is BAG | PDF | Help

Zoeken

spiker

Aantal resultaten: 234

- 't Spiker Warnsveld
- De Spiker Harlingen
- Spikerboor Akkrum
- Spikerpad Warnsveld
- 't Spiker 1 Warnsveld
- De Spiker 1 Harlingen
- Spikerboor 1 Akkrum
- 't Spiker 1b Warnsveld
- 't Spiker 2 Warnsveld
- De Spiker 2 Harlingen
- Spikerboor 2 Akkrum
- 't Spiker 3 Warnsveld
- De Spiker 3 Harlingen
- Spikerboor 3 Akkrum
- 't Spiker 4 Warnsveld
- De Spiker 4 Harlingen
- Spikerboor 4 Akkrum
- 't Spiker 5 Warnsveld
- De Spiker 5 Harlingen
- Spikerboor 5 Akkrum

› »

Uitgebreid zoeken

Filteren

| BAG powered by Kadaster |

Resultaat
't Spiker 24 Warnsveld

Pand

ID	0301100000027523
Bouwjaar	1976
Status	Pand in gebruik

Verblijfsobject

ID	0301010000013709
Gebruiksdoel	woonfunctie
Oppervlakte	155 m2
Status	Verblijfsobject in gebruik

Nummeraanduiding

ID	0301200000013709
Postcode	7231JT
Huisnummer	24
Huisletter	
Huisnummer toev.	
Status	Naamgeving uitgegeven

Openbare ruimte

ID	0301300000000553
Naam	't Spiker
Status	Naamgeving uitgegeven

Woonplaats

ID	1396
Naam	Warnsveld
Status	Woonplaats aangewezen

Bronhouder

ID	0301
Naam	Zutphen

Zoek op locatie

Selecteer een dataset(s)

- Lange-afstandswandelroutes (LAW)
- Luchtfoto's en labels
- Mossel- en oesterhabitats
- Mosselzaad invanginstallaties
- NAPinfo
- Nationaal Hydrologisch Instrumentarium (NHI)
- Nationale EnergieAtlas Informatielagen Kadaster
- Nationale Parken
- Nationale Streekpaden
- Natura 2000
  - Natura 2000
- Natuurmeting Op Kaart (NOK) 2014
- Noordzee Vaarwegmarkeringen

2 actieve dataset(s)

Objectinformatie:

Aantal woningen

Aantal woningen

Woningen per provincie

Woningen naar leeftijd koper

Prijsindex

Koopsom

Hypotheken

Executieveilingen

Bouwkavels

Agrarische grond

Aantal schepen

Jaarvergelijking

Downloads

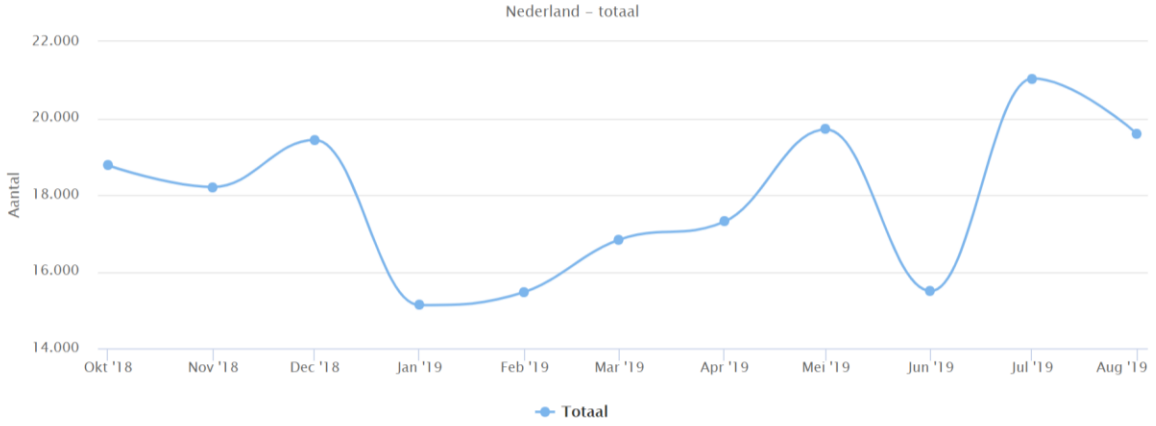
Filters

1 jaar

maand

Categorie

- Totaal
- Woningtype
- Provincie



Publicatiedatum: 7-10-2019 | Kadaster

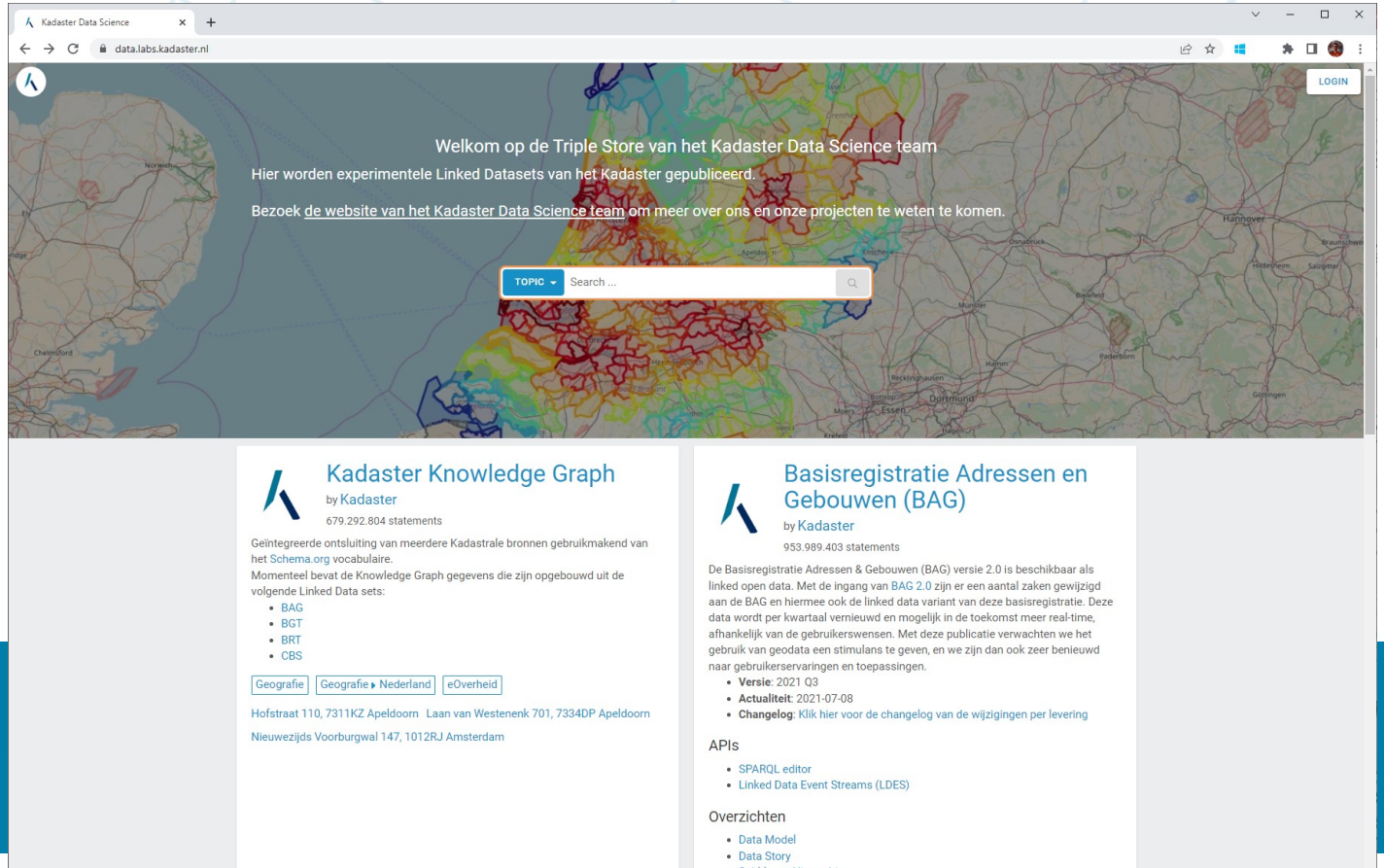
Inzoomen Y-as

Periode vergelijking

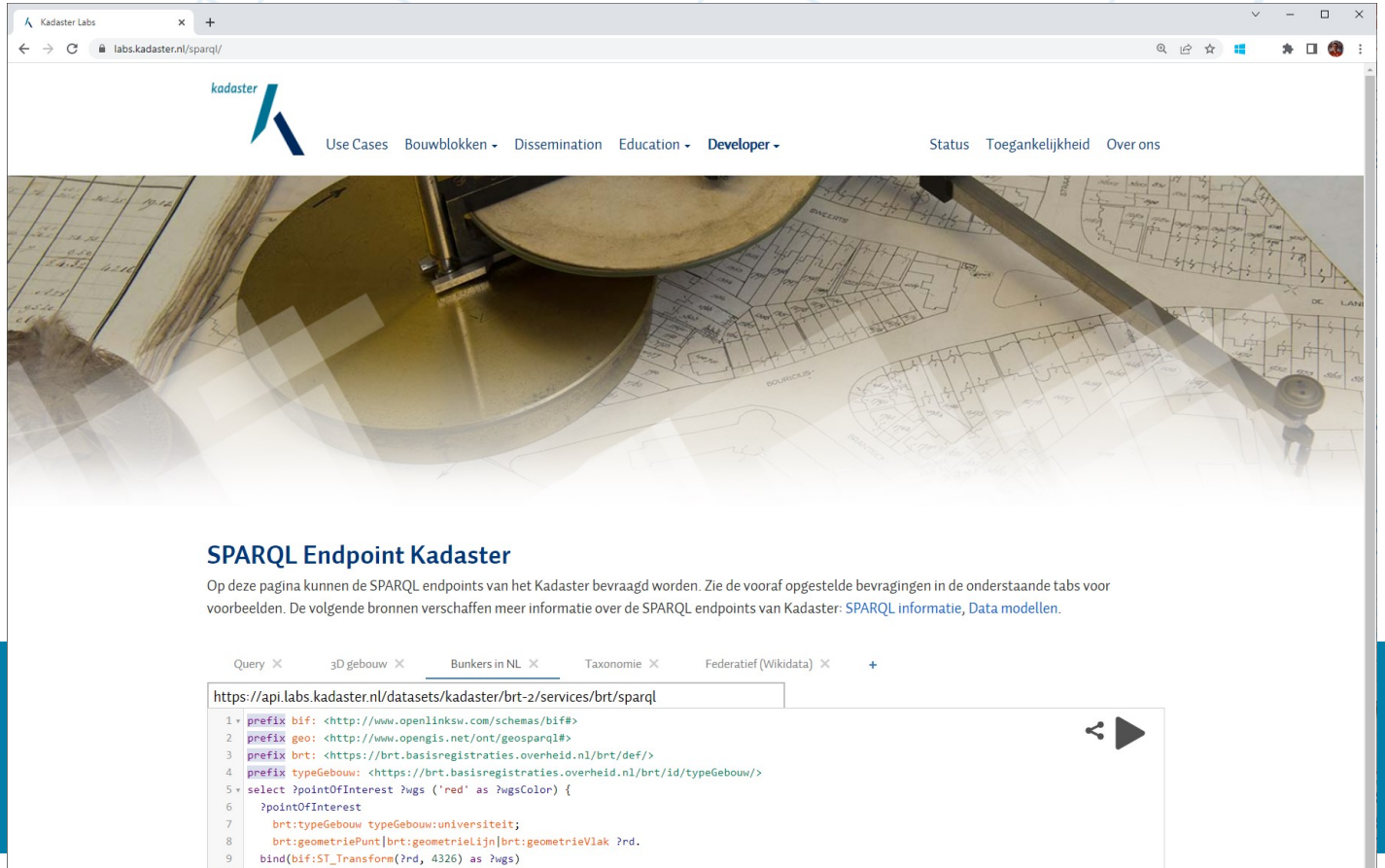
- Geen vergelijking

Phase 1 – The First Attempt
Kadaster Data Platform
Live Demo

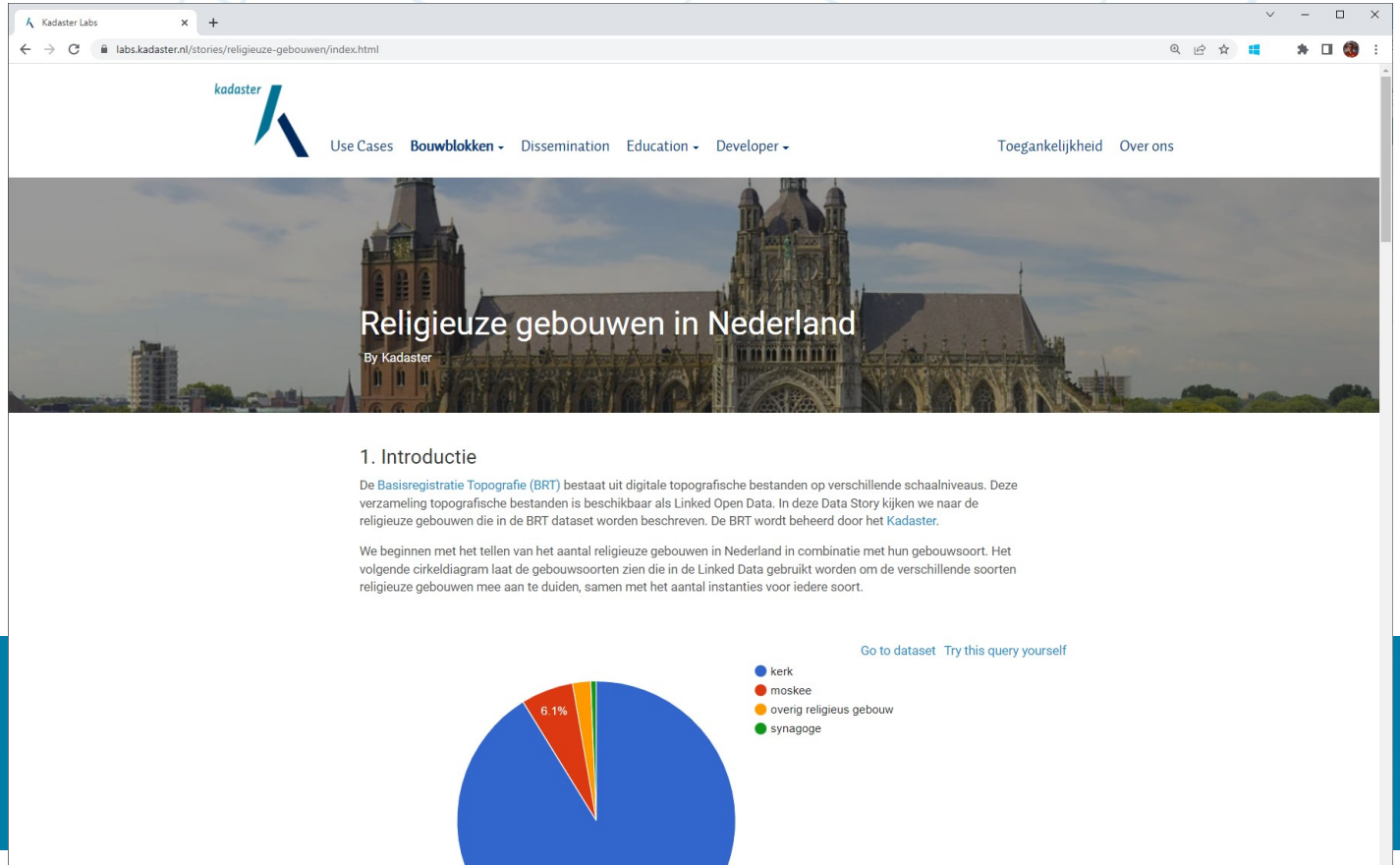
https://data.labs.kadaster.nl



https://labs.kadaster.nl/sparql



https://labs.kadaster.nl/stories/



Rather than publishing online a database of railway station locations in the Netherlands and expecting a user to then query the database for "Amsterdam Centraal Station", publish the database giving each record a URI so for example Amsterdam Centraal Station becomes;

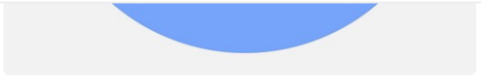
https://brt.basisregistraties.overheid.nl/top10nl/id/gebouw/102625209

Now this is something I can paste into an email, tweet or even share on Facebook !

Kudos to the Dutch Kadaster for taking this approach and providing this example, Ordnance Survey you could do the same ?

This approach also results in such data becoming part of the "mainstream" web indexable and searchable, but I argue the key benefit is the "linkability"

The Spatial Data on the Web best practice document, something of course I recommend you taking a longer look at provides many



Sep 12, 2017

Ed Parsons Retweeted

Sam Zipper
@ZipperSam

Google Earth Engine + @NASA_Landsat = annual 30 m resolution #irrigation maps!

Cool new study by @JillDeines:
onlinelibrary.wiley.com/doi/10.1002/20…

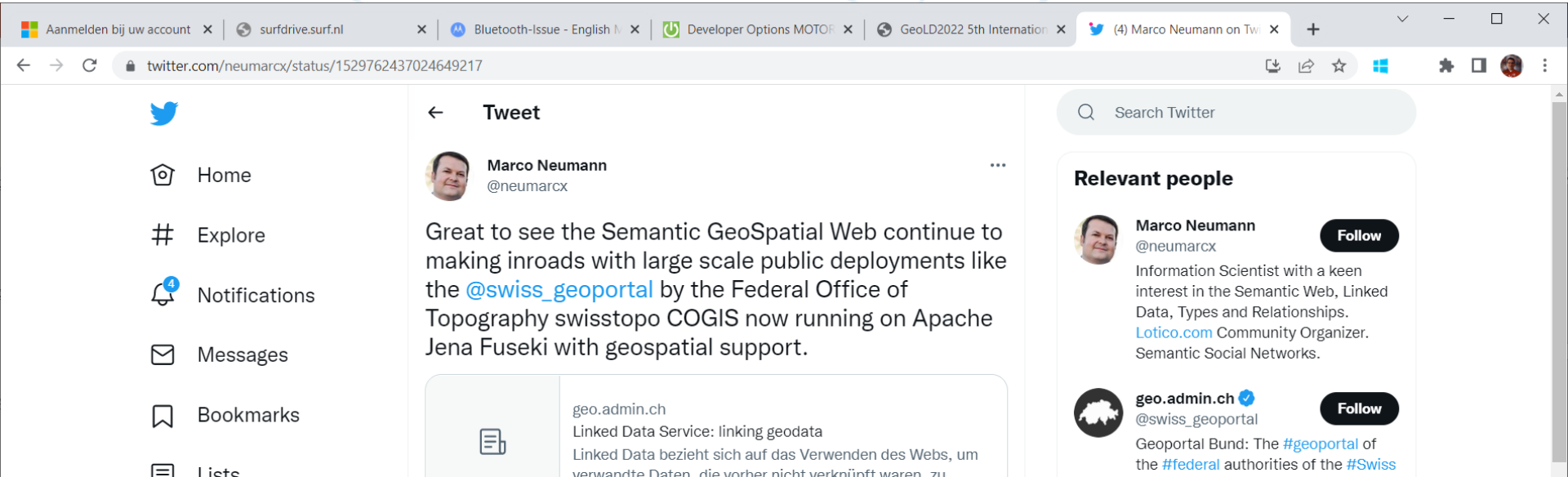
Annual irrigation dynamics in t…
Sustainable management of agricultural water resources
onlinelibrary.wiley.com

Sep 11, 2017

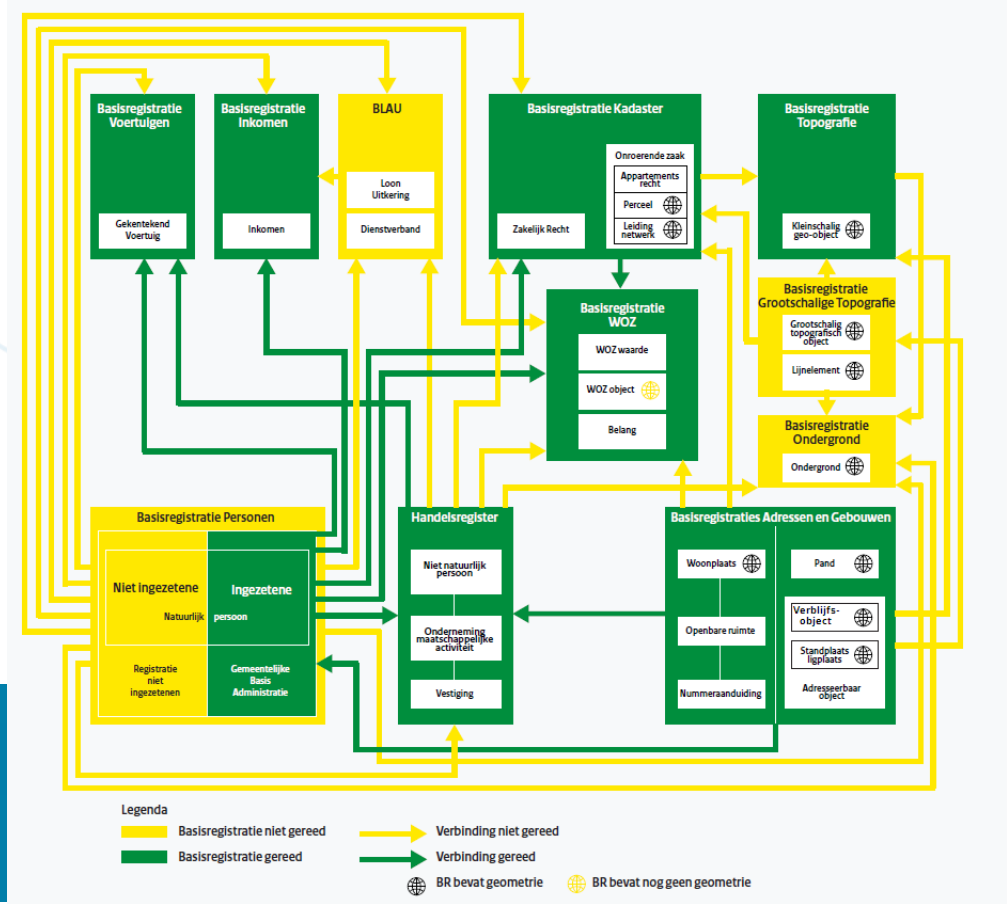
Embed View on Twitter

Btw, 2017???

Where are the others????



Dutch Humour: System of Silos



Conclusion (End 2018):

We created the ability…
…but have no links…still data silo’s.

Phase 2 – 2019-2020 First Experiments Kadaster Knowledge Graph

Can you imagine?

- That in 2022 we still offer data silo’s?
- That citizens can only ask through Wikipedia or Google questions like; what are the churches built before 1900? And based on authentic government data no direct answer is possible?

What is our ambition?

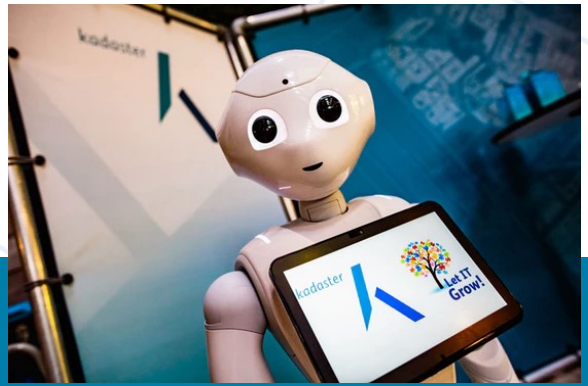
(https://www.kadaster.nl/over-ons/beleid/meerjarenbeleidspl

Geo-informatie voor iedereen

Wij vinden dat geo-informatie voor iedereen toegankelijk moet zijn. We bouwen ons platform verder uit met mogelijkheden voor analyse van data. Daarnaast gaan we datasets onderling koppelen. Voor de ontwikkeling ervan gebruiken we concrete vraagstukken van gebruikers.

My dream!

I search for a palace with surface of >1500 >2500 m2 (BAG) which is a national monument (RCE), and has a value of >1.000.000 (WOZ) in the neighborhood called Berg en Bos (CBS).



Paleis het Loo

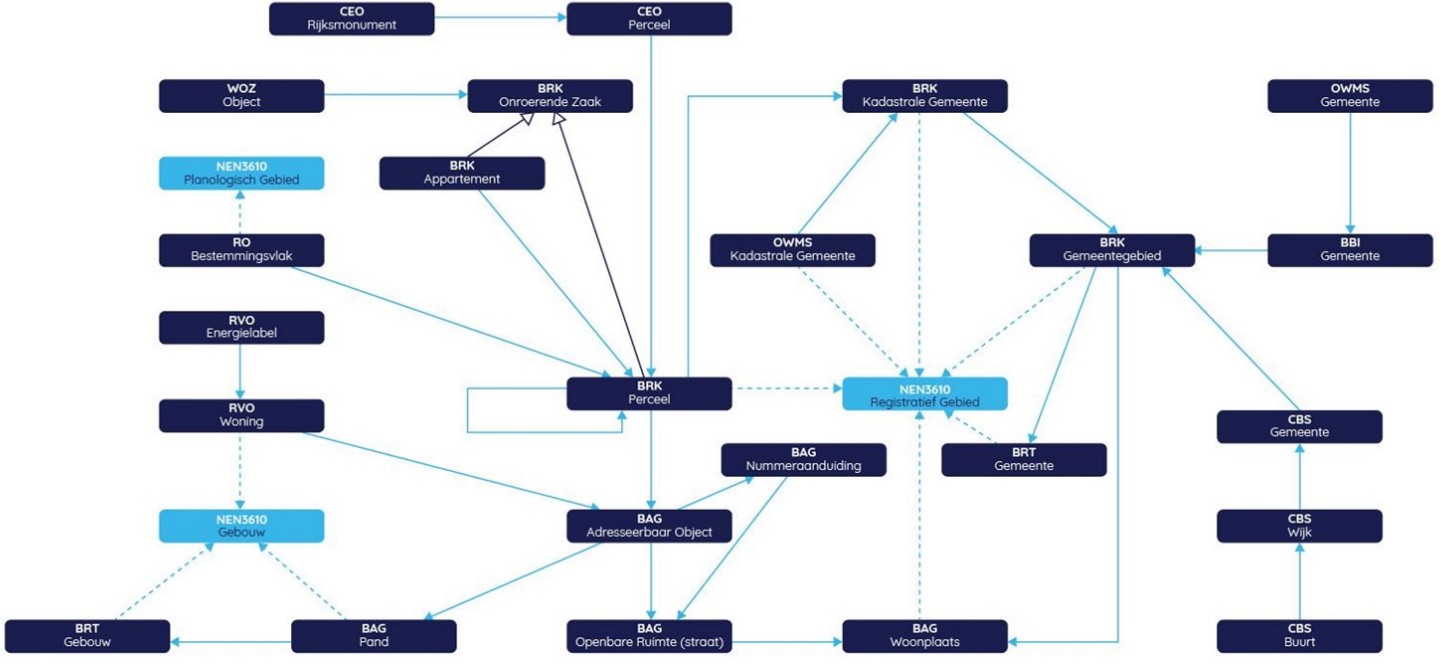
https://brt.basisregistraties.overheid.nl/top10nl/id/gebouw/101895841

Citizens want a complete overview of their environment, which includes Kadaster data, but also municipality data, statistical data, etc. Based on the Knowledge Graph we are able to provide this integrated view on data.

KG Adoption

https://image.slidesharecdn.com/adoption2019-190707103449/95/adoption-of-knowledge-graphs-mid-2019-1-1024.jpg?cb=1562495720

Knowledge Graph pdok



powered by kadaster

Essence of Kadaster KG project

It is not new, it was already possible……but expensive, not scaleable, not open, etc...

<u>The main differences are:</u>

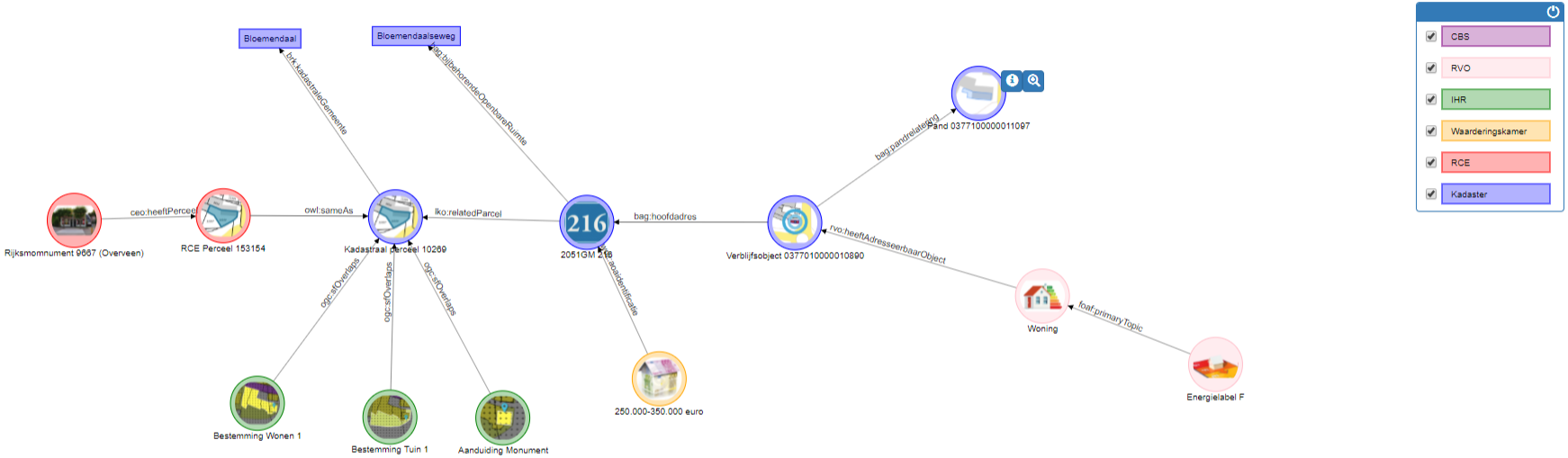
- Web standards based (linked data, interoperable)
- No spatial links, but administrative links.
- Data at the Source (in demo: 6 sparql endpoints federation)
- Application independent.

Phase 2b – How to create management commitment?

Demo
“Graph Browsing”

Start with an object and then explore the graph

Energielabel F



https://linkeddata.cultureelerfgoed.nl/cho-kennis/id/rijksmonument/19157

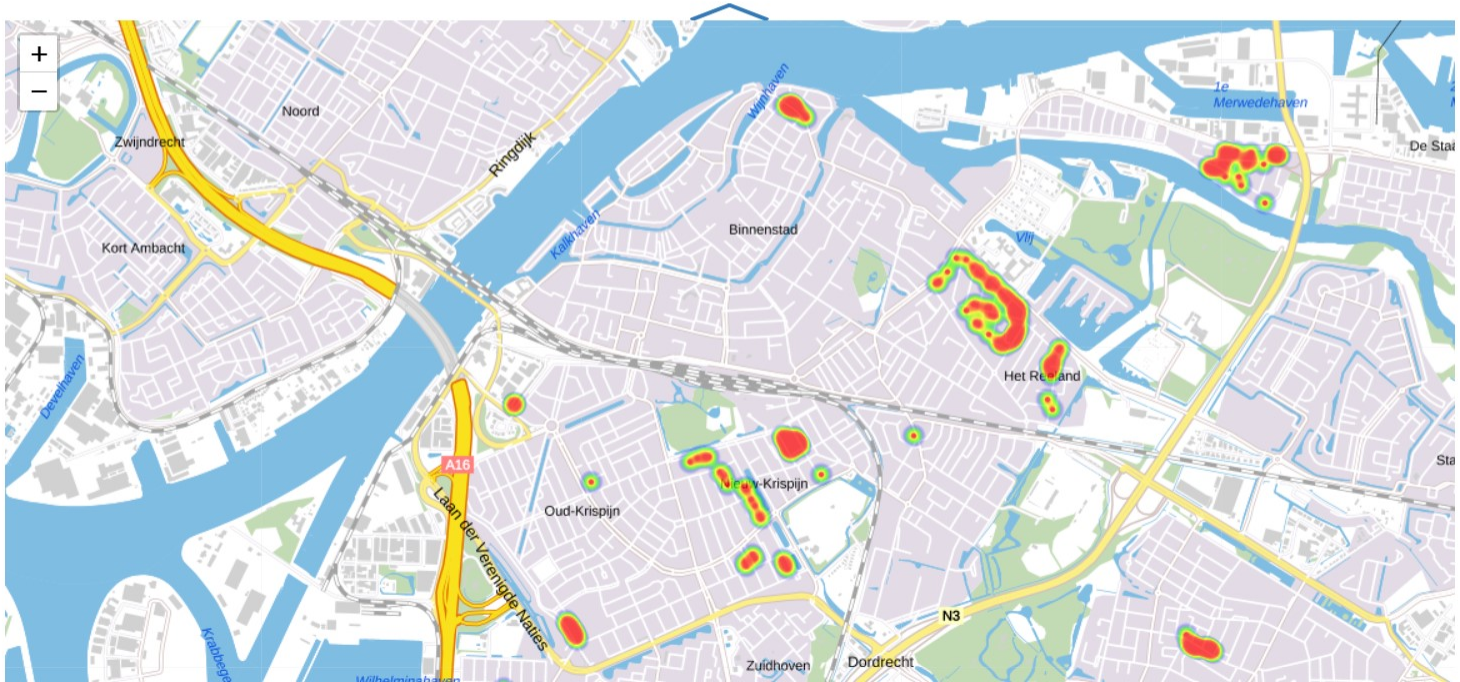
cultuurhistorischObjectnummer	19157
hasGeometry	https://linkeddata.cultureelerfgoed.nl/cho-kennis/id/geometrie/27585
heeftBasisregistratieRelatie	https://linkeddata.cultureelerfgoed.nl/cho-kennis/id/basisregistratierelatie/14588
heeftBebouwdeKomType	https://data.cultureelerfgoed.nl/term/id/rn/a273be15-311e-4246-b99e-52c2efd97a77
heeftFunctie	https://linkeddata.cultureelerfgoed.nl/cho-kennis/id/functie/104088
heeftGeometrie	https://linkeddata.cultureelerfgoed.nl/cho-kennis/id/geometrie/27585

Bevraging 1D: BAG panden die aan de criteria voldoen

Dan gecombineerd met BAG panden van vóór 1970, WOZ waarde in de laagste klasse (t/m € 150.000,-), en energielabel D of hoger. De 'hete' deleten van de kaart duiden aan waar de potentie het hoogst is.

Probeer het uit

Deze heatmap maakt in één oogopslag duidelijk waar de meeste kandidaat panden gelokaliseerd zijn. Het is ook mogelijk om dezelfde informatie op andere manieren te visualiseren, bijvoorbeeld door de editor te openen en weergave optie "Gallery" te kiezen.



Source: https://www.forbes.com/sites/danwoods/2018/09/19/is-the-enterprise-knowledge-graph-going-to-finally-make-all-data-usable/#5113ba747d39

Is The Enterprise Knowledge Graph Finally Going To Make All Data Usable?

Dan Woods Contributor
Enterprise & Cloud

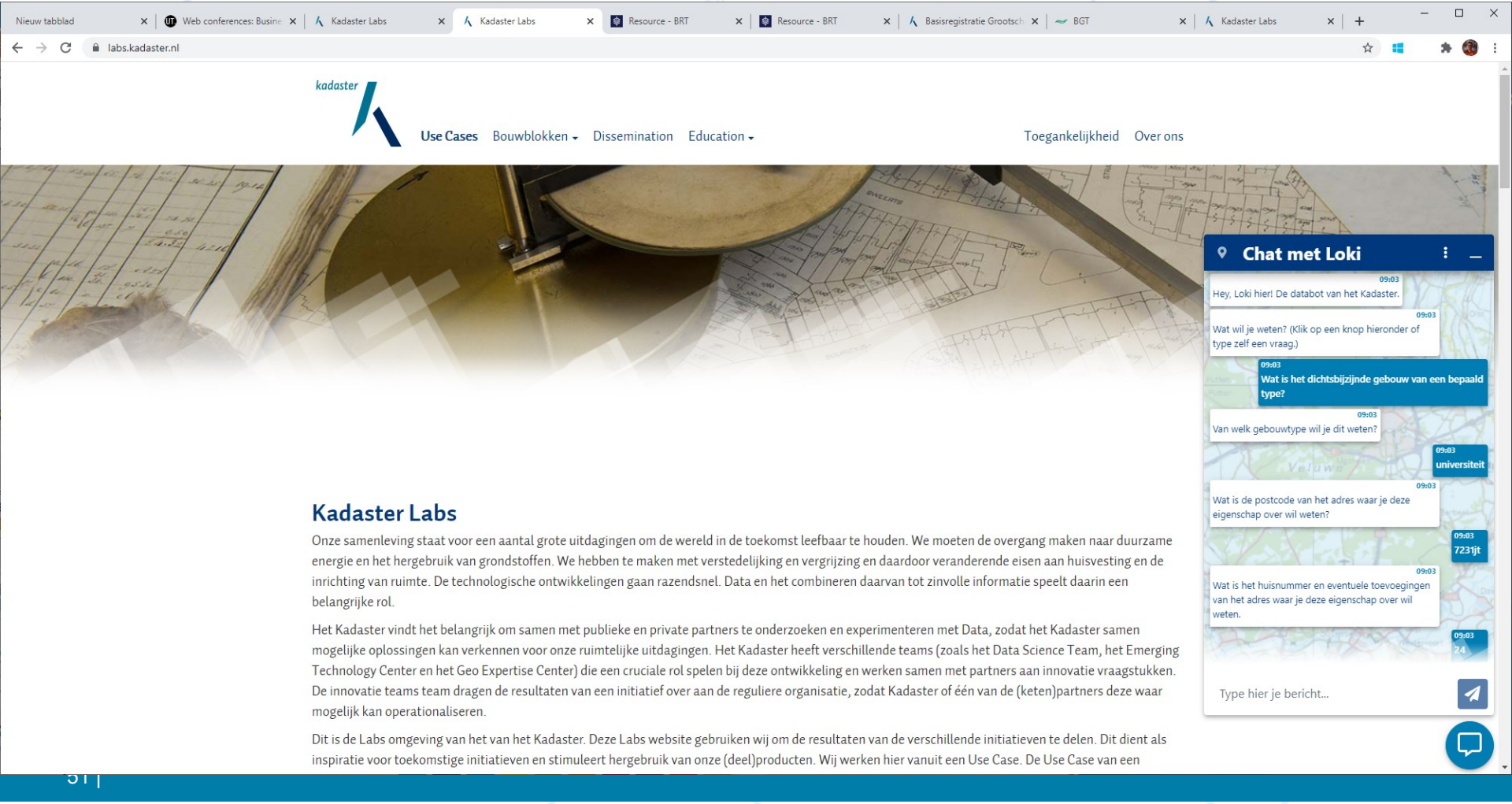
Ask your data EVOLVED MEDIA

When we ask Siri, Alexa or Google Home a question, we often get alarmingly relevant answers. Why? And more importantly, why don't we get the same quality of answers and smooth experience in our businesses where the stakes are so much higher?

The answer is that these services are all powered by extensive knowledge graphs that allow the questions to be mapped to an organized set of information that can often provide the answer we want.

Is it impossible for anyone but the big tech companies to organize information and deliver a pleasing experience? In my view, the answer is no. The technology to collect and integrate data so we can know more about our businesses is being delivered in different ways by a number of products. Only a few use constructs similar to a knowledge graph.

Cookies on Forbes



Kadaster Labs

Onze samenleving staat voor een aantal grote uitdagingen om de wereld in de toekomst leefbaar te houden. We moeten de overgang maken naar duurzame energie en het hergebruik van grondstoffen. We hebben te maken met verstedelijking en vergrijzing en daardoor veranderende eisen aan huisvesting en de inrichting van ruimte. De technologische ontwikkelingen gaan razendsnel. Data en het combineren daarvan tot zinvolle informatie speelt daarin een belangrijke rol.

Het Kadaster vindt het belangrijk om samen met publieke en private partners te onderzoeken en experimenteren met Data, zodat het Kadaster samen mogelijke oplossingen kan verkennen voor onze ruimtelijke uitdagingen. Het Kadaster heeft verschillende teams (zoals het Data Science Team, het Emerging Technology Center en het Geo Expertise Center) die een cruciale rol spelen bij deze ontwikkeling en werken samen met partners aan innovatie vraagstukken. De innovatie teams team dragen de resultaten van een initiatief over aan de reguliere organisatie, zodat Kadaster of één van de (keten)partners deze waar mogelijk kan operationaliseren.

Dit is de Labs omgeving van het van het Kadaster. Deze Labs website gebruiken wij om de resultaten van de verschillende initiatieven te delen. Dit dient als inspiratie voor toekomstige initiatieven en stimuleert hergebruik van onze (deel)producten. Wij werken hier vanuit een Use Case. De Use Case van een

Phase 3 (2021 – 2022) – Building Knowledge Graph - IGO

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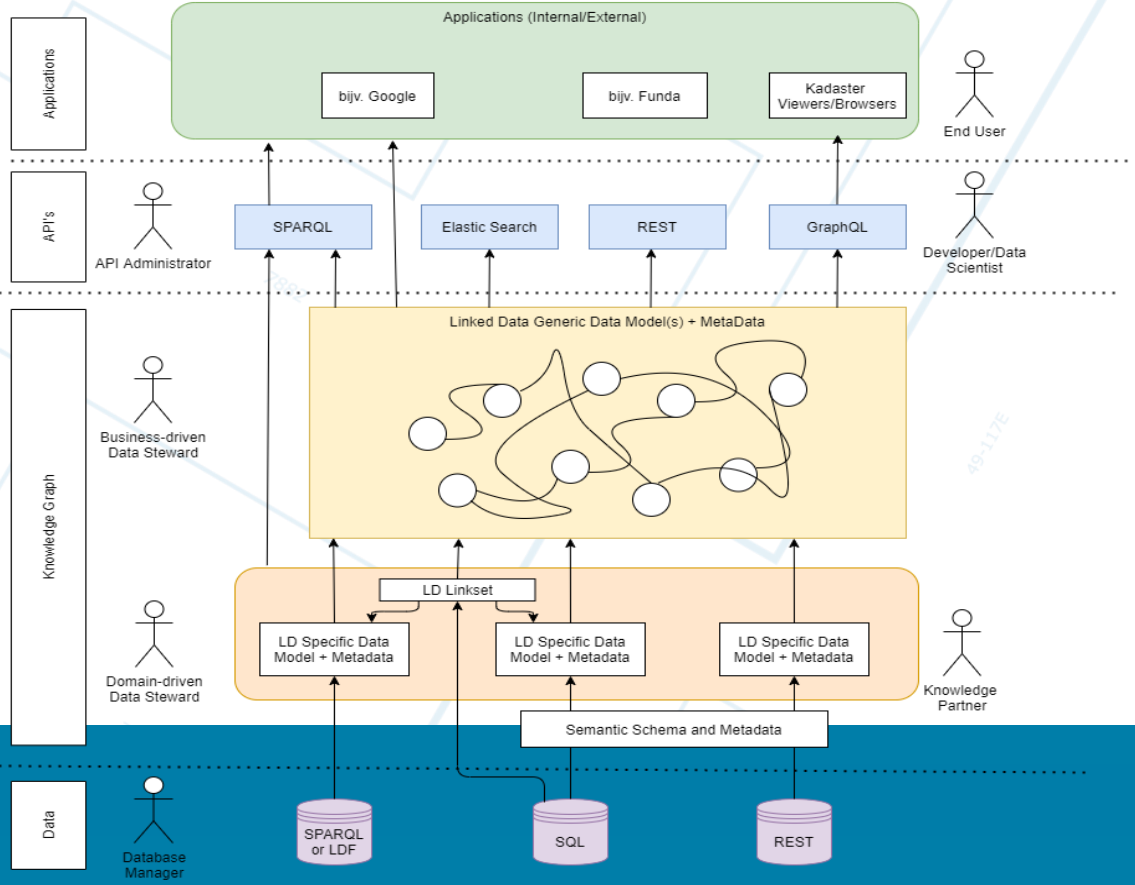
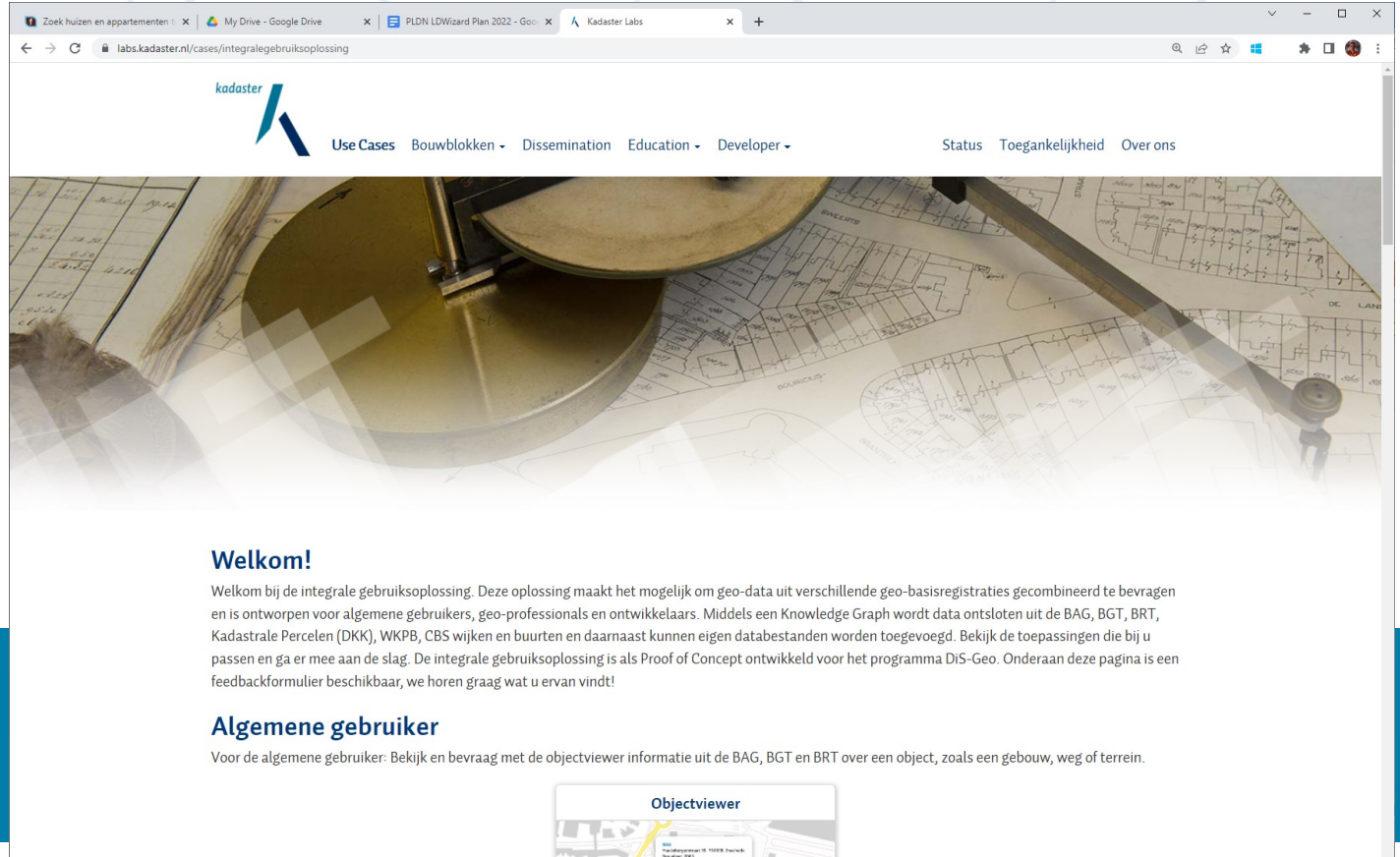
Architectuurvisie



https://labs.kadaster.nl/cases/integralegebruiksoplossing



Phase 4 (2022 -) –

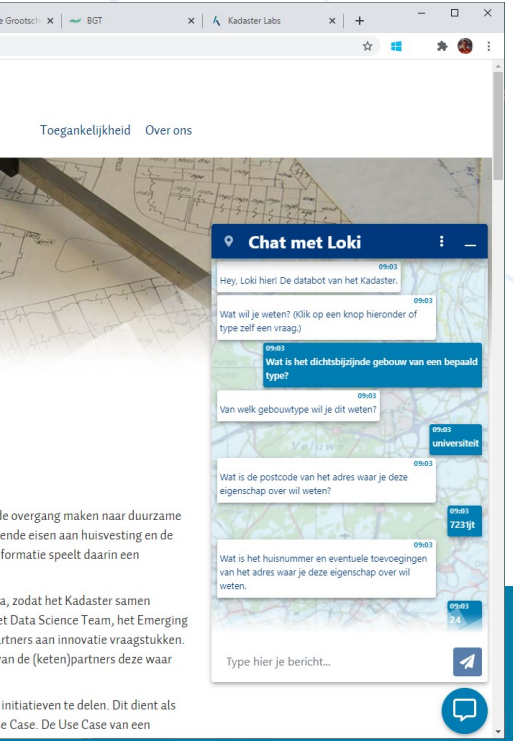
New Focus: Online Analytics

Building Kadaster Knowledge Graph – Production

Current Work/Issues

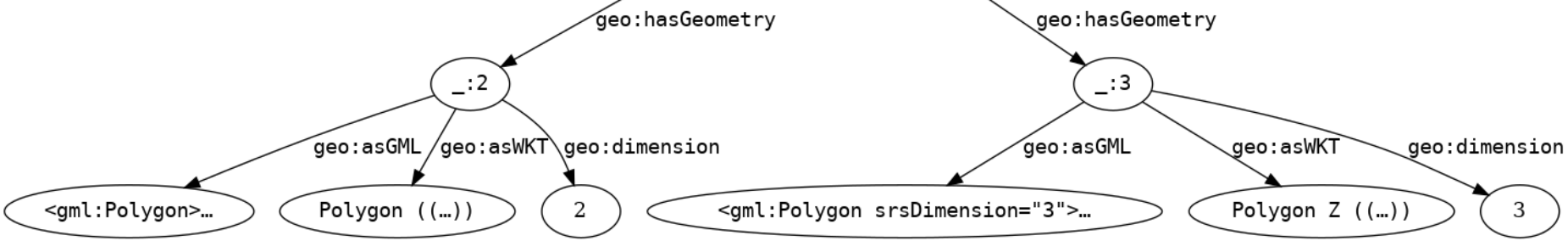
- Procurement of Triplestore
  - Geosparql?
  - Ready by July-August
- From schema.org to SOR model.
- Data ETL from quarterly to maybe daily…
- Federation / SPARQL….but in the end for performance we need the data to be in one triple store.
- New applications/promises

Applications on KG: AI/Chatbots/AR



GeoSPARQL?

GeoSPARQL at Kadaster



- One object/feature
- Multiple geometries
  - Multiple Coordinate Reference Systems (Rijksdriehoekstelsel, WGS84)
  - 2D or 3D
  - Serialization in Well-Known Text or Geography Markup Language

Projection and other common functions

- Namespaces for common CRSes

```
    prefix ogc:
<http://www.opengis.net/def/crs/OGC/1.3/>
   prefix epsg: <http://www.opengis.net/def/crs/EPSG/0/>
```

- Project between CRSes

```
geof:project(?rd, epsg:4326) as ?wgs)
geof:project(?rd, ogc:CRS84) as ?wgs)
```

  From "Rijksdriehoekstelsel" (`?rd`) to "WGS84" (`?wgs`)

- From 3D to 2D

```
geof:2d(?3d) as ?2d)
```

- Area of a surface

```
geof:area(?surface) as ?number
```

Remove things that are not used

Move from "Topology Vocabulary Extension" and "Query Rewrite Extension" to optional modules:

- Egenhofer
- RCC8

Move from "Geometry Extension" to optional module:

- GML serialization

Alignment with other standards

GeoSPARQL users need guidance on how to align with other standards.

- GeoJSON
- CityGML
- CityJSON
- …

Decomposition functions

Make it easy to break up existing geospatial shapes

- Decompose lines/surfaces:
  `geof:coordinate(?line, 1) as ?firstCoordinate`
- Decompose coordinates:
  `geof:lat(?coordinate) as ?lattitude`

Composition functions

Make it easy to create new geospatial shapes

Design 1:

- `geof:point(?long, ?lat) as ?point`
- `geof:line(?coord1, …, ?coordN) as ?line`
- `geof:polygon(?line1, …, ?lineN) as ?polygon`
- …

Design 2:

- `geof:compose(gml:Point, ?long, ?lat) as ?point`
- `geof:compose(gml:LineString, ?coord1, …, ?coordN) as ?line)`
- `geof:compose(gml:Polygon, ?line1, …, ?lineN) as ?polygon)`
- …

Some final personal observations

There should be more on attention on the business aspects of (geo)LD.

No experimental data, but production linked data!

More tools (both open source & commercial)

Open Source & Promotion

Sparklis – Love the idea!

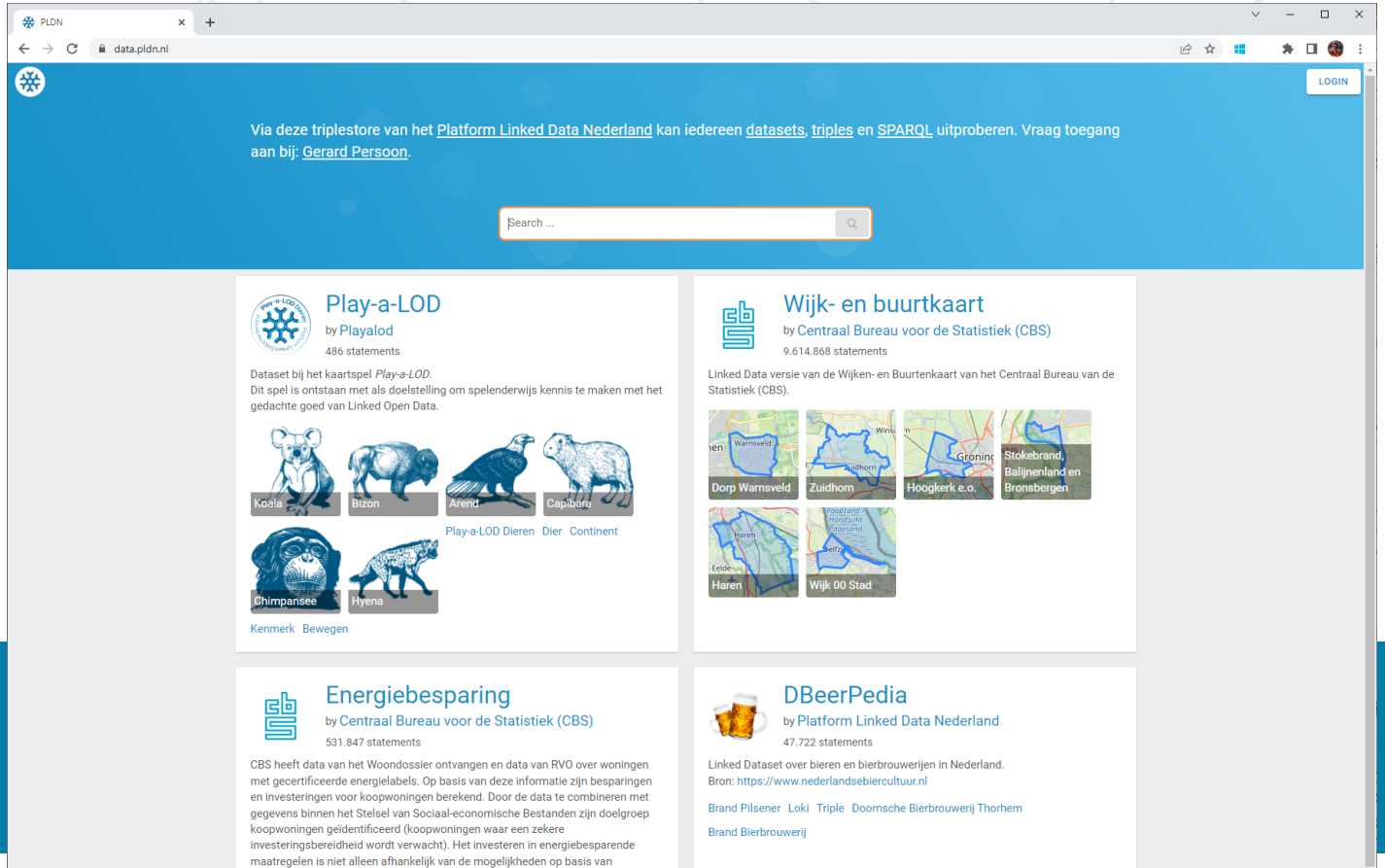
EuroSDR Sandbox (not open source, but free)

LD Wizard

https://github.com/netwerk-digitaal-erfgoed/LDWizard

Facetcheck

https://data.pldn.nl EuroSDR & PLDN Sandbox



Aanmel | surfdriv | Bluetoo | Develop | GeoLD2 | geold2(| Kadaste | Kadaste | GeoLOI | SPARQL | Nieuw t | EuroSD

Niet beveiligd | eurosdr.net

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EuroSDR

SEARCH

About Commissions Research Education Workshops Publications

EuroSDR is a not-for-profit organisation linking National Mapping and Cadastral Agencies with Research Institutes and Universities in Europe for the purpose of applied research in spatial data provision, management and delivery.

LATEST NEWS

Project in the picture | TIME benchmark

19 May 2022

Historical images, i.e.

Read more

New publication | Annual report 2021

8 April 2022

We are very pleased to present our 2021 A

Read more

New workshop | Digital Twins (25 May 2022)

7 April 2022

In January we had a very successful workshop on Digital Twins (DTs) for Nati

IN THE PICTURE

EduServ20 e-learning courses

- Recent LiDAR Technologies
- Working with Volunteered and Crowdsourced Geographic Information
- Integration of 3D City Models and BIM: GeoBIM
- 3D Point Cloud Classification for Mapping Purposes

More information

Tweets

GeoData Wizard

1 Upload — 2 Configure — 3 Publish

No file selected

LOAD YOUR CSV FILE

Or try it with an example CSV file

BACK NEXT

LD Wizard

Documentation
Dataplatform
Github

GeoData Wizard

Upload — 2 Configure — 3 Publish

Key column

Row number

Resource class IRI

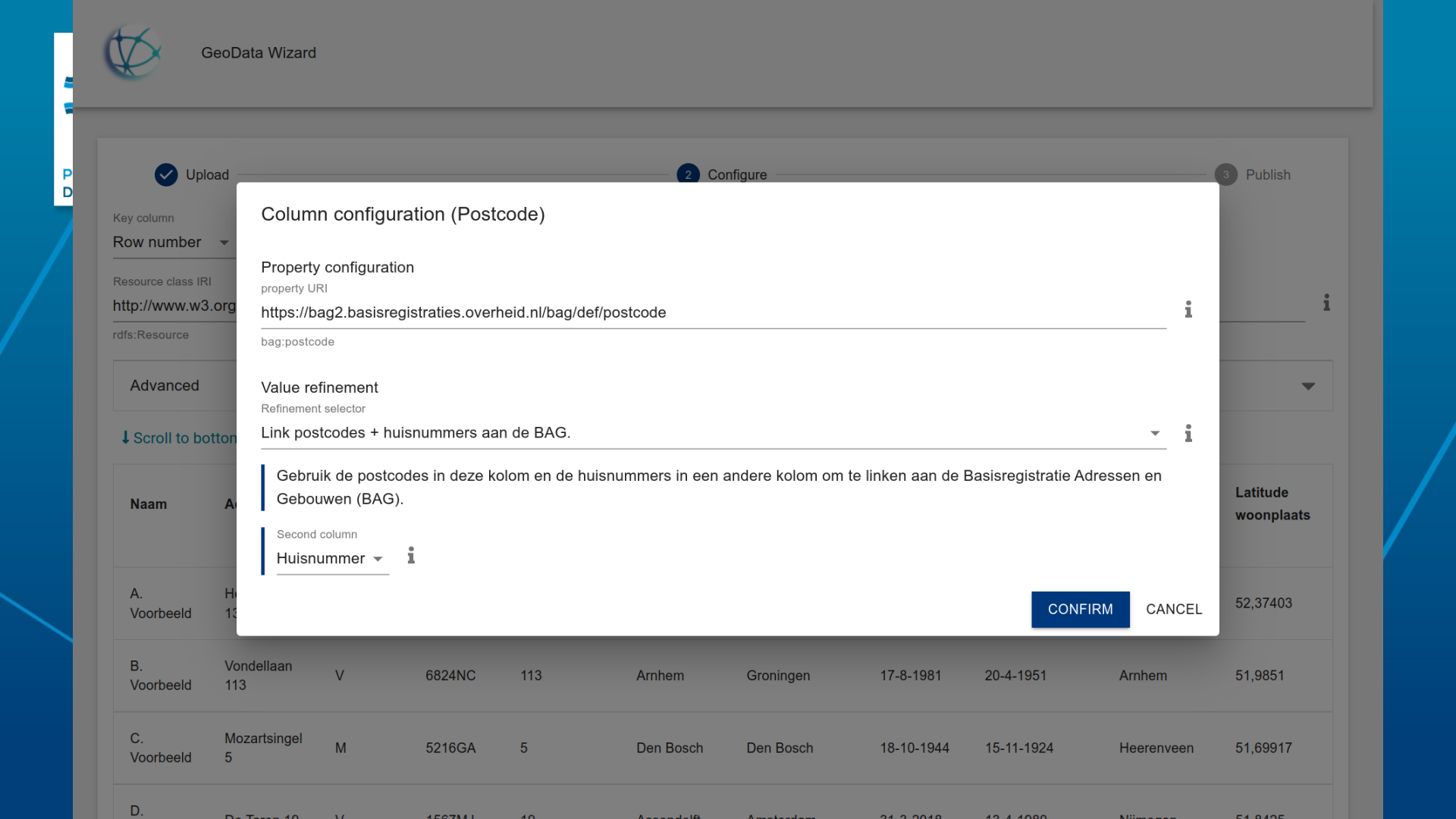
http://www.w3.org/2000/01/rdf-schema#Resource

rdfs:Resource

Advanced

Scroll to bottom

Naam	Adres	Geslacht	Postcode	Huisnummer	Woonplaats	Geboorteplaats	Sterfdatum	Geboortedatum	Sterfteplaats	Latitude woonplaats
A. Voorbeeld	Herengracht 13	M	1015BA	13	Amsterdam	Utrecht	30-4-2016	2-1-1965	Amsterdam	52,37403
B. Voorbeeld	Vondellaan 113	V	6824NC	113	Arnhem	Groningen	17-8-1981	20-4-1951	Arnhem	51,9851
C. Voorbeeld	Mozartsingel 5	M	5216GA	5	Den Bosch	Den Bosch	18-10-1944	15-11-1924	Heerenveen	51,69917
D.										


GeoData Wizard
Upload
2 Configure
3 Publish
Key column
Row number
Resource class IRI
http://www.w3.org
rdfs:Resource
Advanced
Scroll to botton
Column configuration (Postcode)
Property configuration
property URI
https://bag2.basisregistraties.overheid.nl/bag/def/postcode
bag:postcode
Value refinement
Refinement selector
Link postcodes + huisnummers aan de BAG.
Gebruik de postcodes in deze kolom en de huisnummers in een andere kolom om te linken aan de Basisregistratie Adressen en Gebouwen (BAG).
Second column
Huisnummer
CONFIRM
CANCEL
Naam
Latitude woonplaats
A. Voorbeeld
52,37403
B. Voorbeeld
Vondellaan 113
V
6824NC
113
Arnhem
Groningen
17-8-1981
20-4-1951
Arnhem
51,9851
C. Voorbeeld
Mozartsingel 5
M
5216GA
5
Den Bosch
Den Bosch
18-10-1944
15-11-1924
Heerenveen
51,69917
D.

GeoData Wizard

Upload — Configure — 3 Publish

Download results

Download CSV

Your data has been enriched before being transformed, the CoW and RML transformation scripts expect to use this file Download your tabular source data as standardized CSV.

DOWNLOAD ENRICHED CSV

Download RDF

Download the transformed Linked Data (RDF) to your local machine.

DOWNLOAD RDF

Download script

Download a script that you can use to run the transformation yourself. The following script languages are supported: RATT, CoW, RML.

DOWNLOAD RML

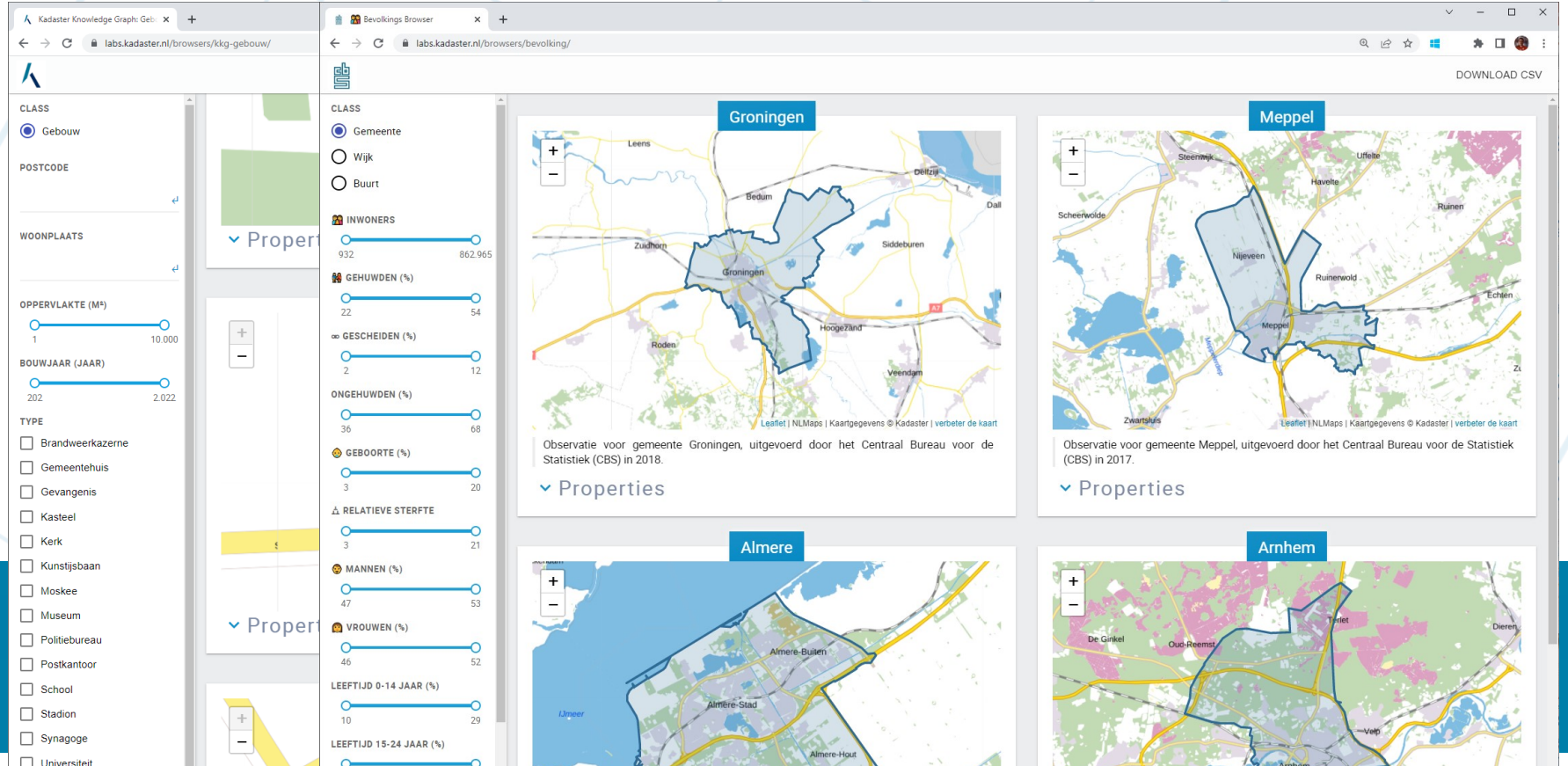
Publish results to PLDN

Using token of account Wouter Beek

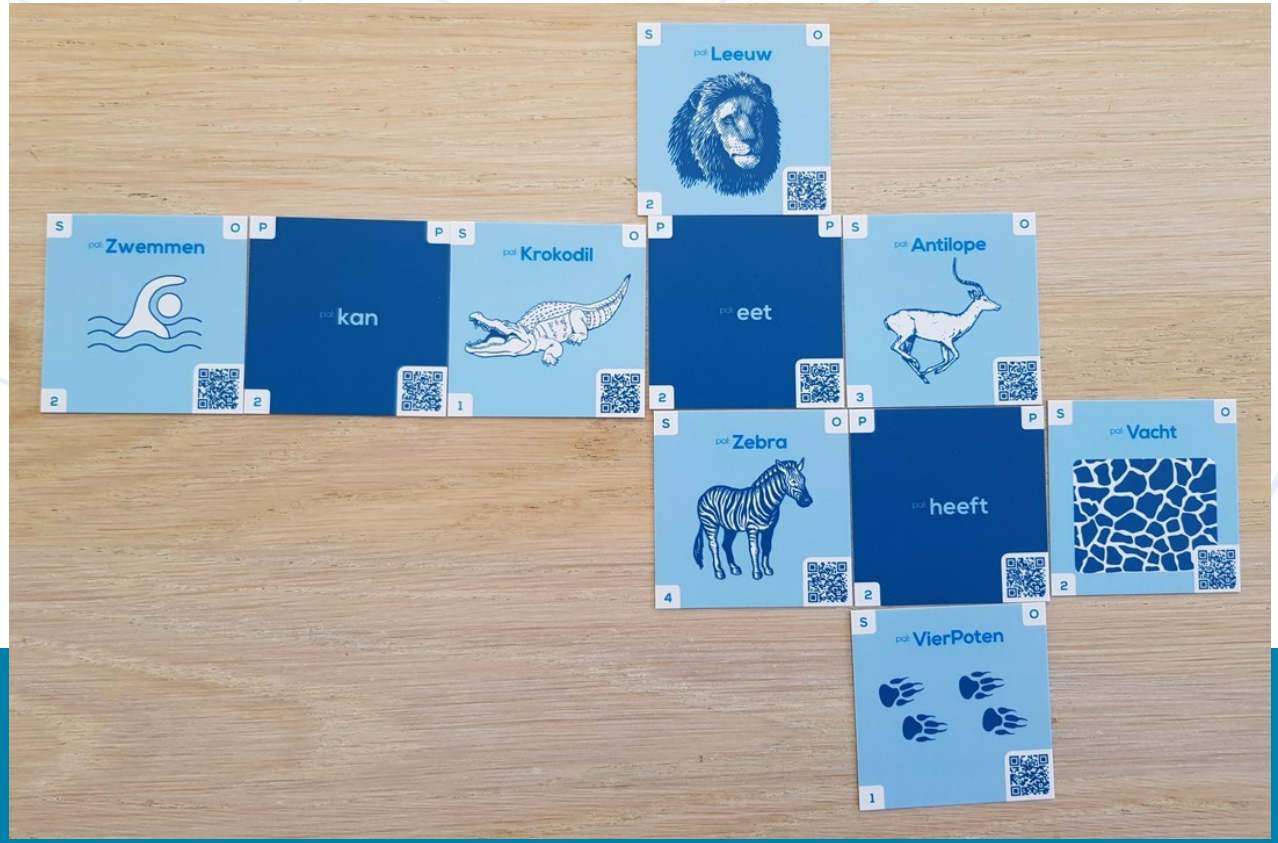
Account: Wouter Beek

Dataset: V voorbeeld

https://labs.kadaster.nl/browsers/bevolking/



Bol.com link


Leeuw
Zwemmen
kan
Krokodil
eet
Antilope
Zebra
heeft
Vacht
VierPoten

kadaster

The Kadaster Data Platform & Knowledge Graph

Ronzhin, S.; Folmer, E.; Maria, P.; Brattinga, M.; Beek, W.; Lemmens, R.; van't Veer, R. Kadaster Knowledge Graph: Beyond the Fifth Star of Open Data. *Information* **2019**, *10*, 310. https://www.mdpi.com/548974

Rowland, A.; Folmer, E.; Beek, W.; Wenneker, R. Interoperability and Integration: An Updated Approach to Linked Data Publication at the Dutch Land Registry. ISPRS Int. J. Geo-Inf. 2022, 11, 51. https://doi.org/10.3390/ijgi11010051

Erwin Folmer 30-5-2022
Erwin.Folmer@kadaster.nl