BIM CONNECTED

Making data valuable

Implementing and managing mappings for data transformation using SHACL Rules

LDAC 2023 – INDUSTRY TRACK

The organisation

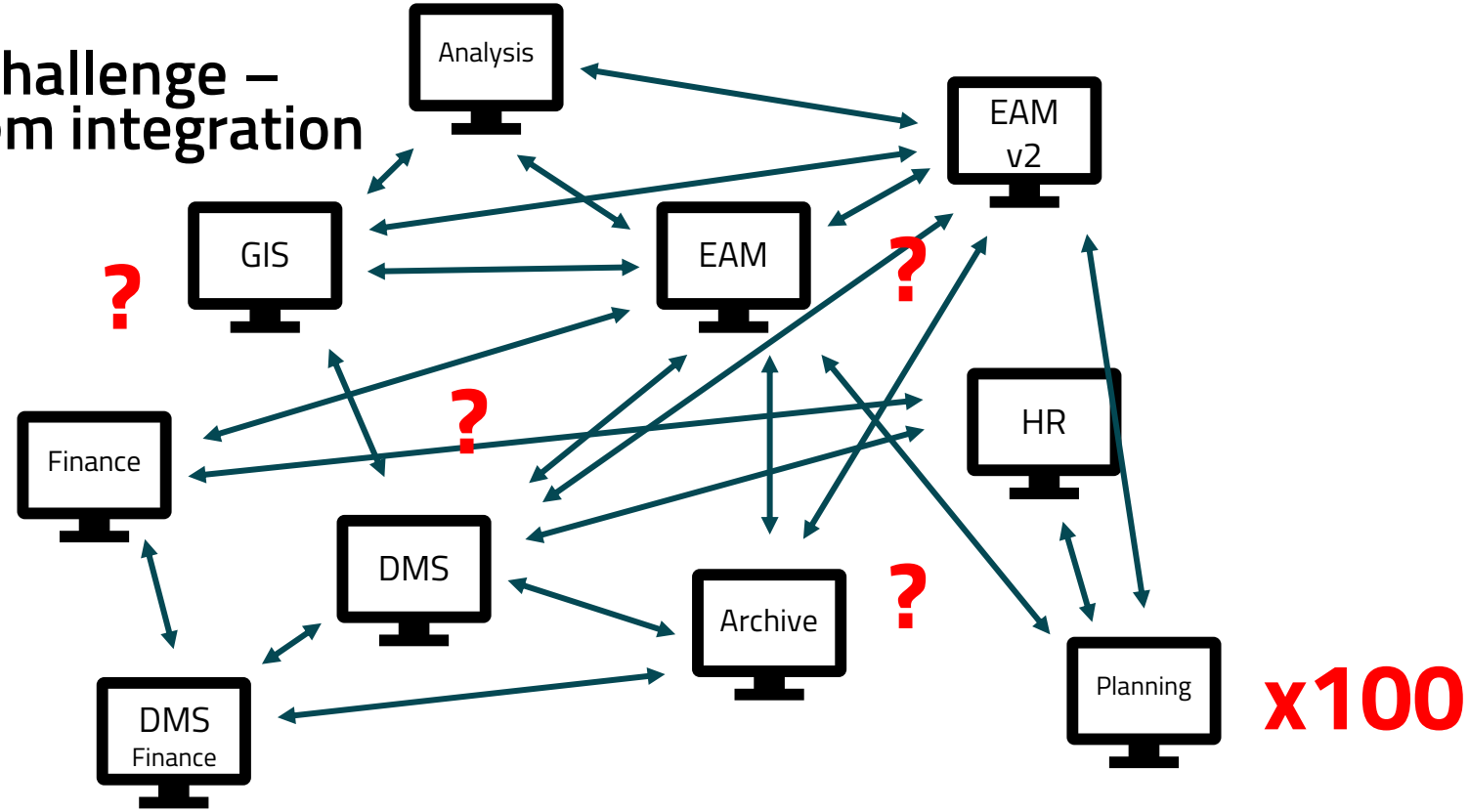
Water management

Urban area in the Netherlands

Government collaboration

1800 employees

The challenge – system integration



The challenge – system integration

Fina

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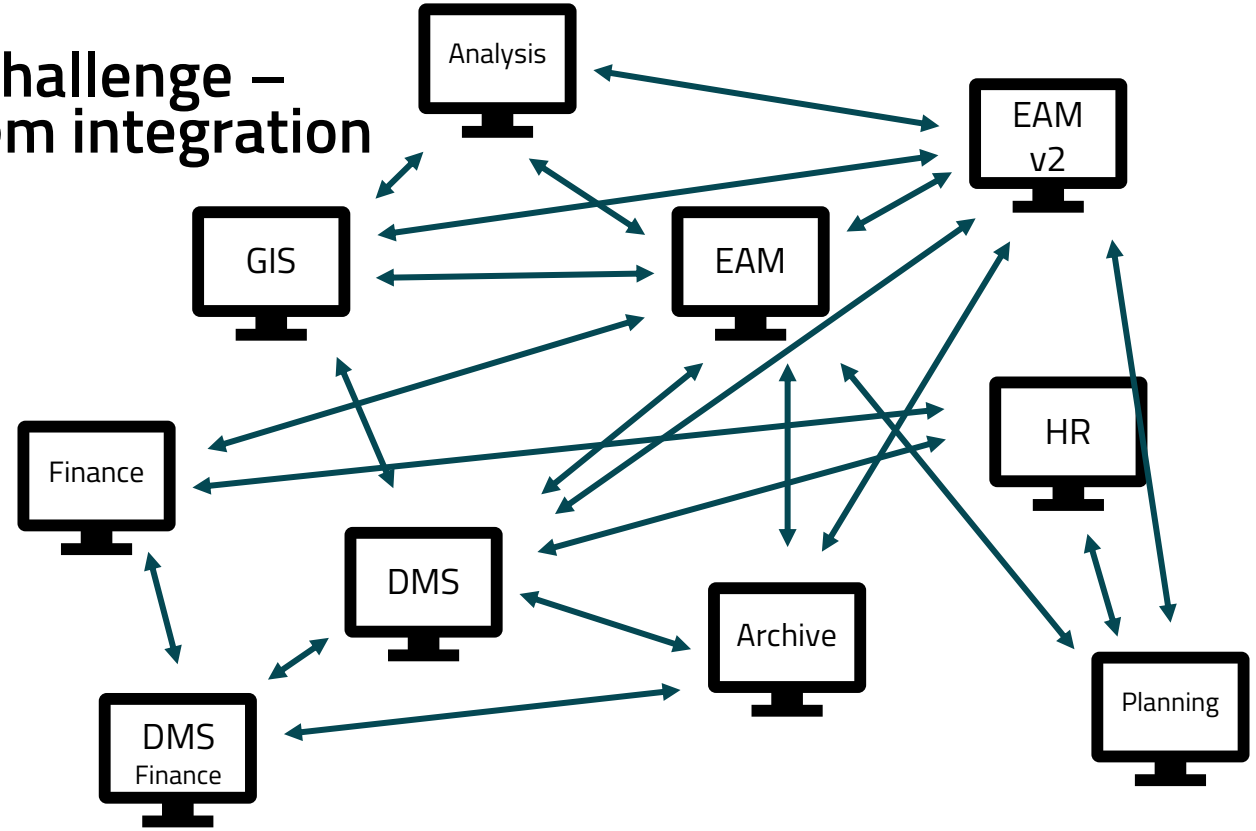
The challenge – information management

Multiple systems (application + database) storing similar and/or related information

- No overview of what data they have, where it is or quality of it
- Redundancy → Inconsistency
- Data integration is hard and untransparent
- Low quality information in reporting and decision making
- Hard to innovate

The challenge – system integration



Solution
Hub and spoke

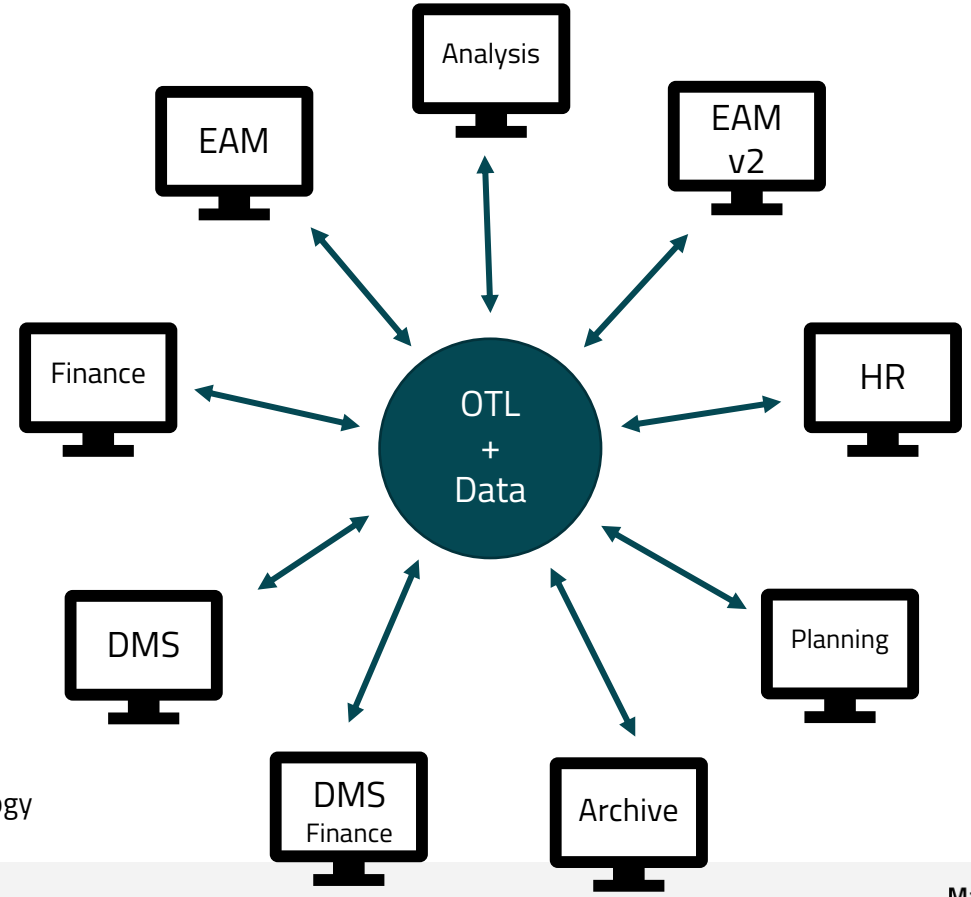
Common language

Measuring data quality

Data dictionary

Data integration

Communication between systems

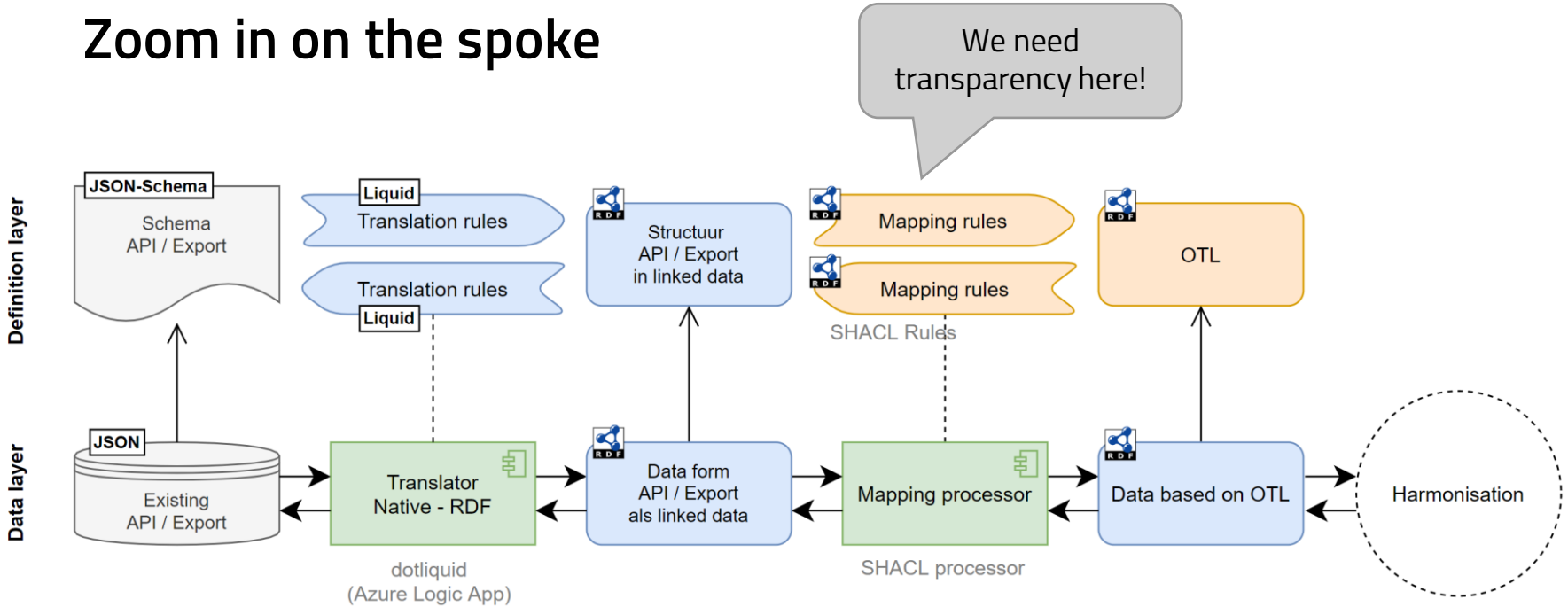


OTL: Object Type Library (as an ontology

Zoom on the spoke

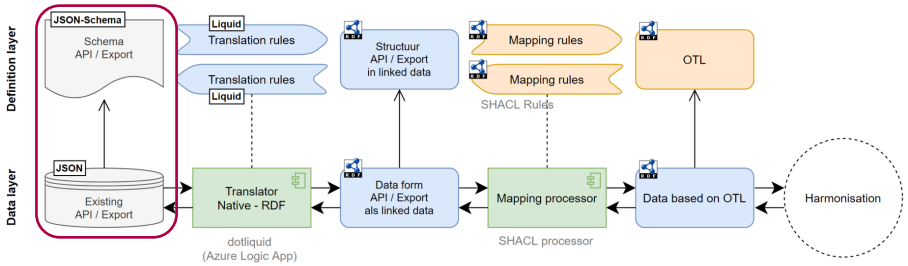
- Hard coded connections (script)
  - Black box
  - Hard to govern / maintain
- RML → Liquid templates
  - Not enough expressive power
  - On way (only from source to RDF)
  - Concerns about performance
- Adding SHACL Rules to encode business logic

Zoom in on the spoke



Zoom on the spoke


```
{
 "attributes": {
  "KBRSOORT": 3,
  "KBRBHBO": null,
  "KBRBHBE": null,
  "KBRHOBO": null,
  "KBRHOBE": null,
  "KBRBREED": 3.2,
  "KBRLENGT": 3.65,
  "KBRMATBD": 5,
  "KDUMATDC": 5,
  "KBRMATPY": 5,
  "KBRMATLH": 5,
  "KBRBEWEG": null,
  "KBRHOPEN": null,
  "KBRHGESL": null,
  "KBRBESRT": null,
  "IWS_AANTAL_PIJLERS": null,
  "KWKSTATU": 300,
  "KWKDATUM": "2001",
  "KWKOPME": null,
  "OSMOMSCH": null,
  "KWKNAAM": null,
  "IWS_LEGGERSTATUS": 4,
  "IWS_AFST_B": 2,
  "KBRIDENT": "KBR05865",
  "RICHTING": 290.38,
  "GLOBALID": "{9AB1C440-433C-4882-96BB-A6
  "WS_MONUMENT": 2,
  "WS_WK_LEGGERSTATUS": null,
  "WS_NOODKUNSTWERK": 2,
  "WS_BEHEERDER": null,
  "WS_FUNCTIONEEL_ONDERH": null,
  "WS_CONSTRUCTIEF_ONDERH": null,
  "WS_BEDIENING": null,
  "WS_DOORSTROOMBREEDTE_10": null,
  "WS_DOORSTROOMBREEDTE_9": null,
  "WS_DOORSTROOMBREEDTE_8": null,
  "WS_DOORSTROOMBREEDTE_7": null,
  "WS_DOORSTROOMBREEDTE_6": null,
  "WS_DOORSTROOMBREEDTE_5": null,
  "WS_DOORSTROOMBREEDTE_4": null,
  "WS_DOORSTROOMBREEDTE_3": null,
  "WS_DOORSTROOMBREEDTE_2": null,
  "WS_DOORSTROOMBREEDTE_1": null,
  "IWS_EIGENAAR_K": null,
  "GN_CREATED_DATE": 1462173186000,
  "GN_LAST_EDITED_DATE": 1673860775000,
  "KBR_ID": 8114,
  "OBJECTID": 7
 },
 "geometry": {
  "x": 123202.85000000149,
  "y": 471187.25
 }
},
```

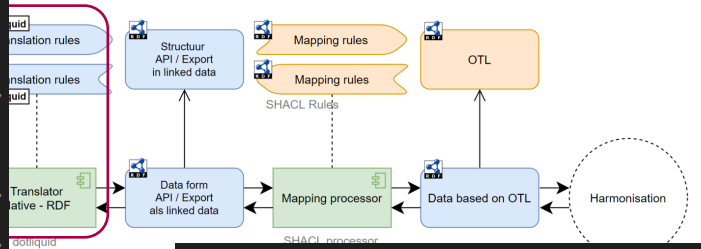
Subset of data:


```
{
 "attributes": {
  "OBJECTID": 8117,
  "KBRSOORT": 1,
  "KBRBREED": 2.3,
  "KBRMATPY": null,
  "KWKDATUM": "2001",
  "OSMOMSCH": "This is a bridge"
 },
 "geometry": {
  "x": 125157.05000000075,
  "y": 473216.25
 }
}
```

Zoom on the spoke

Liquid template

```
{
  "@context": {
  "gis": "https://otl.organisation.org/gis/def/",
  "data": "https://otl.organisation.org/gis/id/"
  },
  "@graph": [
  {%- for feature in features -%}
    {
      "@id": "data:{{ feature.attributes.OBJECTID }}",
      {%- if feature.attributes.KBRSOORT -%}
      "gis:GW_KBR-KBRSOORT": {{ feature.attributes.KBRSOORT }},
      {%- endif -%}
      {%- if feature.attributes.KBRBREED -%}
      "gis:GW_KBR-KBRBREED": "{{ feature.attributes.KBRBREED }}",
      {%- endif -%}
      {%- if feature.attributes.KBRMATPY -%}
      "gis:GW_KBR-KBRMATPY": {{ feature.attributes.KBRMATPY }},
      {%- endif -%}
      {%- if feature.attributes.KWKDATUM -%}
      "gis:GW_KBR-KWKDATUM": "{{ feature.attributes.KWKDATUM }}",
      {%- endif -%}
      {%- if feature.attributes.OSMOMSCH -%}
      "gis:GW_KBR-OSMOMSCH": "{{ feature.attributes.OSMOMSCH }}",
      {%- endif -%}
      {%- if feature.attributes.OBJECTID -%}
      "gis:GW_KBR-OBJECTID": {{ feature.attributes.OBJECTID }},
      {%- endif -%}
      "@type": "gis:GW_KBR",
      "gis:x": {{ feature.geometry.x }},
      "gis:y": {{ feature.geometry.y }}
    }{%- if feature != features.last -%},{%- endif %}
  {%- endfor -%}
  ]
}
```



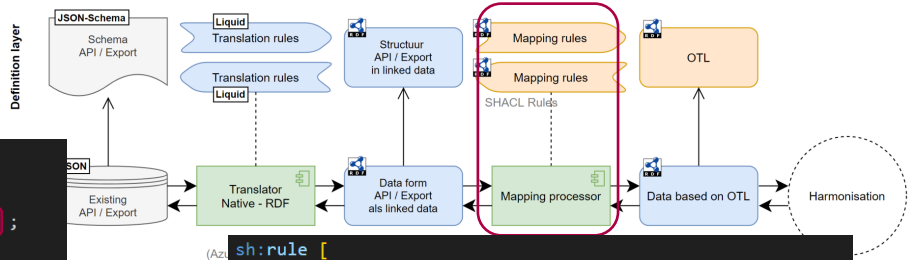

```
data:8117  a                    gis:GW_KBR ;
        gis:GW_KBR-KBRBREED     "2.3" ;
        gis:GW_KBR-KBRSOORT     1 ;
        gis:GW_KBR-KWKDATUM     "2001" ;
        gis:GW_KBR-OBJECTID     8117 ;
        gis:GW_KBR-OSMOMSCH     "This is a bri
        gis:x                   1.251570500000
        gis:y                   4.7321625E5 .
```

```
{
 "attributes": {
  "OBJECTID": 8117,
  "KBRSOORT": 1,
  "KBRBREED": 2.3,
  "KBRMATPY": null,
  "KWKDATUM": "2001",
  "OSMOMSCH": "This is a bridge"
 },
 "geometry": {
  "x": 125157.05000000075,
  "y": 473216.25
 }
}
```

```
{
  "@id": "data:8117",
  "gis:GW_KBR-KBRSOORT": 1,
  "gis:GW_KBR-KBRBREED": "2.3",
  "gis:GW_KBR-KWKDATUM": "2001",
  "gis:GW_KBR-OSMOMSCH": "This is a bridge",
  "gis:GW_KBR-OBJECTID": 8117,
  "@type": "gis:GW_KBR",
  "gis:x": 125157.050000001,
  "gis:y": 473216.25
}
```

Zoom on the spoke

Business logic




```
sh:rule [
  a sh:TripleRule ;
  sh:subject sh:this ;
  sh:predicate otl:1bfe7a04-64d7-373c-a758-b8fc87de40b1 ;
  sh:object otl:70c9c1a3-ff3a-3ed3-9f8b-2ab8db18795e ;
  sh:condition [
    sh:property [
      sh:path gis:GW_KBR-KBRSOORT ;
      sh:hasValue 1 ;
    ] ;
  ] ;
] ;
sh:rule [
  a sh:TripleRule ;
  sh:subject sh:this ;
  sh:predicate otl:1bfe7a04-64d7-373c-a758-b8fc87de40b1 ;
  sh:object otl:3a0f9c0c-3bd7-3631-bbb1-48fcb11b7c5d ;
  sh:condition [ sh:property [ sh:path gis:GW_KBR-KBRSOORT ; s
] ;
sh:rule [
  a sh:TripleRule ;
  sh:subject sh:this ;
  sh:predicate otl:1bfe7a04-64d7-373c-a758-b8fc87de40b1 ;
  sh:object otl:601075ab-2372-3dc6-922c-58f4a6696d44 ;
  sh:condition [ sh:property [ sh:path gis:GW_KBR-KBRSOORT ; s
] ;
```

```
sh:rule [
  a sh:SPARQLRule ;
  sh:prefixes otl:mappingGISOTL ;
  sh:construct """
   CONSTRUCT {
      $this otl:c1fc51c1-d3b9-3ab4-adc3-576cd5da66d7 ?bn .
      ?bn a otl:00104d2c-27fd-331e-aa68-6a9d0d701e5f ;
        rdf:value ?value ;
        nta:unit qudt:M ;
        .
    }
    WHERE {
      $this gis:GW_KBR-KBRBREED ?valueSTR .
      BIND(STRDT(?valueSTR, xsd:decimal) AS ?value)
      BIND(BNODE() AS ?bn) .
    }
    """ ;
  skos:related gis:GW_KBR-KBRBREED,
    otl:c1fc51c1-d3b9-3ab4-adc3-576cd5da66d7
] ;
```

Triple rules vs SPARQL rules

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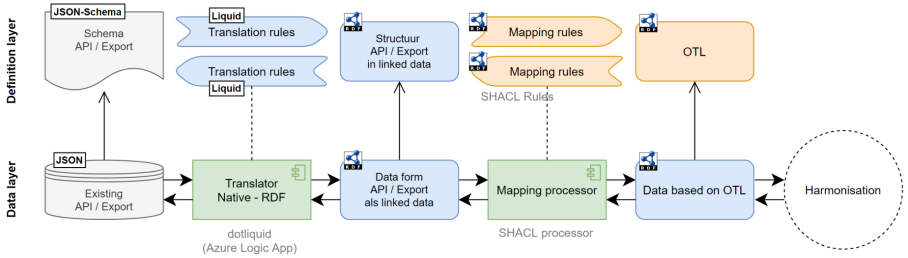
Zoom on the spoke

Source data transformed to OTL

```
data:8117  rdf:type  otl:9c6fb0e2-6efe-3ddf-99b9-a89df9f49996 ;
        otl:1bfe7a04-64d7-373c-a758-b8fc87de40b1
                otl:70c9c1a3-ff3a-3ed3-9f8b-2ab8db18795e ;
        otl:9c126169-1ba4-3531-bf9d-bbb32ed5f430
                "This is a bridge" ;
        otl:c1fc51c1-d3b9-3ab4-adc3-576cd5da66d7
                [ rdf:type    otl:00104d2c-27fd-331e-aa68-6a9d0d701e5f ;
                  rdf:value   2.3 ;
                  nta:unit    qudt:M
                ] ;
        otl:de592649-bb0a-3f79-9887-1d5bd9179a5b
                "2001"^^xsd:gYear .
```



Data translated to a target format

```
{
  "doorvaarbreedte": 2.3,
  "intreeverlies": 0.5,
  "uittreeverlies": 0.7,
  "typekruising": 2,
  "id": "8117"
}
```

Status and future work

Conclusions

- Limited amount of implementations can process SHACL rules
- Challenges recarding creation and managing the rules
- Sharing rules with business stakeholders (viewing, validating)

Future work

- Connecting other sytems
- Moving to a cloud platform to go in production
- Harmonisation of data (matching instances)
- Orchestrating data flow
- Event / query based approach

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