Federal Ministry of Food and Agriculture

MACS-G20 Workshop

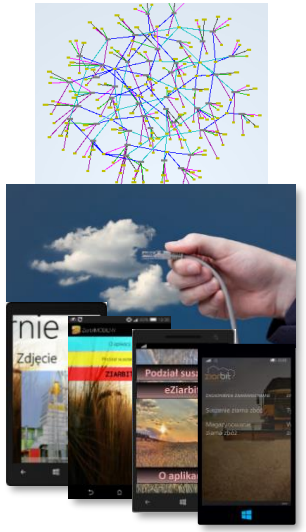
Linked Open Data in Agriculture

Berlin, September 27 – 28, 2017

GODAN Global Open Data for Agriculture & Nutrition

KTBL

Programming technologies supporting management of linked open data in the domain of cereal grain drying and storage



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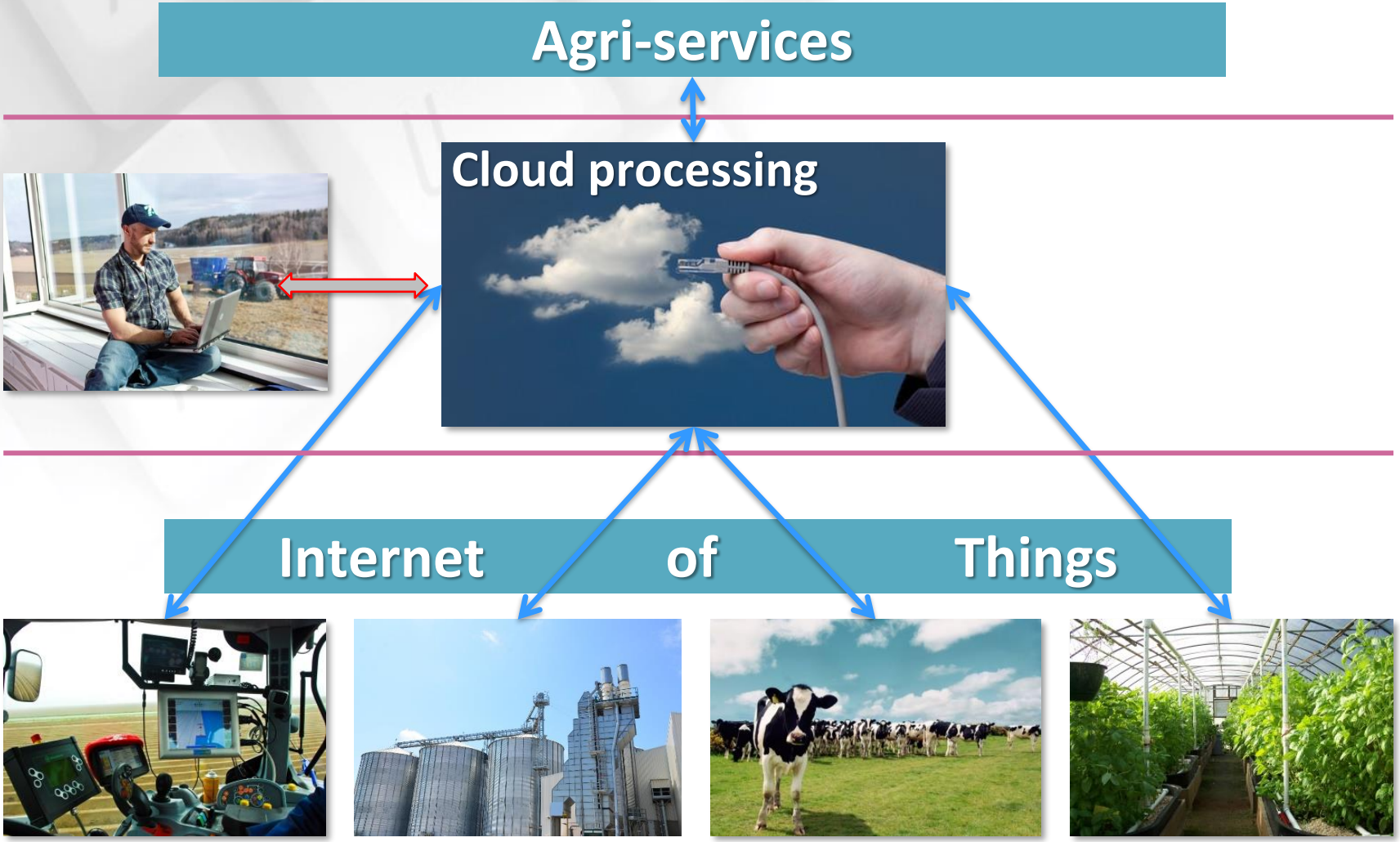
Jerzy Weres

Motivation



Motivation

54,962 Google searches in 1 second.

90% of world's data has been produced in last two years.

”We are drowning in information
but starved for knowledge”

(John Naisbitt)

Possible steps:

- linking of data on a global scale,
- free access to data *(interoperability),*
- advanced software.

Motivation





Motivation

Problems

- Complexity of handling, drying, heating, cooling and storing agri-food products.
- Lack of reliable data on product properties.
- Vast amounts of unstructured data.
- Fast changes in ICT – hard to follow technologies to their full advantages.

Remedies

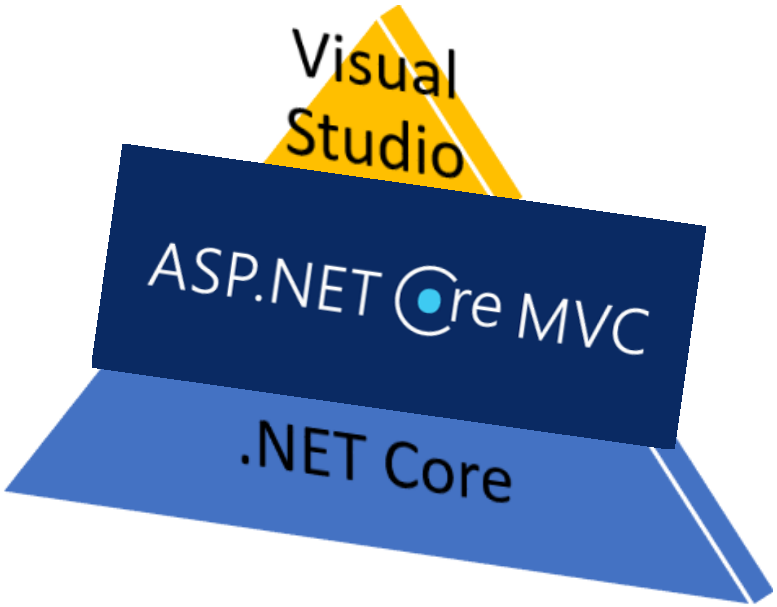
- Inverse FE approach to estimate reliable data on properties.
- Future Internet infrastructure.
- Data processing
  - predictions,
  - visualization,
  - semantics.
- Advanced programming technologies for developing semantic Web-based apps.

Objective

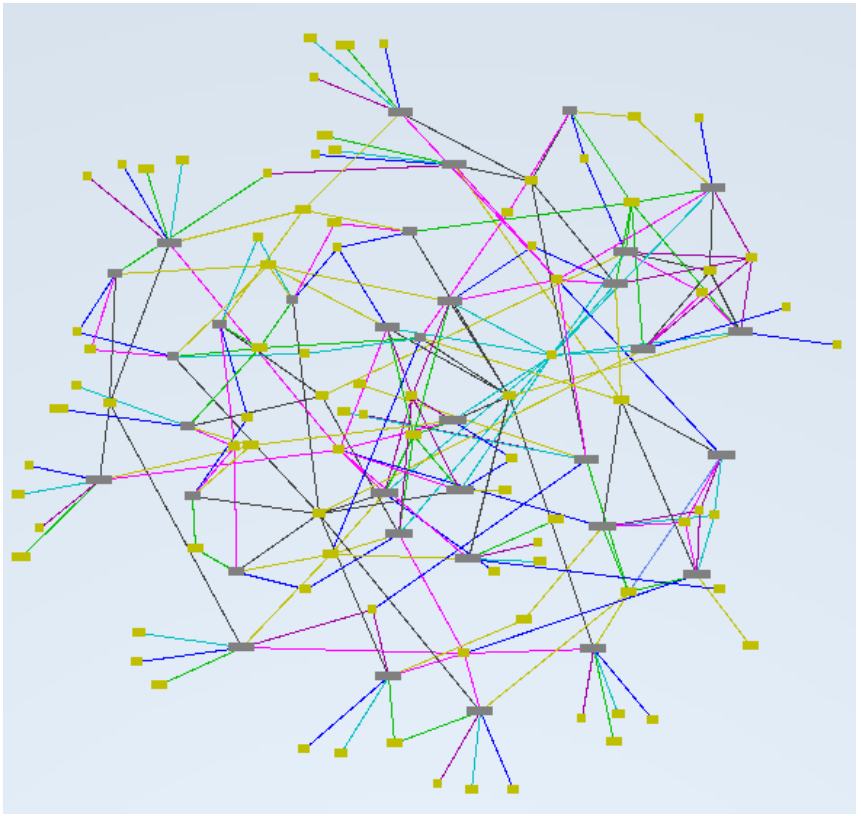
- To improve functionality and performance of our software in the domain of drying and storage of agri-food products with respect to:
  - estimation of more reliable data on product properties,
  - visualization of investigated processes,
  - development of linked open data approaches,
  - implementation of advanced programing technologies for multi- and cross-platform data processing.

Methods – programming technologies

Visual Studio 2017



Software development supporting Linked Open Data approach

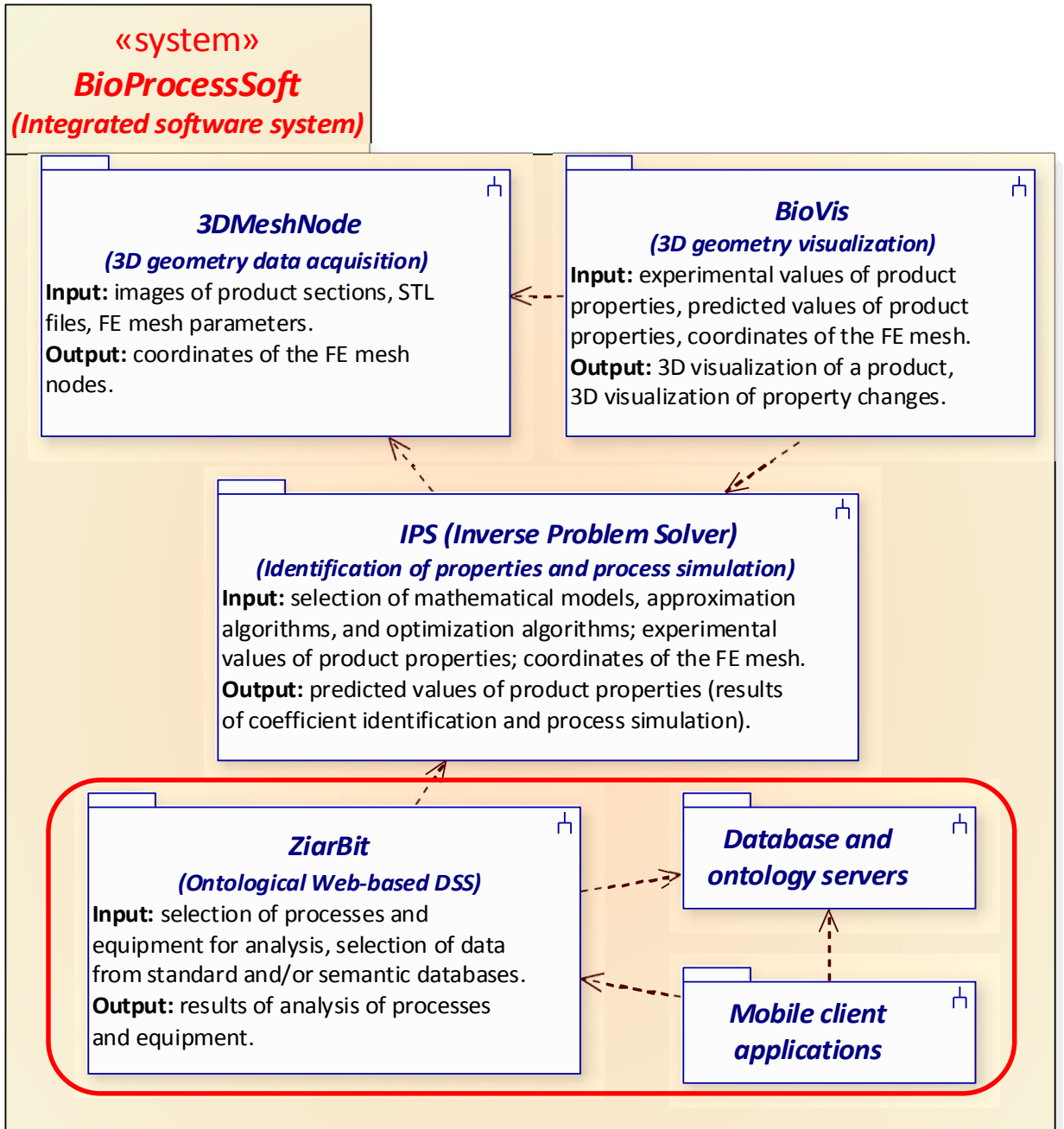


.NET Core platform

- **.NET Core**: Cross-platform programming.
  - Runs on Windows, macOS and Linux.
  - Runs on various devices, embedded systems, IoT and cloud.
  - Supported by Microsoft and GitHub hosting servers.
  - Open source.

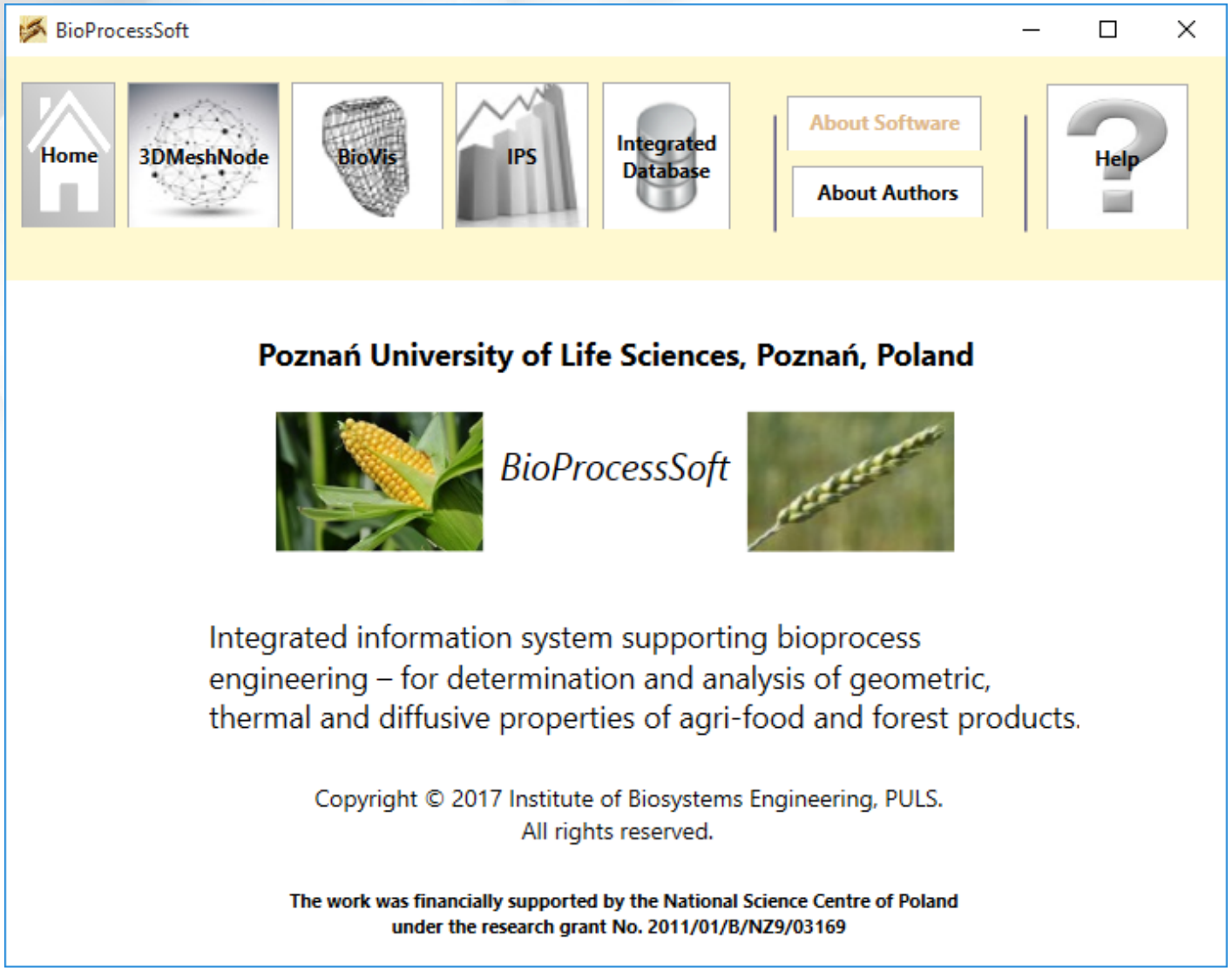
- **ASP.NET Core**: Next generation of the ASP.NET Web framework.
  - Runs either on .NET Framework or .NET Core.
  - Implements MVC templates – ASP.NET Core MVC.

Methods – package diagram for the *BioProcessSoft* system



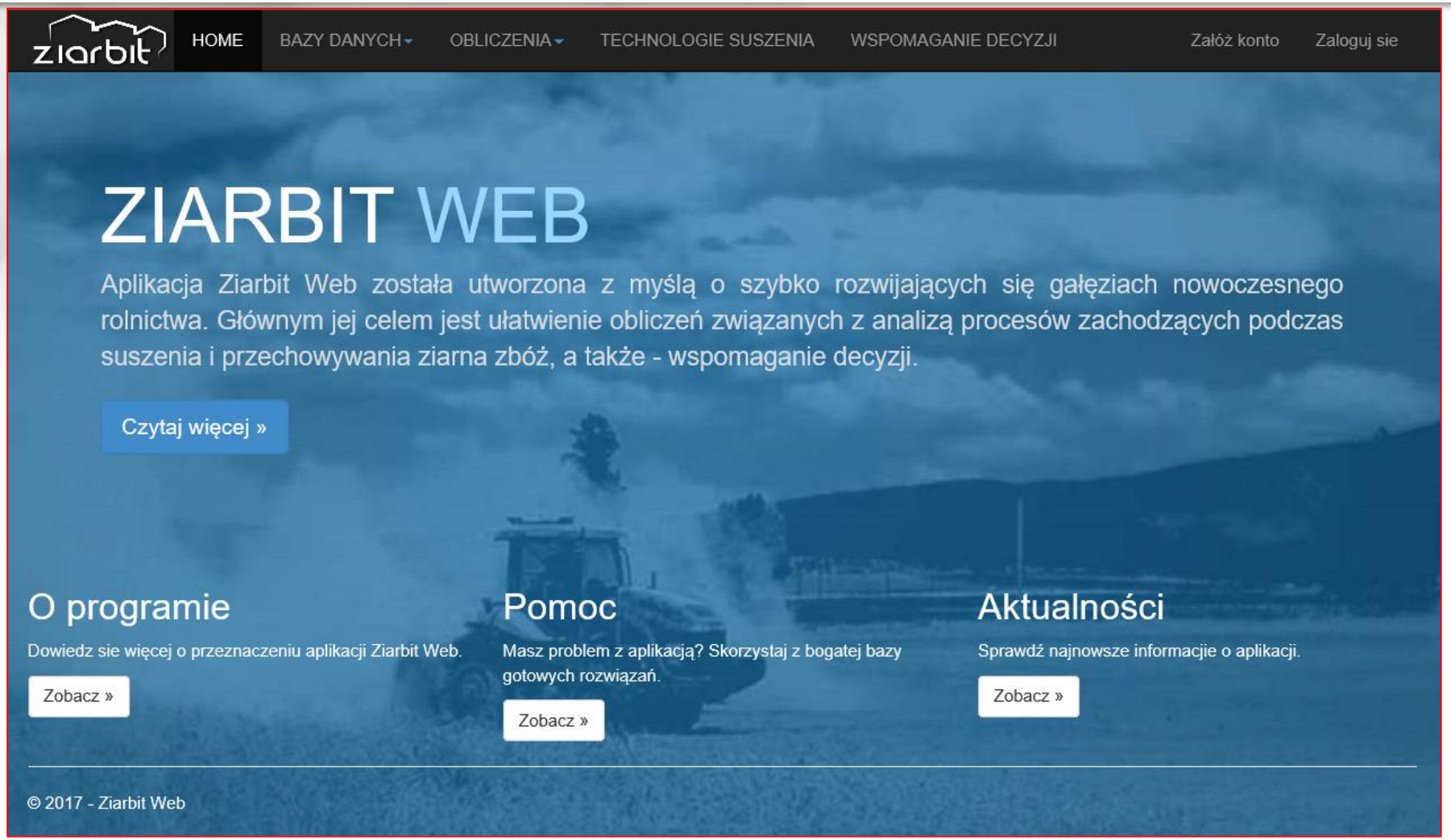
Visual Studio 2017 – Windows Presentation Foundation

- Interface of the integrated *BioProcessSoft* system



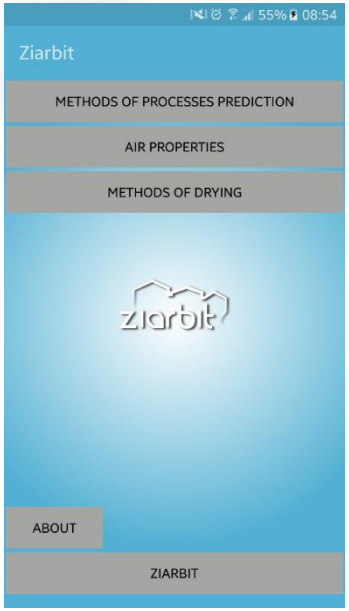
ASP .NET Core MVC

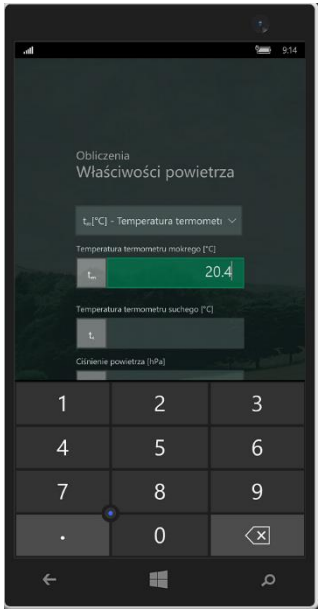
- Interface of the *Ziarbit* subsystem (Web server)

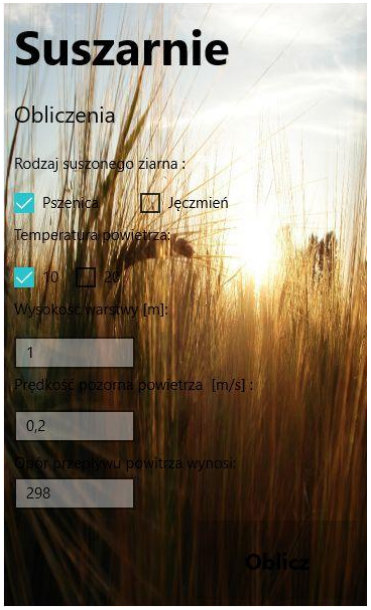


Xamarin

- Client mobile apps (C# - Xamarin - VS 2017) for the *Ziarbit* Web server



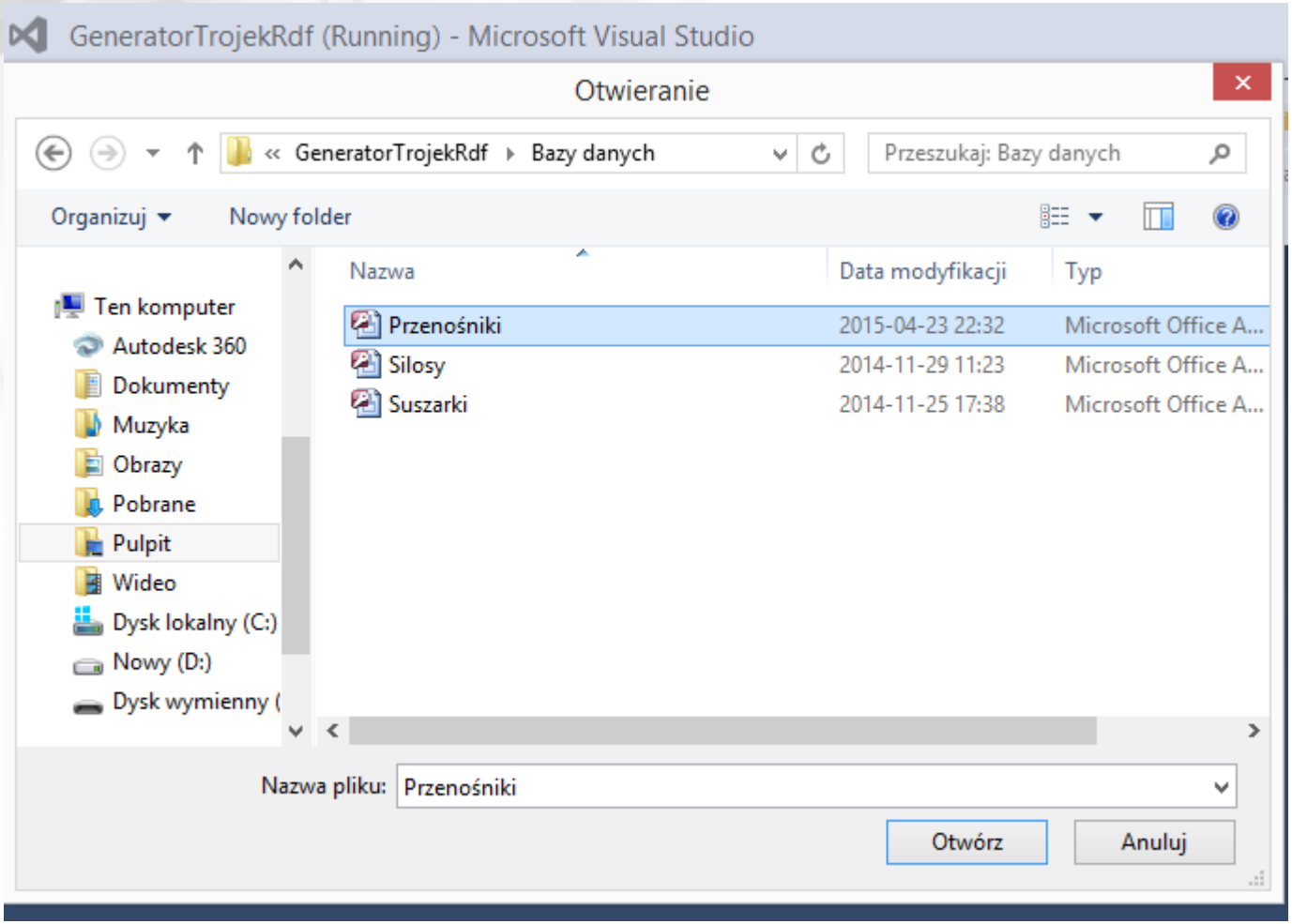




Linked open data technologies

Construction of ontologies in RDF/Turtle – *RDF/Turtle Triple Generator*

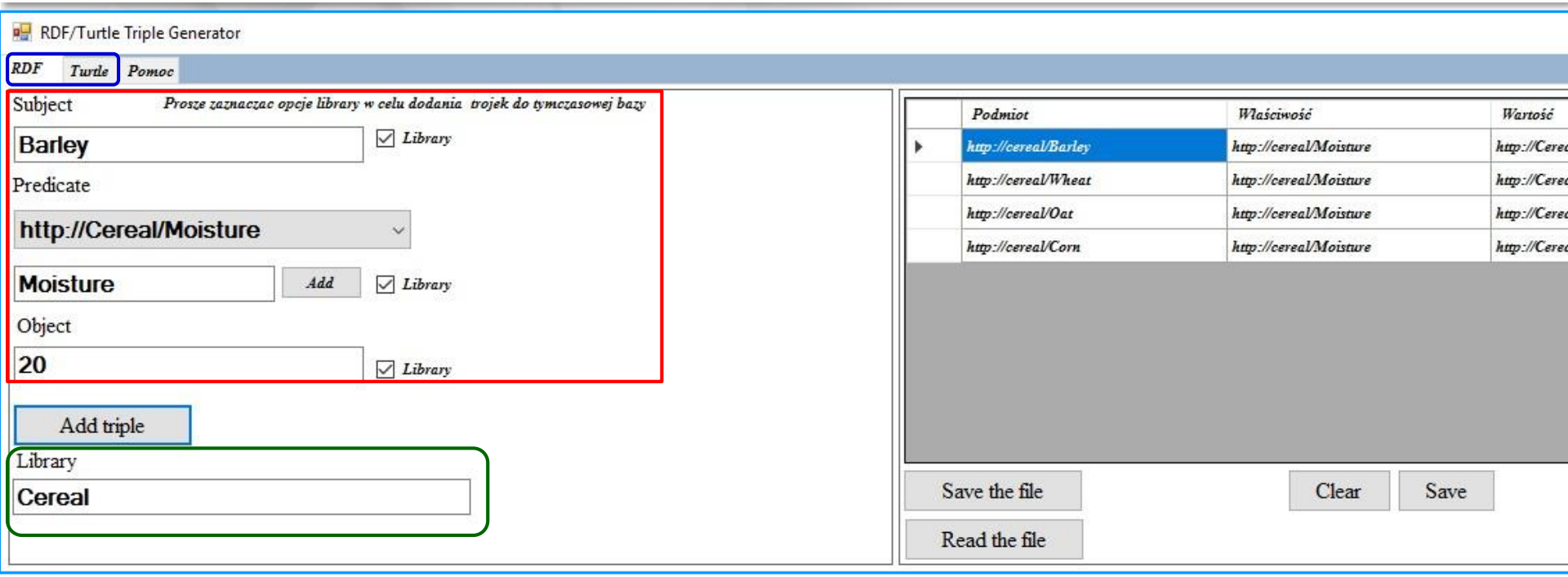
Selection of a database file.



Linked open data technologies

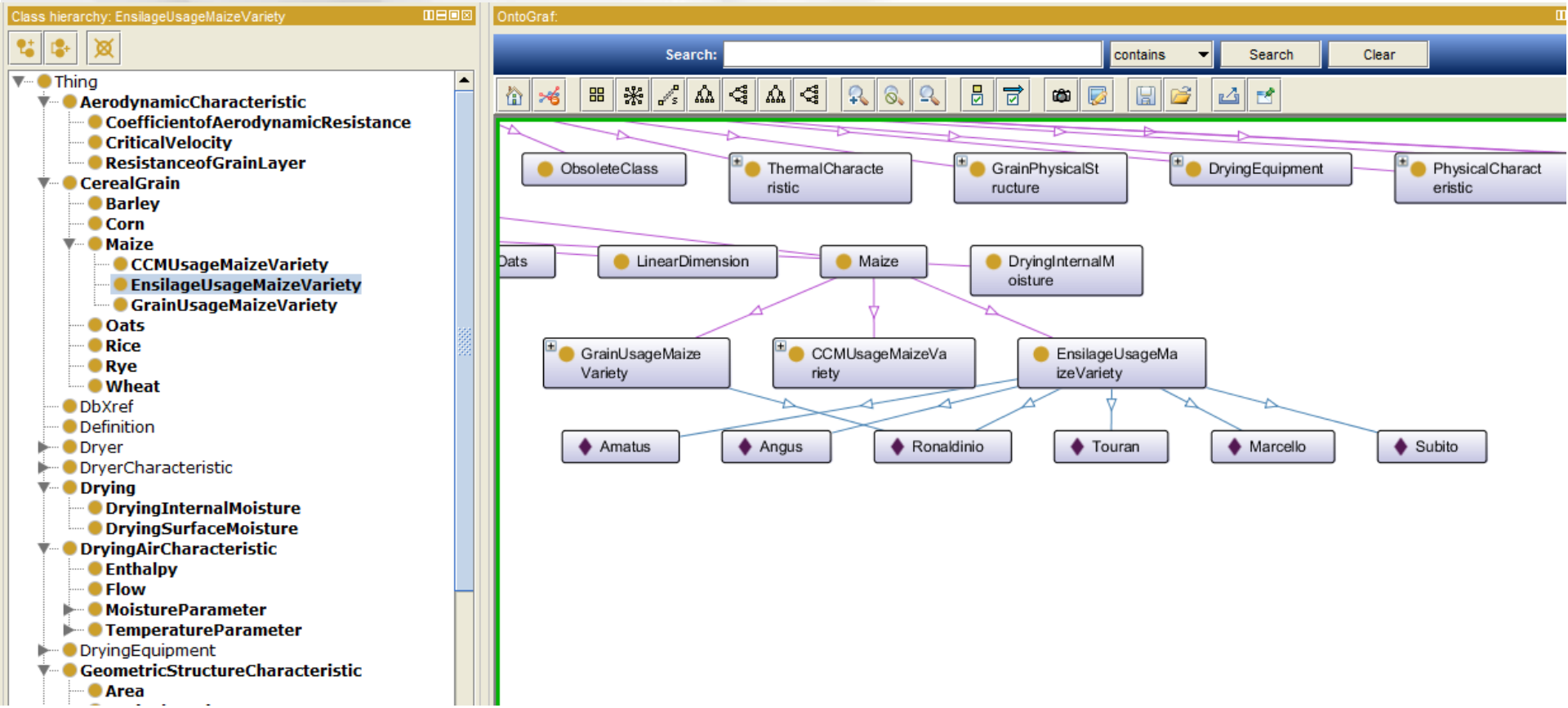
Construction of ontologies in RDF/Turtle – *RDF/Turtle Triple Generator*

Choice of serialization method and data entry.



Linked open data technologies

Construction of ontologies in RDF/Turtle – *Protégé*



Linked open data technologies

Construction of ontologies (Web Ontology Language) – *Fluent Editor*

Document

```
every bucket-elevator is a transporter.
every screw-conveyor is a transporter.
every chain-conveyor is a transporter.
every redler is chain-conveyor.

every bucket-elevator have-capacity-rpm(some integer value ) and have-length(some integer
value ) and have-min-electric-power(some integer value ) and have-max-electric-power(some
integer value ) and have-chain-speed(some integer value ) and have-dimension(some integer
value ) and have-turns-frequency(some integer value ).

Every chain-conveyor has-capacity-rpm(some integer value ) and has-chain-speed(some integer
value ) and has-dimension(some integer value ) and has-max-electric-power(some integer value )
and has-min-electric-power(some integer value ) and has-turns-frequency(some integer value )
and has-length (some integer value ) .

every screw-conveyor has-capacity-rpm(some integer value ) and has-dimension(some integer
value ) and has-length(some integer value ) and has-max-electric-power(some integer value )
and has-min-electric-power(some integer value ) .

every grain is transported by a transporter.
every grain is dry by a dryer.
```

Reasoner

```
Who-Or-What is a silo.
```

Enter

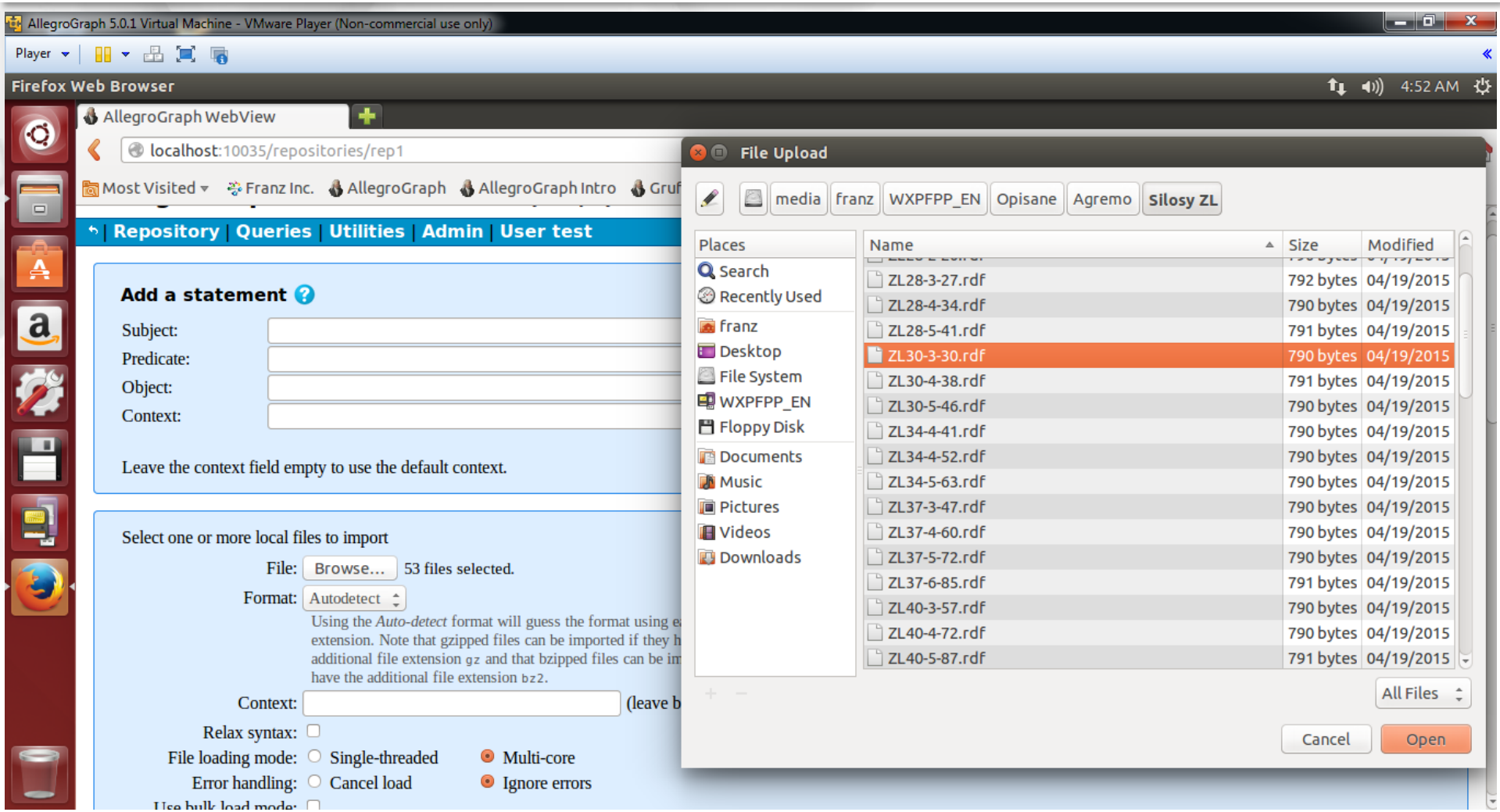
<?> is a silo. *Total: 3 instances found.*	Every <?> is a silo. *Total: 0 subconcepts found*	Every silo is a <?>. *Total: 1 superconcepts fou*
Spa-50 Spa-100 Spa-35		warehouse-device

Taxonomy Tree

- "thing"
  - grain
    - cereal
  - producer
    - Araj
    - Ferrum
    - Riela
  - warehouse-device
    - dryer
    - silo
      - Spa-100
      - Spa-35
      - Spa-50
    - transporter
- "nothing"
- relation
  - dry
  - have-capacity
  - making
  - stores
  - transport
- attribute
  - have-capacity
  - have-capacity-rpm
  - have-chain-speed
  - have-dimension
  - have-humidity

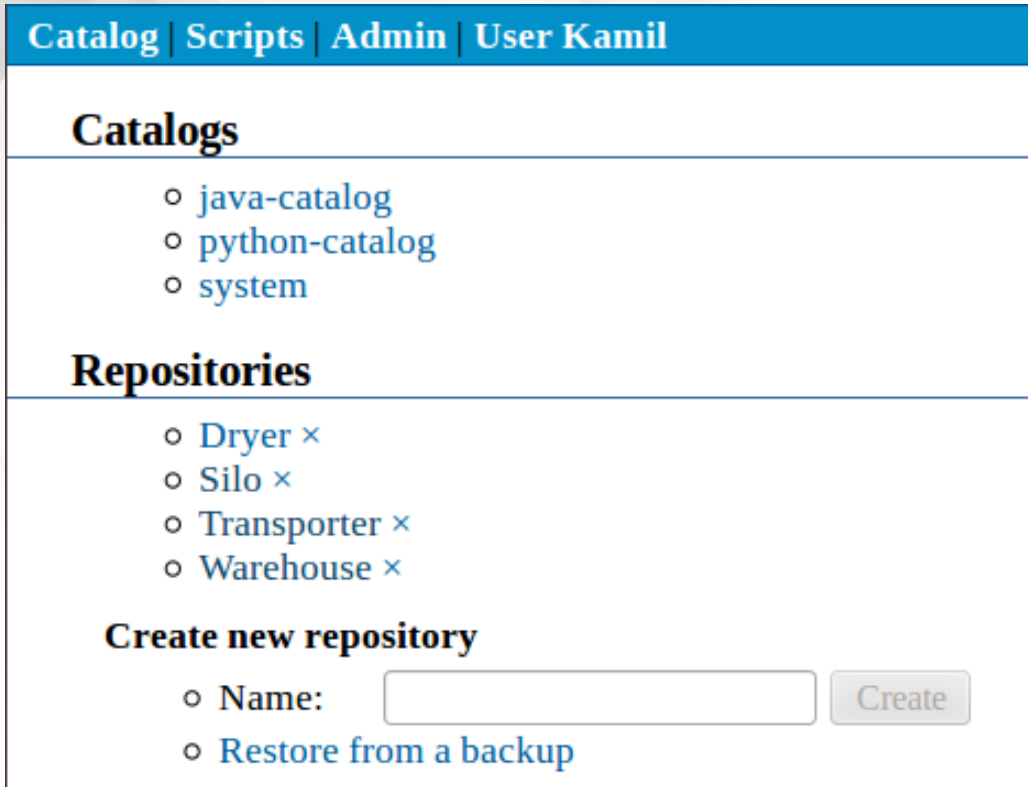
Linked open data technologies

Loading ontologies into a graph database – *AllegroGraph*



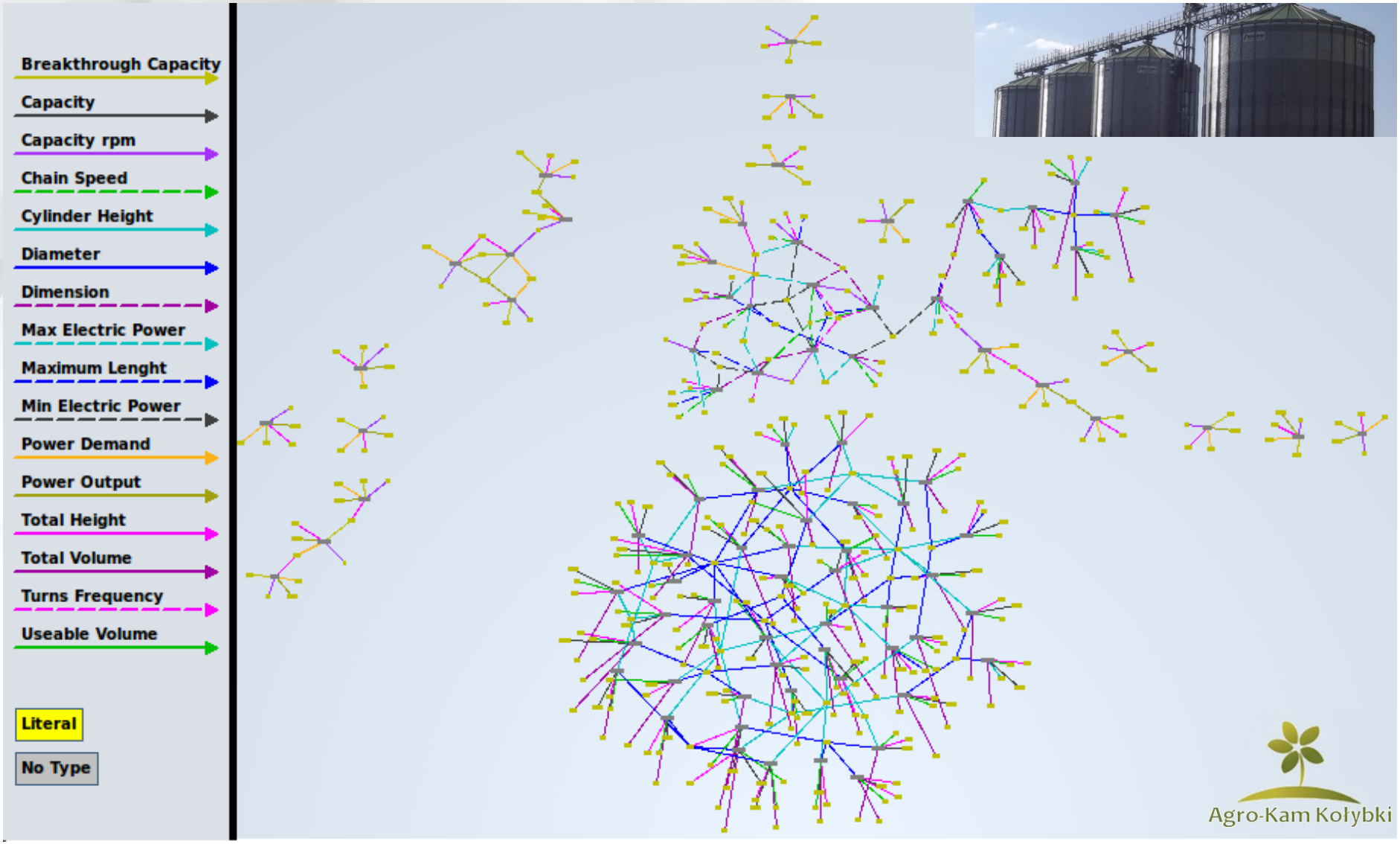
Linked open data technologies

Repository creation – *AllegroGraph*



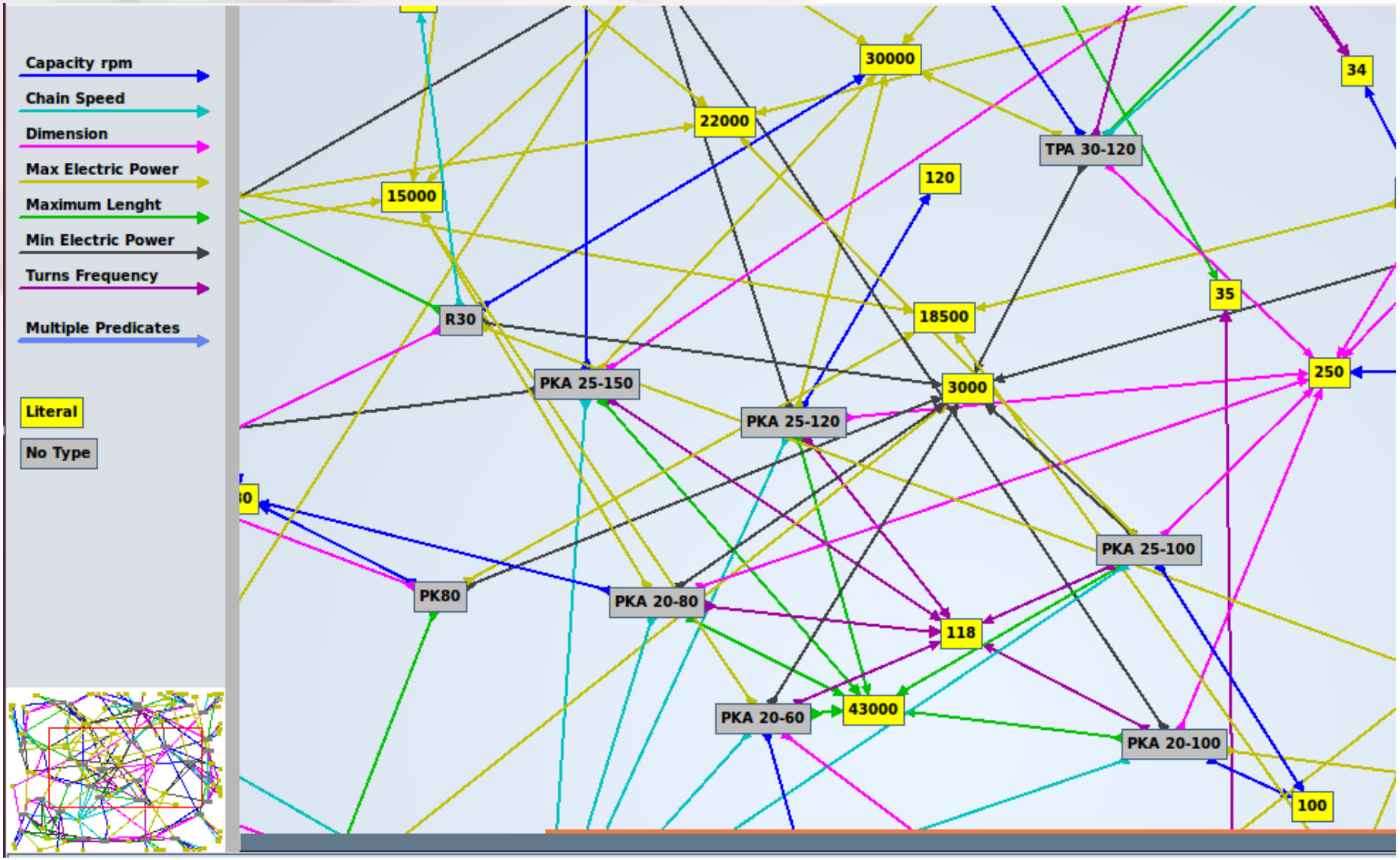
Linked open data technologies

Ontology visualization - grain storage system in Kołybki – *Gruff*



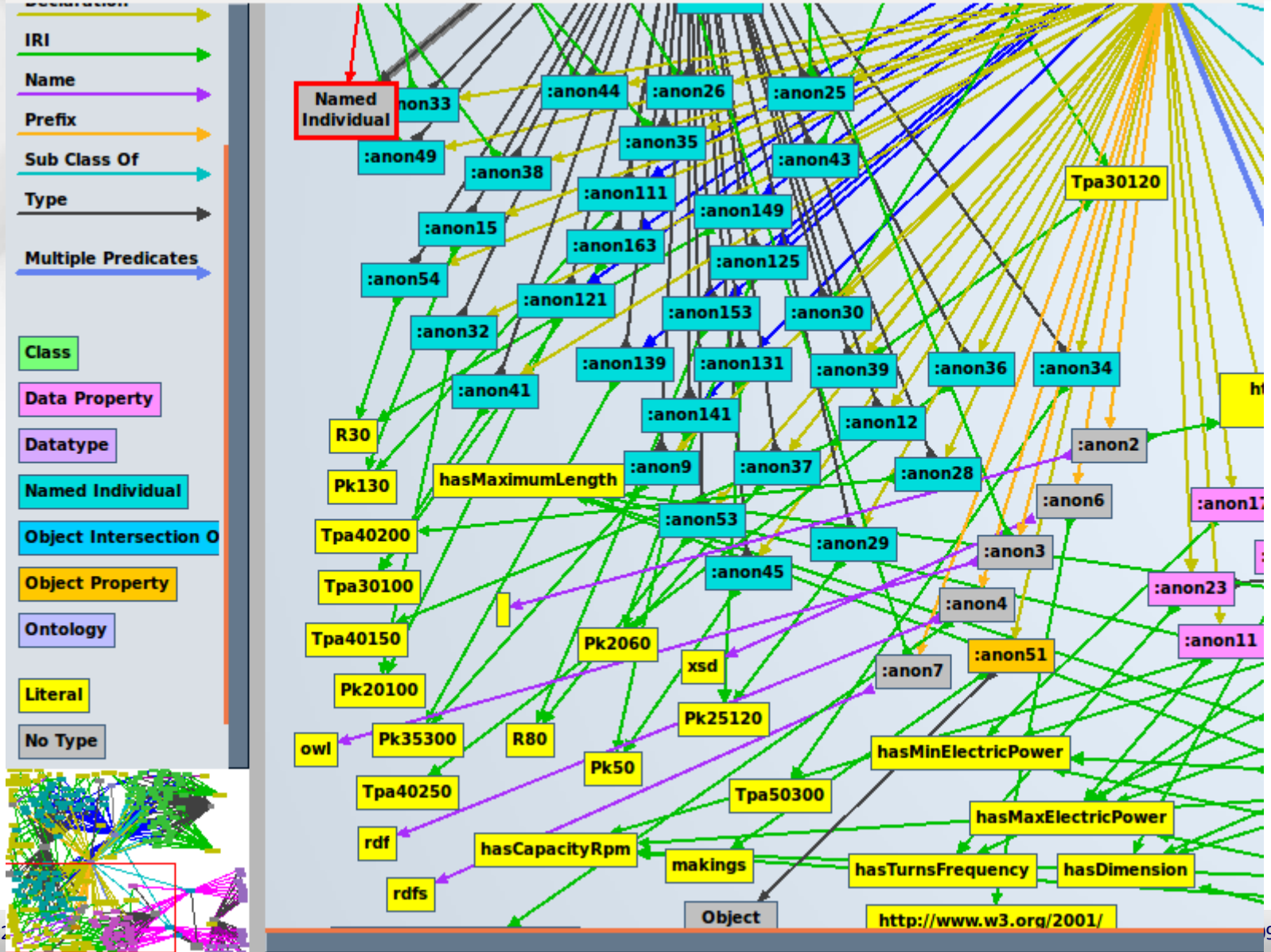
Linked open data technologies

Conveyors, RDF notation – *Gruff*



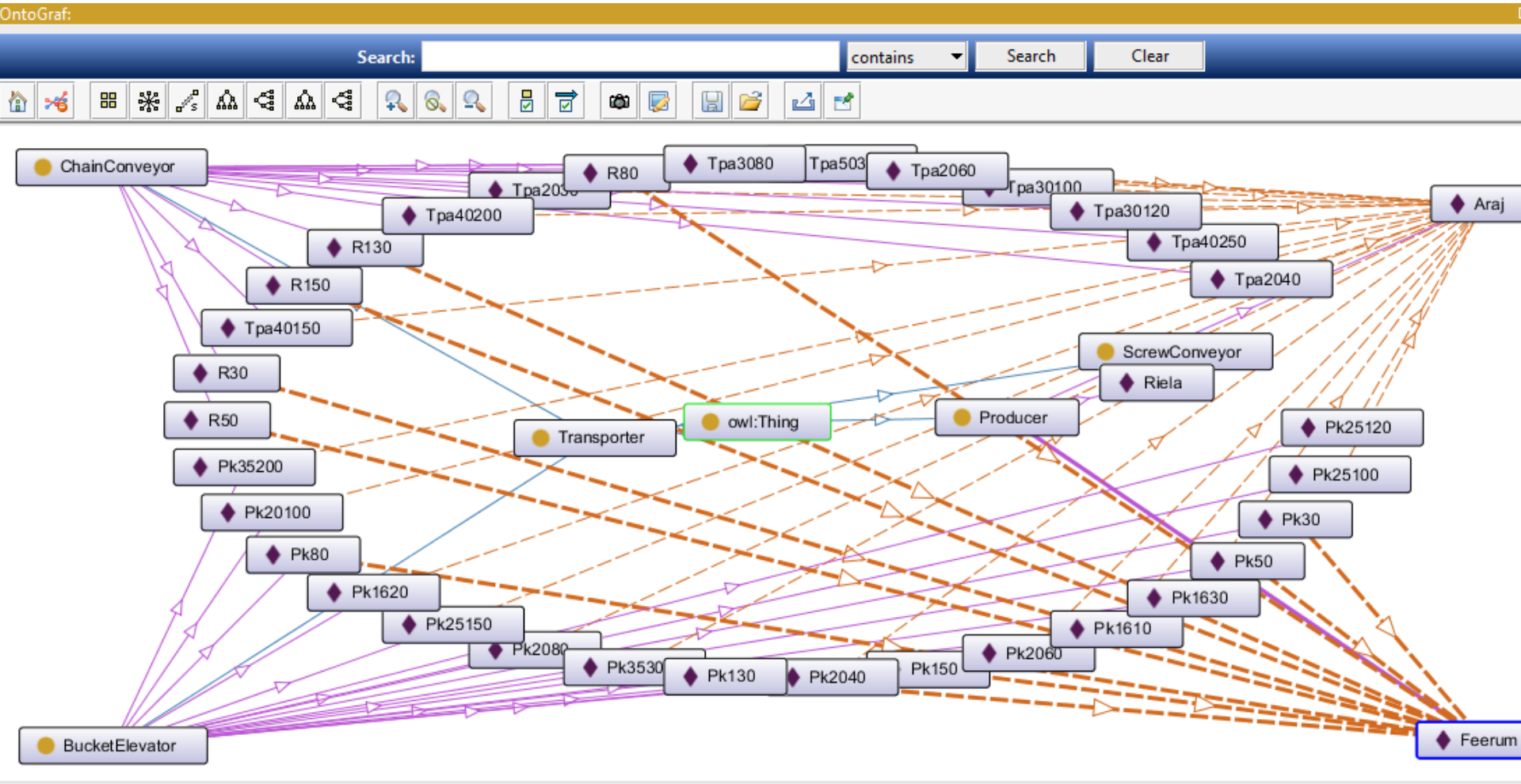
Linked open data technologies

Conveyors, OWL notation – *Gruff*



Linked open data technologies

Conveyors, OWL notation – *OntoGraf*



Linked open data technologies

R30 Conveyor, RDF and OWL notation

RDF

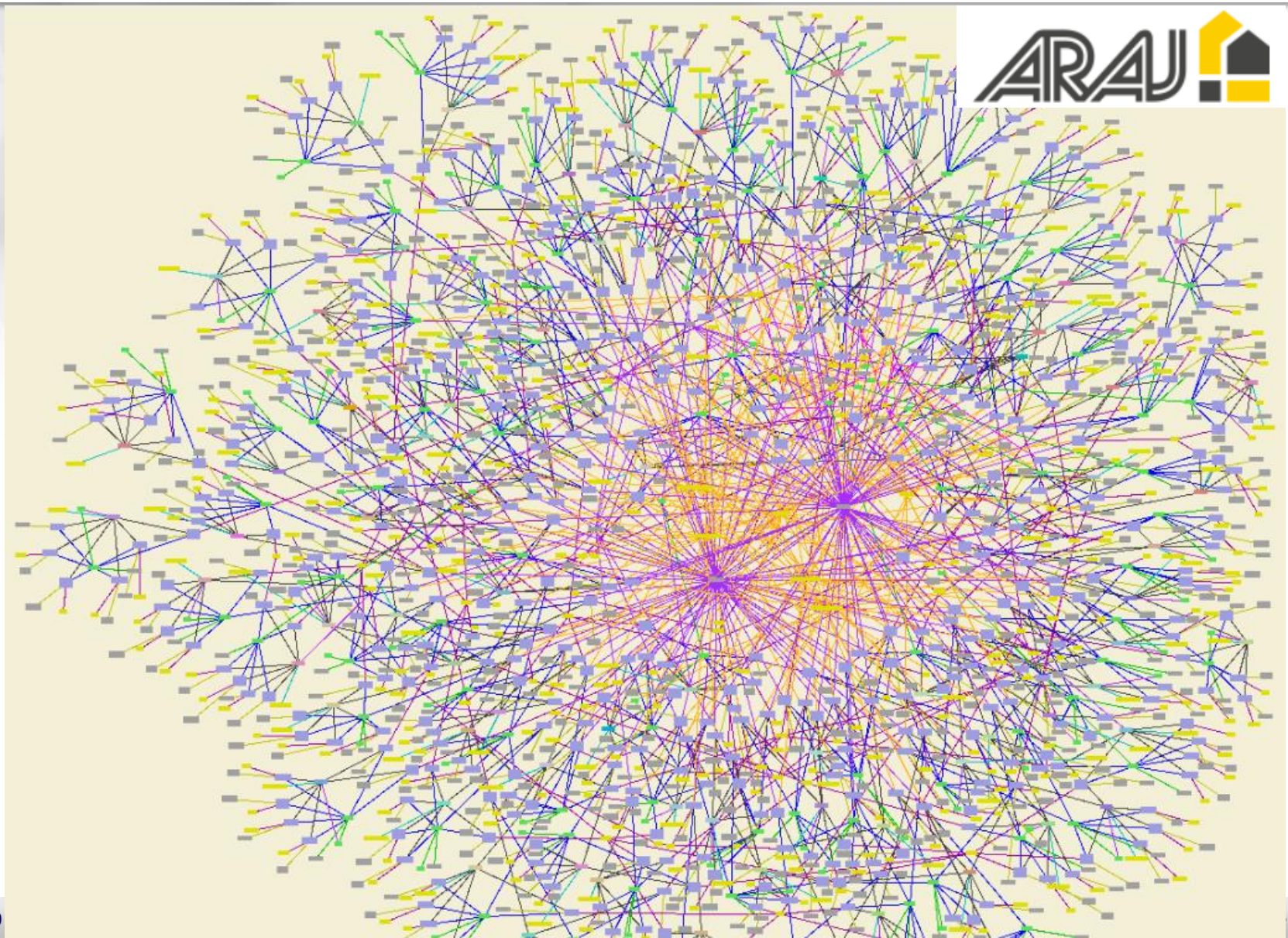
```
<rdf:Description rdf:about="http://up.poznan.pl/se
  <li0:Capacity_rpm>30</li0:Capacity_rpm>
  <li0:Chain_Speed>0,5</li0:Chain_Speed>
  <li0:Dimension>159</li0:Dimension>
  <li0:Max_Electric_Power>11000</li0:Max_Electric_P
  <li0:Maximum_Lenght>21000</li0:Maximum_Lenght>
  <li0:Min_Electric_Power>3000</li0:Min_Electric_Po
</rdf:Description>
```

OWL

```
<DataPropertyAssertion>
    <DataProperty IRI="hasCapacityRpm"/>
    <NamedIndividual IRI="R30"/>
    <Literal datatypeIRI="http://www.w3.org/2001/XMLSchema#double">30.0</Literal>
</DataPropertyAssertion>
<DataPropertyAssertion>
    <DataProperty IRI="hasChainSpeed"/>
    <NamedIndividual IRI="R30"/>
    <Literal datatypeIRI="http://www.w3.org/2001/XMLSchema#double">0.5</Literal>
</DataPropertyAssertion>
<DataPropertyAssertion>
    <DataProperty IRI="hasDimension"/>
    <NamedIndividual IRI="R30"/>
    <Literal datatypeIRI="http://www.w3.org/2001/XMLSchema#double">219.0</Literal>
</DataPropertyAssertion>
<DataPropertyAssertion>
    <DataProperty IRI="hasMaxElectricPower"/>
    <NamedIndividual IRI="R30"/>
    <Literal datatypeIRI="http://www.w3.org/2001/XMLSchema#double">15000.0</Literal>
</DataPropertyAssertion>
<DataPropertyAssertion>
    <DataProperty IRI="hasMaximumLength"/>
    <NamedIndividual IRI="R30"/>
    <Literal datatypeIRI="http://www.w3.org/2001/XMLSchema#double">21000.0</Literal>
</DataPropertyAssertion>
<DataPropertyAssertion>
    <DataProperty IRI="hasMinElectricPower"/>
    <NamedIndividual IRI="R30"/>
    <Literal datatypeIRI="http://www.w3.org/2001/XMLSchema#double">4000.0</Literal>
</DataPropertyAssertion>
```

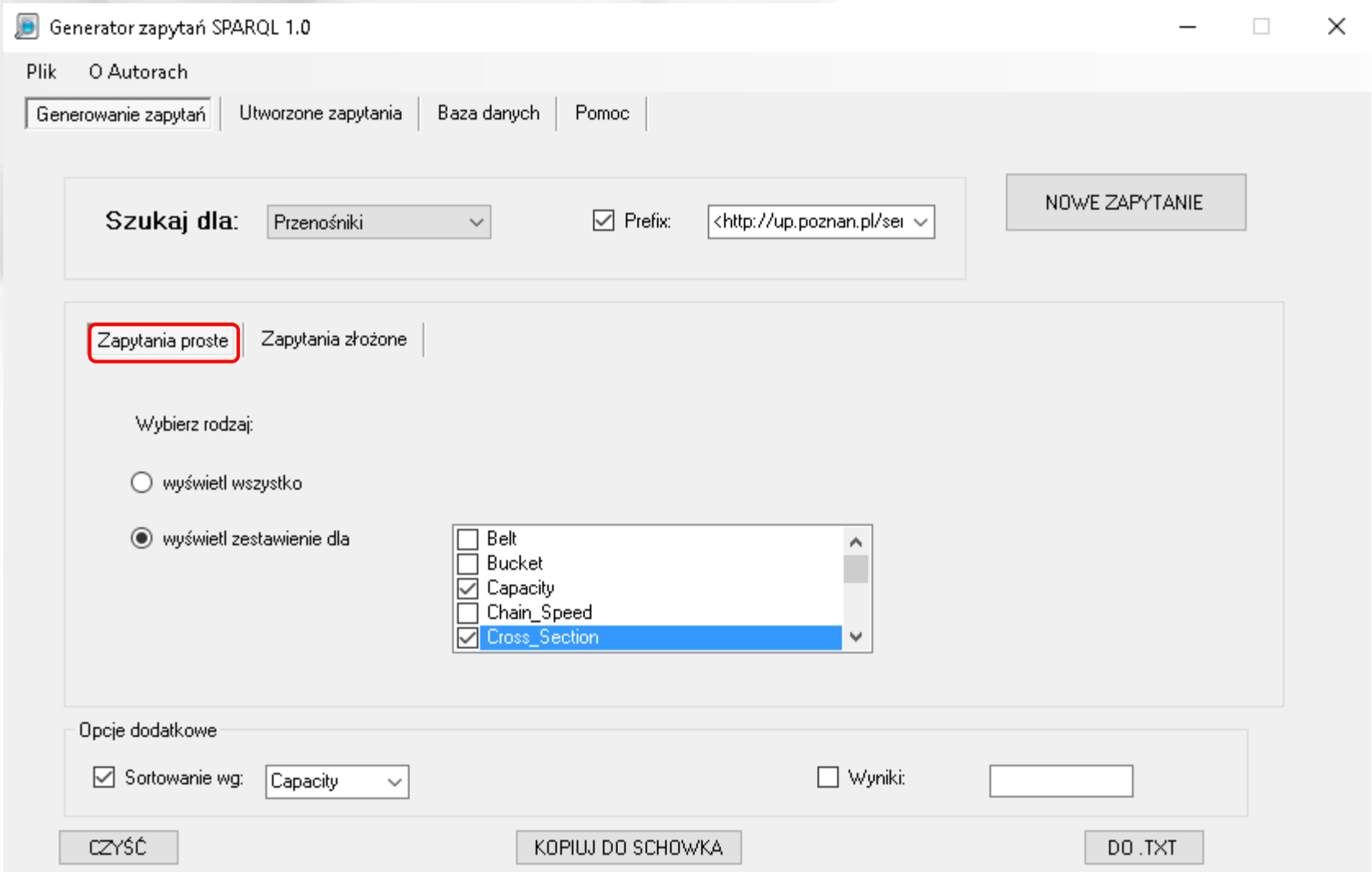
Linked open data technologies

Grain storage bins produced by Araj, RDFS notation – *Gruff*



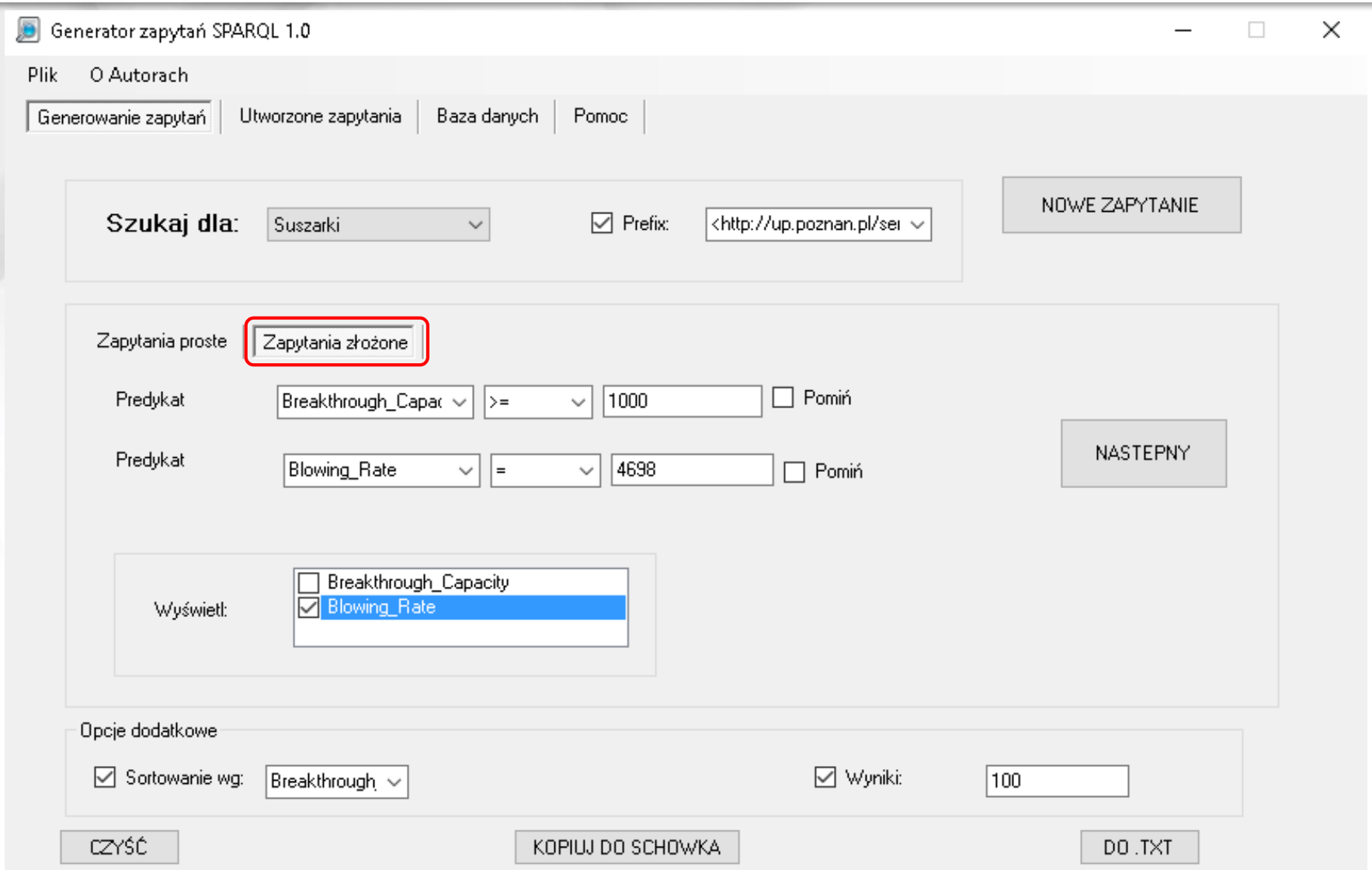
Linked open data technologies

Simple query for RDF – *SPARQL Query Generator*



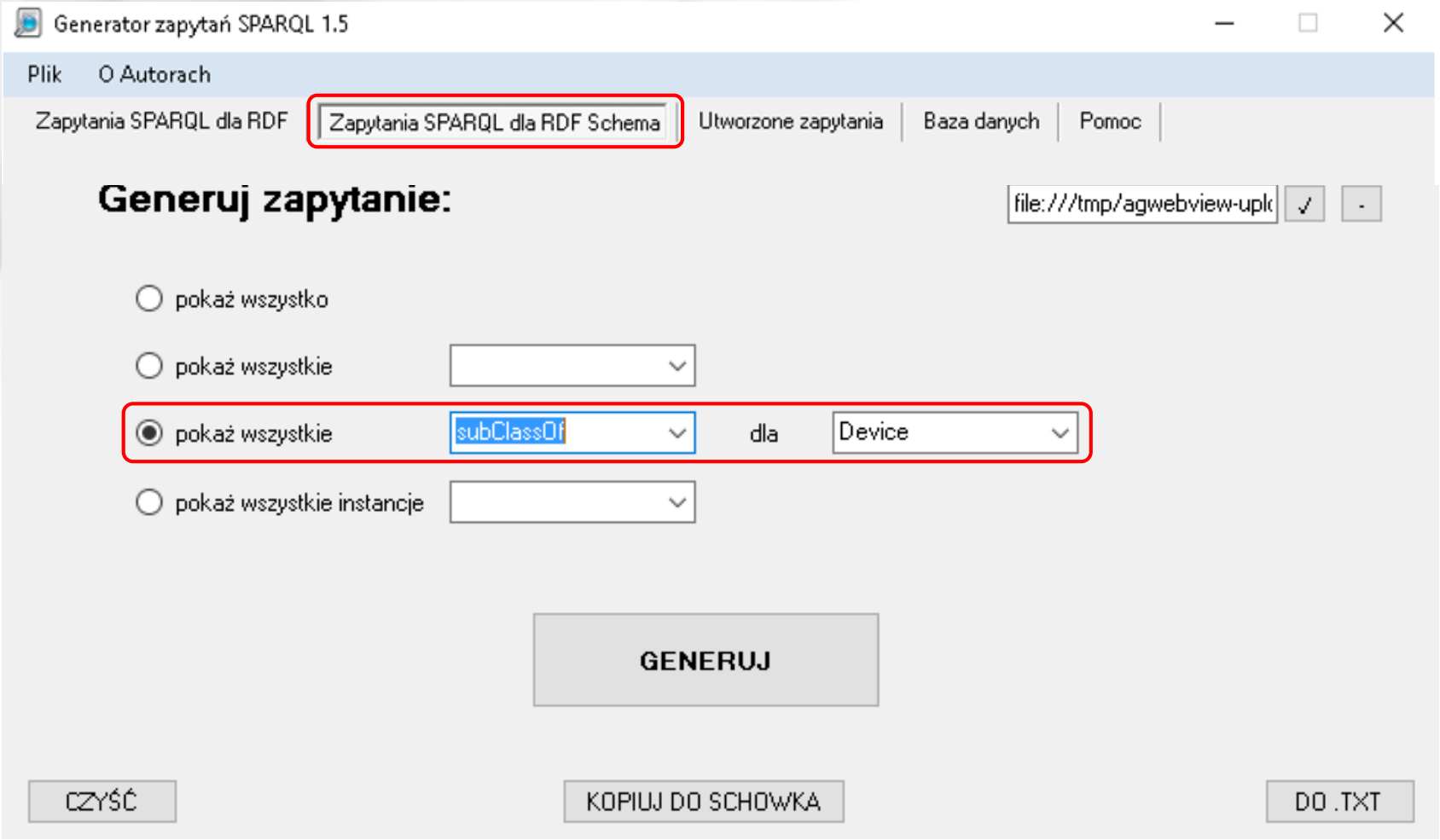
Linked open data technologies

Complex query for RDF – *SPARQL Query Generator*



Linked open data technologies

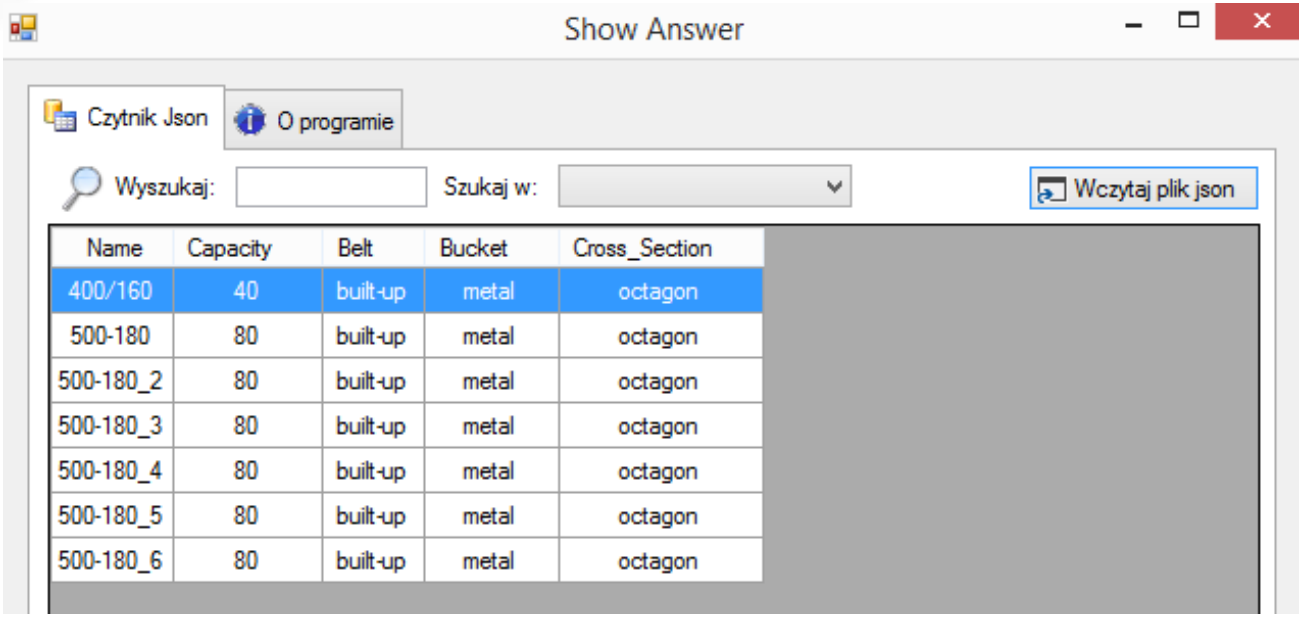
Query for RDFS – *SPARQL Query Generator*



Linked open data technologies

Presentation of query results (json) – *ShowAnswer*


```
{
  "x":{"type":"uri","value":"http://up.poznan.pl/semantic/500-180_5"},
  "Belt":{"type":"literal","value":"built-up"},
  "Bucket":{"type":"literal","value":"metal"},
  "Capacity":{"type":"literal","value":"80"},
  "Cross_Section":{"type":"literal","value":"octagon"}
},
```

Conclusions

1. Advanced programming technologies *(WPF, ASP.NET Core MVC, Xamarin, multi- and cross-platform data processing)* were implemented to improve functionality and performance of the software for analyzing drying and storage of agri-food products.

2. Estimation of geometric and thermo-mechanical properties of agri-food products, and also visualization of processes were improved in the software.

3. Applications for constructing, storing and querying ontological models for grain drying and storage enhanced the system. It facilitated access to the linked open data sets for users.

4. Future research: to expand the scope of the ontologies to better represent the problem domain.


Thank you for your attention!
Q A