



Federal Ministry
of Food
and Agriculture



MACS-G20 Workshop

Linked Open Data in Agriculture

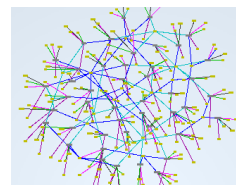
Berlin, September 27 – 28, 2017

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



Poznan University of
Life Sciences
Poznań, Poland



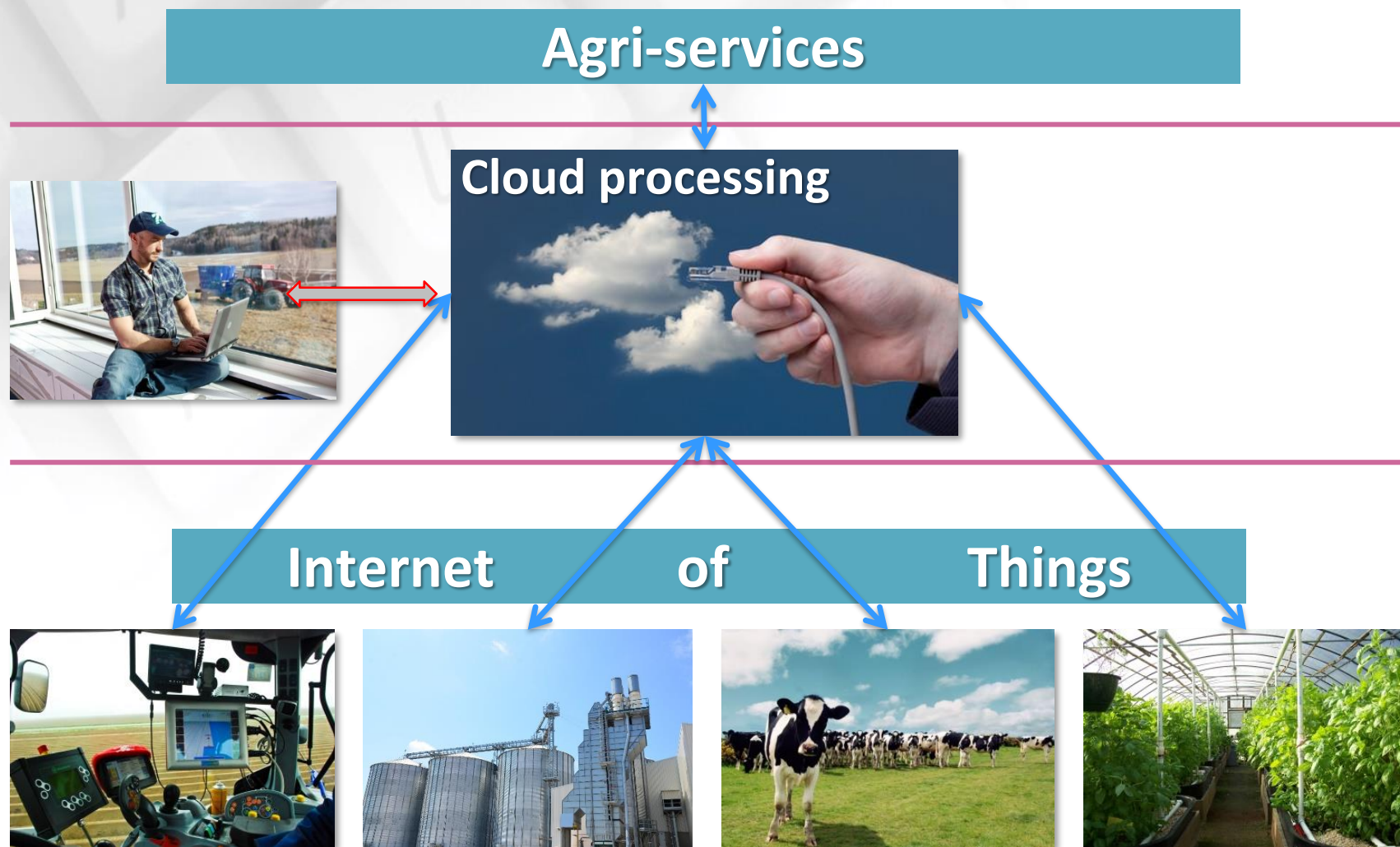
INSTITUTE OF BIOSYSTEMS
ENGINEERING



DEPARTMENT OF APPLIED
INFORMATICS

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

4/30



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.



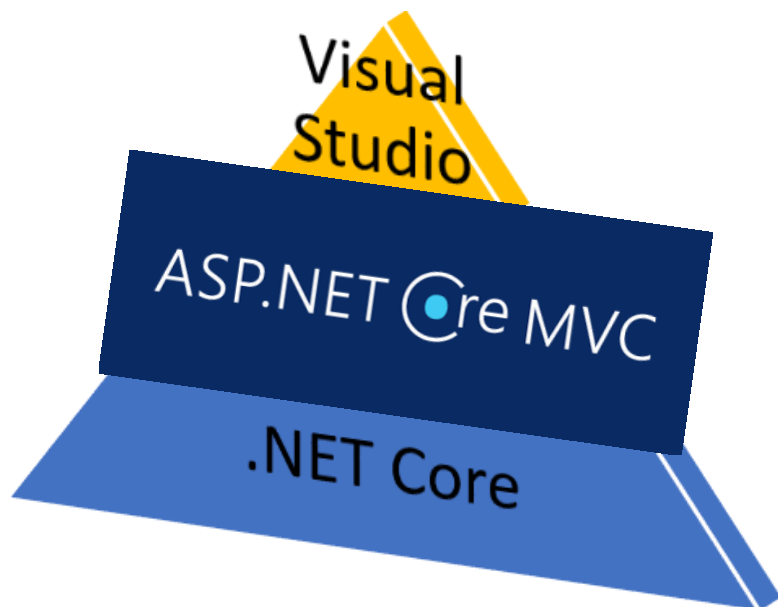
Objective

- 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 programming technologies for multi- and cross-platform data processing.

Methods – programming technologies

7/30

Visual Studio 2017



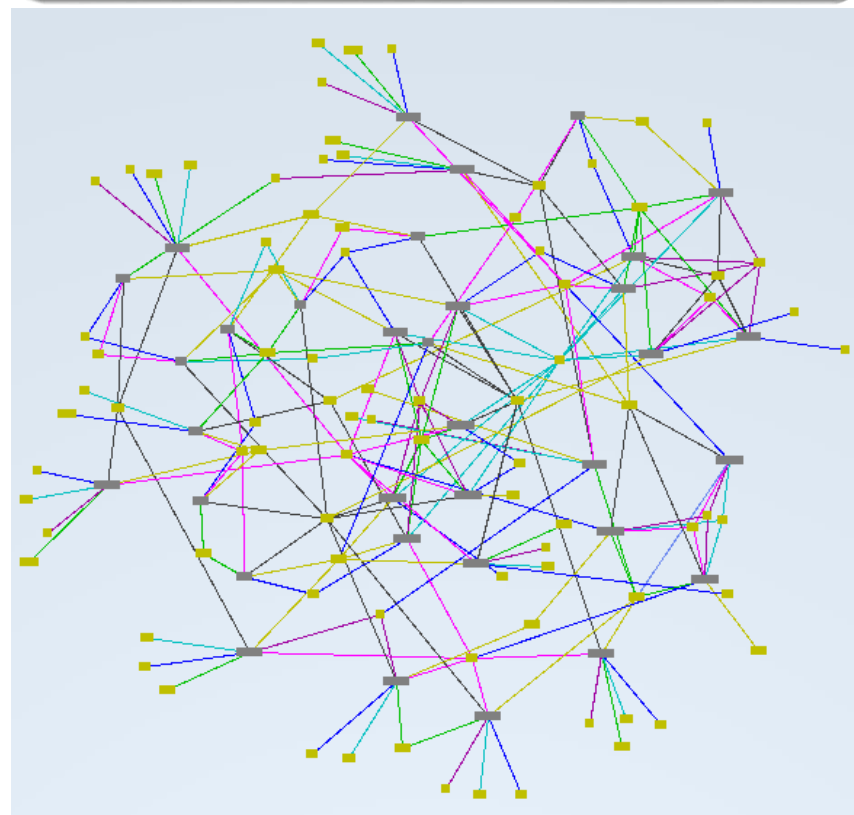
 Visual Studio



Xamarin



Software development supporting Linked Open Data approach

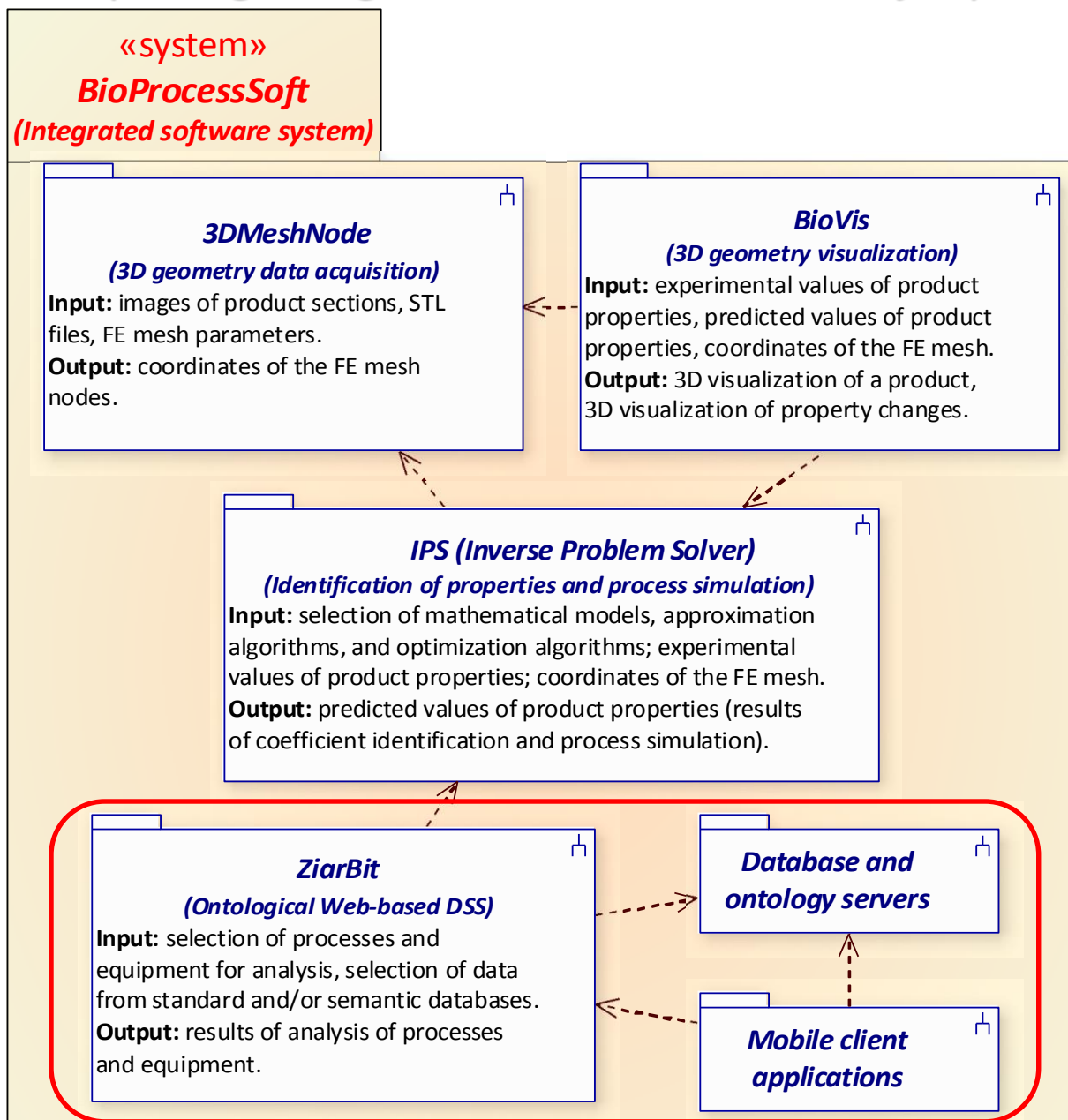


.NET Core platform

- **.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.**

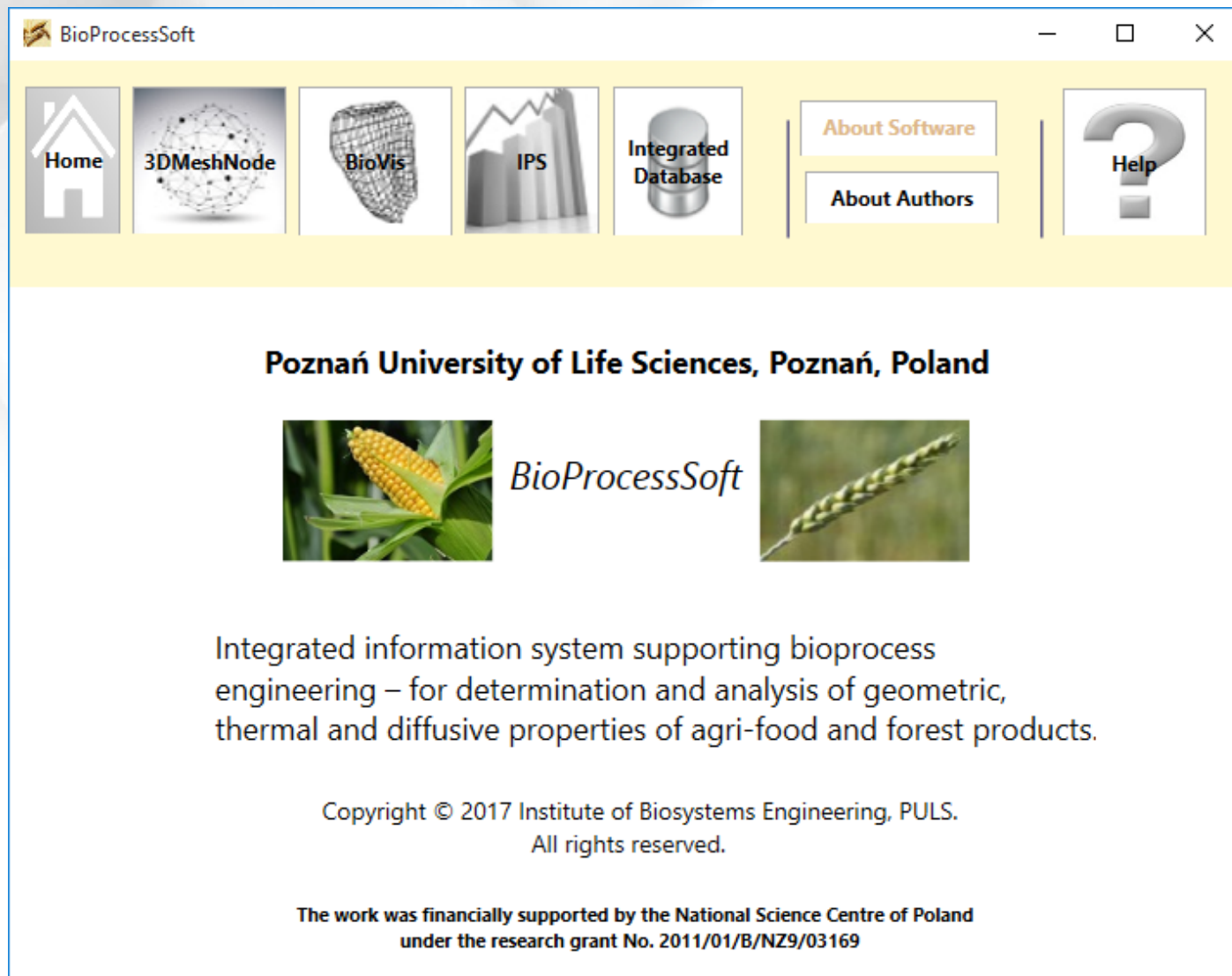
Methods – package diagram for the *BioProcessSoft* system



Visual Studio 2017 – Windows Presentation Foundation

10/30


- Interface of the integrated *BioProcessSoft* system



ASP .NET Core MVC

11/30

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

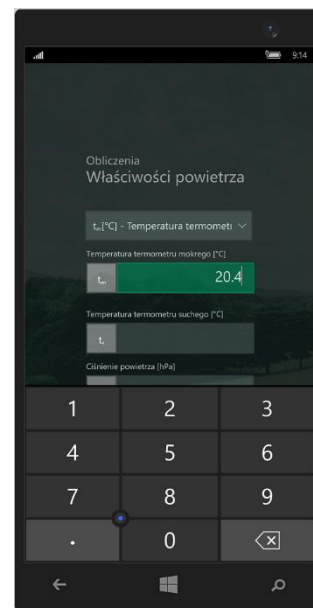
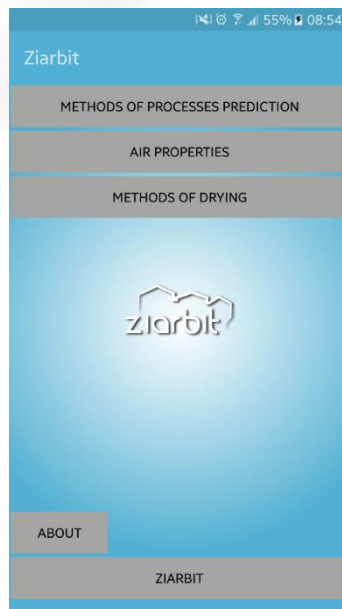
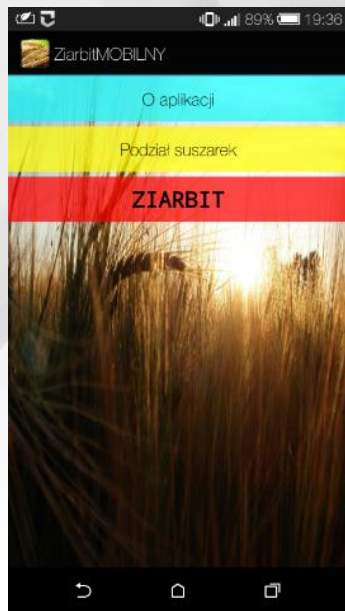


The screenshot shows the Ziarbit Web application interface. The header is dark with the Ziarbit logo and navigation links: HOME, BAZY DANYCH, OBLICZENIA, TECHNOLOGIE SUSZENIA, and WSPOMAGANIE DECYZJI. On the right, there are links for 'Założ konto' and 'Zaloguj się'. The main content area has a blue background with a tractor in a field. The title 'ZIARBIT WEB' is prominently displayed. Below it, a paragraph describes the application's purpose: 'Aplikacja Ziarbit Web została utworzona z myślą o szybko rozwijających się gałęziach nowoczesnego rolnictwa. Głównym jej celem jest ułatwienie obliczeń związanych z analizą procesów zachodzących podczas suszenia i przechowywania ziarna zbóż, a także - wspomaganie decyzji.' A blue button labeled 'Czytaj więcej »' is positioned below the text. At the bottom, there are three sections: 'O programie' (About the program), 'Pomoc' (Help), and 'Aktualności' (News). Each section has a brief description and a 'Zobacz »' button. The footer contains the copyright notice '© 2017 - Ziarbit Web'.

Xamarin

12/30

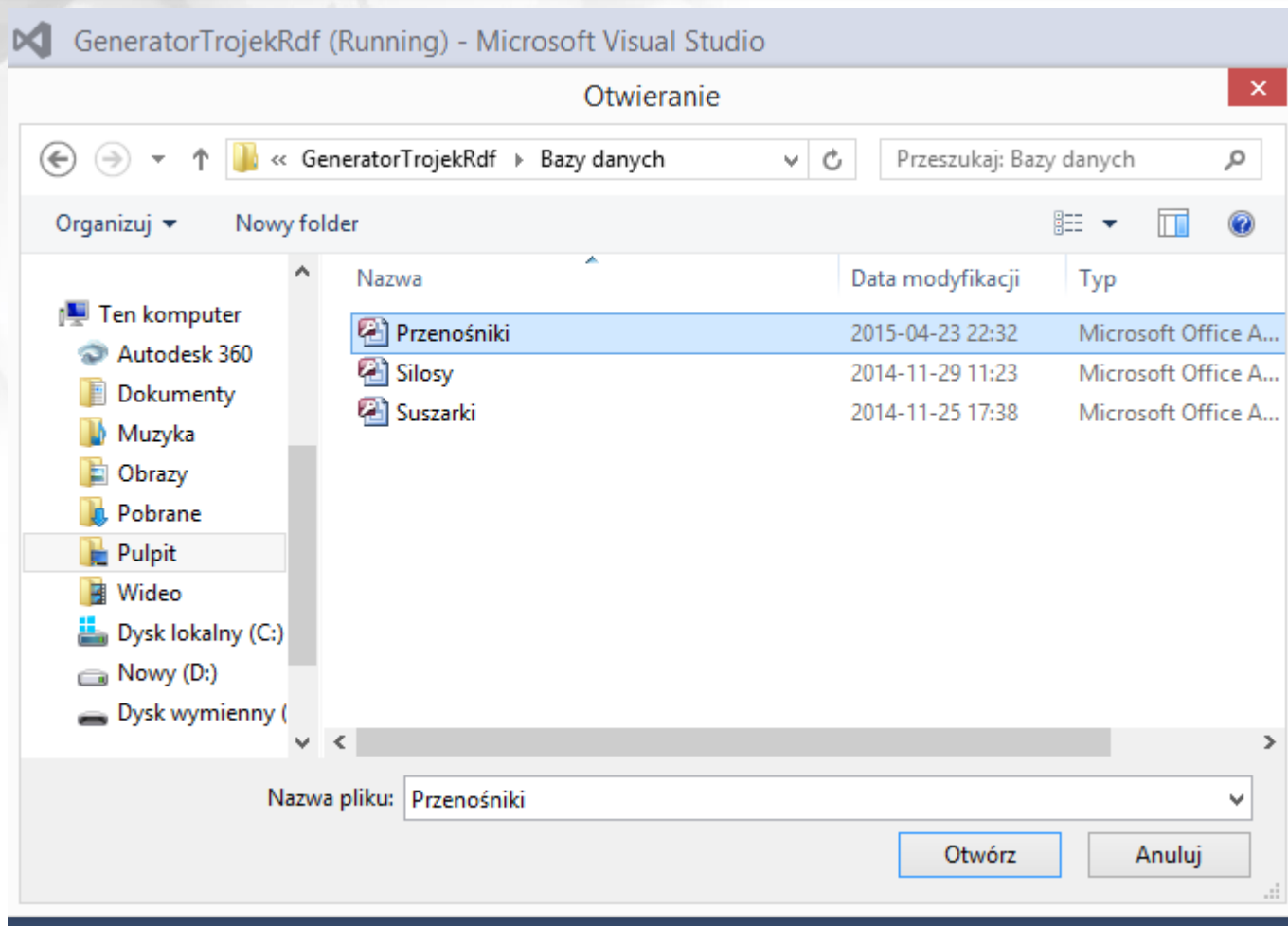
- Client mobile apps (C# - Xamarin - VS 2017) for the **Ziarbit** Web server



Linked open data technologies

13/30

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.

RDF/Turtle Triple Generator

RDF Turtle Pomoc

Subject *Proszę zaznaczyć opcje library w celu dodania trojek do tymczasowej bazy*

Barley ☒ Library

Predicate

http://Cereal/Moisture

Moisture ☒ Library

Object

20 ☒ Library

Library

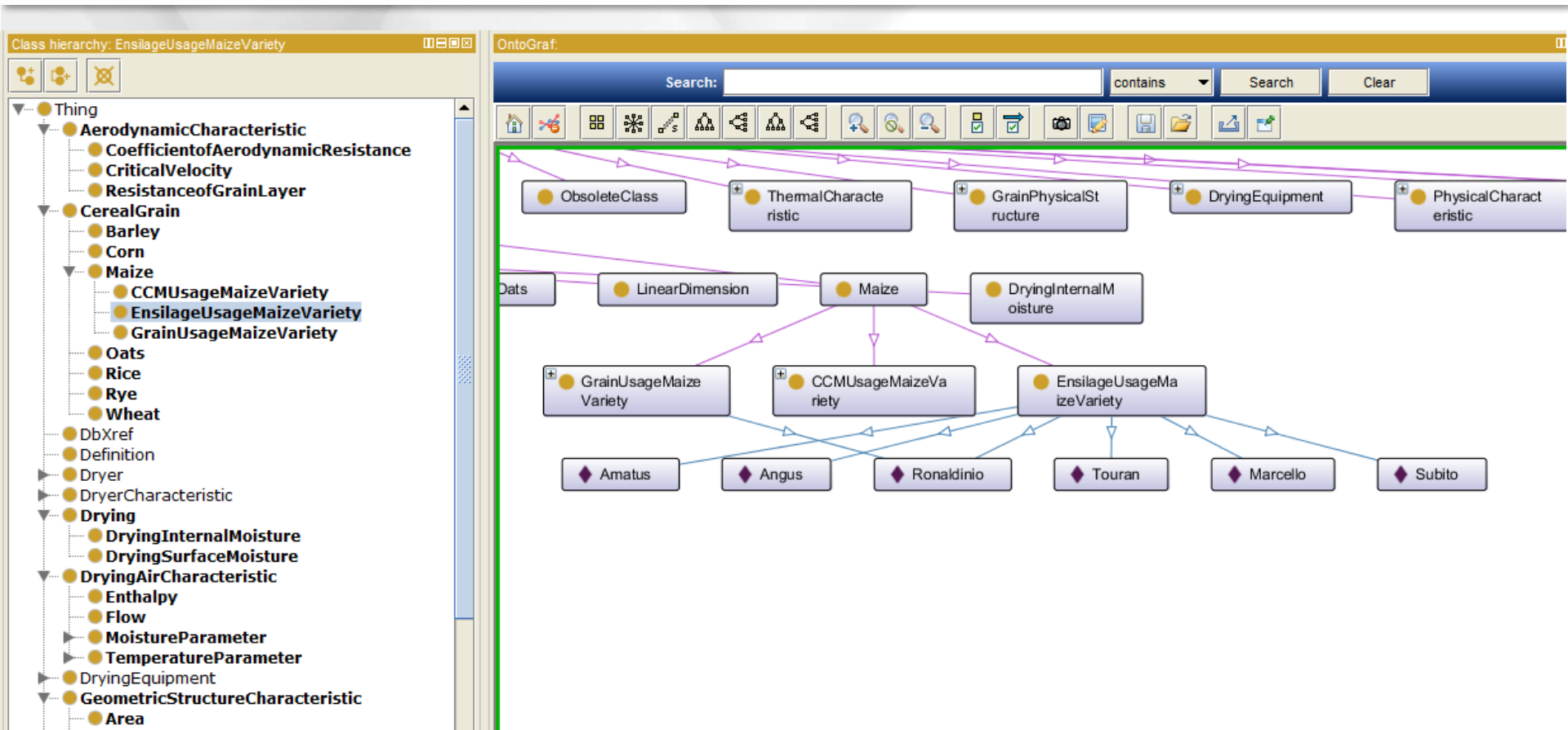
Cereal

Podmiot	Właściwość	Wartość
http://cereal/Barley	http://cereal/Moisture	http://Cereal/...
http://cereal/Wheat	http://cereal/Moisture	http://Cereal/...
http://cereal/Oat	http://cereal/Moisture	http://Cereal/...
http://cereal/Corn	http://cereal/Moisture	http://Cereal/...

Linked open data technologies

15/30

Construction of ontologies in RDF/Turtle – *Protégé*



Linked open data technologies

16/30

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

Document

```

9 every bucket-elevator is a transporter.
10 every screw-conveyor is a transporter.
11 every chain-conveyor is a transporter.
12 every redler is chain-conveyor.
13
14 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 ).
15
16 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 ) .
17
18 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 ) .
19
20 every grain is transported by a transporter.
21 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 found
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

17/30

Loading ontologies into a graph database – *AllegroGraph*

AllegroGraph 5.0.1 Virtual Machine - VMware Player (Non-commercial use only)

Player ▾ | [Icons] | [Icons]

Firefox Web Browser

AllegroGraph WebView

localhost:10035/repositories/rep1

Most Visited ▾ | Franz Inc. | AllegroGraph | AllegroGraph Intro | Gruf

Repository | Queries | Utilities | Admin | User test

Add a statement ?

Subject:

Predicate:

Object:

Context:

Leave the context field empty to use the default context.

Select one or more local files to import

File: 53 files selected.

Format:

Using the Auto-detect format will guess the format using extension. Note that gzipped files can be imported if they have the additional file extension gz and that bziped files can be imported if they have the additional file extension bz2.

Context: (leave blank for default)

Relax syntax: ☐

File loading mode: ☐ Single-threaded ☒ Multi-core

Error handling: ☐ Cancel load ☒ Ignore errors

Use bulk load mode: ☐

File Upload

media | franz | WXPFPF_EN | Opisane | Agremo | Silosy ZL

Places

- Search
- Recently Used
- franz
- Desktop
- File System
- WXPFPF_EN
- Floppy Disk
- Documents
- Music
- Pictures
- Videos
- Downloads

Name	Size	Modified
ZL28-3-27.rdf	792 bytes	04/19/2015
ZL28-4-34.rdf	790 bytes	04/19/2015
ZL28-5-41.rdf	791 bytes	04/19/2015
ZL30-3-30.rdf	790 bytes	04/19/2015
ZL30-4-38.rdf	791 bytes	04/19/2015
ZL30-5-46.rdf	790 bytes	04/19/2015
ZL34-4-41.rdf	790 bytes	04/19/2015
ZL34-4-52.rdf	790 bytes	04/19/2015
ZL34-5-63.rdf	790 bytes	04/19/2015
ZL37-3-47.rdf	790 bytes	04/19/2015
ZL37-4-60.rdf	790 bytes	04/19/2015
ZL37-5-72.rdf	790 bytes	04/19/2015
ZL37-6-85.rdf	791 bytes	04/19/2015
ZL40-3-57.rdf	790 bytes	04/19/2015
ZL40-4-72.rdf	790 bytes	04/19/2015
ZL40-5-87.rdf	791 bytes	04/19/2015

All Files ▾

Linked open data technologies

18/30

Repository creation – *AllegroGraph*

Catalog | Scripts | Admin | User Kamil

Catalogs

- java-catalog
- python-catalog
- system

Repositories

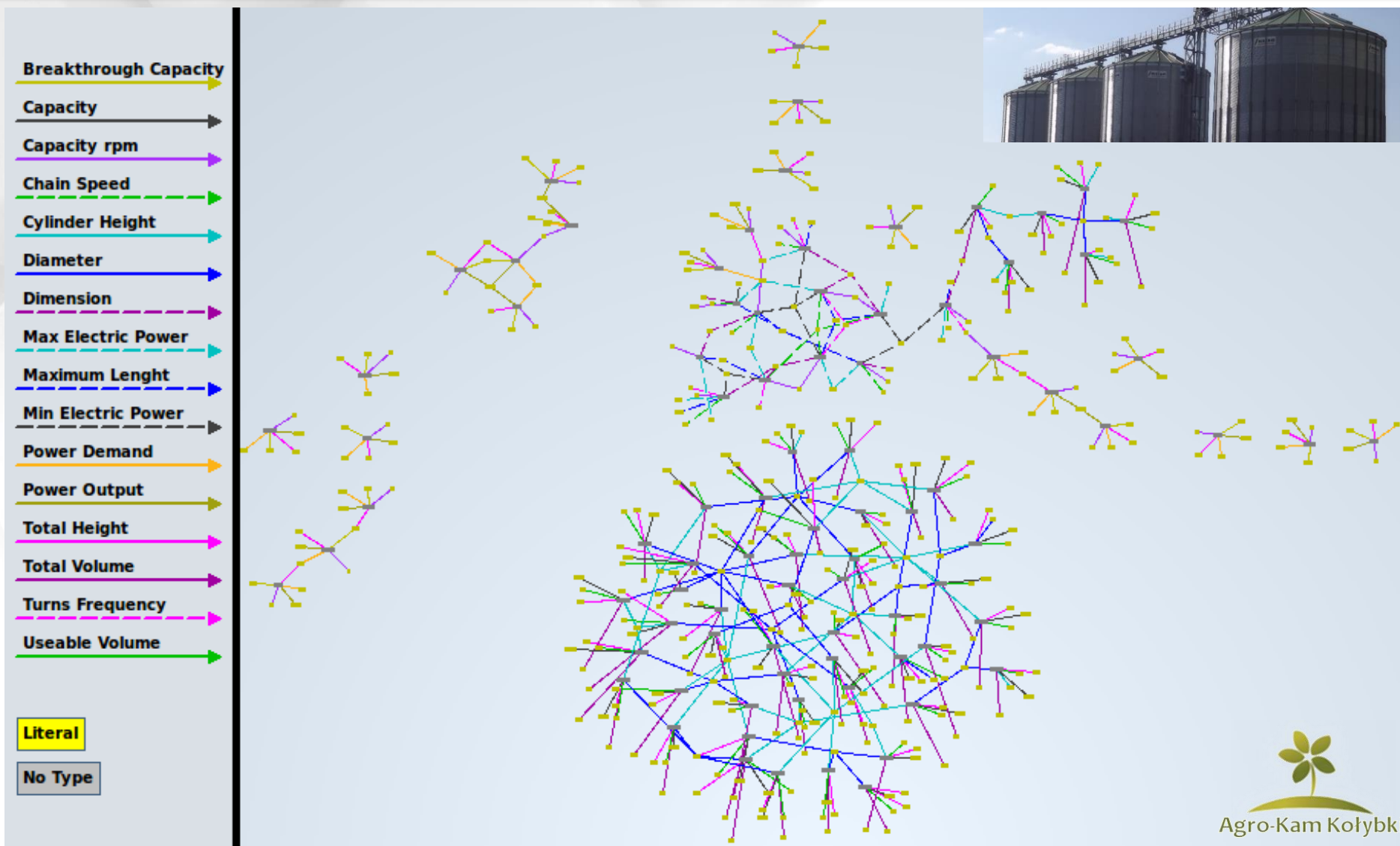
- Dryer ×
- Silo ×
- Transporter ×
- Warehouse ×

Create new repository

- Name:
- Restore from a backup

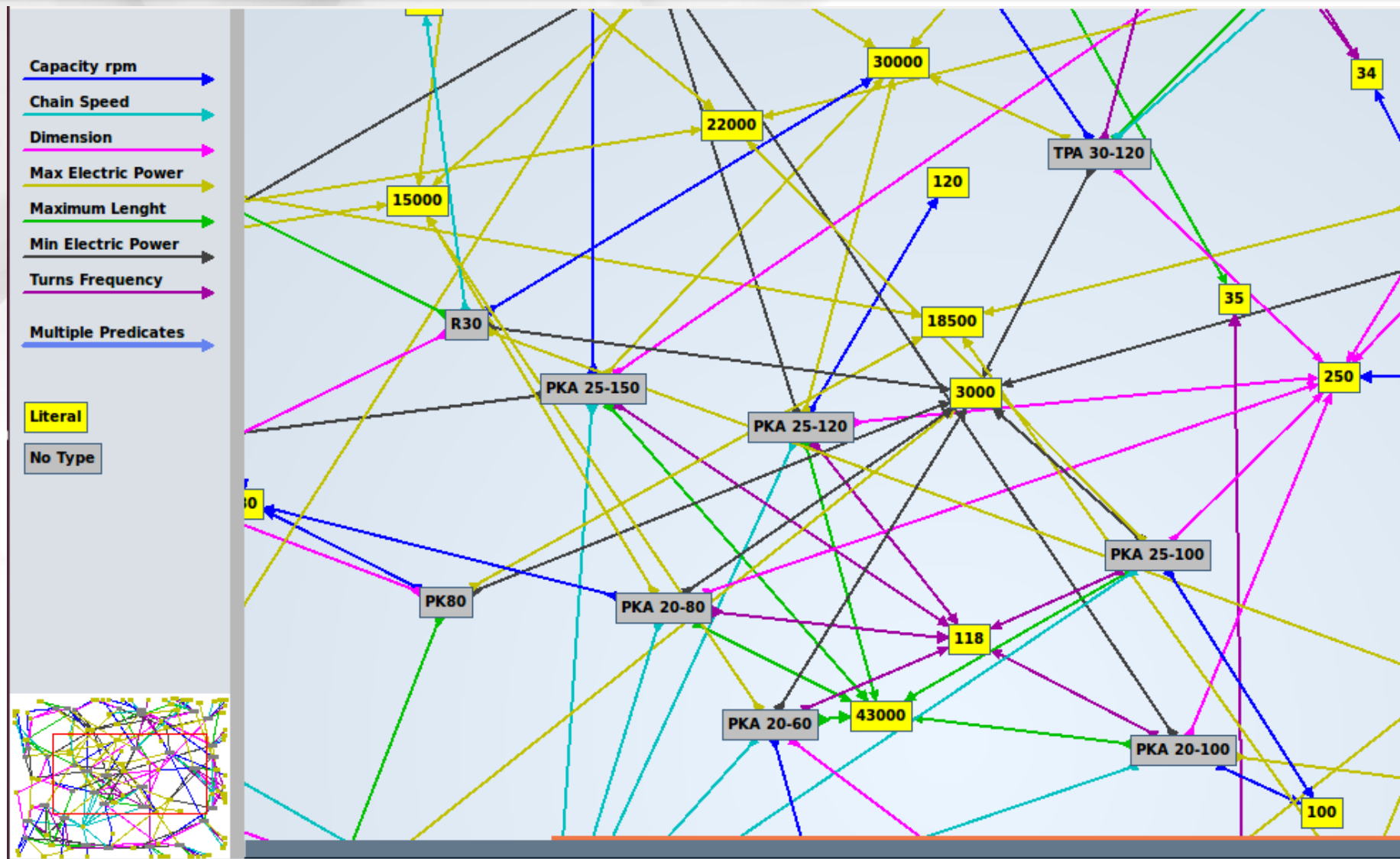
Linked open data technologies

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



Linked open data technologies

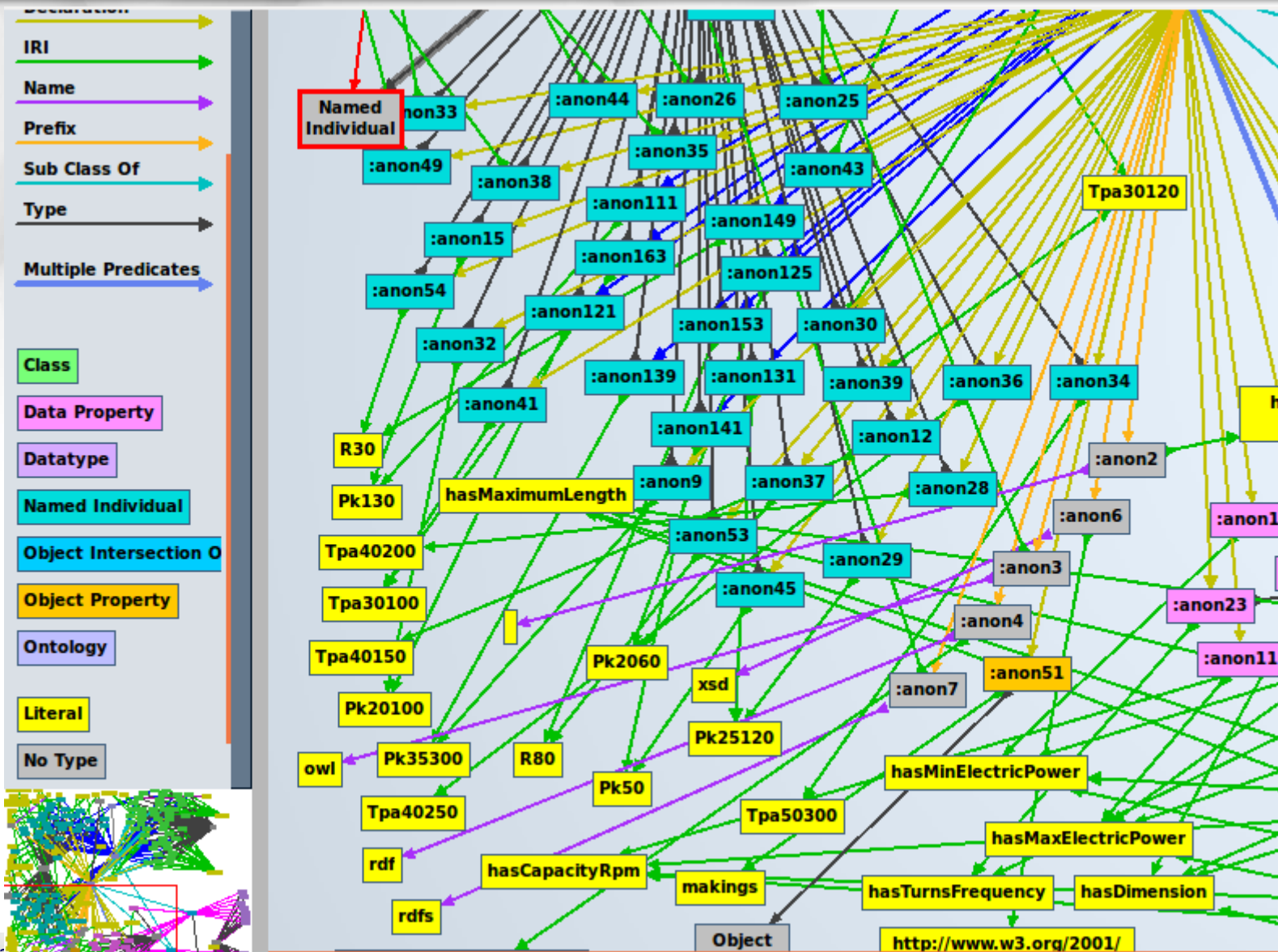
Conveyors, RDF notation – *Gruff*



Linked open data technologies

21/30

Conveyors, OWL notation – *Gruff*

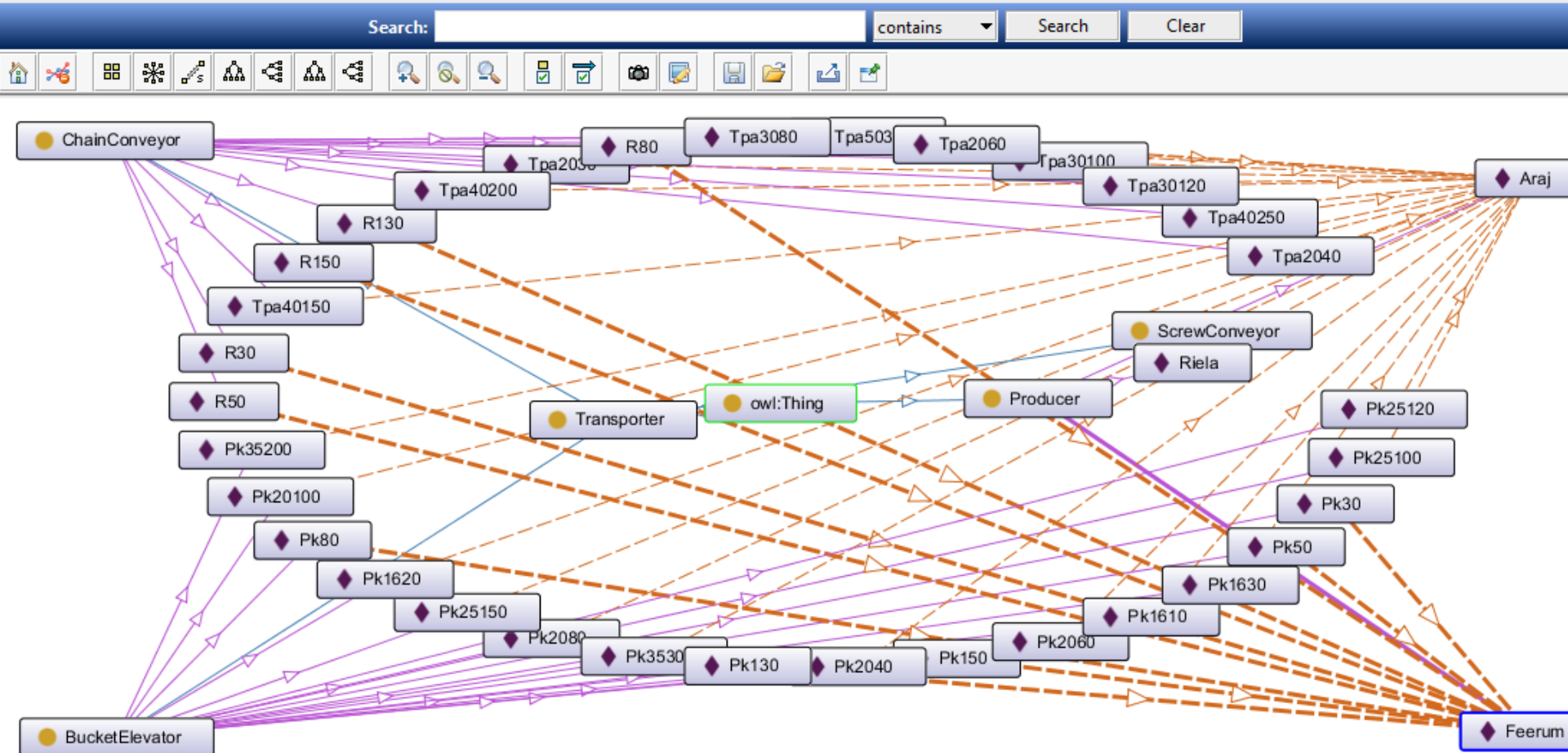


Linked open data technologies

22/30

Conveyors, OWL notation – *OntoGraf*

OntoGraf:



Linked open data technologies

23/30

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>
```

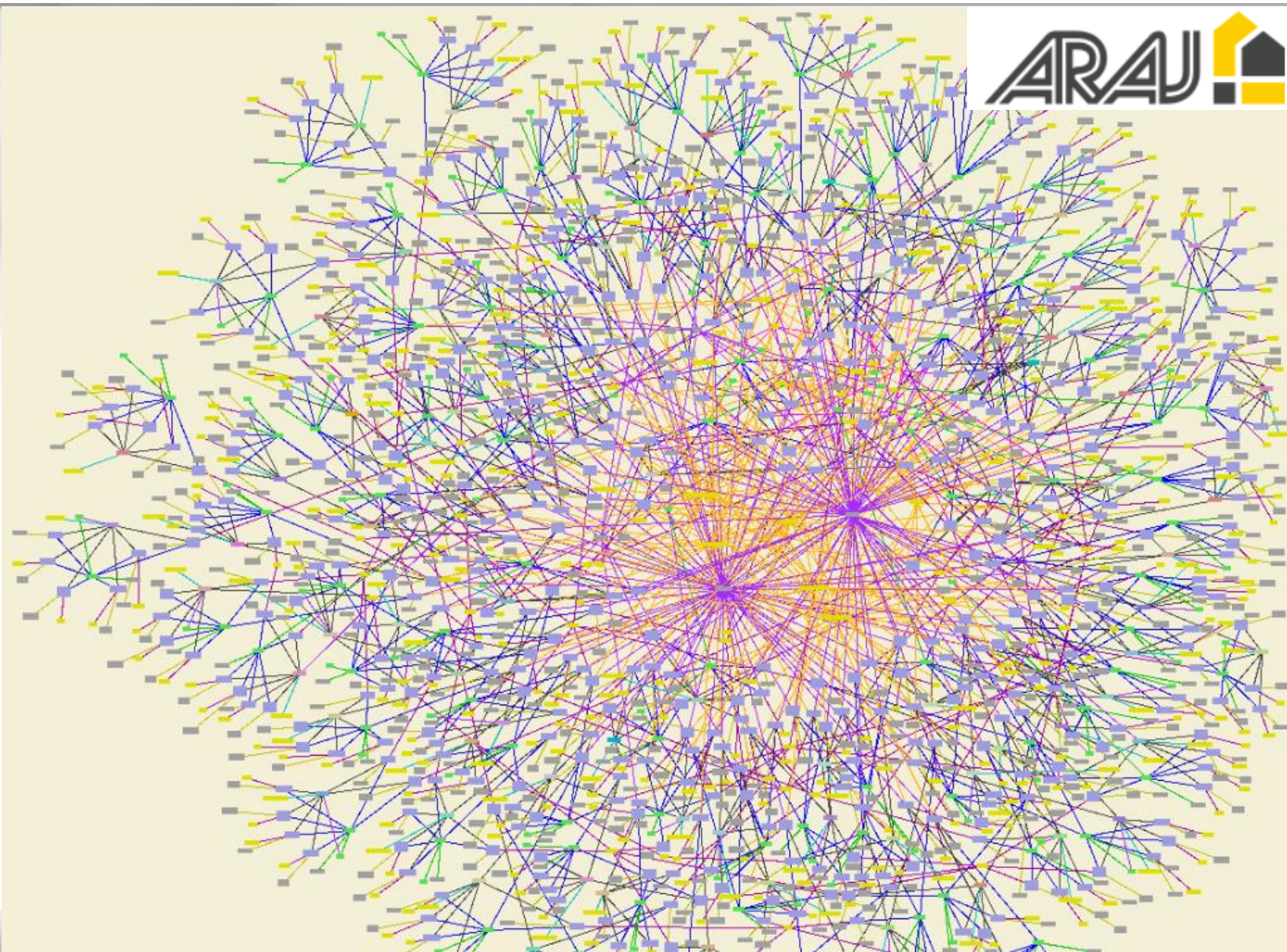
OWL

```
<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

24/30

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



Linked open data technologies

Simple query for RDF – *SPARQL Query Generator*

Generator zapytań SPARQL 1.0

Plik O Autorach

Generowanie zapytań | Utworzone zapytania | Baza danych | Pomoc

Szukaj dla: Przenośniki ☒ Prefix: <http://up.poznan.pl/sei

Zapytania proste | Zapytania złożone

Wybierz rodzaj:

☐ wyświetl wszystko

☒ wyświetl zestawienie dla

☐ Belt

☐ Bucket

☒ Capacity

☐ Chain_Speed

☒ Cross_Section

Opcje dodatkowe

☒ Sortowanie wg: Capacity ☐ Wyniki:

Linked open data technologies

26/30

Complex query for RDF – *SPARQL Query Generator*

Generator zapytań SPARQL 1.0

Plik O Autorach

Generowanie zapytań | Utworzone zapytania | Baza danych | Pomoc

Szukaj dla: ☒ Prefix:

NOWE ZAPYTANIE

Zapytania proste ☒ Zapytania złożone

Predykat ☐ Pomiń

Predykat ☐ Pomiń

NASTEPNY

Wyświetl: ☐ Breakthrough_Capacity ☒ Blowing_Rate

Opcje dodatkowe

☒ Sortowanie wg: ☒ Wyniki:

CZYŚĆ KOPIUJ DO SCHOWKA DO .TXT

Linked open data technologies

27/30

Query for RDFS – *SPARQL Query Generator*

Generator zapytań SPARQL 1.5

Plik O Autorach

Zapytania SPARQL dla RDF **Zapytania SPARQL dla RDF Schema** Utworzone zapytania Baza danych Pomoc

Generuj zapytanie: file:///tmp/agwebview-upk ✓ -

☐ pokaż wszystko
☐ pokaż wszystkie
☒ pokaż wszystkie dla
☐ pokaż wszystkie instancje

GENERUJ

CZYŚĆ KOPIUJ DO SCHOWKA DO .TXT

Linked open data technologies

28/30

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"}
},
```

Wyszukaj: Szukaj w:

[Wczytaj plik json](#)

Name	Capacity	Belt	Bucket	Cross_Section
400/160	40	built-up	metal	octagon
500-180	80	built-up	metal	octagon
500-180_2	80	built-up	metal	octagon
500-180_3	80	built-up	metal	octagon
500-180_4	80	built-up	metal	octagon
500-180_5	80	built-up	metal	octagon
500-180_6	80	built-up	metal	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.

