

# The contribution of the Platform MaterialDigital (PMD) in building up a Materials Data Space Application to glass design and manufacturing

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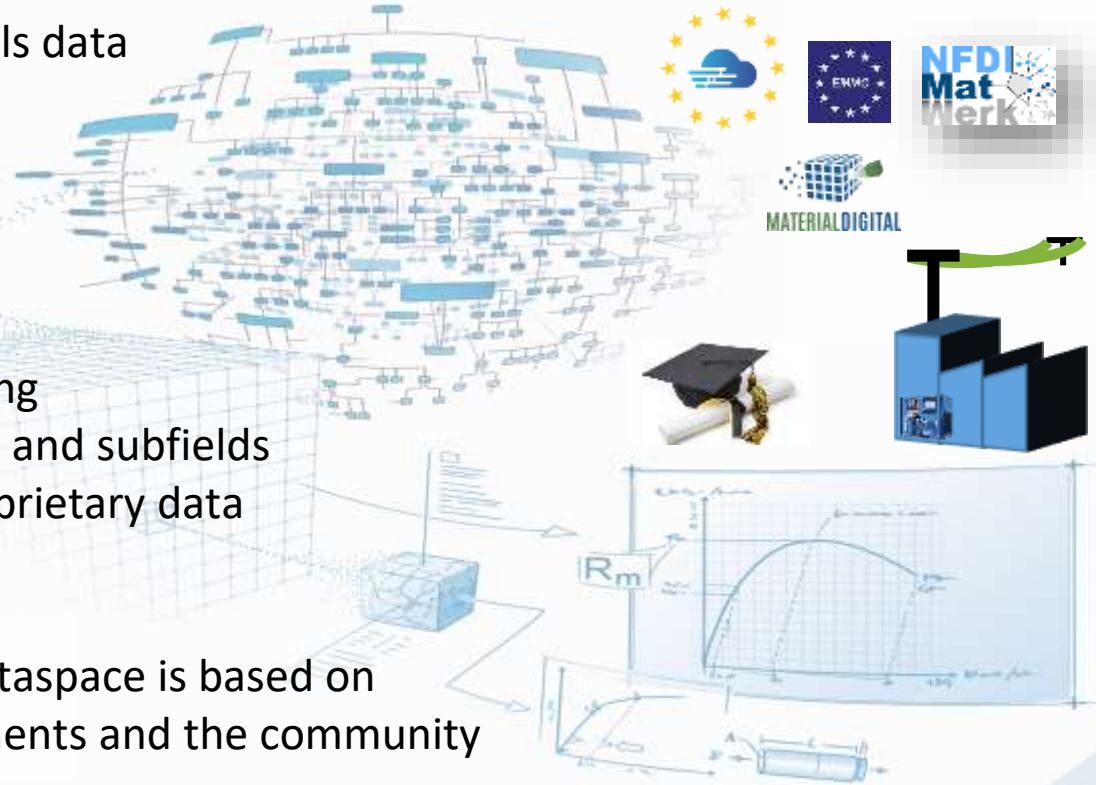
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<sup>2</sup> Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin

Die Plattform für die Digitalisierung von Materialien

Ein Verbundprojekt von:

- Encompassing all available materials data
- Semantic interoperability
- Standardization and conformity
- FAIR data
- Comprehensive searching combining information from different sources and subfields
- Data analysis beyond the own/proprietary data
- Applicability of tools, scaling
- Implementation of the material dataspace is based on standardized architectural components and the community

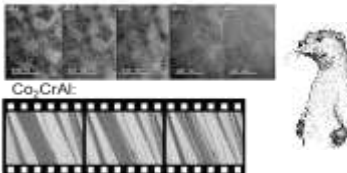


z.B. Gummidichtungen



DIGITRUBBER

NiCoMnAl:  
Co-CrAl:




DiProMag




DiStAl



GlasDigital



DigitBatMat

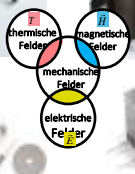


SensoTwin



ODE\_AM

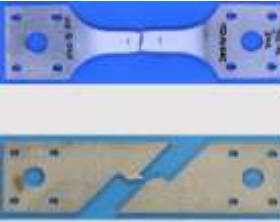
FGL MS DE PC




SmaDi



MATERIALDIGITAL




StahlDigital



LeBeDigital



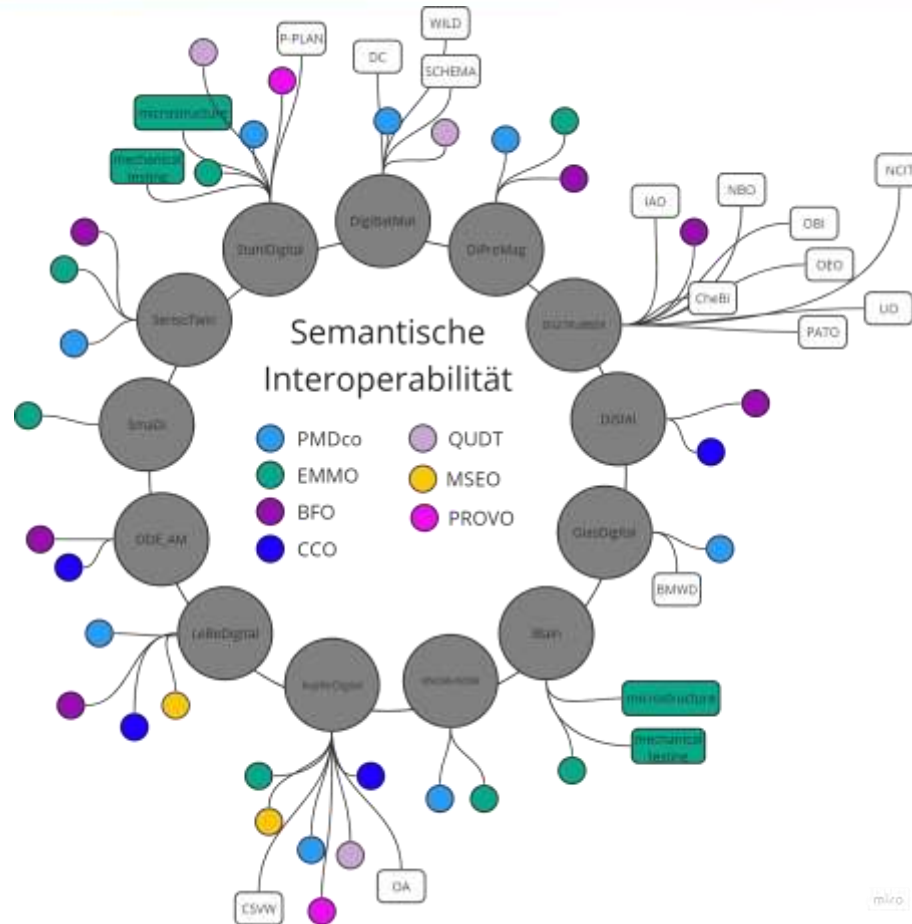
KupferDigital

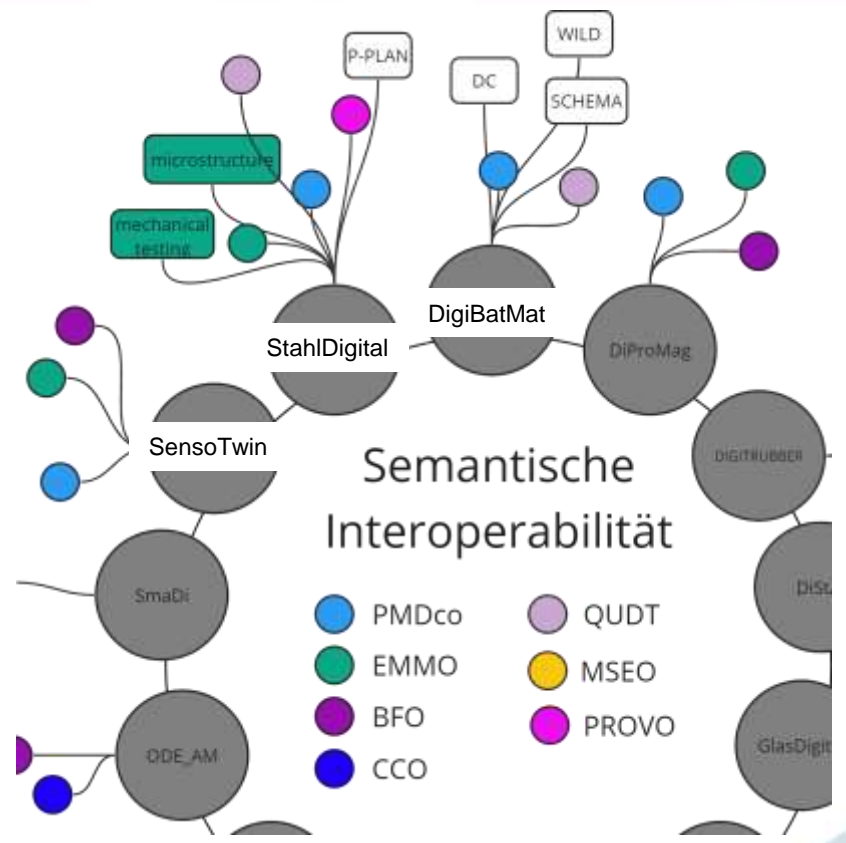
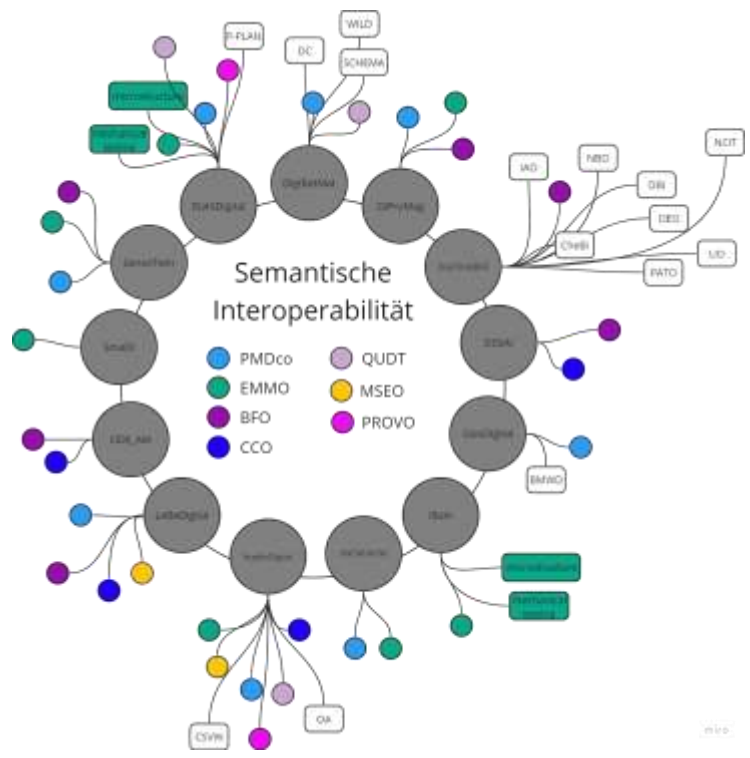


iBain

Technische Keramik  
Funktionskeramik

KNOW-NOW







## Processes

Analysing Process  
Simulation Process  
Assembling Process  
Measuring Process  
...

**pmd:Process**

## Processing Nodes

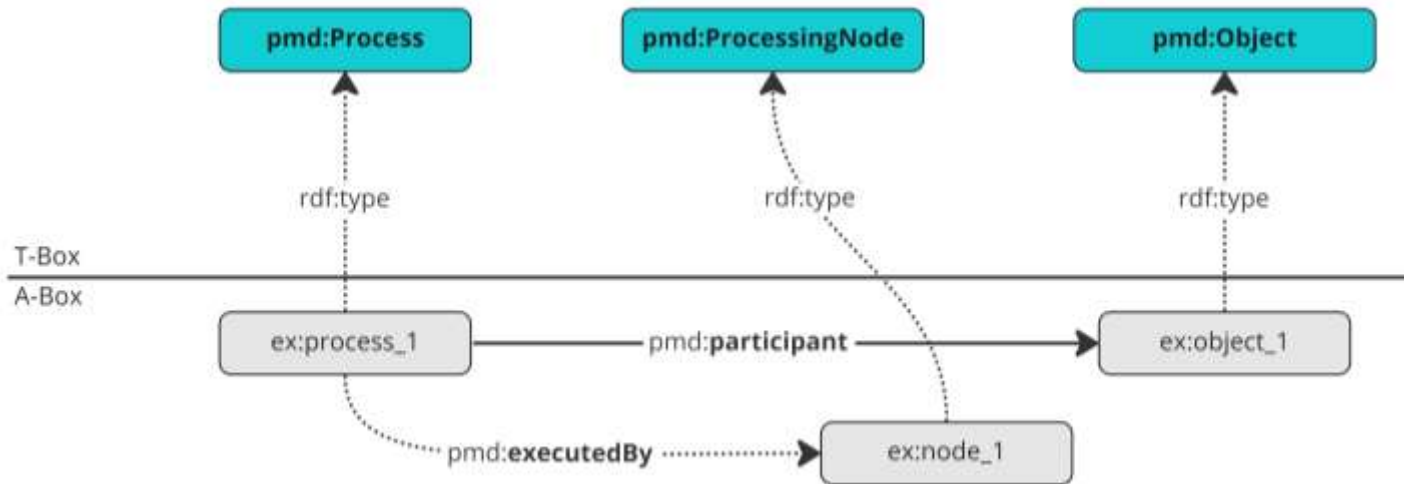
Furnace  
Measuring Device  
Computing Node  
Some Special Machine  
...

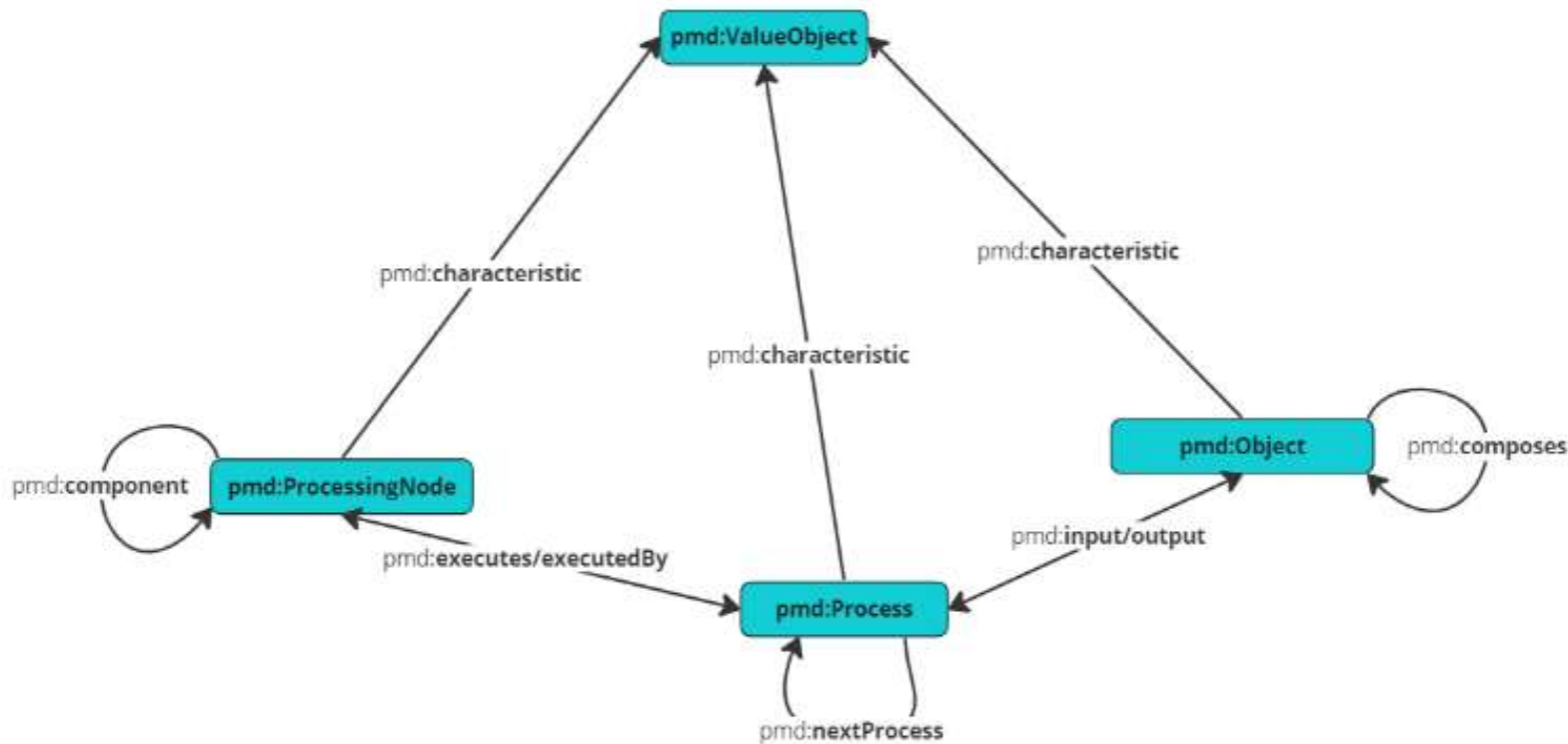
**pmd:ProcessingNode**

## Objects

A Piece of Material  
An Image (e.g. Microscopy)  
A Sample or Testpiece  
A Region of Interest of sth.  
...

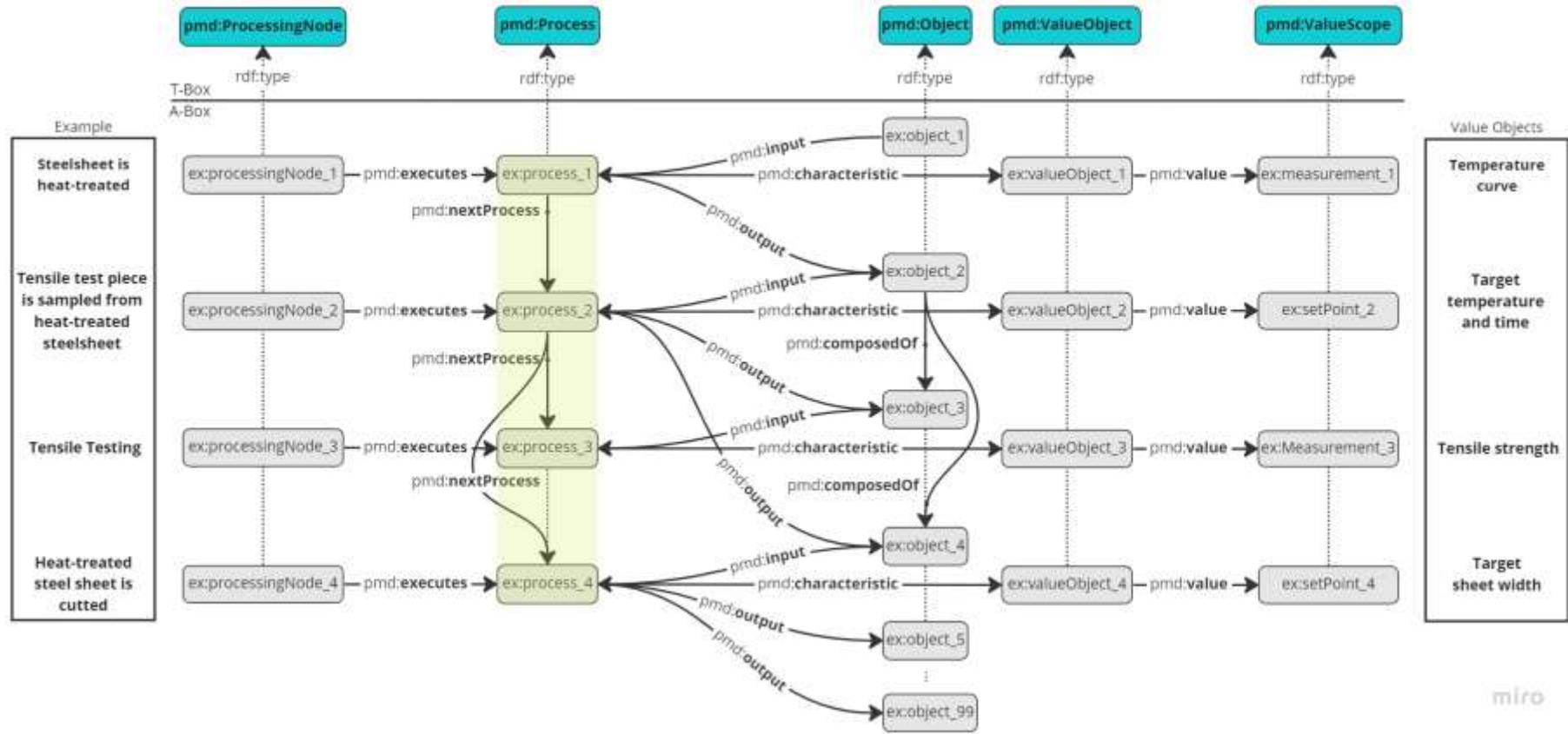
**pmd:Object**







# PMD Core Ontology – PMDco



## PMD Core Ontology: Towards Semantic Interoperability in Materials Science

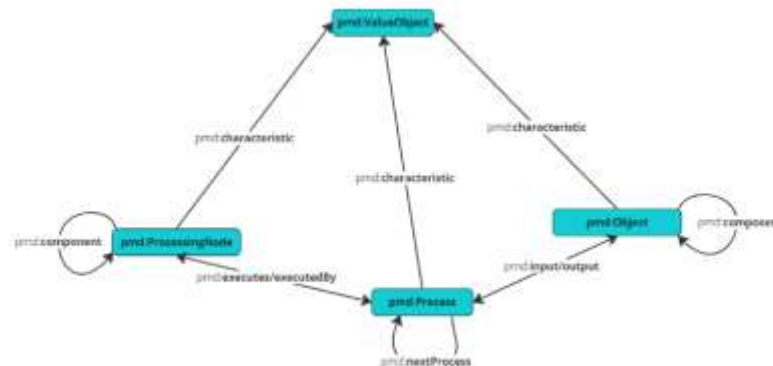
Bernd Bayerlein, Markus Schilling, Henk Birkholz, Matthias Jung, Jörg Waitelonis, Lutz Mädler, Harald Sack

## The Intersection between Semantic Web and Materials Science

Andre Valdestilhas, Bernd Bayerlein, Benjamín Moreno Torres, Ghezal Ahmad Jan Zia, Thilo Muth  
Accepted for publication in Advanced Intelligent Systems

PMDco

<https://github.com/materialdigital/core-ontology>



INTERNATIONAL  
STANDARD

ISO  
6892-1

Third edition  
2019-11

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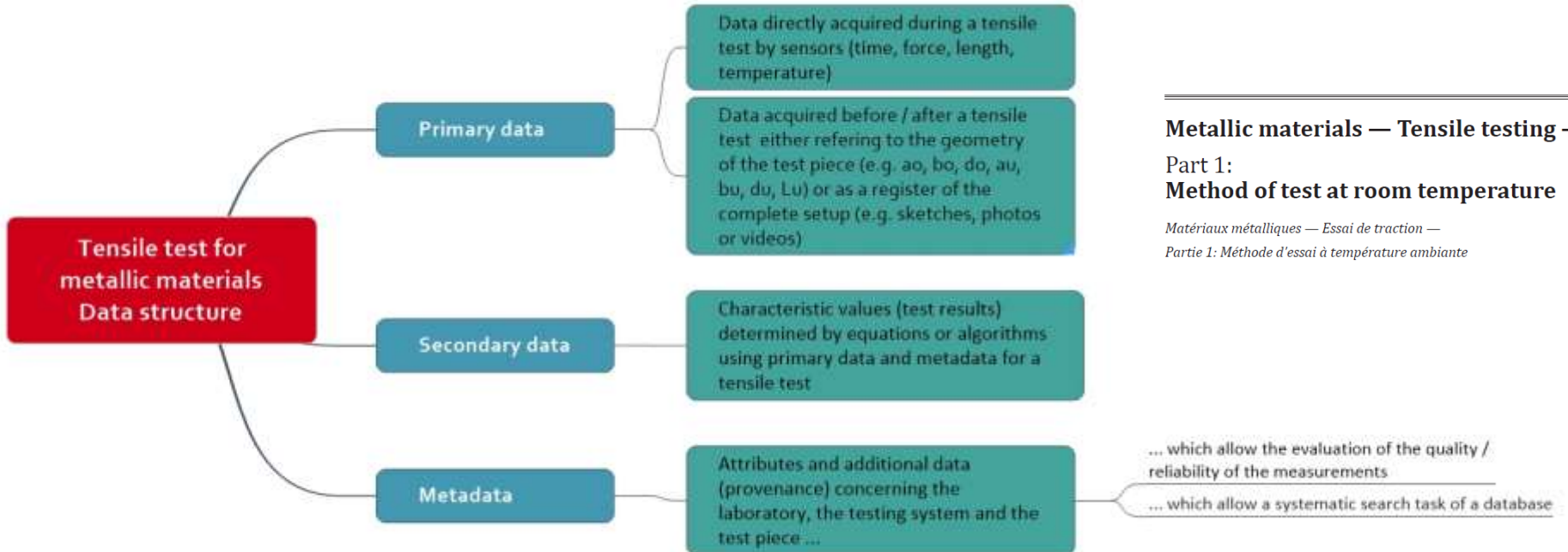
**Metallic materials — Tensile testing —  
Part 1:  
Method of test at room temperature**

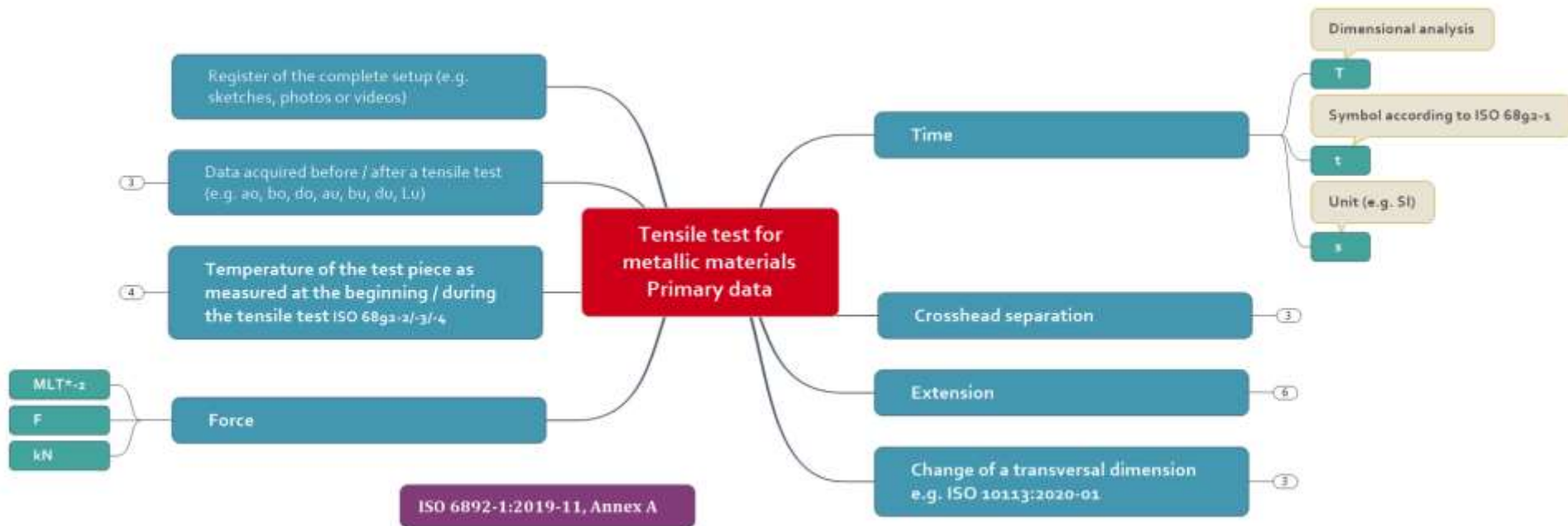
*Matériaux métalliques — Essai de traction —  
Partie 1: Méthode d'essai à température ambiante*

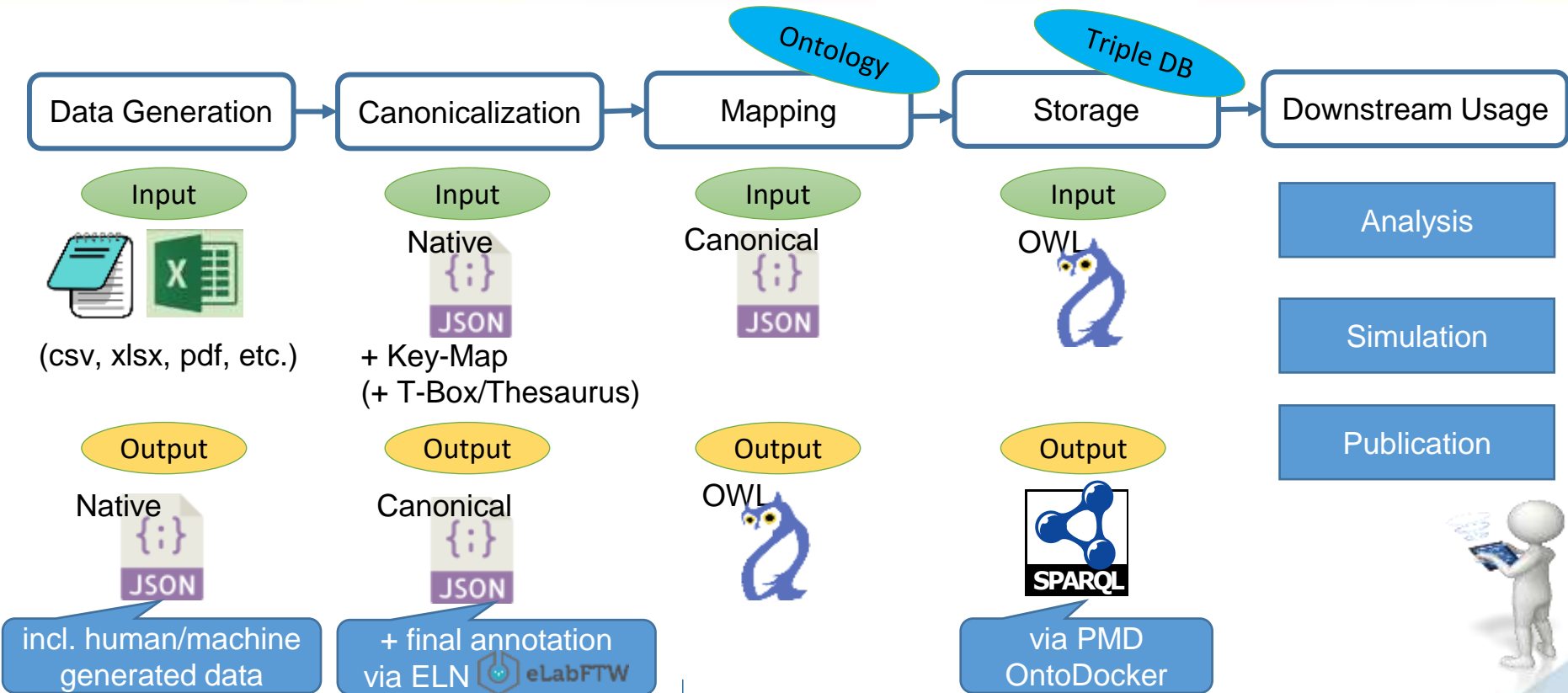


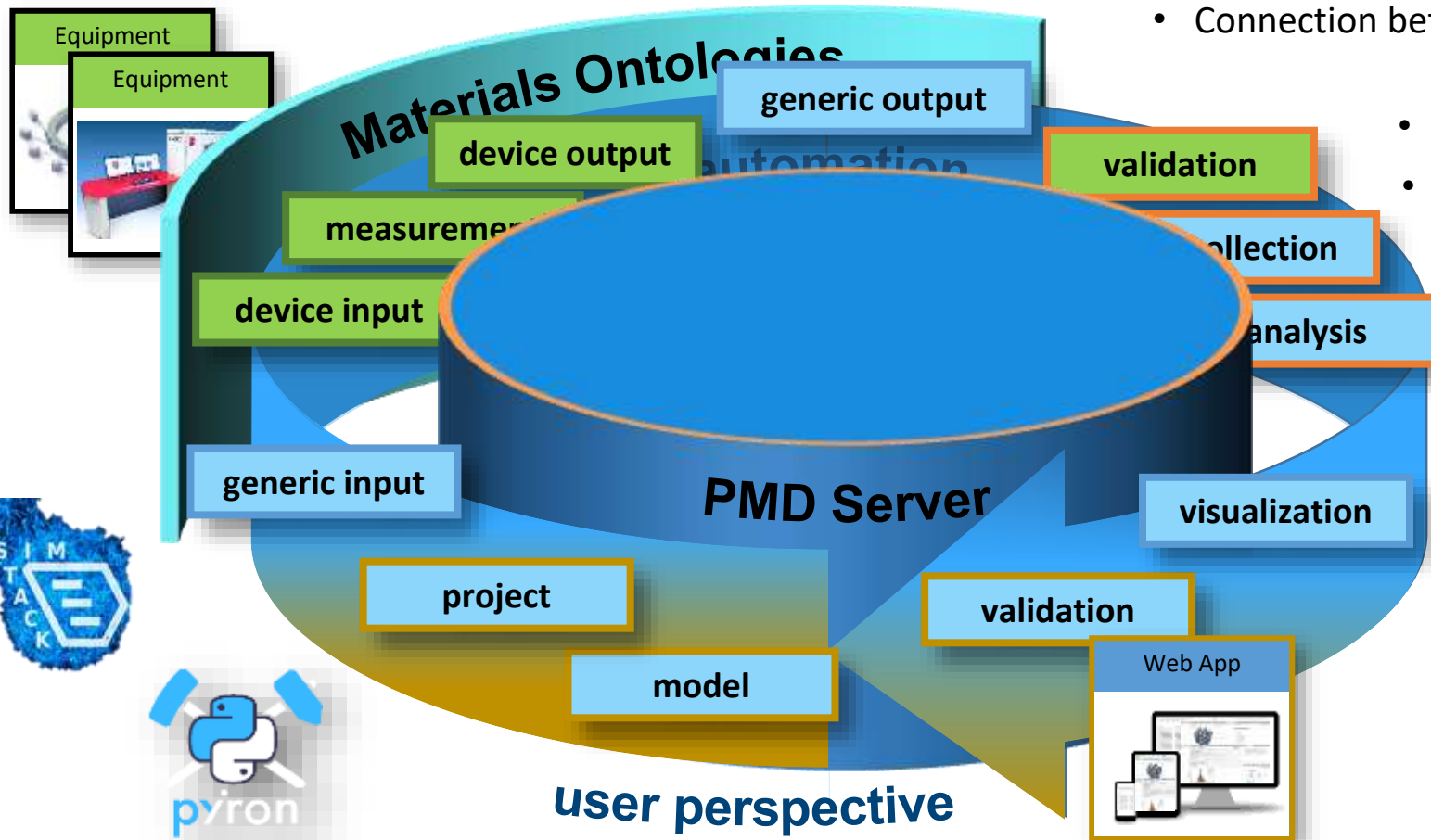
DIN NA 062-01-42 AA “Zug- und Duktilitätsprüfung für Metalle“

Third edition  
2019-11









- Connection between Ontology and Workflow
- Server network
- Reproducibility
- Flexibility



### Obtaining the experimental dataset

```
In [7]: ! job.get_dataset(uri=download_url)
In [8]: ! job.experimental_json
Out[8]:
```

job_date	Data Resource	Object
http://www.materials_datacenter.org/201707	http://dx.doi.org/10.26434/chemrxiv-2017-07-01	None
http://dx.doi.org/10.26434/chemrxiv-2017-07-01	http://dx.doi.org/10.26434/chemrxiv-2017-07-01	None

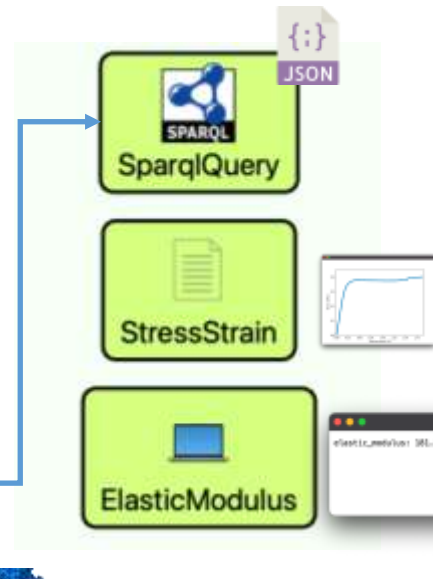
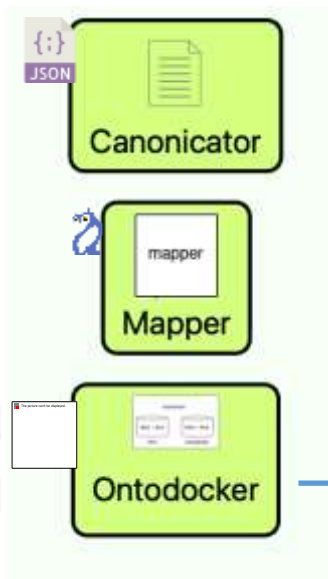
### Extracting stress and strain data from the dataset

```
In [9]: ! job.extract_stress_strain()
In [10]: ! job.plot_stress_strain()
```

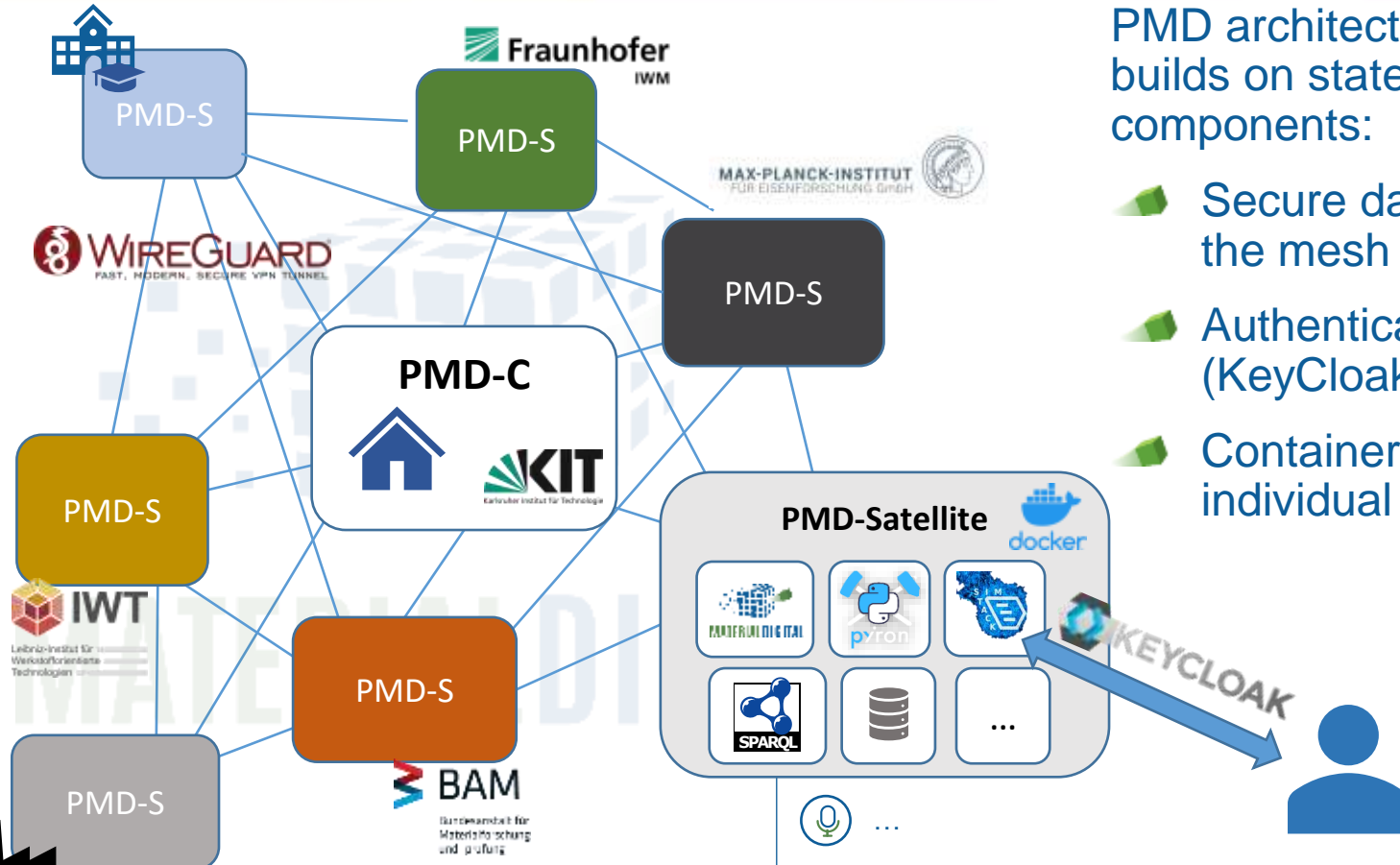


### Calculating the elastic modulus

```
In [12]: ! job.run()
The job tensile_job was saved and received the ID: 5
In [13]: ! job.output_elastic_modulus
Out[13]: 181.58485412597656
```



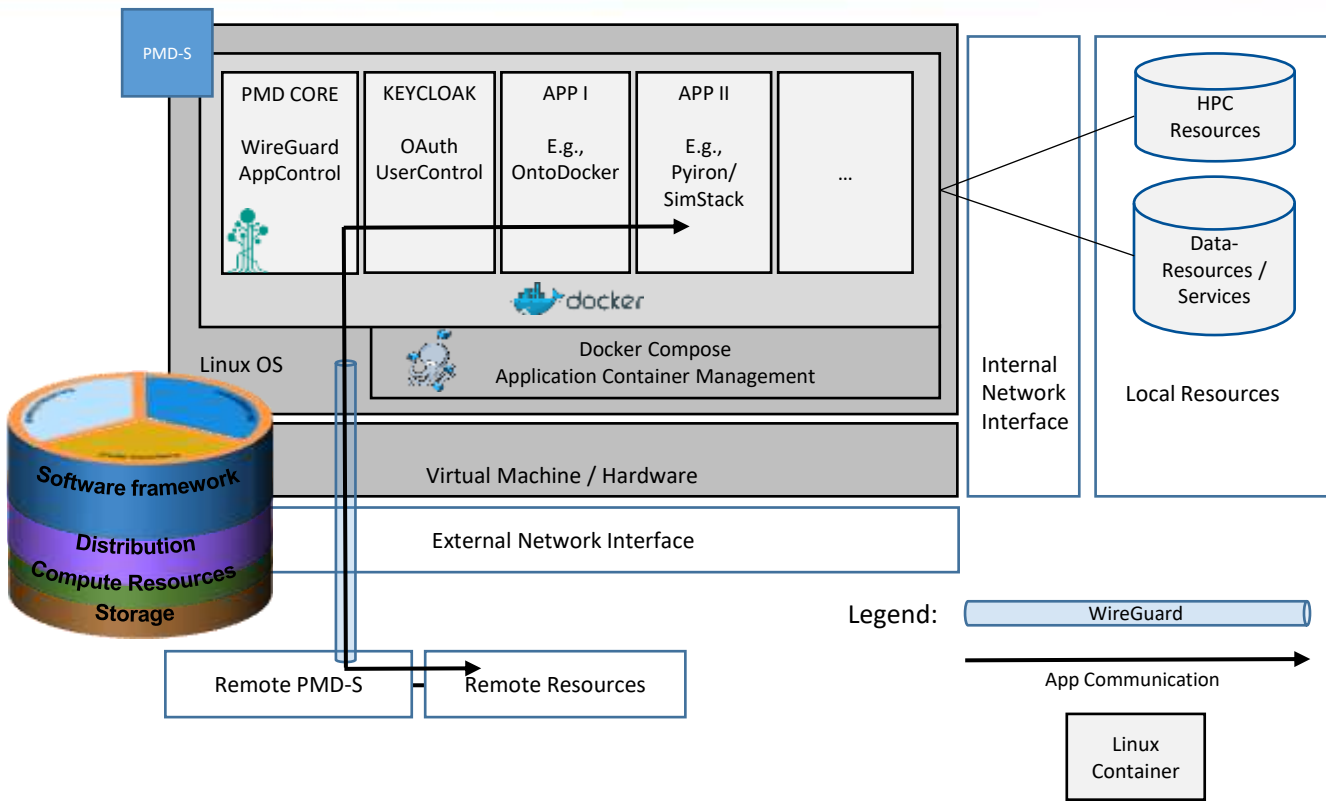




PMD architecture prototype builds on state-of-the-art components:

- Secure data transfer within the mesh (WireGuard)
- Authentication/Authorisation (KeyCloak)
- Containerisation of individual services (Docker)

# PMD-S – Network Prototype



All PMD-S Server have the same structure

- Connectivity
- Security
- Flexibility



Glass melting

Up to 20 crucibles

Control balance

Raw materials

Dosing station

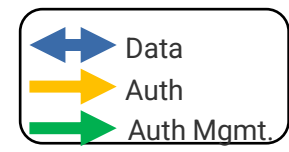
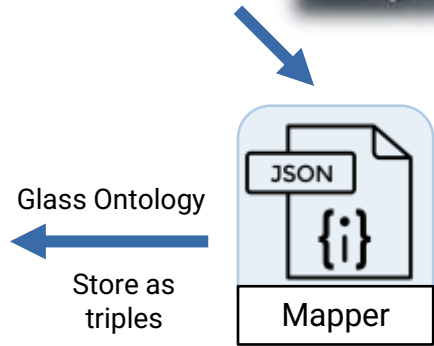
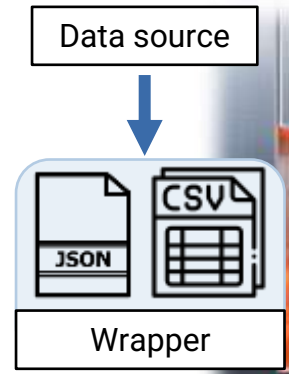
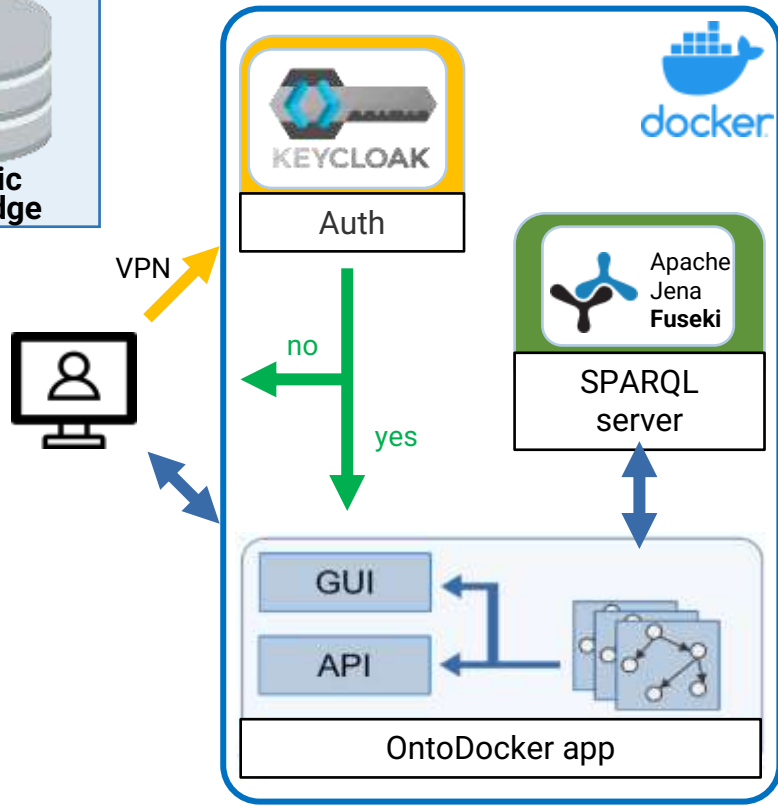


3 furnaces for  
controlled cooling

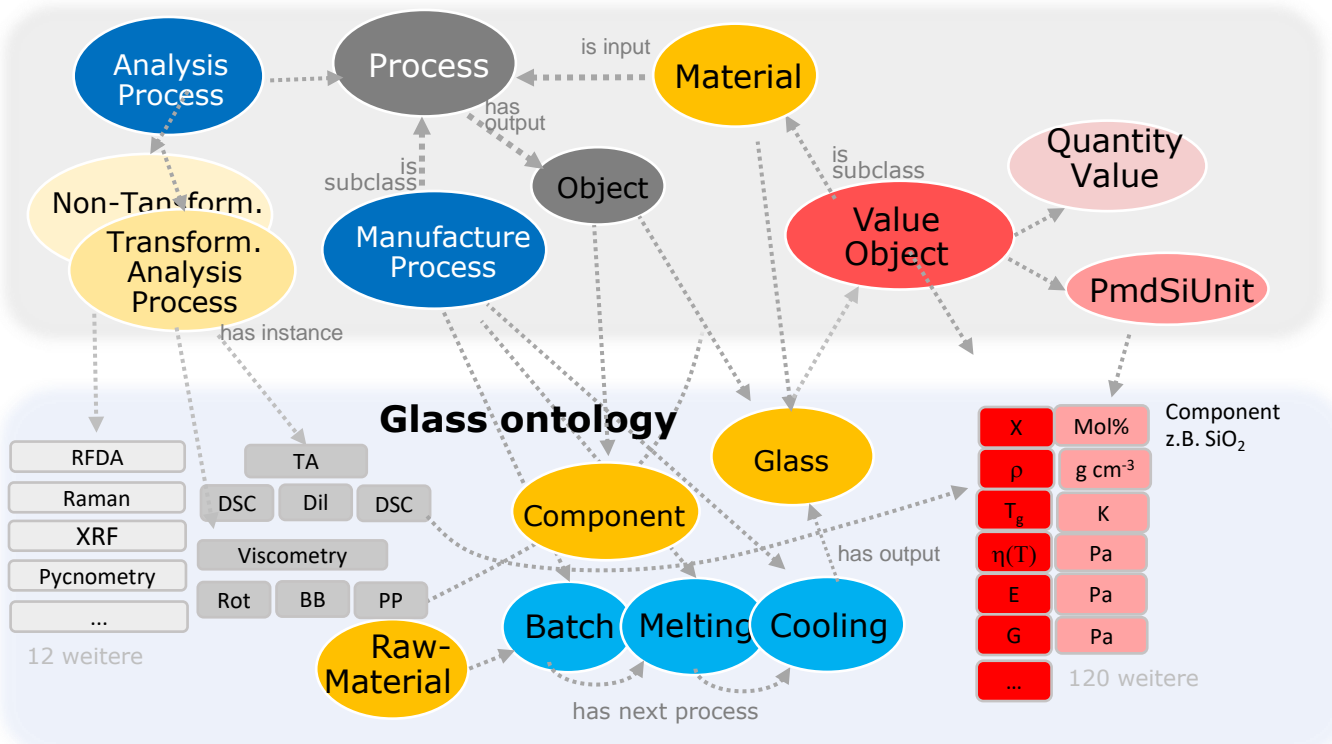
Pouring pots

Pot covers

# GlasDigital – Ontology-Based Digital Infrastructure



## PMD Core Ontology 1.0



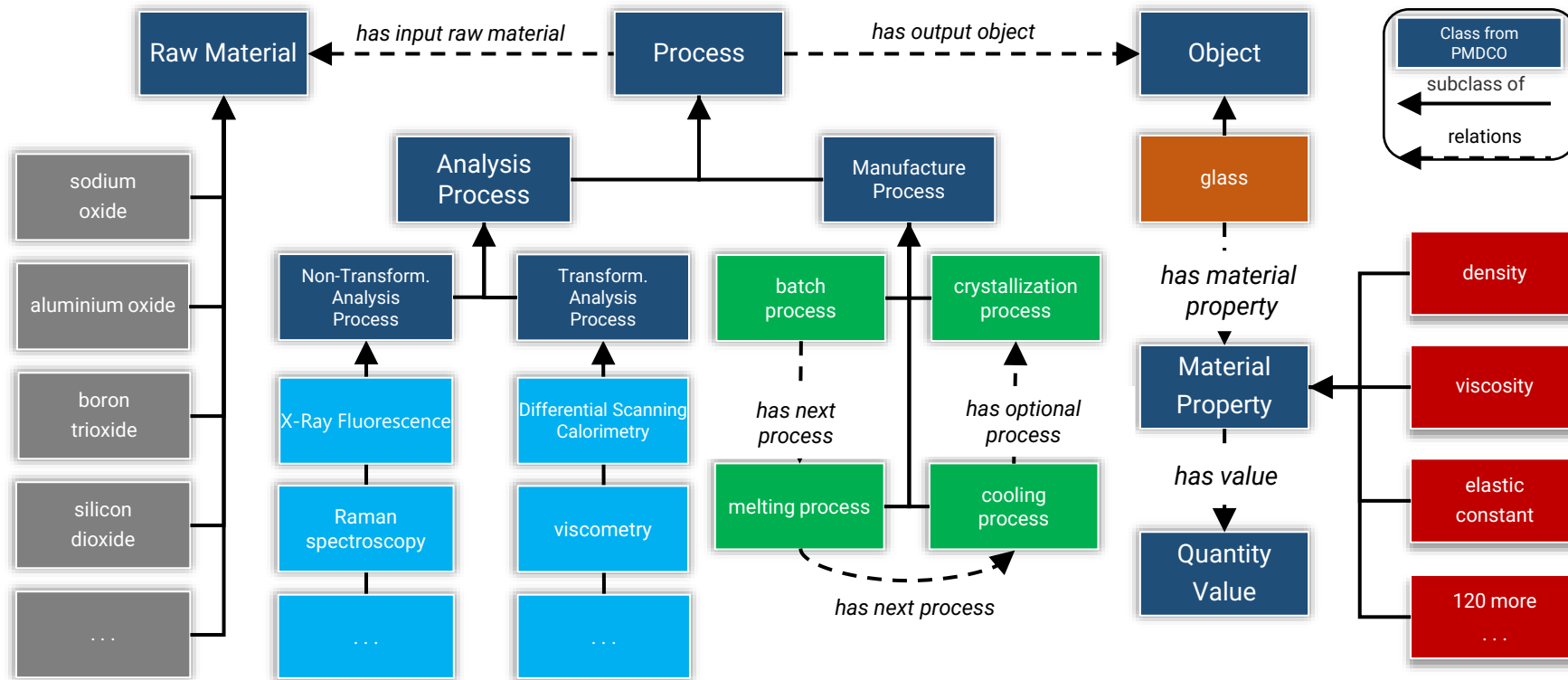
- Data
- Units
- Connectors
- Workflow (Python)

X	Mol%	Component z.B. SiO <sub>2</sub>
ρ	g cm <sup>-3</sup>	
T <sub>g</sub>	K	
η(T)	Pa	
E	Pa	
G	Pa	
...	120 weitere	

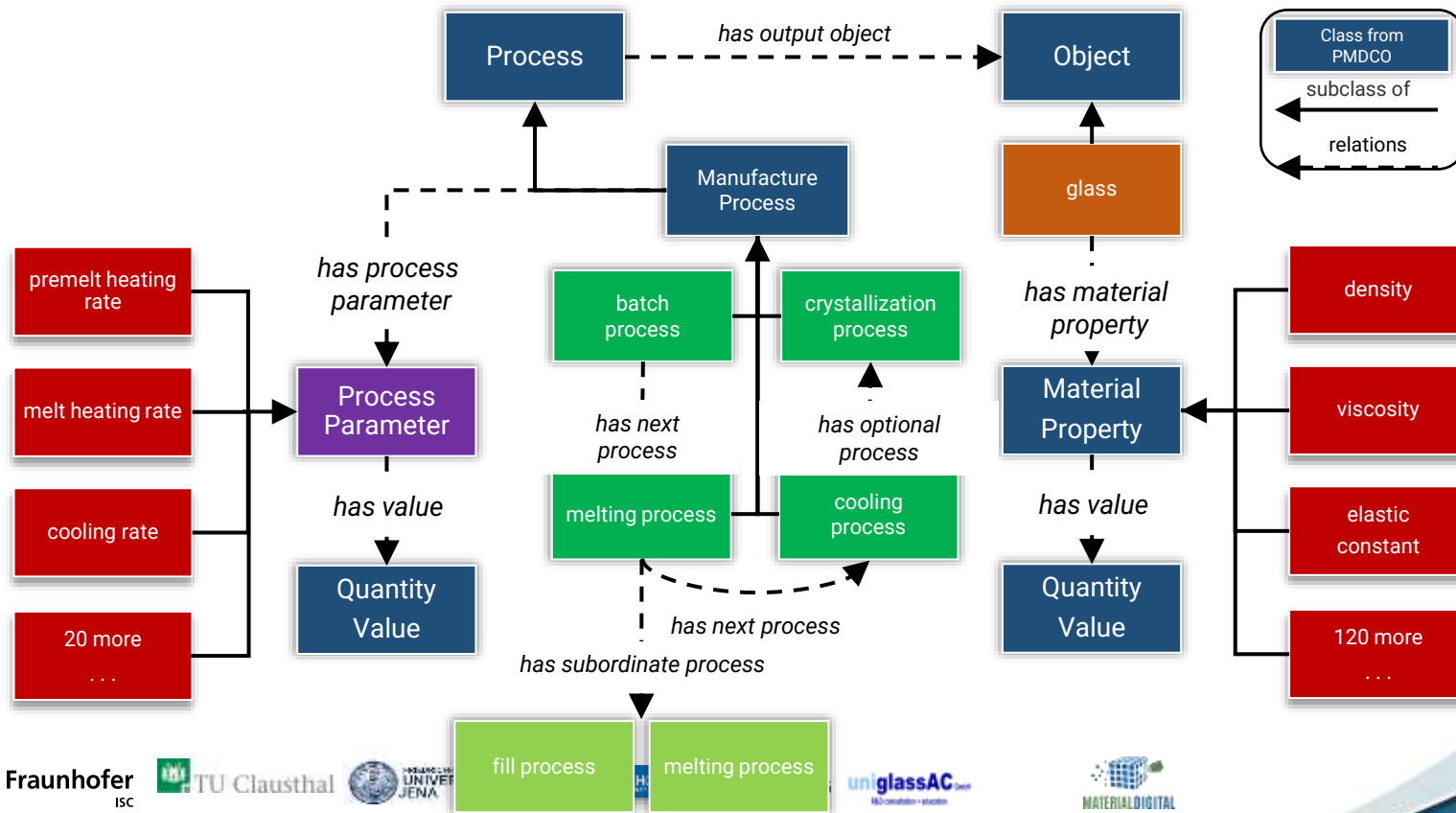
```

pmdco:hasLabel "gram per cubic centimetre"@en ;
rdfs:label "gram per cubic centimetre"@en ;
owl:sameAs wikidata:Q13147228 ;
pmdco:hasUnitCode "g/cm3" ;
pmdco:hasUnitLabel "g/cm3"
    
```

# Glass Ontology Based on PMD Core Ontology (PMDco 1.0)



# Glass Ontology Based on PMD Core Ontology (PMDco 1.0)





**MATERIALDIGITAL**

[GlasDigital](#)

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