



metaphacts

Smart Data. Smart Apps. Smart Decisions.

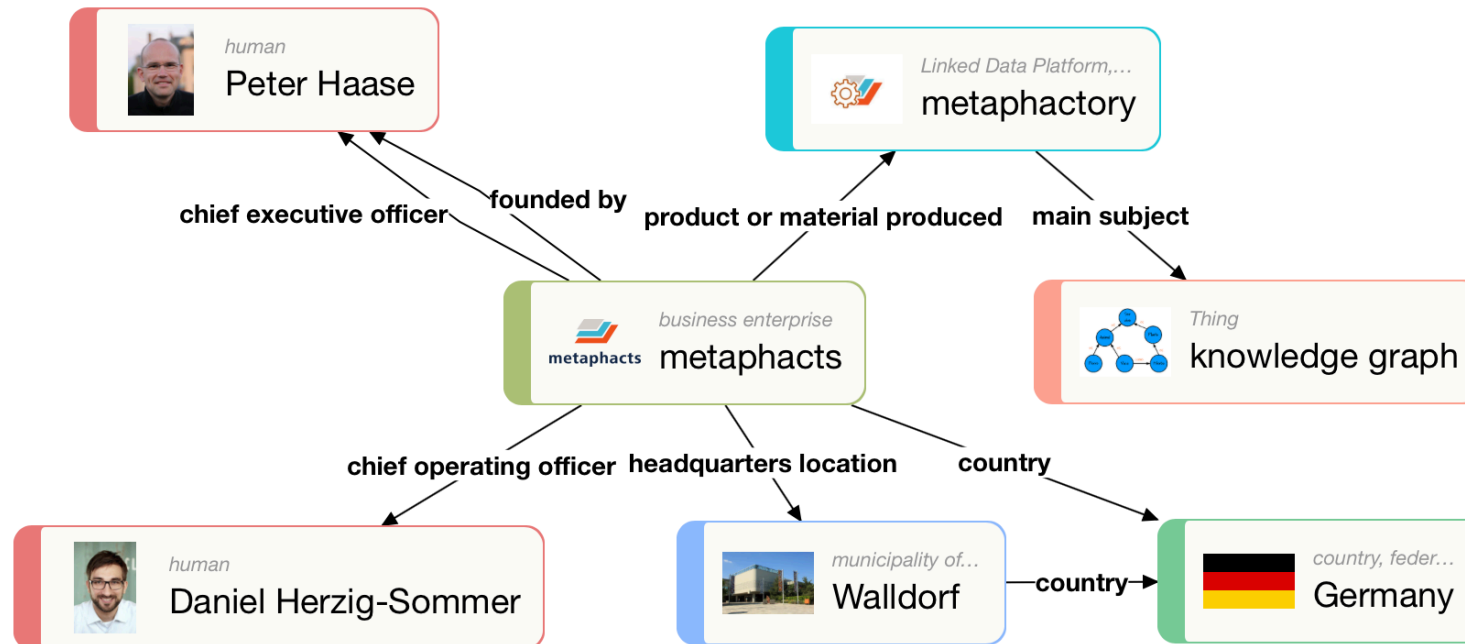
Creating Value from Data with Knowledge Graphs

Dr. Daniel Herzig-Sommer
COO at metaphacts GmbH

Sep 10, 2019
SEMANTiCS 2019, Karlsruhe

COMPANY FACTS

- metaphacts GmbH
- Founded in Q4 2014
- Headquartered in Walldorf, Germany
- Currently ~20 people
- Independent software vendor
- Privately-held, owner-managed company
- Platform for knowledge graphs and knowledge graph applications

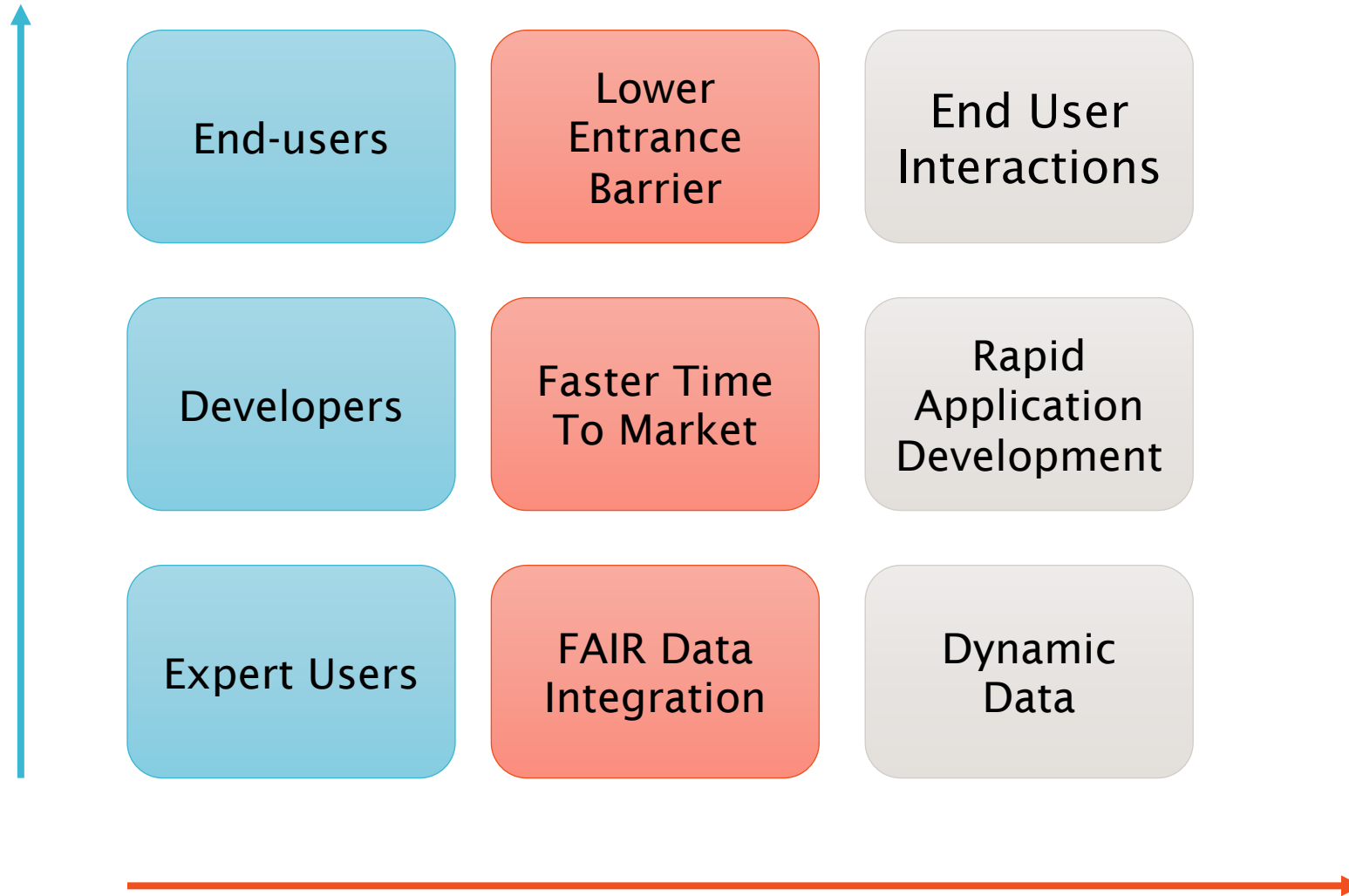


„ease onboarding into the world of
enterprise knowledge graphs“



metaphactory

end-to-end Knowledge Graph platform
for Knowledge Graph management, rapid application development and
end-user oriented interaction with Knowledge Graphs

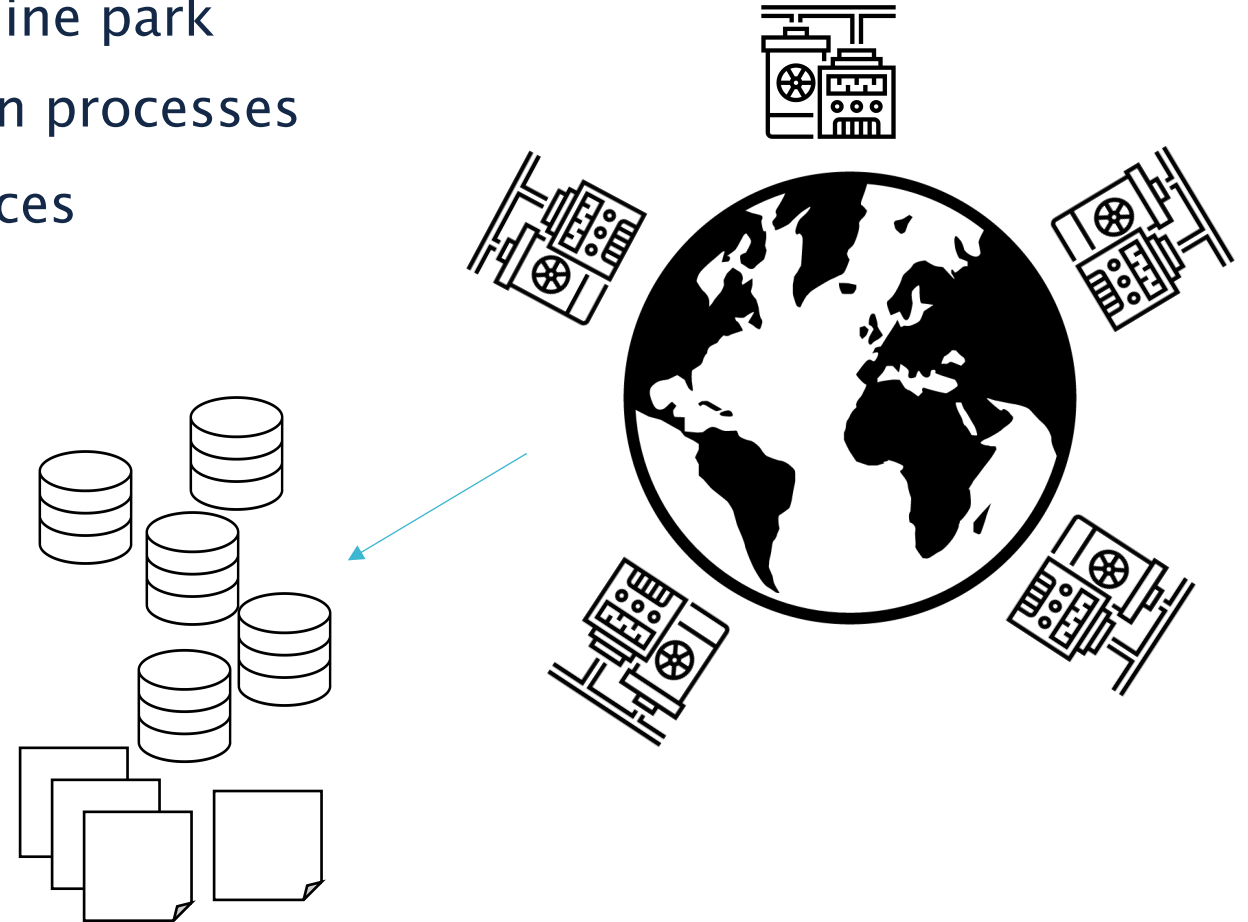


- We will look at a blueprint for the Industry 4.0
- Based on Knowledge Graph applications in use by several customers
 - Automotive suppliers
 - Machine manufacturer
- Our reference customer with the most use cases and expertise is



SIEMENS

- Operator of a large, world wide machine park
- Machines are integrated in production processes
- Many distributed, separate data sources
 - Design database
 - BOM and parts specifications
 - Supplier information
 - Configuration database
 - Customer sales database
 - Maintenance and service database
 - Operational database
 - Live sensor data





„We saw that pressure pipe A from supplier S breaks early in humid climates when exposed to temperatures above 100°C.“



- Where is pipe A in use?
- Which machine type uses pipe A?
- Which machines are located in humid climates?
- Which pipes are exposed to $T > 100^{\circ}\text{C}$?

„I start searching for an answers“



Findable

- (Meta)data based on W3C Semantic standards
- IRIs as identifiers
- RDF-based metadata

Interoperable

- OWL-based ontologies
- References and links to existing data sources

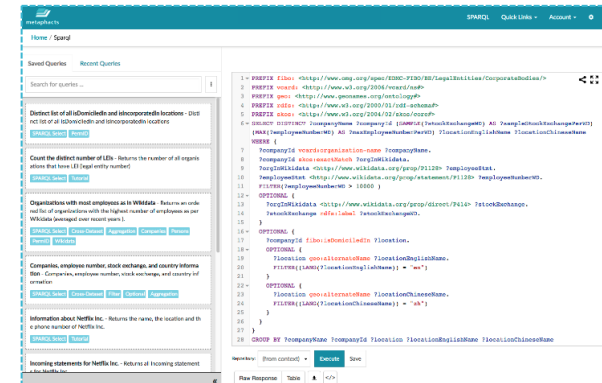
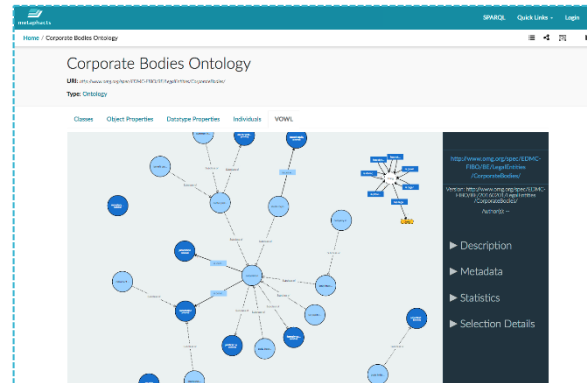
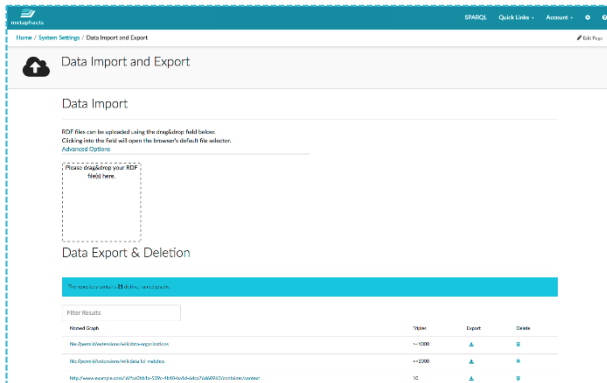
Accessible

- HTTP-resolvable URIs
- SPARQL Endpoint
- Linked Data Platform API

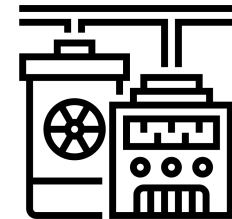
Re-usable

- Use of established vocabularies for (meta)data
- Management of data provenance (VOID)

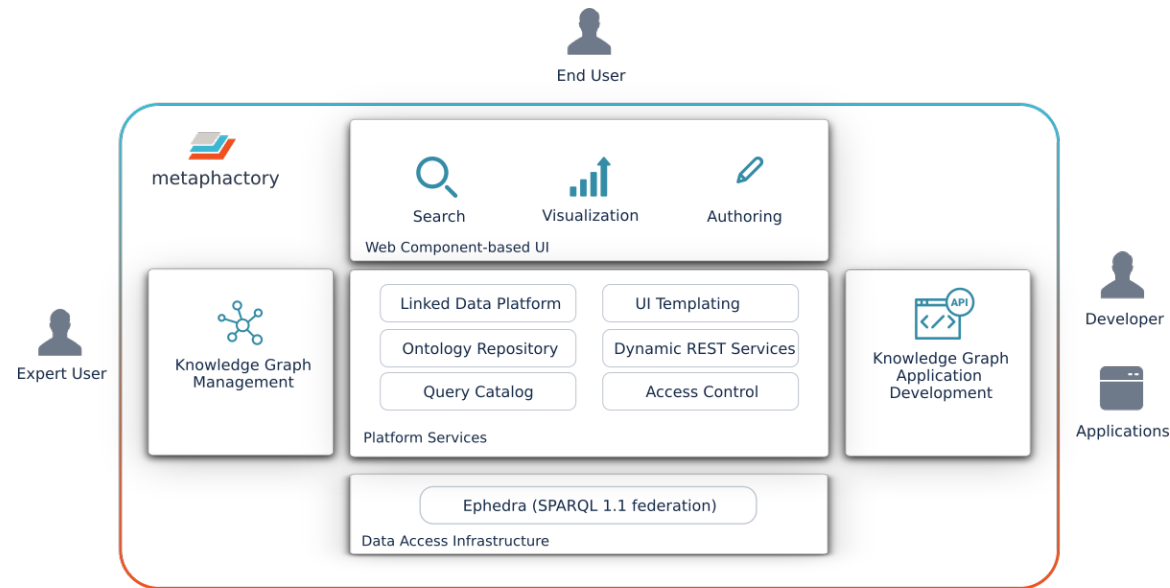
- metaphactory supports expert users, whose core tasks are data management and data integration
 - SPARQL Editor and Query Catalog
 - Ontology Catalog
 - Linked Data Platform



- Not all data is available as RDF
- Not all data needs to be in RDF (but the meta data about it)
- Data may continue to live in non-RDF datasources
- Example
 - (Live) Sensor data
 - Weather / climate data from external providers
 - API to fetch data



Enterprise Knowledge Graphs Span Multiple Data Spaces



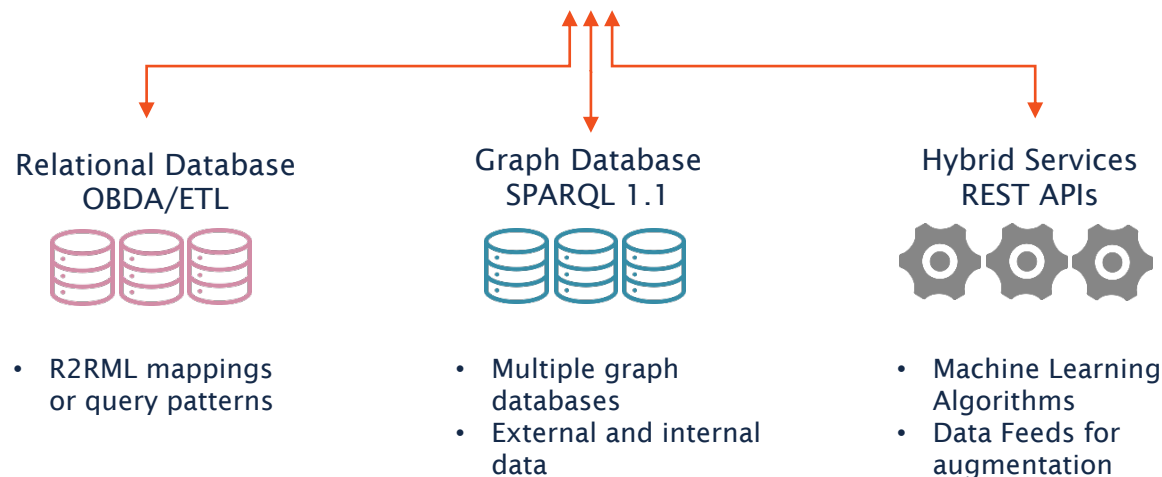
Advantages of Enterprise Knowledge Graphs

- Unlock isolated data silos
- Query across data sources
- 360° view on data

Ephedra – metaphactory’s federation engine

Virtual and materialized integration of multiple data sources

- Graph databases
- Relational databases
- Compute services
- REST APIs



Data Quality Assurance using SHACL



Ensure technical and logical conformity of instance data

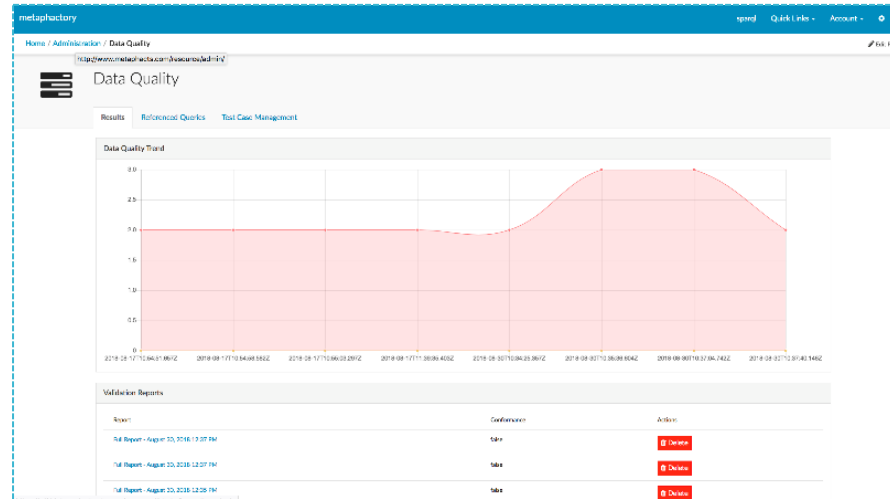


Technical Validation

Use SHACL to create rules and constraints

Logical Validation

Define syntactic checks and semantic validations that are specific to business uses cases



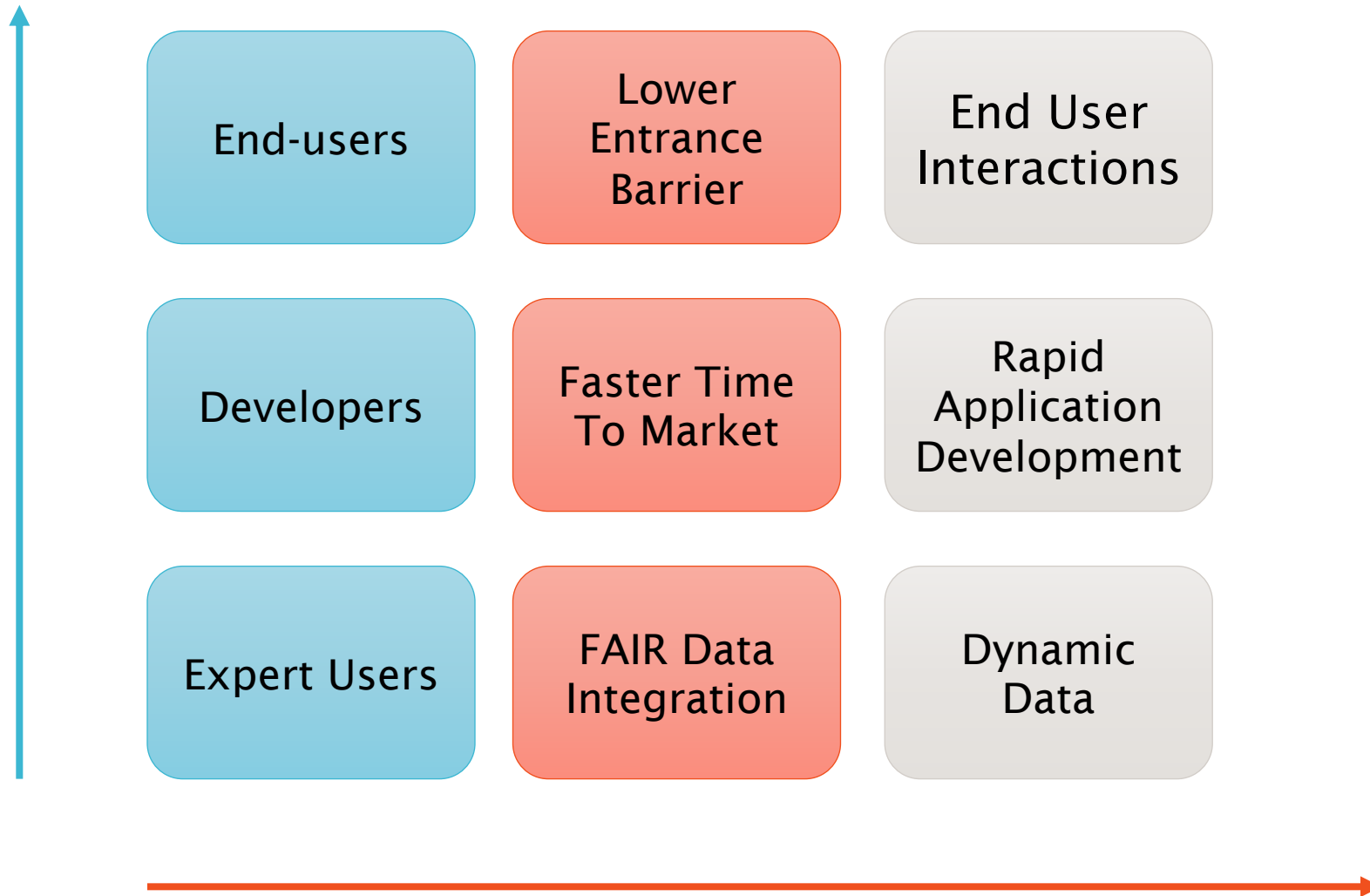
The screenshot shows the 'Data Quality' dashboard in the metaphactory interface, displaying SHACL code. The code includes various prefixes and rules for validation, such as 'sh:rule' and 'sh:SPARQLConstraint'. The code is displayed in a monospaced font within a text area.

Do all machines have a location with geo coordinates?



Less than 50% of all pressure pipes should come from one vendor





- Dynamic data requires a dynamic application development
- metaphactory leverages the flexibility and extensibility of the underlying data model for rapid application development
- Rapid Application Development
 - Declarative Web Applications
 - Templating
 - Reusable UI components
 - “Low-code configure-only paradigm”

- Business Owner wants a change in the application, e.g. show new sensor data in the application
- The usual process development process:
 - Write down specifications
 - Send to development team
 - Wait for next sprint
 - Review change and signoff
 - Upgrade to new version of application
- Weeks until change is available

“I need to see the reading of the temperature sensors.”

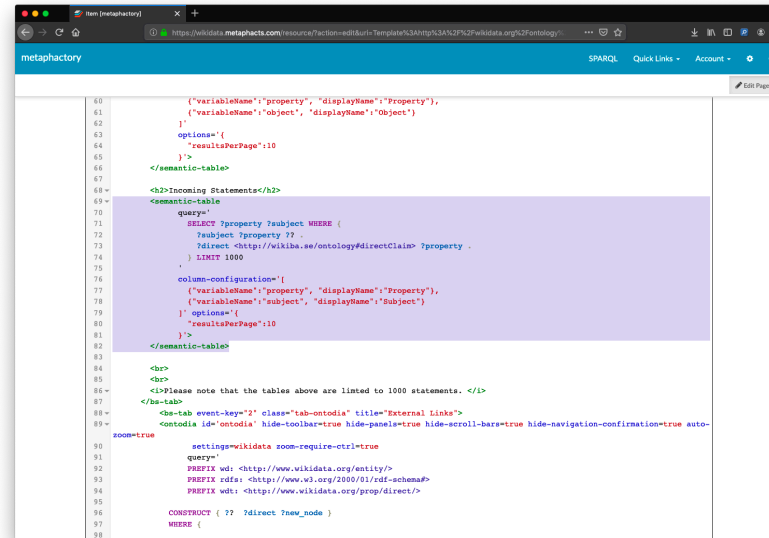


1. Choose

- HTML5 Components
 - Query Component
 - Carousel Component
 - Table Component
 - Graph Component
 - Tree Component
 - Timeline Component
 - Geographic Map Component
 - Chart Component
 - Ontodia Diagram Component
 - Simple Search Component
 - Semantic Search Framework
 - Example: Structured search
 - Example: Keyword search with facets
 - Example: Constant search with facets
 - Documentation and Example: Form-based search
 - Data Input / Authoring Components
 - React Bootstrap Components
 - Utility Components
 - Event System
 - CSS Layout

- 20+ HTML5 components
- Visualizations
- Interactions

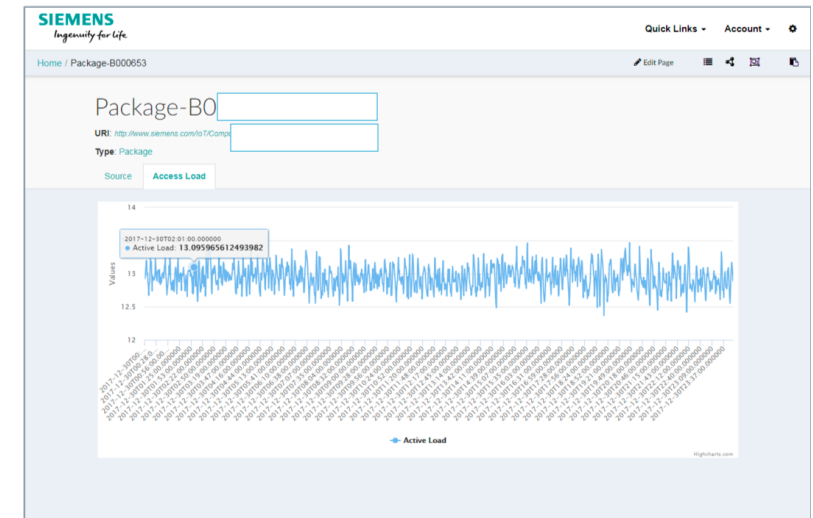
2. Configure



```
60      ("variableName": "property", "displayName": "Property"),
61      ("variableName": "object", "displayName": "Object")
62    ]
63    options={
64      "resultsPerPage": 10
65    }
66  }
67  </semantic-table>
68  <#>Incoming Statements</#>
69  <#>Semantic Table</#>
70  query=
71  SELECT ?property ?subject WHERE {
72    ?subject ?property ??
73    ?direct <http://wikiba.se/ontology#directClaim> ?property .
74    } LIMIT 1000
75  }
76  column-configuration=[
77    ("variableName": "property", "displayName": "Property"),
78    ("variableName": "subject", "displayName": "Subject")
79  ] options={
80    "resultsPerPage": 10
81  }
82  </semantic-table>
83  </#>
84  <br>
85  <br>
86  <!--Please note that the tables above are limited to 1000 statements. -->
87  </#>
88  <#>tab event-key="?" class="tab-ontodia" title="External Links">
89  <ontodia id="ontodia" hide-coolbars=true hide-panel=true hide-scroll-bars=true hide-navigation-confirmation=true auto-
90  zoom=true
91  settings=wikidata zoom-require-ctrl=true
92  query=
93  PREFIX wd: <http://www.wikidata.org/entity/>
94  PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
95  PREFIX wdtr: <http://www.wikidata.org/prop/direct/>
96  CONSTRUCT { ?? ?direct ?new_node }
97  WHERE {
98
```

- Set config and save

3. Use



- Immediately available

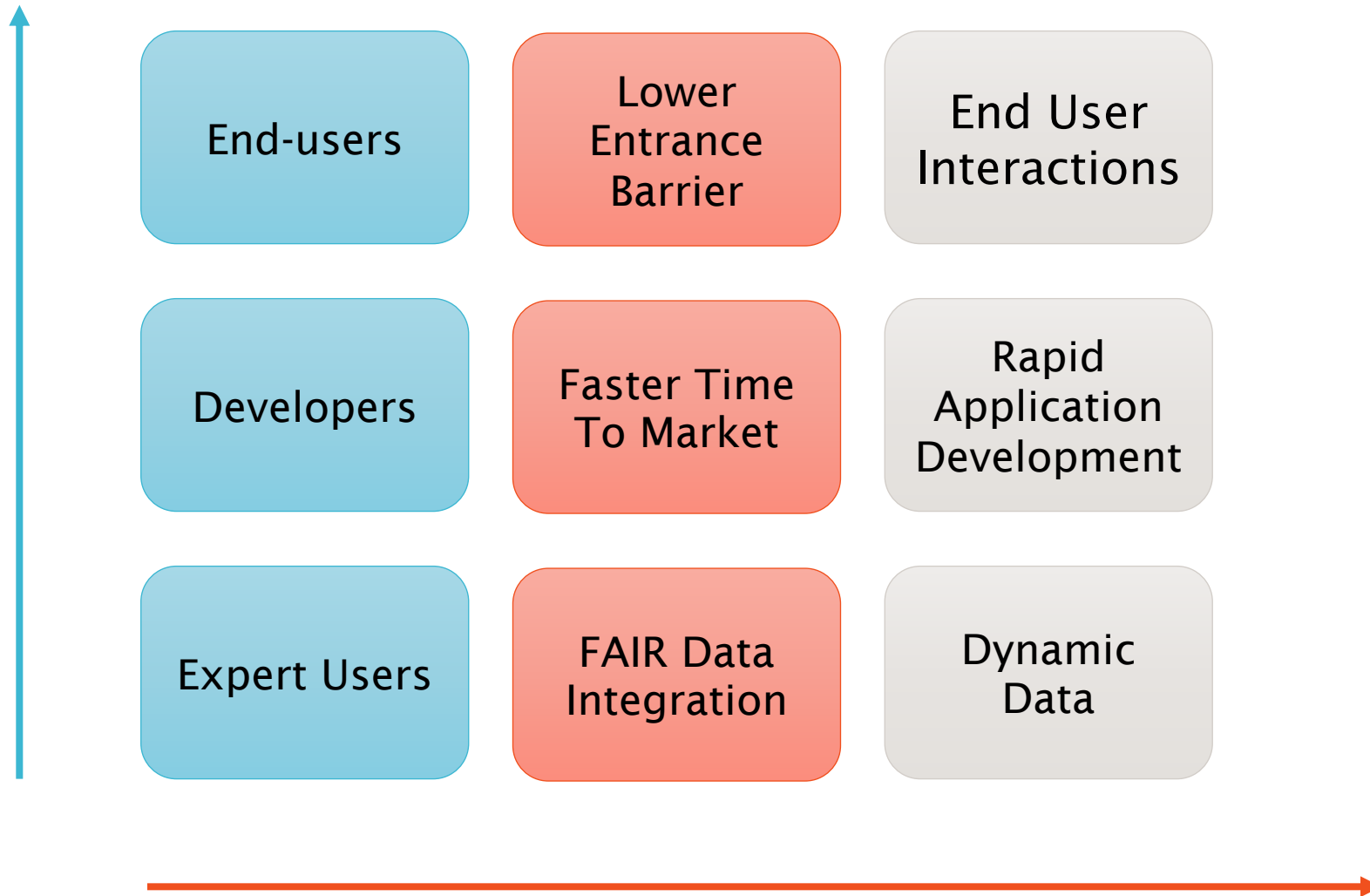
“Low-code configure-only paradigm”

Rapid Application Development

- See results early during application development
- Small changes require small efforts
- Faster turn around cycles
- Lower Time To Market

I do small
changes
myself!





- End-users want so solve problems
- Our goal is to bring the power of semantic technologies to end-users and hide the underlying complexity by providing the right abstraction layers
- Lower Entrance Barrier
- Faster onboarding
- Wide audience of users

„Which machines need a service?“



Structured Search – Guided search experience

SIEMENS
Ingenuity for Life

Find: Drive trains HAS PACKAGE Package where packages fuel type Gas and DRIVE TRAIN OF Plant where plants plant

Drive Train has package Package [remove](#)

WHERE


Package fuel type Fuel Type Gas [remove](#)

AND

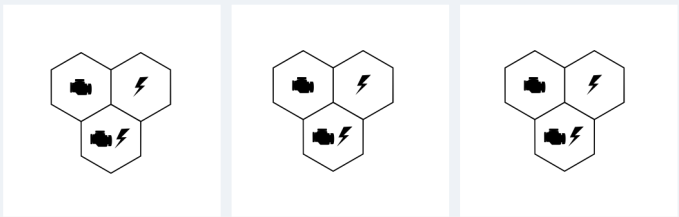
Drive Train drive train of Plant [remove](#)

WHERE

Plant plant of Site [remove](#)

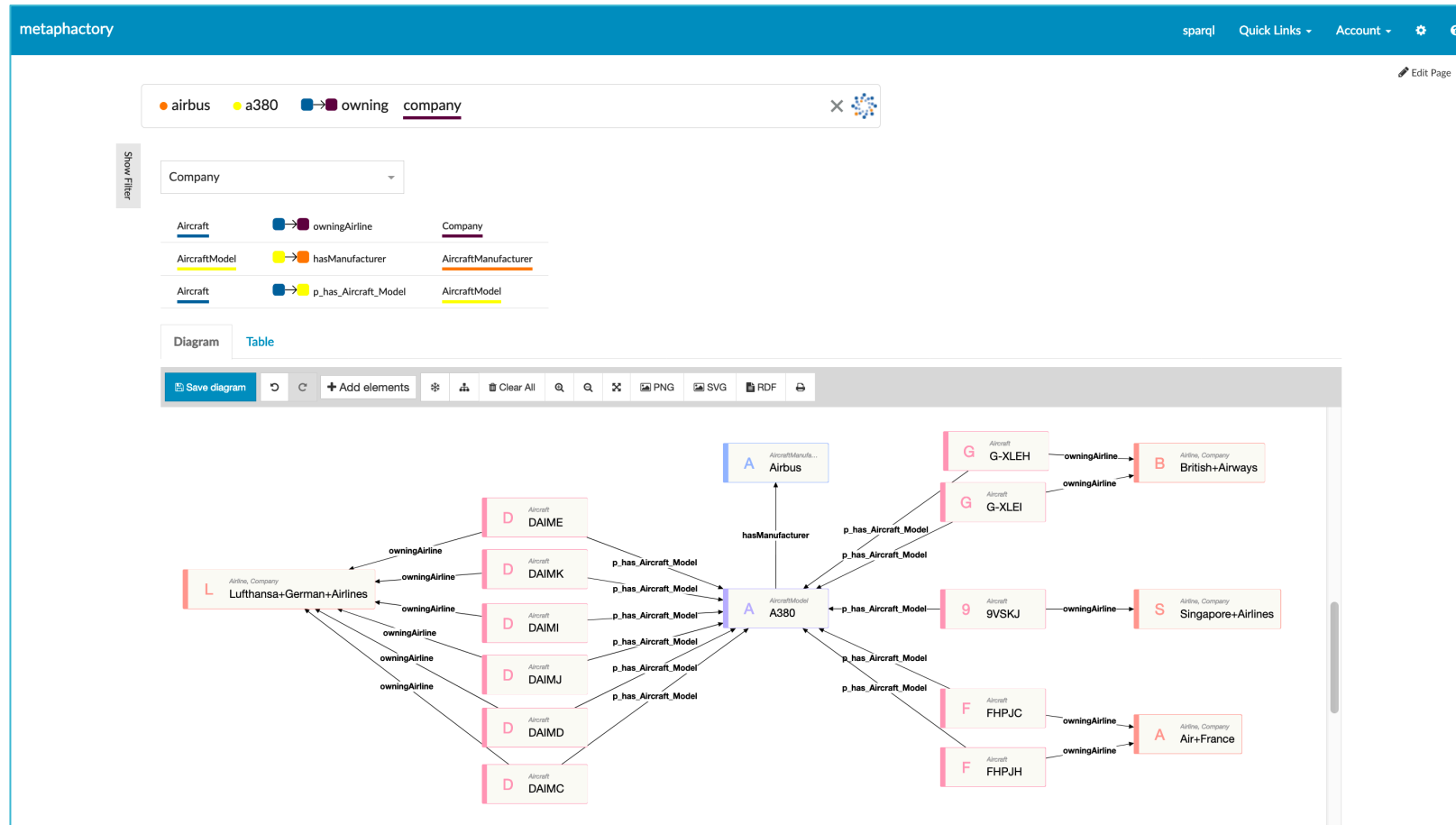
 Hide Filter

3 matches.



Satisfy complex information needs and get precise results without learning SPARQL

GraphScope – Smart Keyword Search over Knowledge Graphs



- Google-like keyword search over Knowledge Graphs
- Keywords are interpreted and translated into SPARQL
- Domain and use-case independent
- Unsupervised - No training needed

Explore relationships between entities

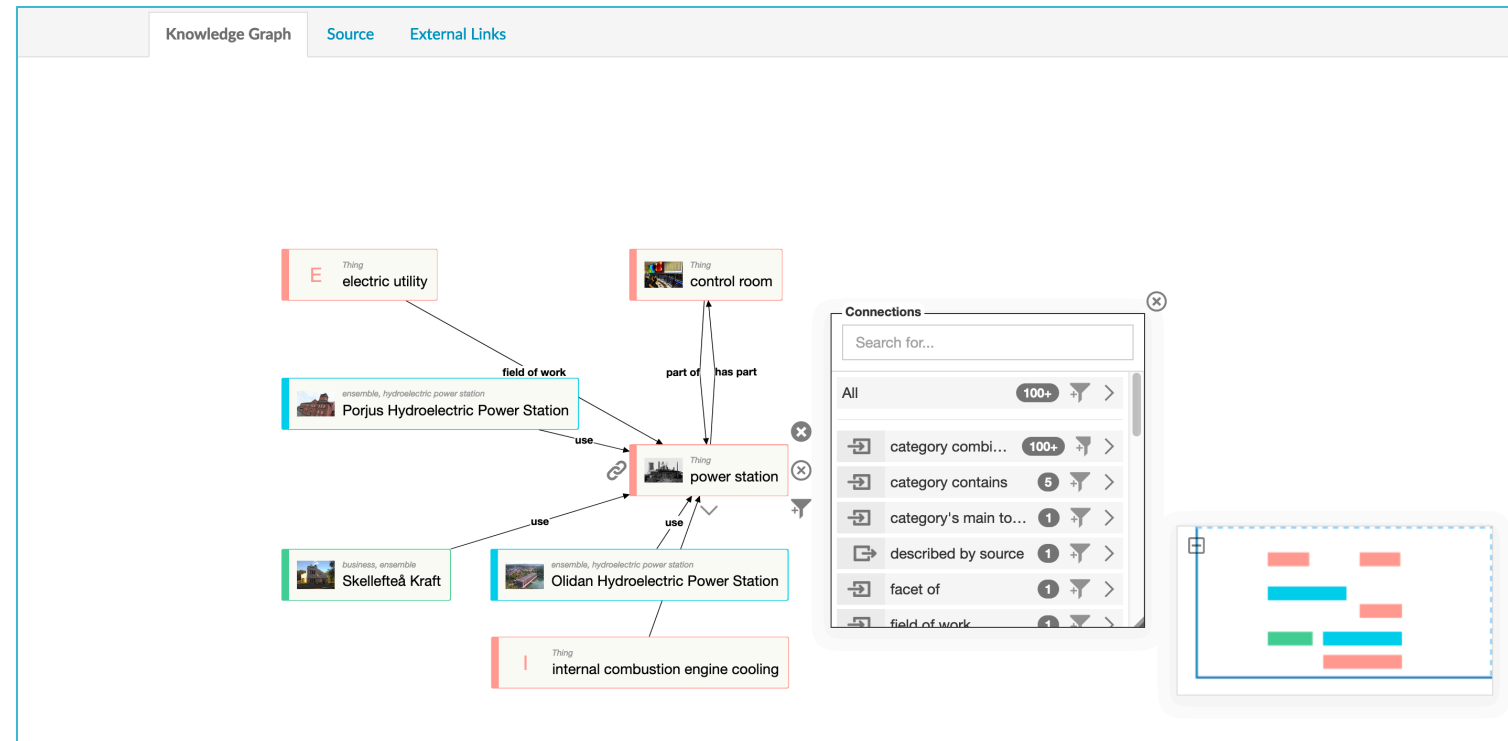


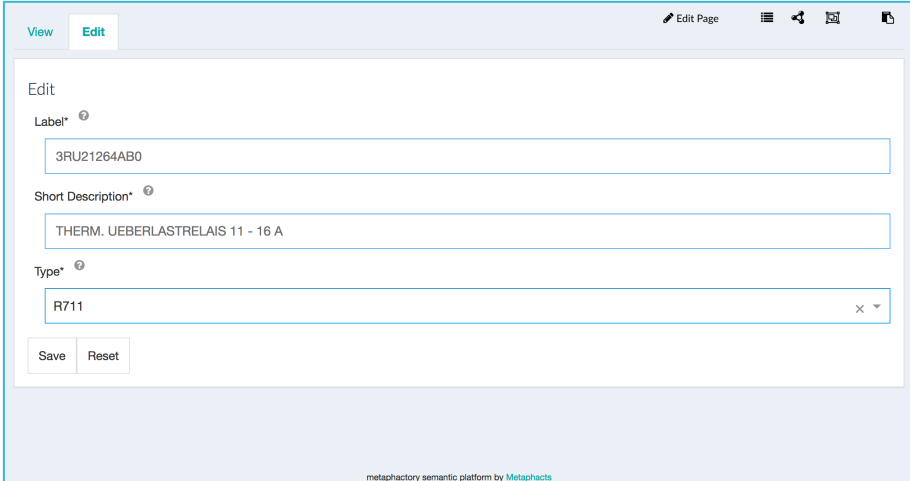
Exploration

Visualize complex relationships in an interactive graph

Discovery

Extend the visualization to depict relationships to neighboring entities



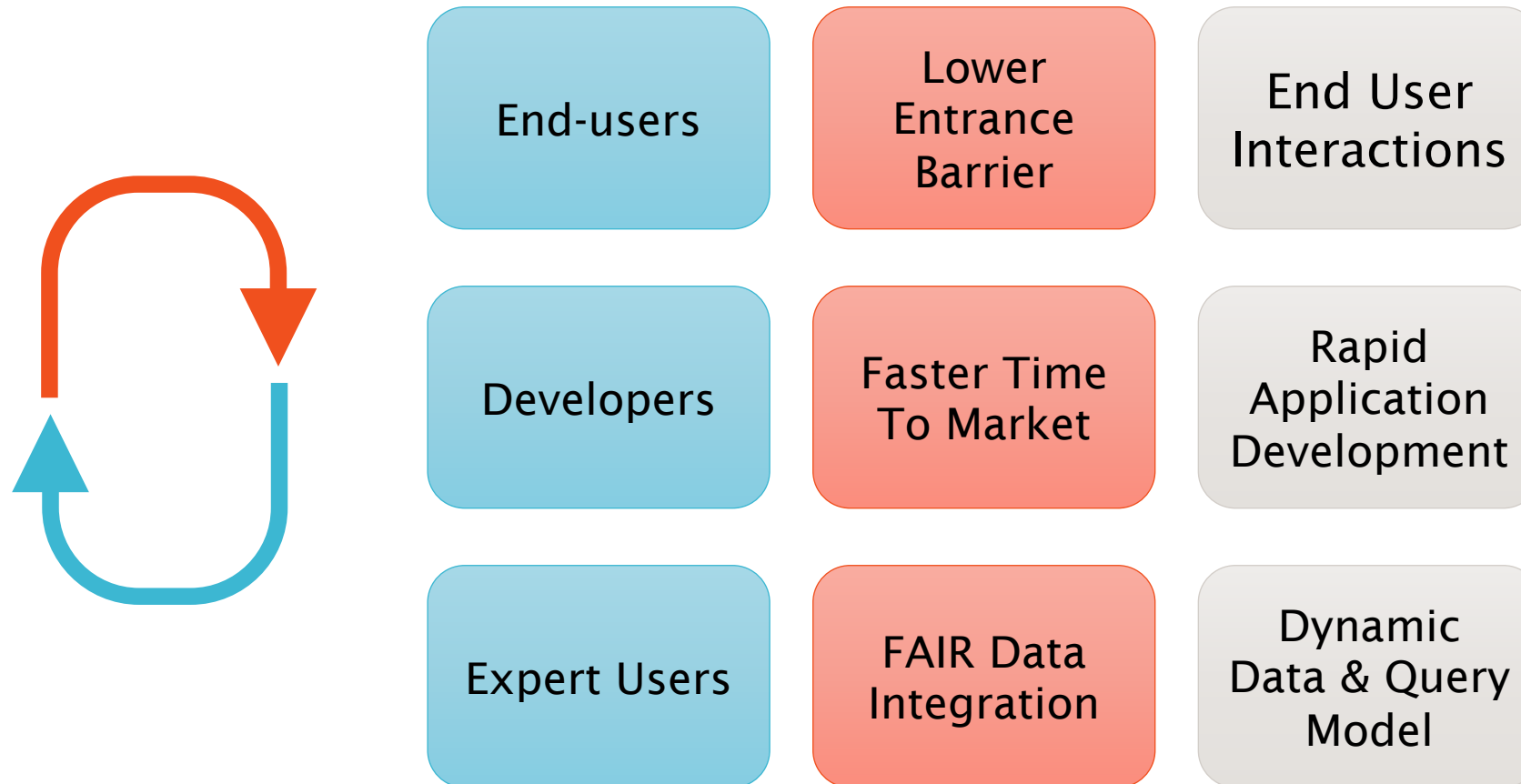


The screenshot shows a web interface for editing a knowledge graph entity. At the top, there are tabs for 'View' and 'Edit', with 'Edit' selected. Below the tabs, there are three input fields: 'Label*' containing '3RU21264AB0', 'Short Description*' containing 'THERM. UEERLASTRELAIS 11 - 16 A', and 'Type*' containing 'R711'. At the bottom of the form are 'Save' and 'Reset' buttons. The footer of the interface reads 'metaphactory semantic platform by Metaphacts'.

Collaboratively create and author knowledge graphs

I changed pressure pipe A in machine 100 on Tuesday, Sep 10 2019.





We support the entire life-cycle of Knowledge Graphs in one platform



We saw that pressure pipe A from supplier S breaks early in humid climates when exposed to temperatures above 100°C.



- Where is part A in use?
- Which machine type uses pipe A?
- Which machines are located in humid climates?
- Which pipes are exposed to $T > 100^{\circ}\text{C}$?

„I start searching for an answers“



I found the machines we need to service! 😊

The image shows a woman in a white hard hat and a high-visibility yellow and blue safety vest working at a computer workstation. She is looking at two monitors. The left monitor displays a 'Knowledge Graph' interface with a network diagram of nodes and edges. The right monitor displays a query editor with a list of saved queries and a SQL query.

Knowledge Graph Interface (Left Monitor):

- Search by type
- Search any type
- Structured search by type and relations
- Add a new node
- Delete a node

Query Editor Interface (Right Monitor):

- Home / Saved
- Search for queries
- Distinct list of all iConicInlets and iConicOutlets locations - Distinct list of all iConicInlets and iConicOutlets locations
- Count the distinct number of LDs - Returns the number of all organizations that have LD (legal entity number)
- Organizations with most employees as in Wikidata - Returns an ordered list of organizations with the highest number of employees as per Wikidata (averaged over recent years)
- Companies, employee number, stock exchange, and country information - Companies, employee number, stock exchange, and country information
- Information about Netflix Inc. - Returns the name, the location and the phone number of Netflix Inc.
- Incoming statements for Netflix Inc. - Returns all incoming statements for Netflix Inc.

```
1 = PREFIX Edbio <http://www.org.org/DBIO/130100/Species/Line/Corporate/Entities/>
2 PREFIX wdata <http://www.w3.org/2004/02/sparql-query#>
3 PREFIX geo <http://www.geonames.org/ontology#>
4 PREFIX rdfs <http://www.w3.org/2000/01/rdf-schema#>
5 PREFIX skose <http://www.w3.org/2004/02/sparql-query#>
6 = SELECT DISTINCT ?organization ?employeeId (STR(?employeeId)) AS ?employeeName ?location ?locationName ?locationType ?locationCode
7 ?employeeId ?organizationName ?employeeName
8 ?employeeId ?organizationName ?employeeName
9 ?employeeId ?organizationName ?employeeName
10 ?employeeId ?organizationName ?employeeName
11 FILTER(?employeeId > 20000 )
12 = OPTIONAL {
13 ?employeeId ?organizationName ?employeeName
14 ?employeeId ?organizationName ?employeeName
15 ?employeeId ?organizationName ?employeeName
16 }
17 = OPTIONAL {
18 ?employeeId ?organizationName ?employeeName
19 ?employeeId ?organizationName ?employeeName
20 ?employeeId ?organizationName ?employeeName
21 }
22 = OPTIONAL {
23 ?employeeId ?organizationName ?employeeName
24 ?employeeId ?organizationName ?employeeName
25 }
26 }
27 }
28 GROUP BY ?organizationName ?employeeId ?locationName ?locationCode
```



Challenges

Many (external) data sources
 Different data formats
 Complex domain with many object types and relationships



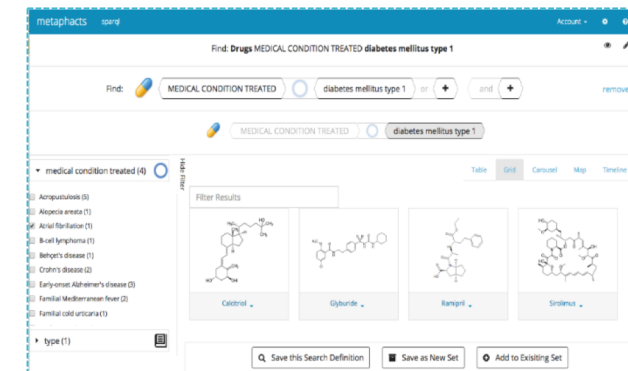
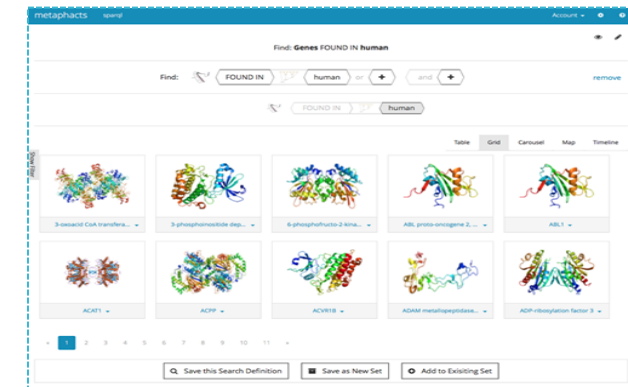
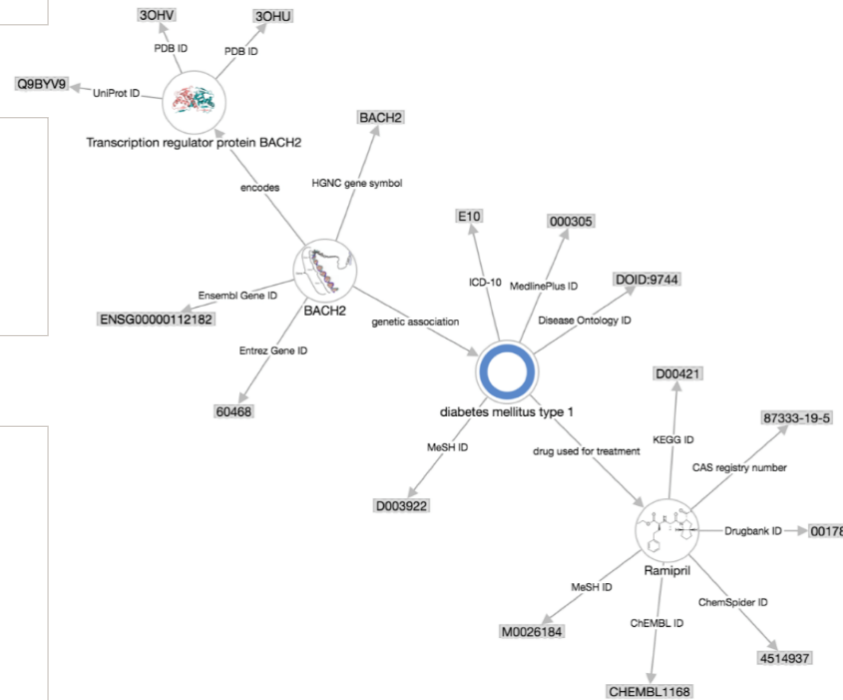
Approach

Integration of 20+ data sources
 Development of a global ontology
 Customization of metaphactory for drug discovery



Benefits & Value Proposition

One-stop portal to more than 1 billion facts
 Rich semantic search on a conceptual level
 Entry points to additional data, in-house and external
 Crossing boundaries between private and open data
 Target dashboard
 Integrated knowledge representation
 Common format
 Stable, global identifiers
 Federated queries across data sources



Challenges

Support researchers and curators in the refinement and expansion of existing data, and the creation of semantic narratives and meaningful visualizations



Approach

CIDOC CRM-based System: Integration of data from various sources while allowing for the data to retain its individual characteristics, original meaning and perspective

Customized components for data analysis, search and collaboration



Benefits & Value Proposition

Faster and more comprehensive research

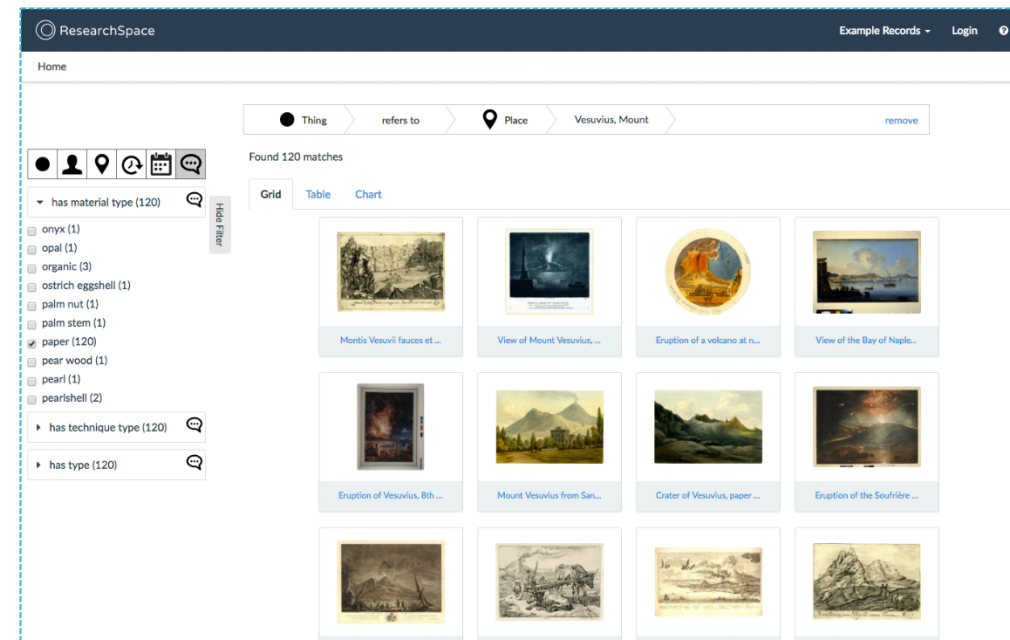
Whole collection of The British Museum in one Knowledge Graph

Support for semantic search, Geo search, semantic annotations & narratives, assertions and arguments

Researchers find related artefacts and can establish new links

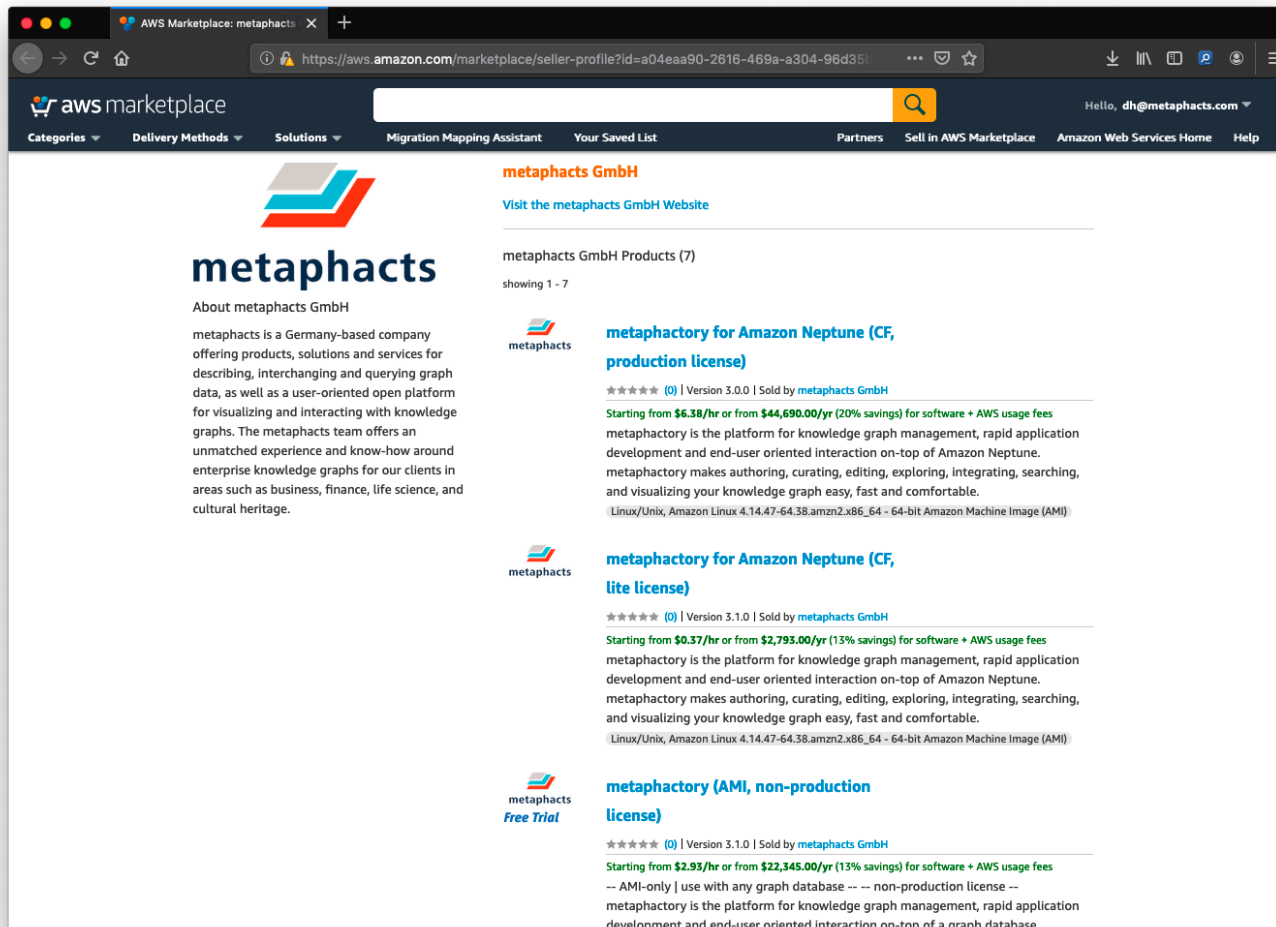
Semantic and intelligent clipboard for better collaboration

THE BRITISH MUSEUM



The screenshot displays the ResearchSpace interface. At the top, there's a navigation bar with 'ResearchSpace' on the left and 'Example Records' and 'Login' on the right. Below the navigation bar, a breadcrumb trail shows 'Home' > 'Thing' > 'refers to' > 'Place' > 'Vesuvius, Mount'. A search bar on the right contains 'Vesuvius, Mount' and a 'remove' button. Below the breadcrumb, it says 'Found 120 matches'. There are three tabs: 'Grid' (selected), 'Table', and 'Chart'. On the left side, there's a filter panel with a 'Hide Filter' button. The filter panel shows a list of material types: 'has material type (120)' with sub-items like 'onyx (1)', 'opal (1)', 'organic (3)', 'ostrich eggshell (1)', 'palm nut (1)', 'palm stem (1)', 'paper (120)' (checked), 'pear wood (1)', 'pearl (1)', and 'pearlshell (2)'. Below this, there are 'has technique type (120)' and 'has type (120)' filters. The main content area shows a grid of 12 image thumbnails, each with a caption below it. The captions include: 'Montis Vesuvii fauces et...', 'View of Mount Vesuvius...', 'Eruption of a volcano at n...', 'View of the Bay of Naple...', 'Eruption of Vesuvius, 8th...', 'Mount Vesuvius from San...', 'Crater of Vesuvius, paper...', and 'Eruption of the Soufrière...'.

Try metaphacts yourself!



- Available on the AWS marketplace with Free Trial

- metaphacts @ AWS marketplace

<https://aws.amazon.com/marketplace/seller-profile?id=a04eaa90-2616-469a-a304-96d35bd77641>

metaphacts GmbH

Daimlerstraße 36

69190 Walldorf

Germany

p +49 6227 6989965

m +49 157 50152441

e info@metaphacts.com

 [@metaphacts](https://twitter.com/metaphacts)

We are hiring!
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metaphactory - end-to-end Knowledge Graph platform

