The Open Digital Twin Platform (ODTP)

The Prototype Digital Twin for Research the Swiss Mobility System

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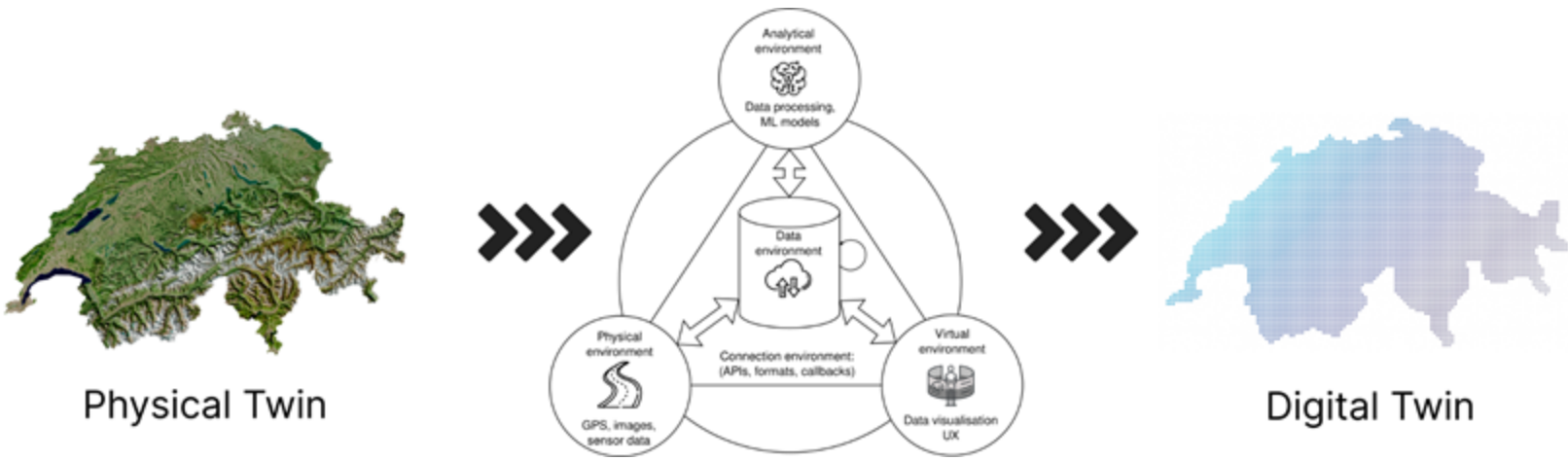
ODTP Workshop

Outline

- Introduction to ODTP
- Eqasim: ODTP 1st Case of Use
- ODTP Architecture
- Data Governance
- Semantics
- Development
- Demo

Open Digital Twin Platform



ODT - Open Digital Twin of the Swiss Mobility System

A case of use for reusability by design and by default

Problems to be solved.

- Development of a semantic standard for **open source digital twins** applied to mobility.
- **Privacy and security solutions** for dealing with highly sensitive data.
- Design of a **microservice architecture** compatible with analytical workflows involving multiple running ecosystems.
- Development **of an open-source platform that support traceability, reusability, inspection, and querying of digital twins.** The platform can be installed locally.
- Development of a **online repository** containing pointers to ODTP community products.

ODTP core features are a implementation of ORD best practices

CLI / Web-based UI

Analysis tracker / Traceability

Workflow manager

Analysis comparison

Container-based analysis

Data governance / License manager

Semantic validation

Snapshots Storage

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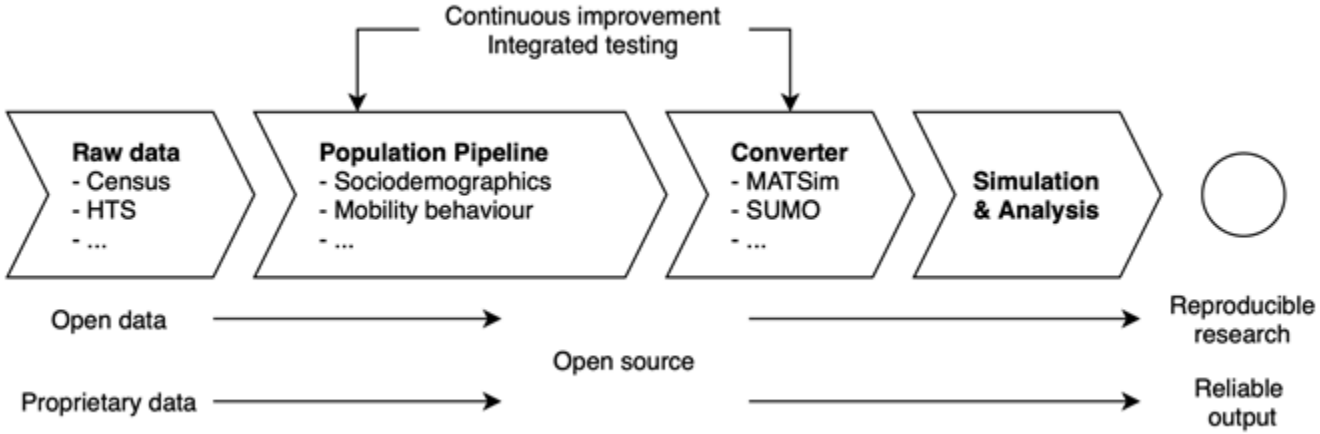
Eqasim
ODTP: 1st case of use.

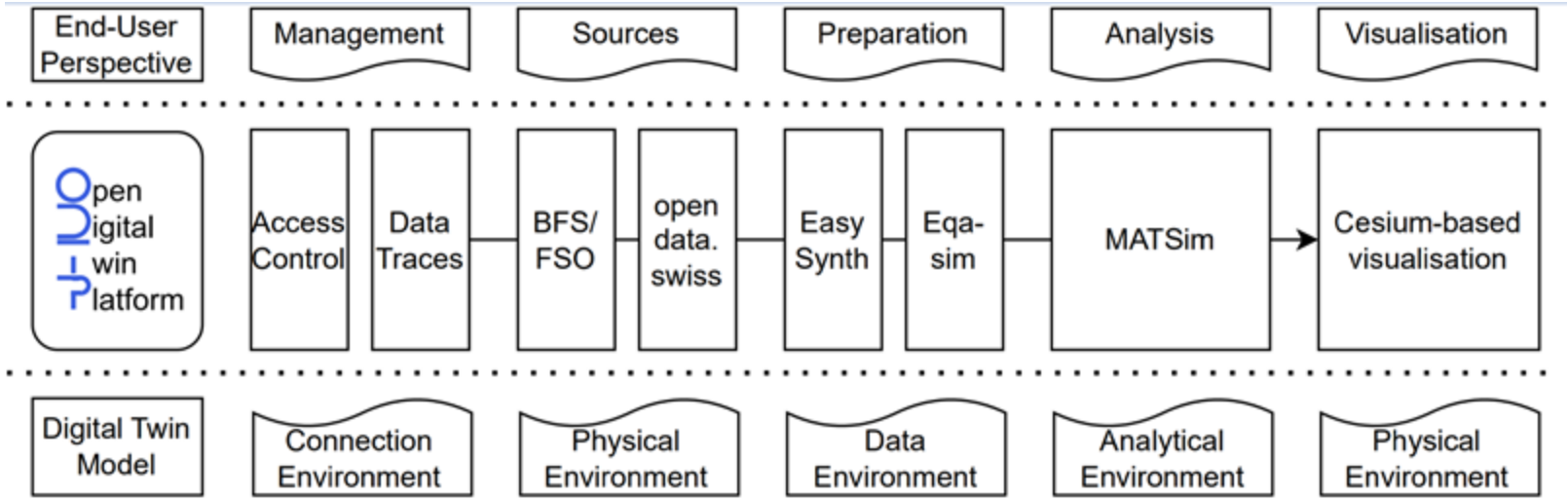
ODTP 1st Case of use: Eqasim.



Working scenarios: Île-de-France, Switzerland, and Corsica.

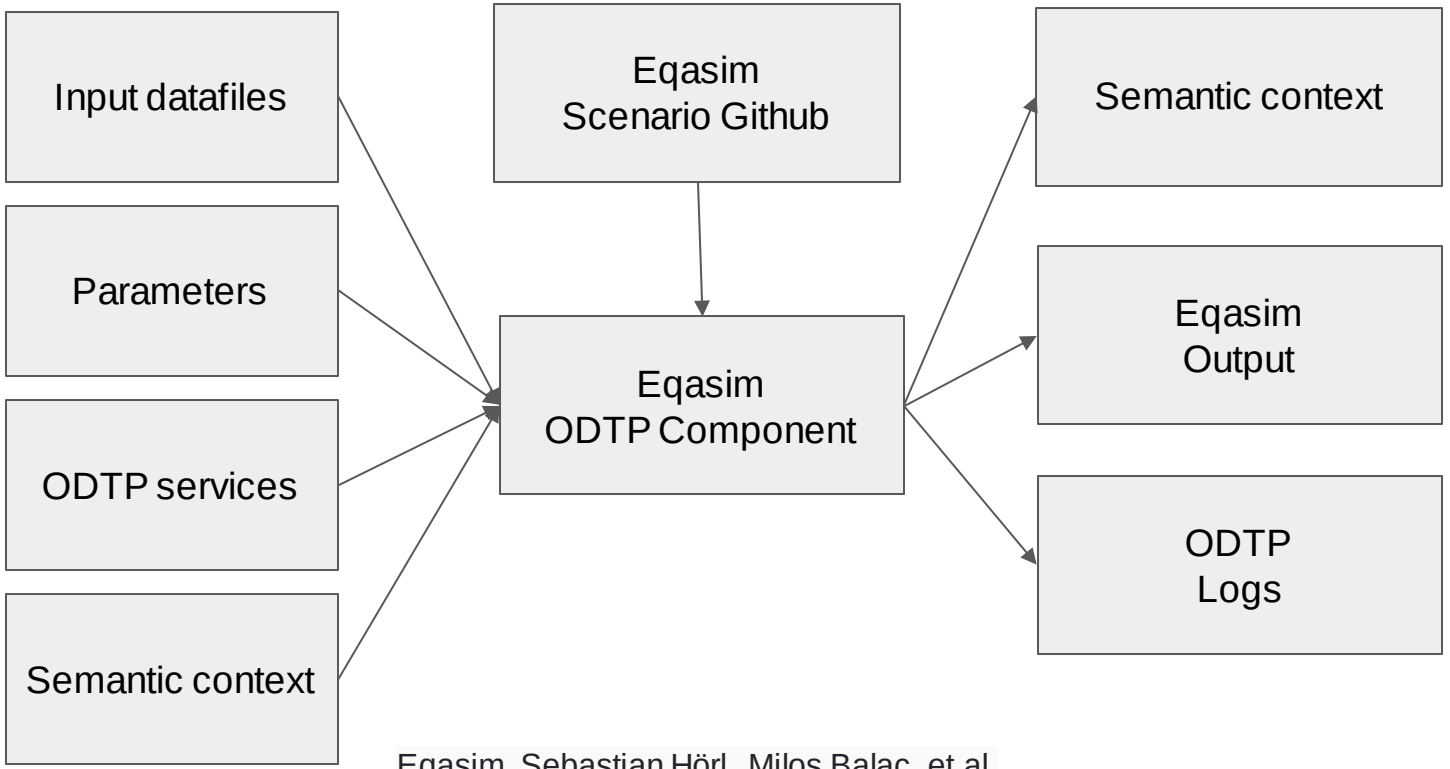
Eqasim. Sebastian Hörl, Milos Balac, et al.

Eqasim PoC



Eqasim. Sebastian Hörl, Milos Balac, et al.

Eqasim



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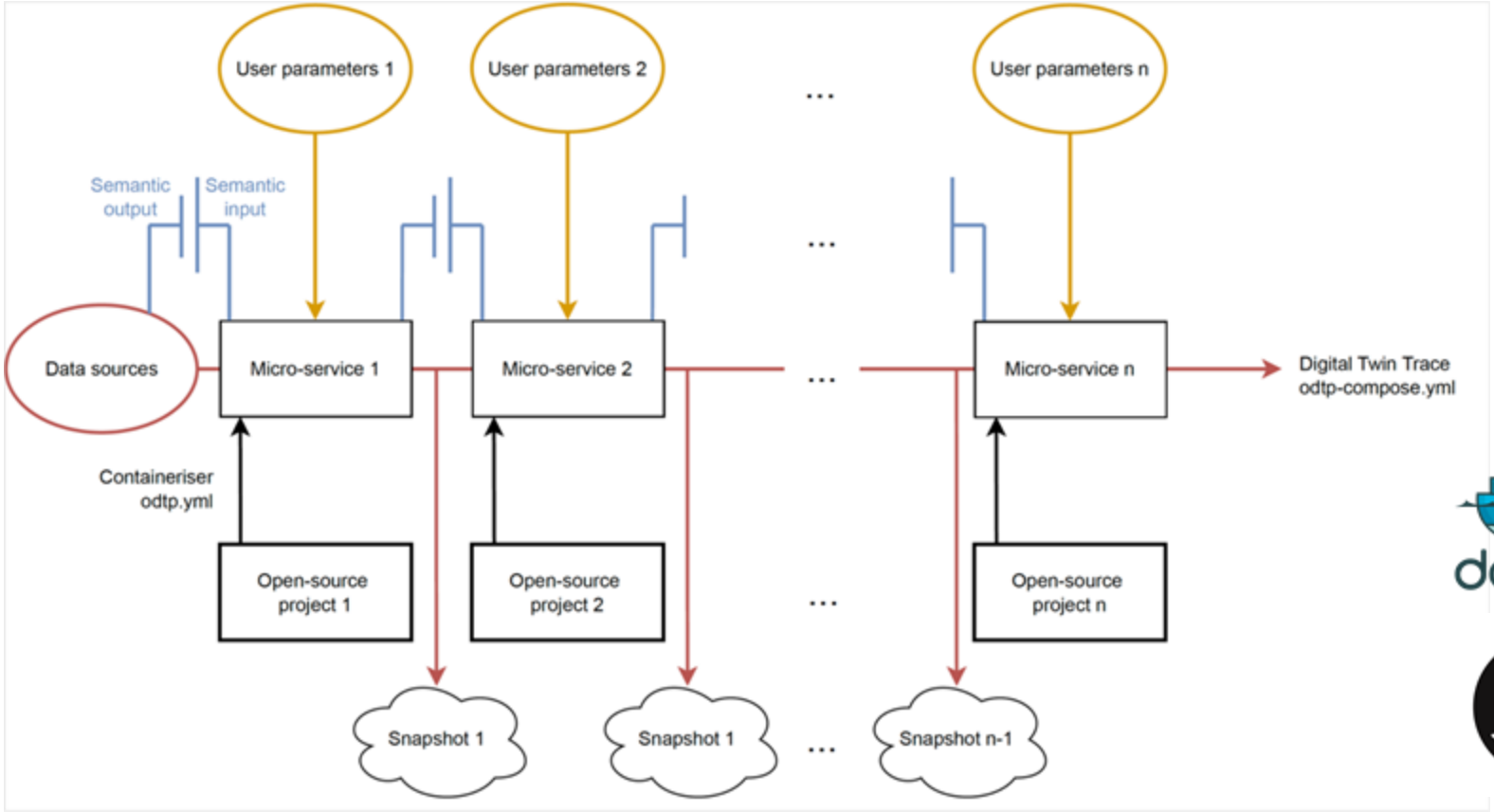
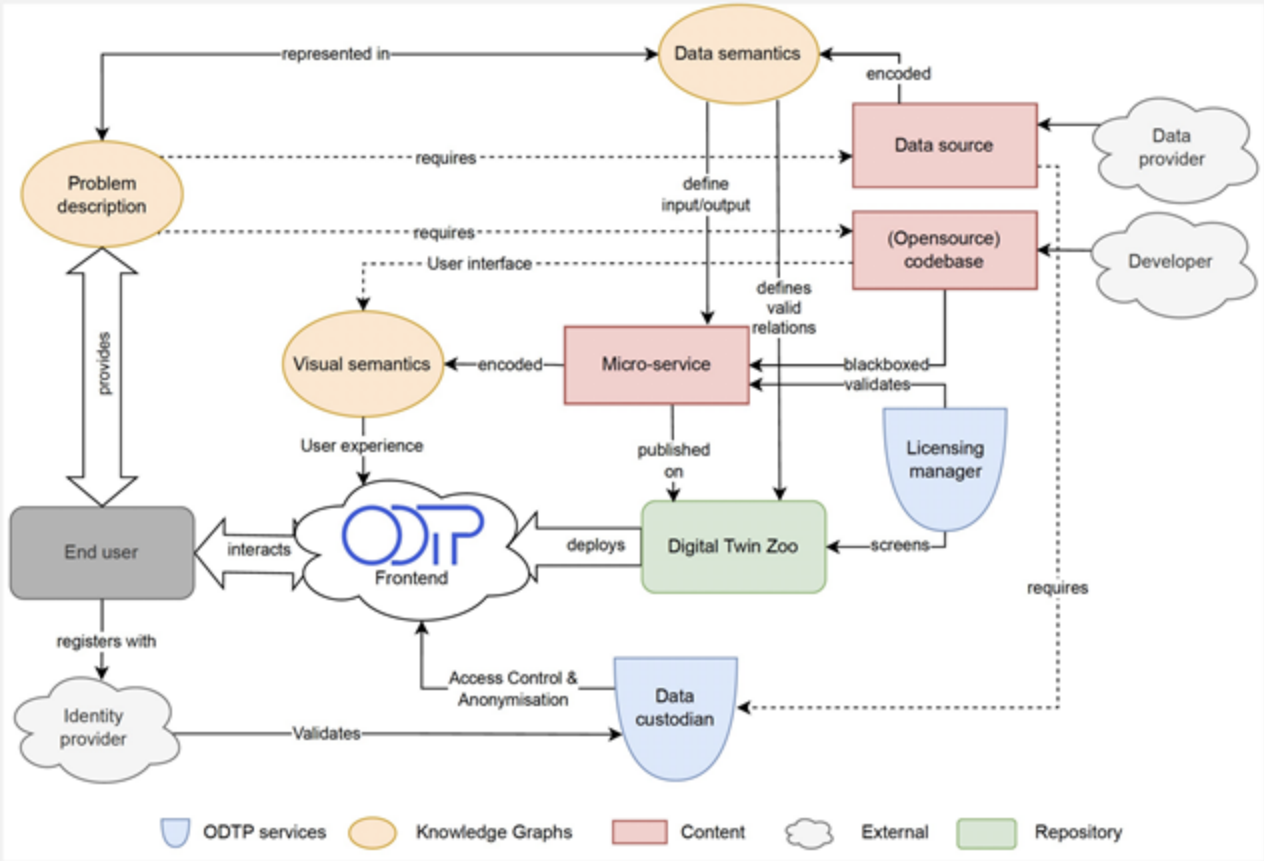
ODTP Architecture

Digital Twin representation



Architecture detail



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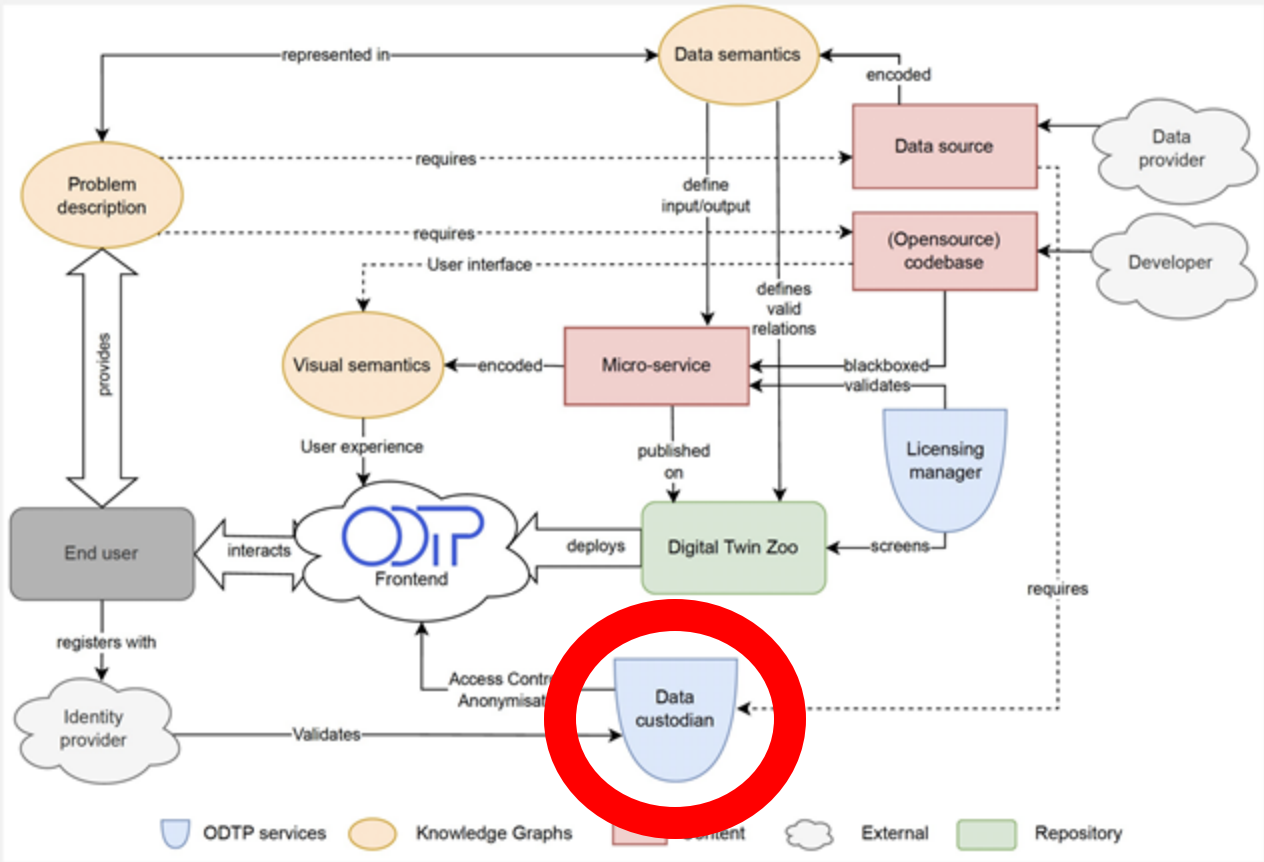

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ODTP Governance, Confidentiality and Security

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WHY

Digital Twin Platform Security, Confidentiality Issues

Digital Twins Platforms Privacy and Security Concerns

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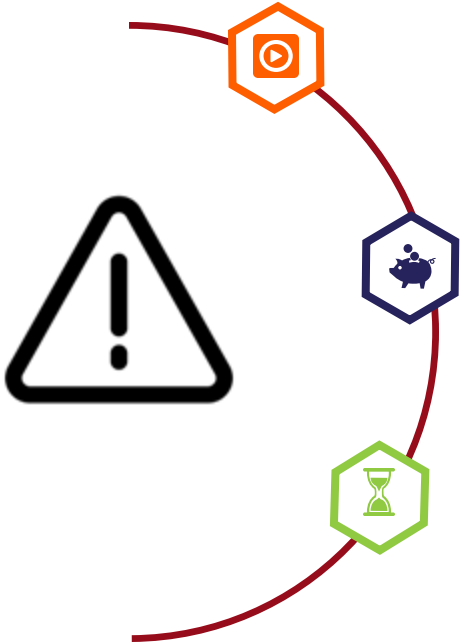

Data breaches

Exposes confidential, protected information to an unauthorized person

Unauthorized Access

- Target for cyberattacks
- Data pipeline and storage can be compromised

Non compliance with regulation

- FADP
- GDPR

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HOW

Mitigating Confidentiality and Security Risks in ODTP

Enforce Privacy / Security Best Practices

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Access control

Ex: The users, applications, and services that interact with the data pipelines

Encryption

Ex: Ensure that data is encrypted according to sensitivity and value, type, source, and destination

Privacy Preservation

Ex: Combine the technical measures, such as data anonymization and encryption, and regulatory measures

Monitoring

Ex: Audit and log the activities and events that occur in data pipelines

A dynamic privacy-based access control and governance

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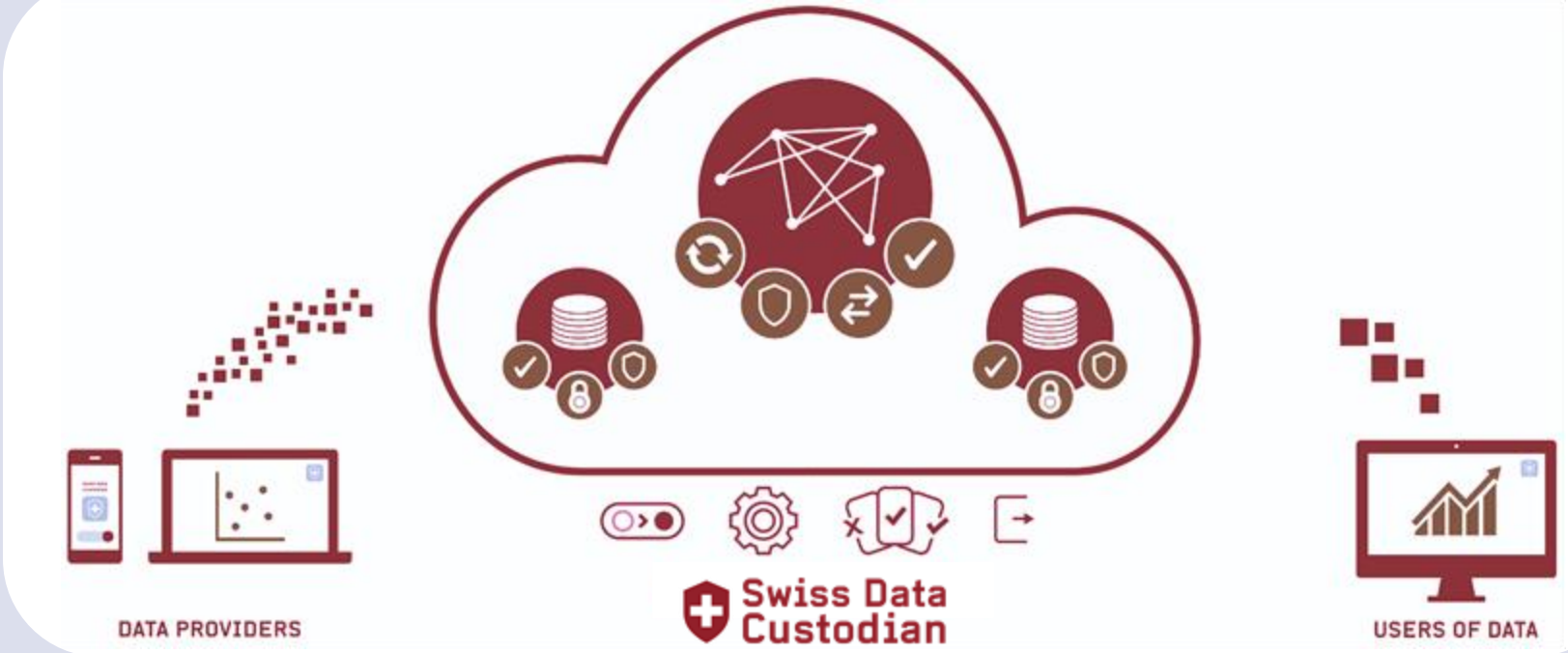
According to the terms of human and machine-readable digital contracts



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Governance

Key Automation Capabilities

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Contract Generation

Create tailored templates for data governance contracts to meet the specific needs of involved parties.

Contract Review

Automatically review contracts for compliance with relevant laws and regulations.

Contract Monitoring

Track and ensure ongoing compliance and implementation of data governance contracts over time.

Scenario Example with SDC

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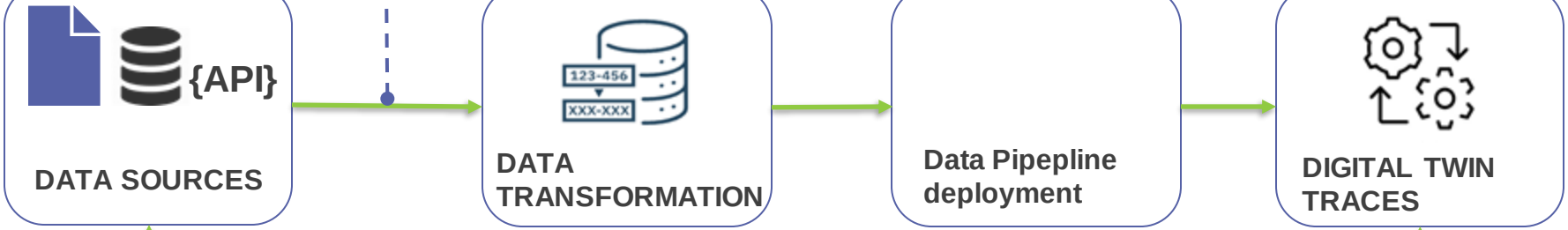
- Semantic Data Shape
- Privacy Requirements
- Consent (legal ground)
-

Contract

- Data collection
- Synthetization
- Pseudonimization
- Anonymization

- Rules for deploying



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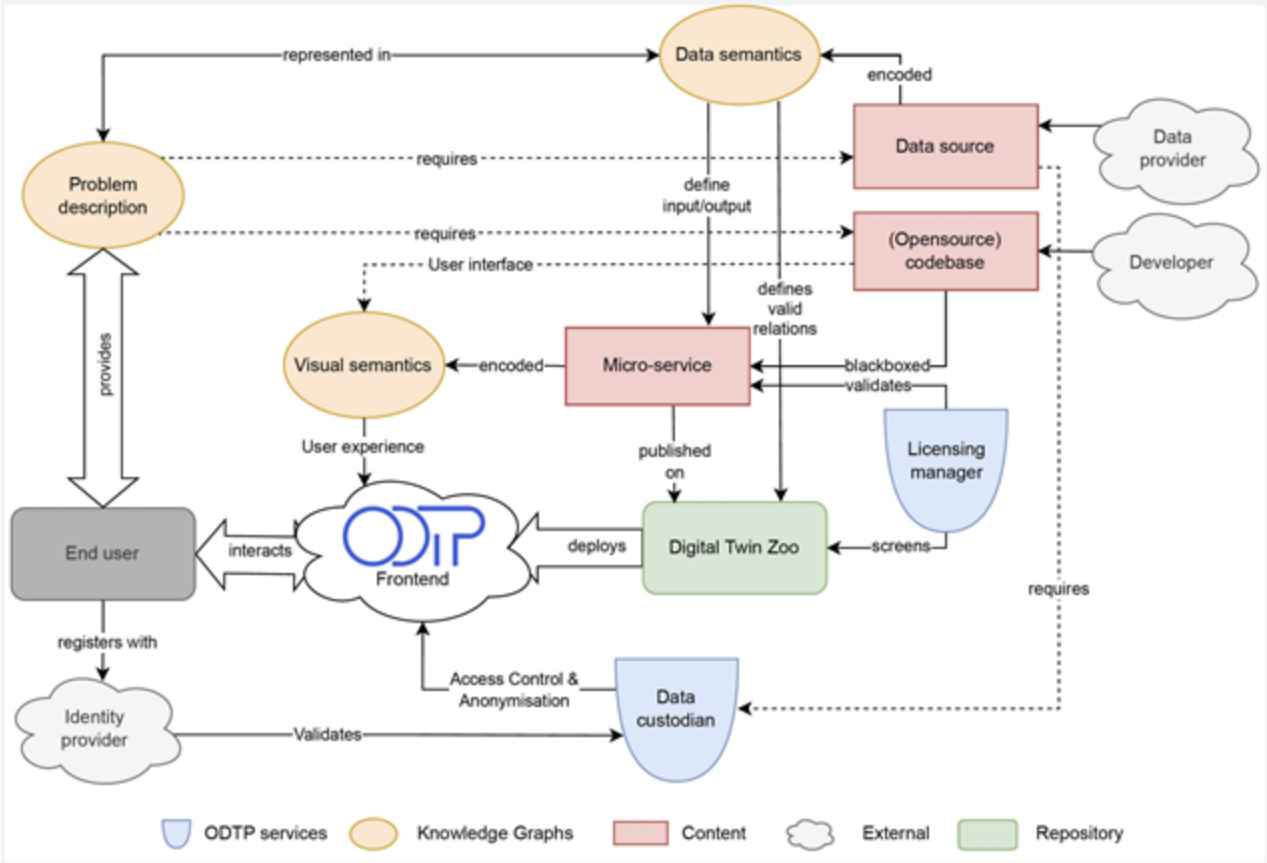
- ODTP Access Control
- ODTP Monitoring

Architecture detail



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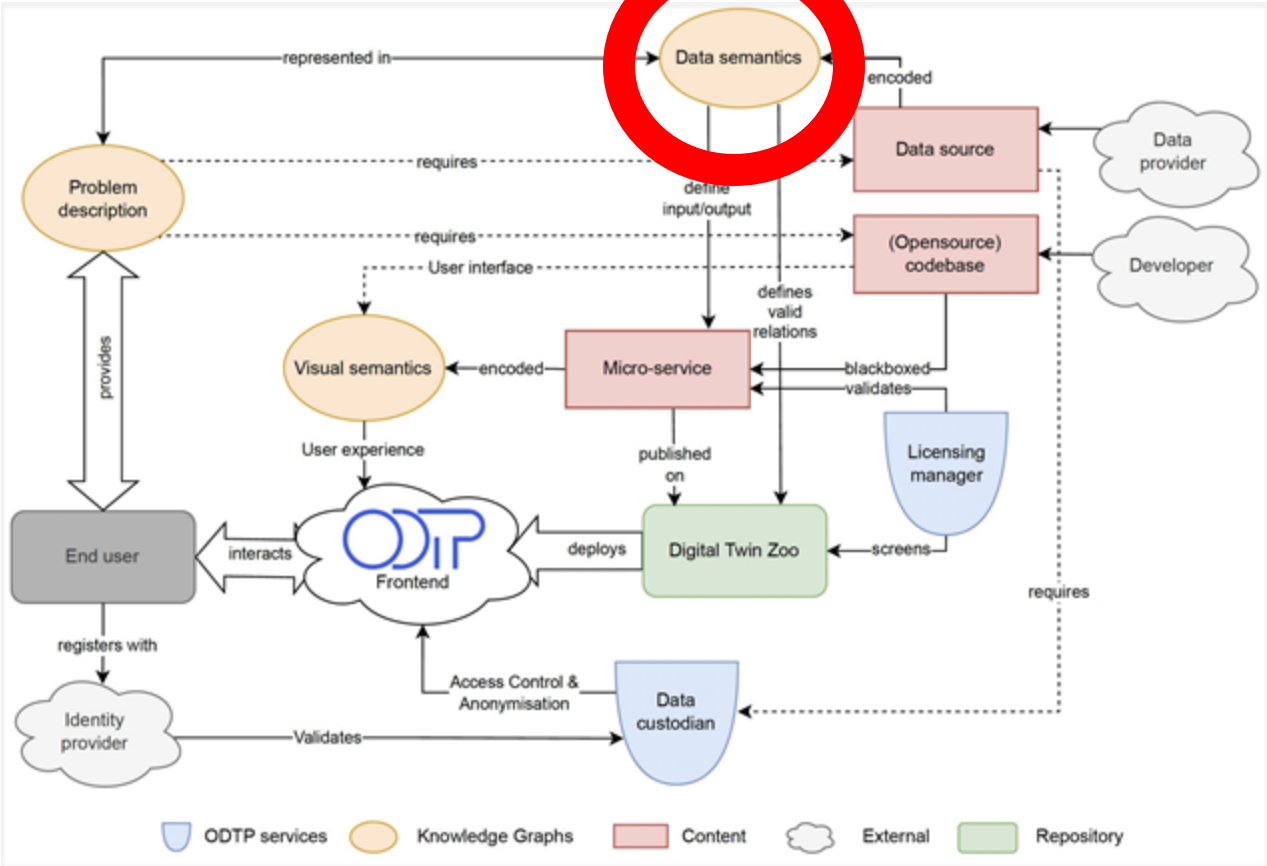

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ODTP Semantics

The Problem with sharing tools & data

User has a dataset

User wants to use your tool

Your tool is not built for their dataset (except Eqasim haha)

Those requirements should be:

- Human readable
- Flexible/expandable
- Computer verifiable

Automated verification of file folders:

1. Look inside folder
2. List files
3. Compare list with required list of files
4. Go into file
5. Look at column headers
6. List column headers
7. Compare list with required list of variables
8. (optionally) check datatype of random samples
9. Give user feedback on what files/variables are missing/wrong

Why?

Meaning negotiation

•Definitions, labels, datatypes and other restrictions make it possible for humans to interpret whether their variable “means the same” as the one requested.

Translation

•Capturing languages of labels with synonyms allows easy translation between datasets in different languages

From strings to things

•If people re-use variables explicitly defined on the web, you can refer to them, rather than re-defining them yourself.

The Problem with sharing tools & data

ID	Werkt	Inkomen_brutto	OV_abbo_sinds	Dalurenkaart
12345abc	Ja	3850	13 juni 2017	Ja
…	…	…	…	…

ID	Employed	Income_before_tax	Public_transport_subscription_since	Off-peak_hours_discount_card
4567def	True	$4000	07-08-2012	True
…	…	…	…	…

GUID1	GUID2	GUID3	GUID4	GUID5
asdfh3487	False		01/02/04	True
…	…	…	…	…

A solution

Variable name	**Income_gross**	**Employed**	**Public_transport_subscription_since**	
Label (en)	Gross Income	…	…	…
Label (de)	Bruttoeinkommen	…	…	…
Label (nl)	Brutto Inkomen	…	…	…
Label (fr)	Revenu Brut	…	…	…
Definition (en)	an individual's total earnings before taxes or other deductions.	…	…	…
Definition (de)	der Gesamtverdienst einer Person vor Steuern oder anderen Abzügen.	…	…	…
Definition (nl)	het totale inkomen van een individu vóór belastingen of andere inhoudingen.	…	…	…
Definition (fr)	le revenu total d'un individu avant impôts ou autres déductions.	…	…	…
Datatype	xsd:decimal	xsd:boolean	xsd:date	

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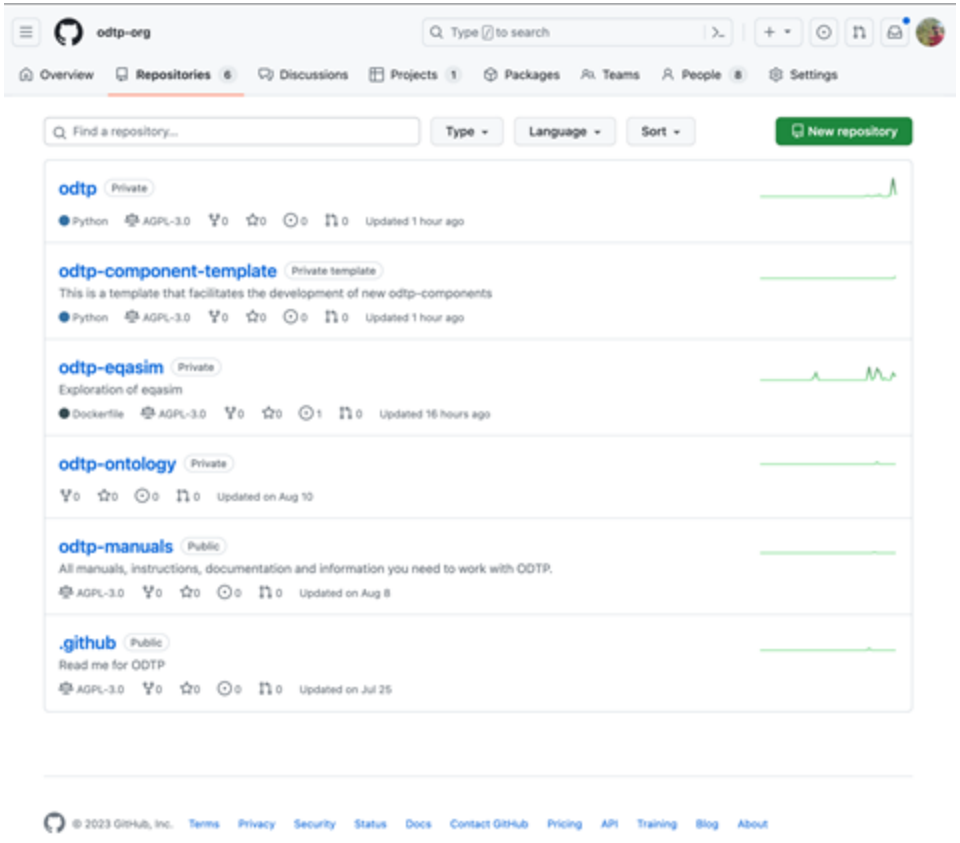
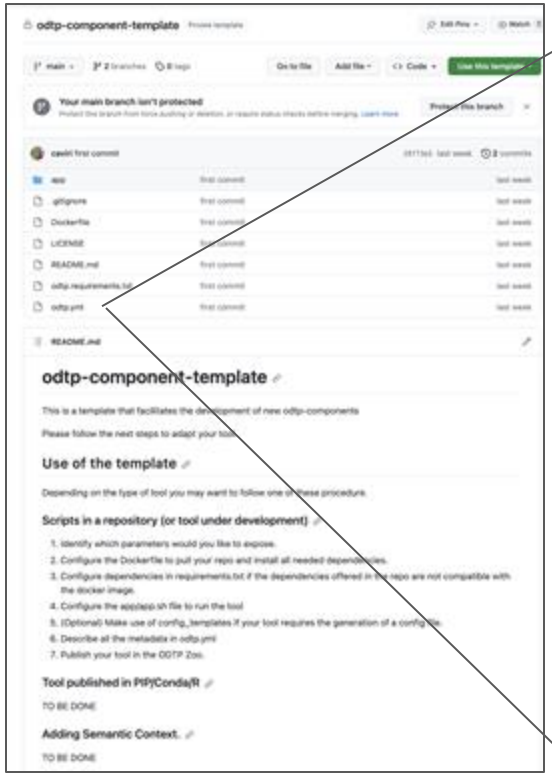
Development

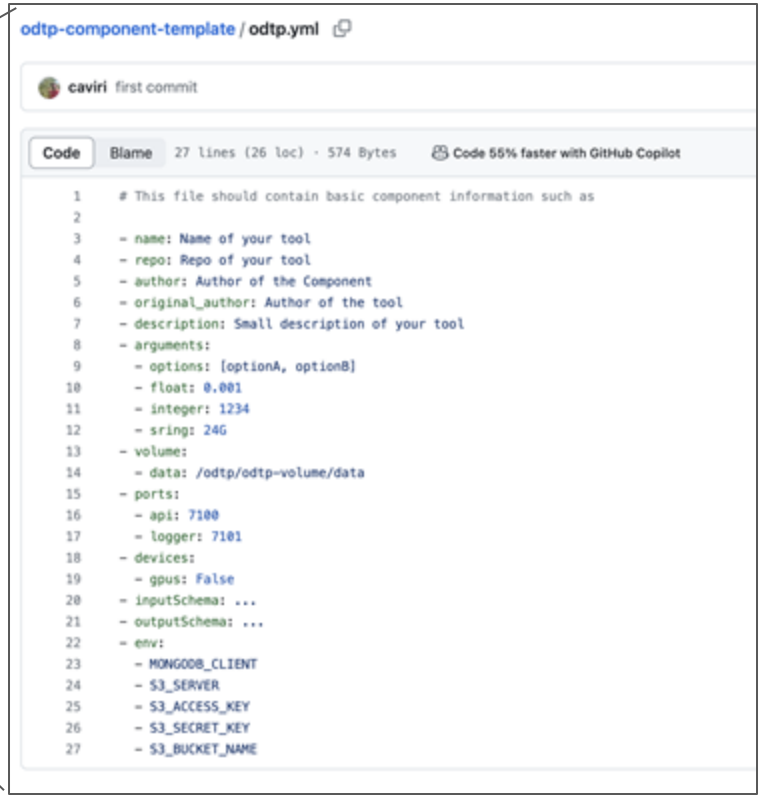
Project development

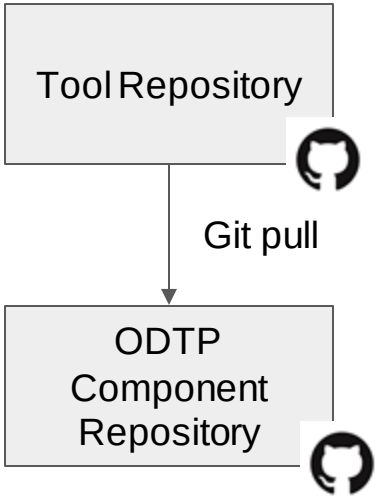


https://github.com/odtp-org

Project development







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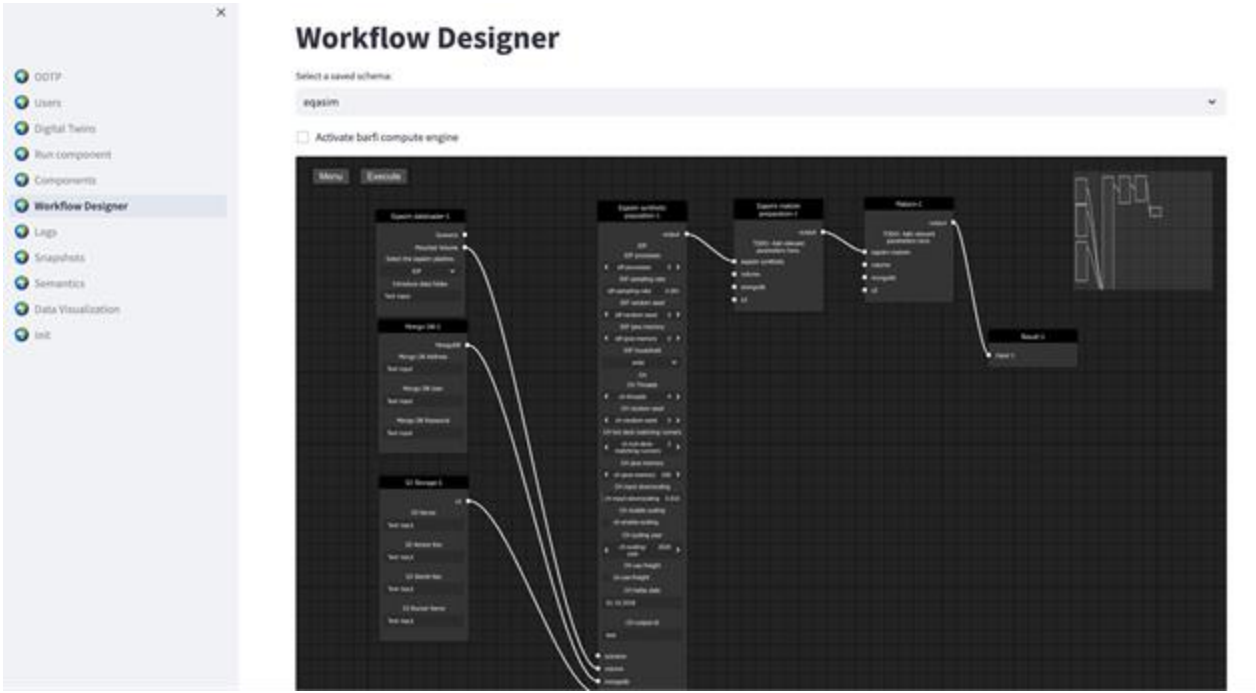
Demo

Demo


Workflow Designer
OOTP
Users
Digital Twins
Run component
Components
Workflow Designer
Logs
Snapshots
Semantics
Data Visualization
Init
Select a saved schema:
eqasim
Activate barfi compute engine
Menu
Execute

Soon…

What's next?

- Integrate ODTP with semantic technologies (WIP)
- Integrate ODTP with Swiss Data Custodian (WIP)
- Implement Eqasim with Semantics & Data Governance solutions.
- Develop ODTP component for Interpretable and Robust Machine Learning for Mobility Analysis (Yanan's project)
- Develop ODTP for Chenyu's Eqasim visualization tool.
- Publish ODTP zoo for open components.

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Thank you!
Questions?