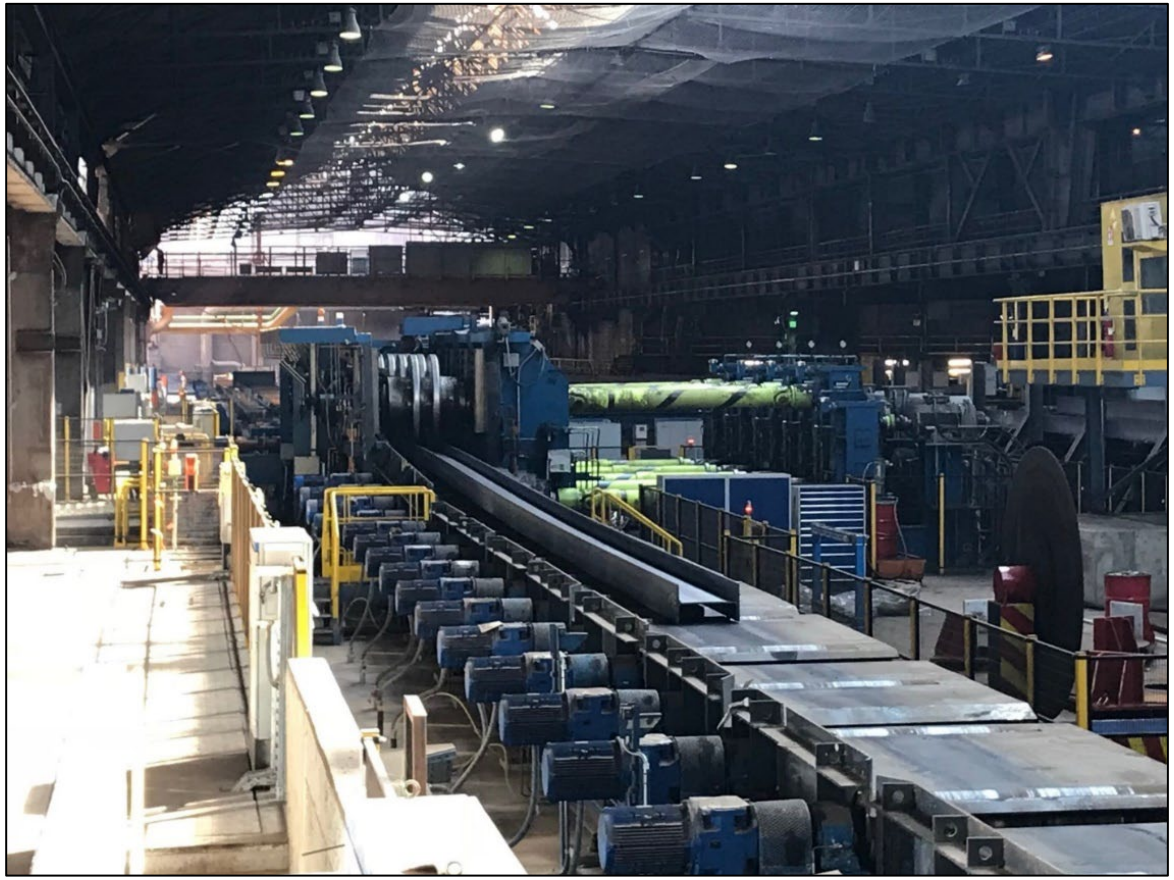
APP4 – Section Mill

Translator: CMCL

Industrial Partner: ArcelorMittal



Business Case

In terms of the business case, the following factors were highlighted as the most important:

- well-controlled and optimised production process
- even a small improvement could lead to a huge change in a large-scale production
- optimising the steel production process is a key to tackle raising energy, materials or CO_2 tariff costs
- digital tools for production process optimisation / analysis reduces costly experimental tests

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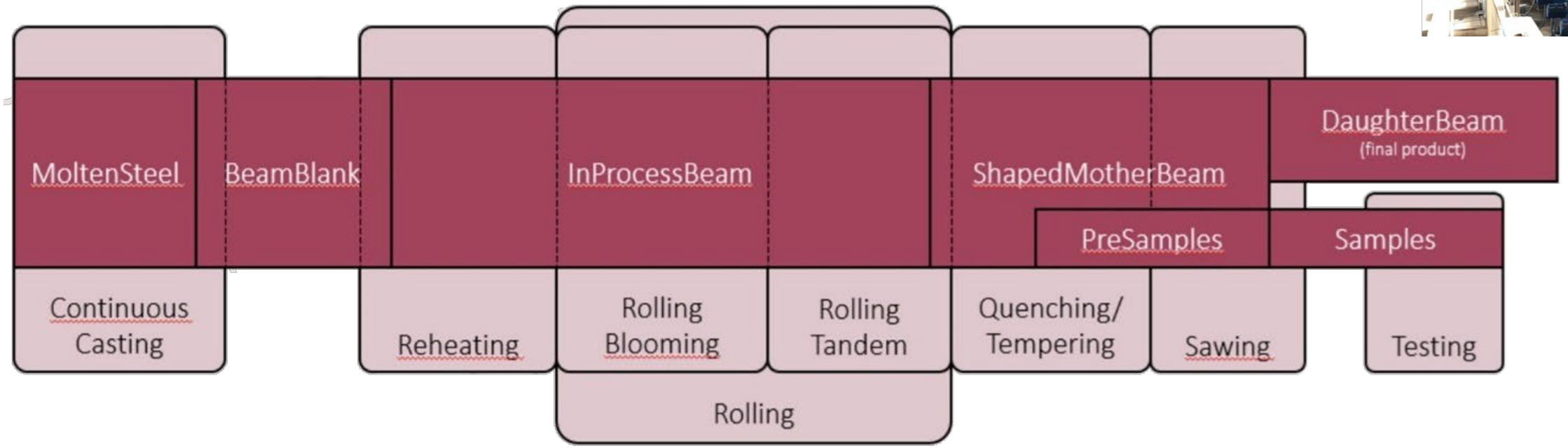
Industrial Case



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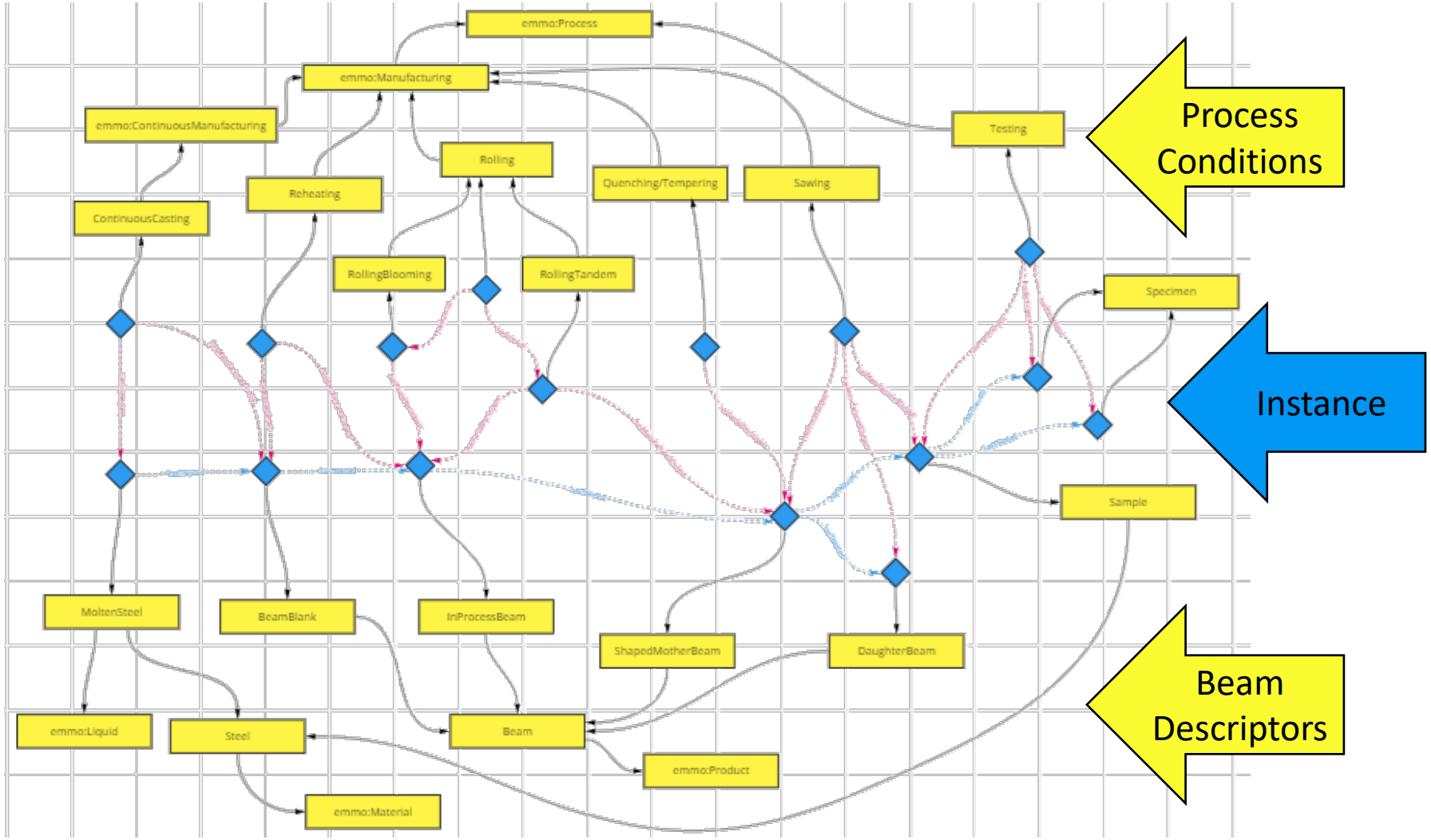
EMMO Compliant Application Ontology

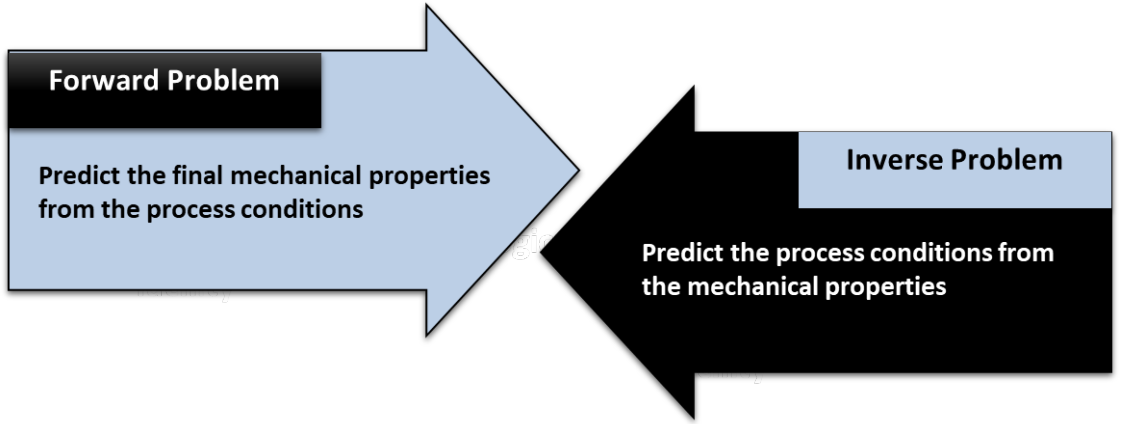


Full EMMO description of industrial process

The Challenge

APP4 interface designed to take into account both following problems:

- Predict the final mechanical properties of steel beams from the process conditions – Forward Problem
- Predict the process conditions from the mechanical properties – Inverse Problem



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Data and Metadata Curation

- Two-step curation process : Plant and Translator Level

Plant Level

collected raw production data was curated and verified by an experienced ArcelorMittal R&D engineer who worked on similar products

Translator Level

data cleaning, correlation analysis, metadata analysis – creation of detailed properties tables for each material, subprocess (together with partners)

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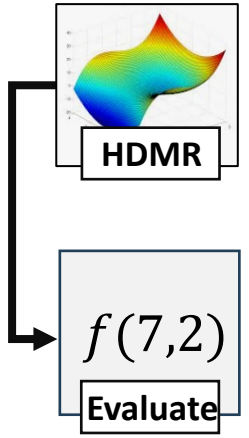
Forward Problem

Based on the previous steps, CMCL, the translator for this use case offers:

- The experimental data is used to generate a surrogate model where a fast-response surface is directly fitted based on the use case experimental data using the HDMR algorithm



- The used specifies a set of process conditions and the surrogate model is evaluated

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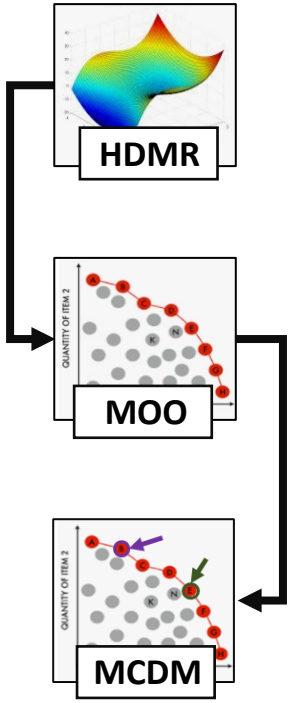
Backward Problem

Based on the previous steps, CMCL, the translator for this use case offers:

- a Surrogate Model workflow where a fast-response surface is directly fitted based on the use case experimental data using the HDMR algorithm
- a Multi-Objective Optimisation workflow (MOO) to optimise the use case KPIs, taking as an input the fitted surrogate model from the previous step
- a Multi-Criteria Decision-Making workflow (MCDM), taking as an input the Pareto front points from the previous MOO step



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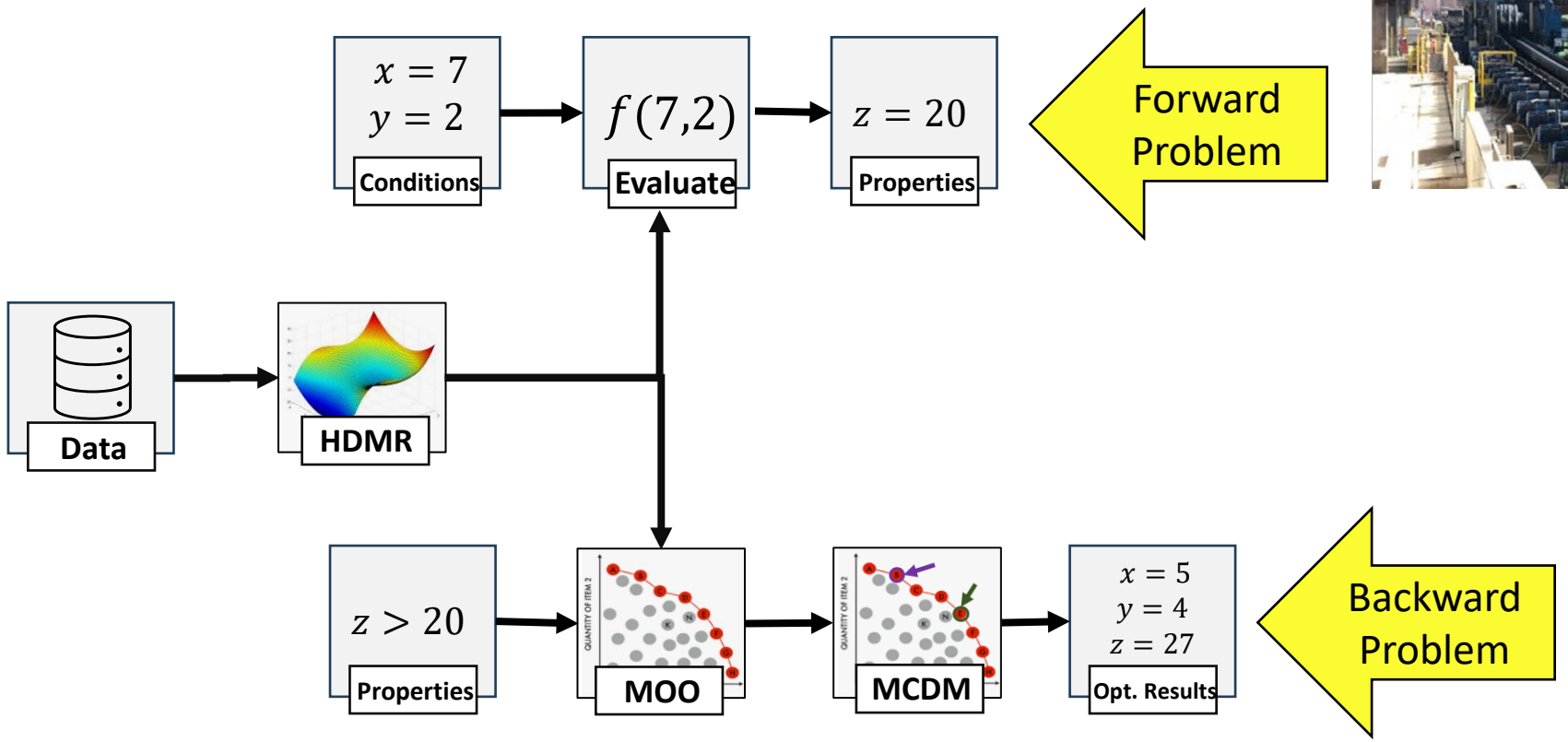
Process Model



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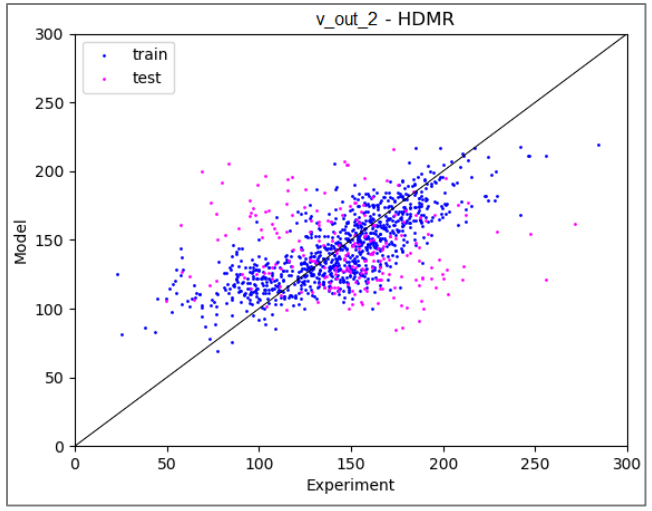
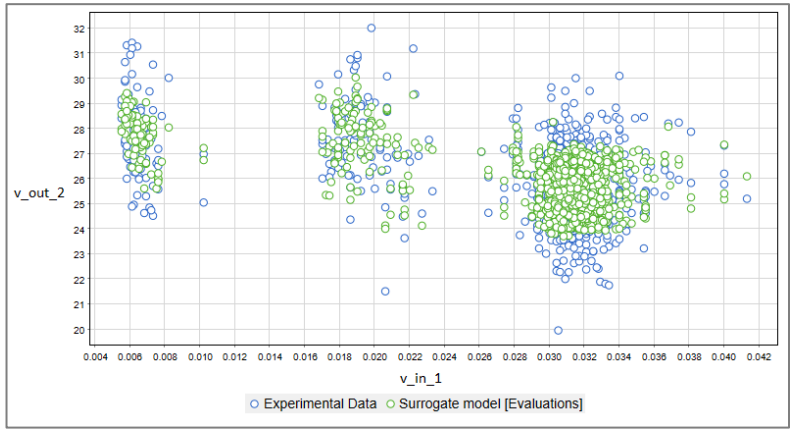
Model Validation & Communication





- Theoretical: Cross-validation of results over a test set of experimental data which have not been used in the modelling phase
- Industrial: Perform experiments (in factory/lab) using the new information arising from modeling and optimization procedures

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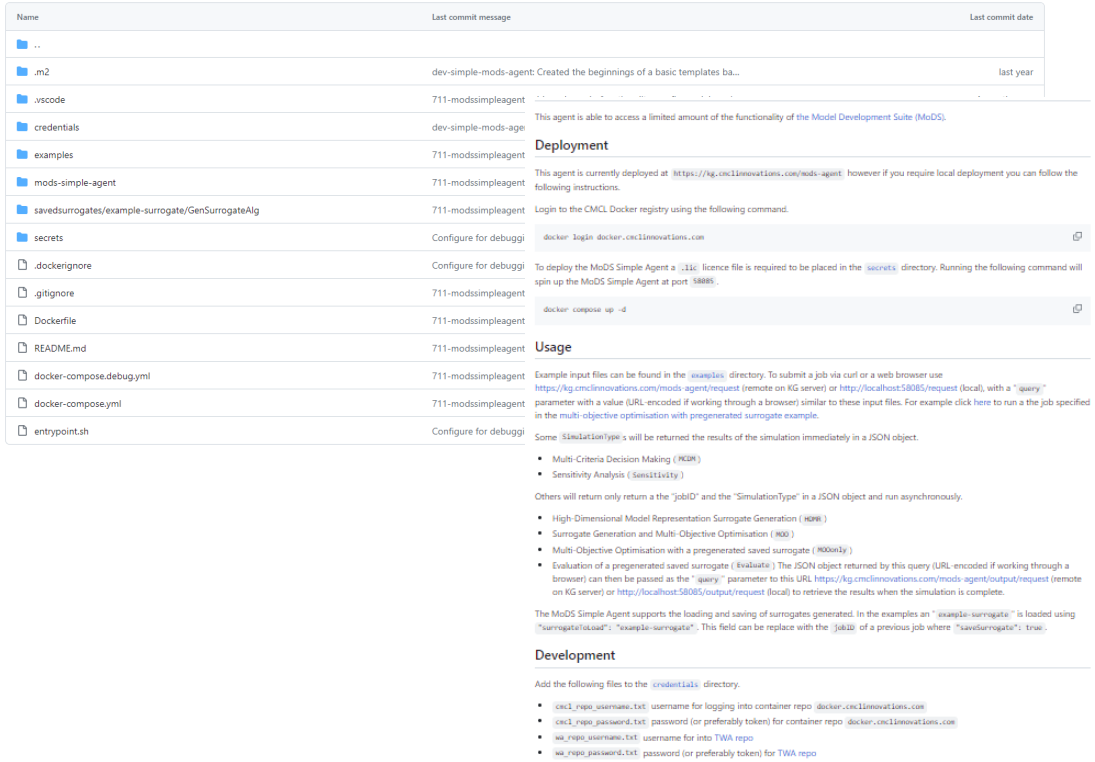
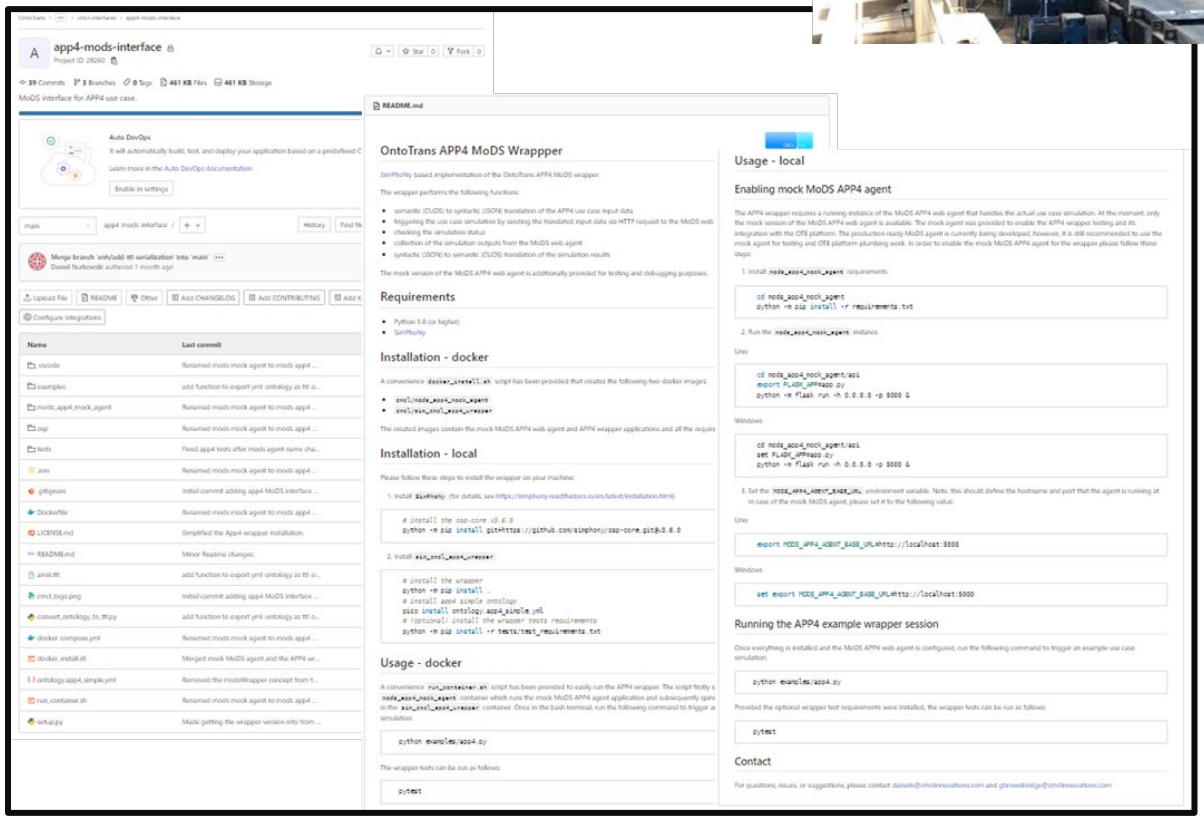
MoDS Agent

- Model Development Suite from CMCL
- MoDS Agent is a REST API for the Model Development Suite.
- Different functionality being developed for both projects.



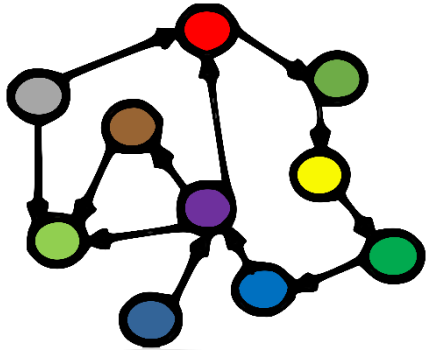
APP4 Interface

- The APP4 Interface beta version released on GitLab
- The interface built using the SimPhoNy-OSP
- Now supports forward and backward problem.
- The APP4 interface relies on the MoDS Agent to perform the necessary simulations.

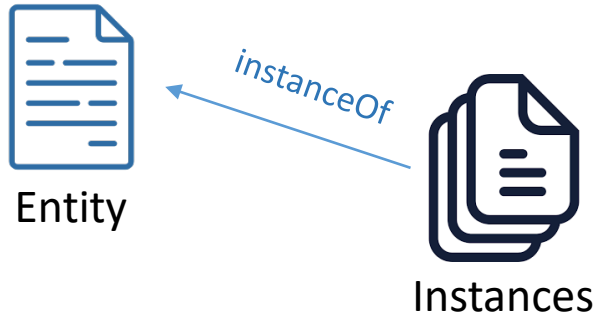


CUDS and DLite

- CUDS
  - data structure based on ontology
  - CUDS is an ontology individual
  - each CUDS object can be seen as a node in a graph
  - a certain instance can be seen as a container of other instances

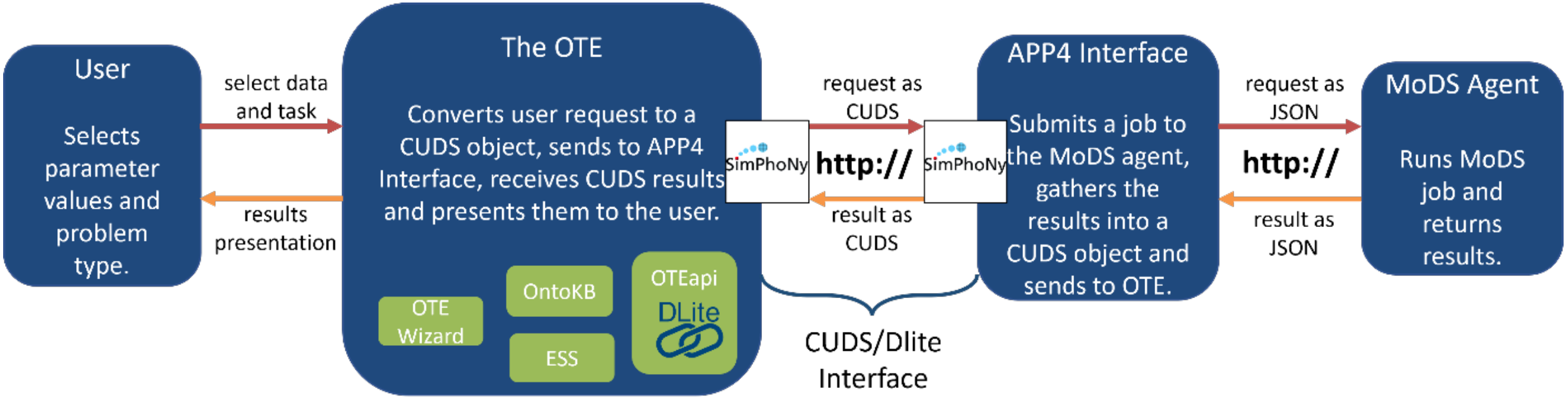


- DLite
  - data-centric framework for interoperability
  - Separation between data and metadata
  - DLite instances are described by data models
  - Metadata schema: identity, description, dimensions, properties
  - Semantics via mappings to ontologies



Technical Workflow

- App Interface
- Ontology development
- UI design



Advantage Brought by OntoTrans

- Complete ontological description of workflow:
  - Enhances understanding of industrial case.
  - Allows interoperability.
- Will allow users to explore the data themselves in a standardised way without needing any prior knowledge of any software or modelling techniques.
- Gives access to tools to post process and analyse data.
- Gives ability to expand on use case.