s-X-AIPI Project

self-X AI for humans in the factories of the future

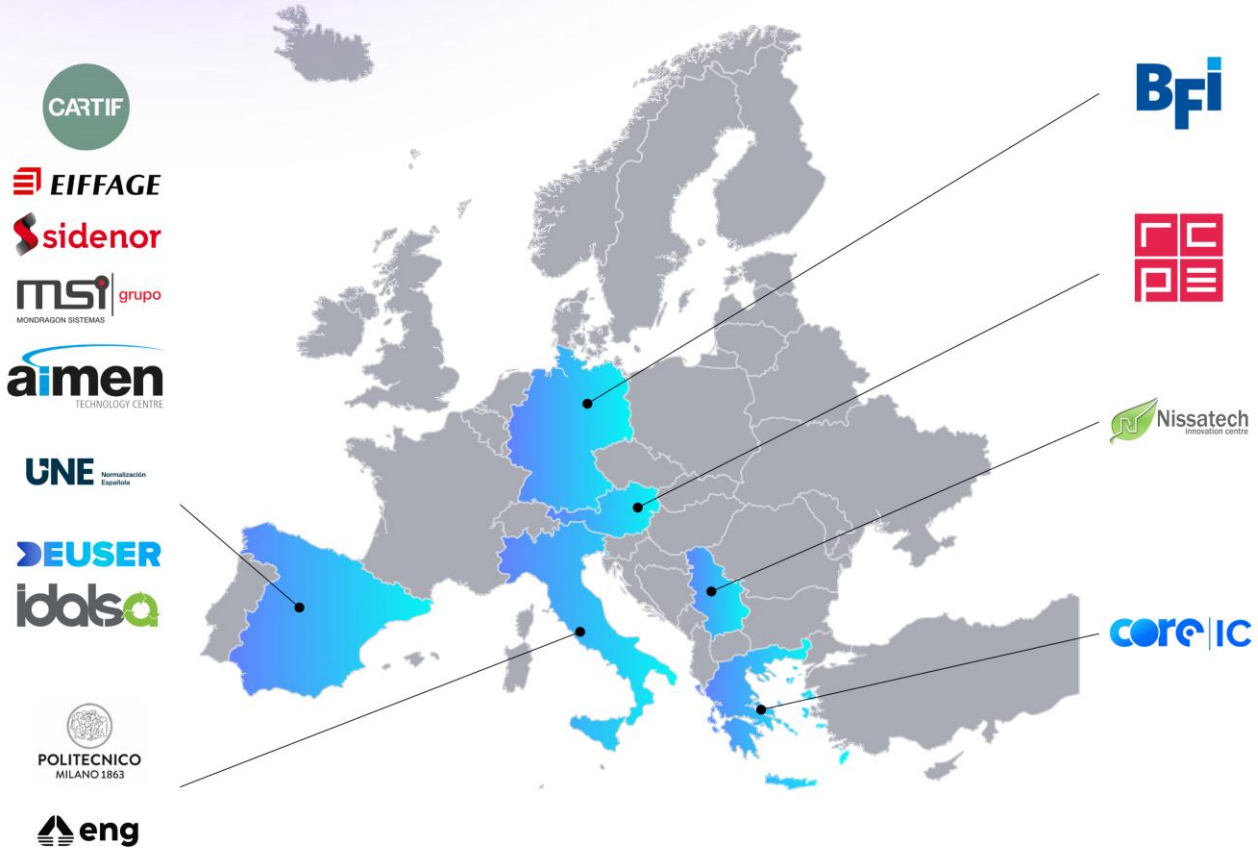
Co-funded by the European Union

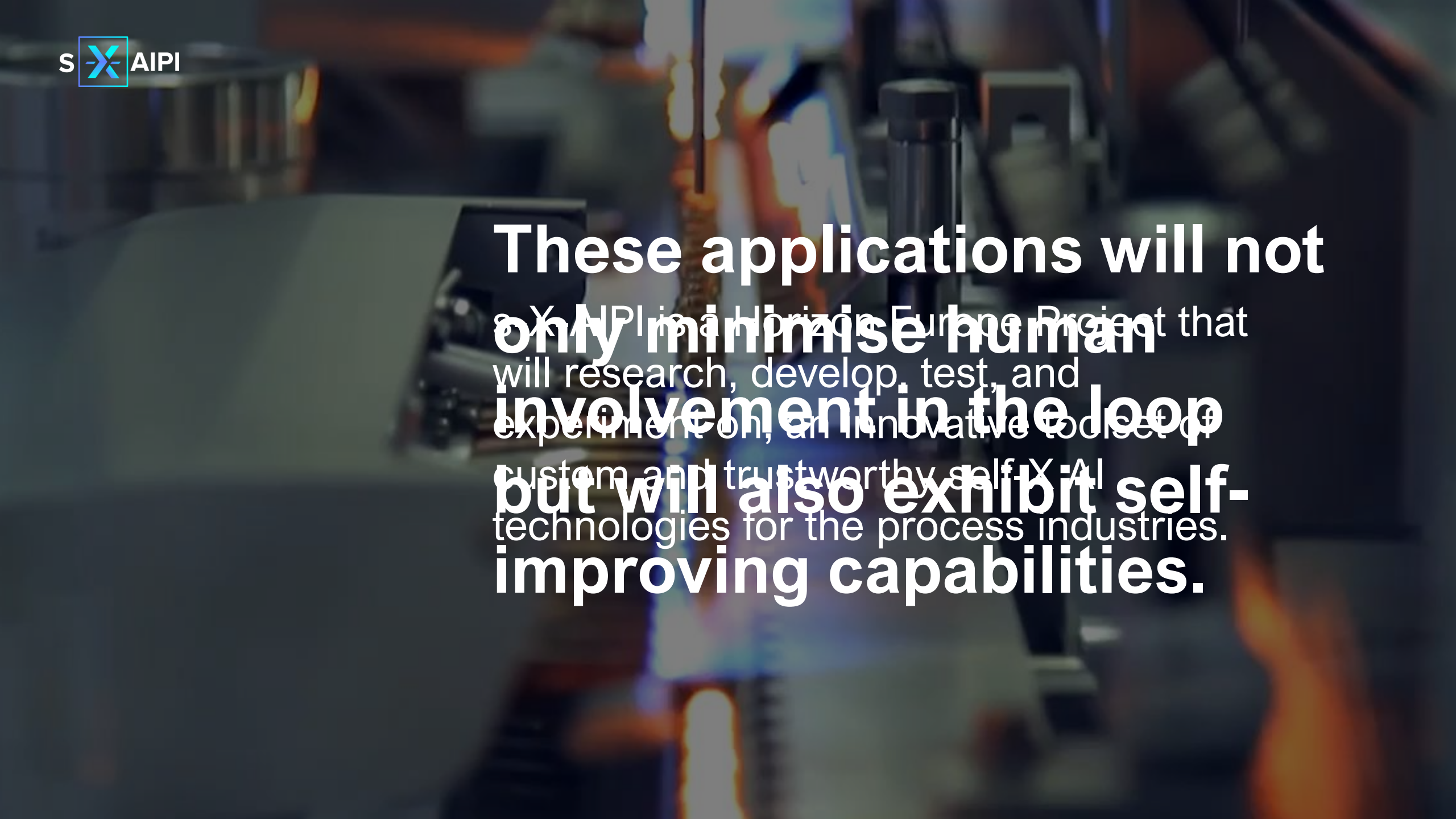
Grant Number 101058715

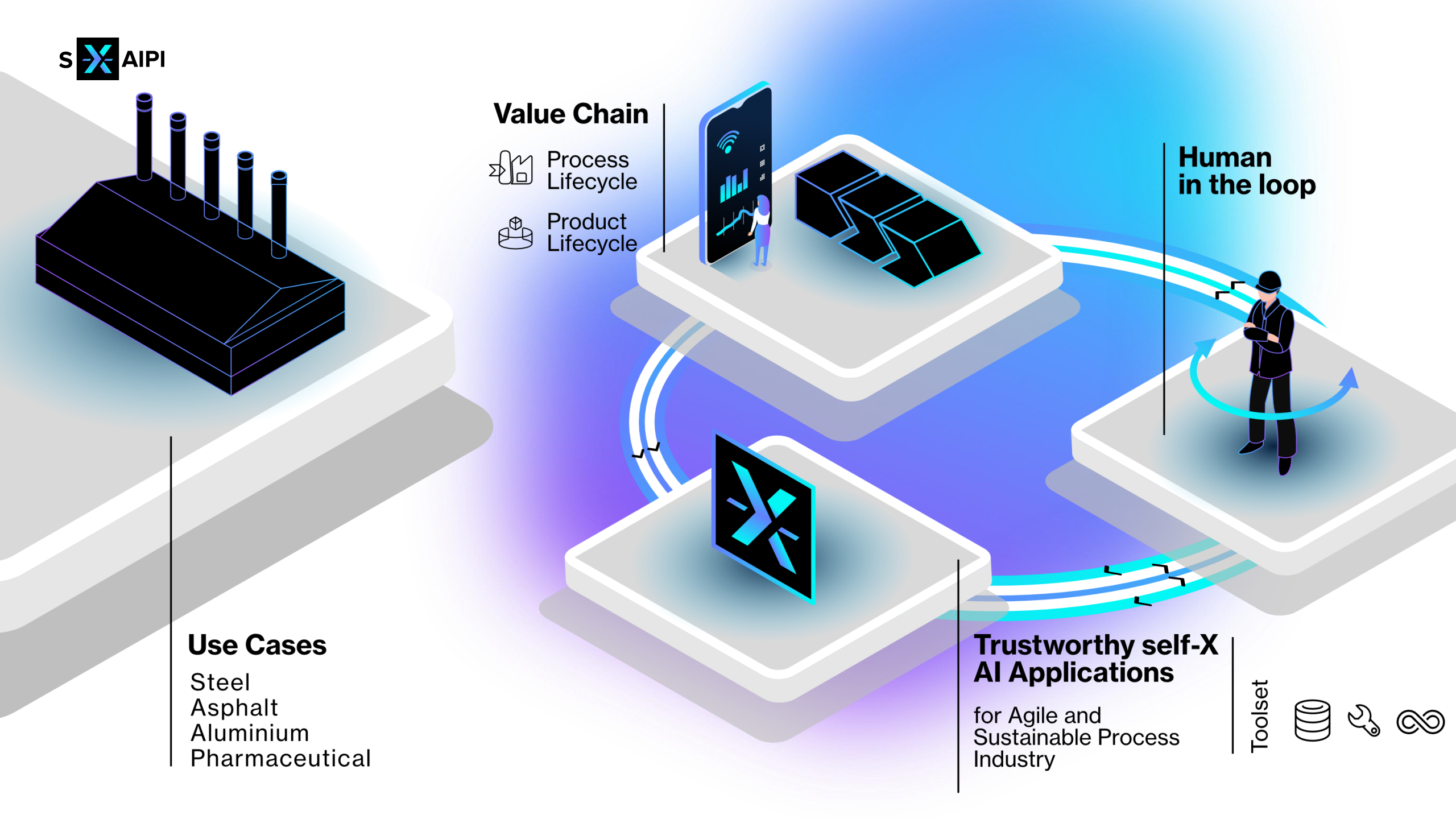
SXAIPI

Partners

The Consortium is composed by 14 partners across 6 European countries including SMEs, large industries, leading research institutions and standardization bodies.

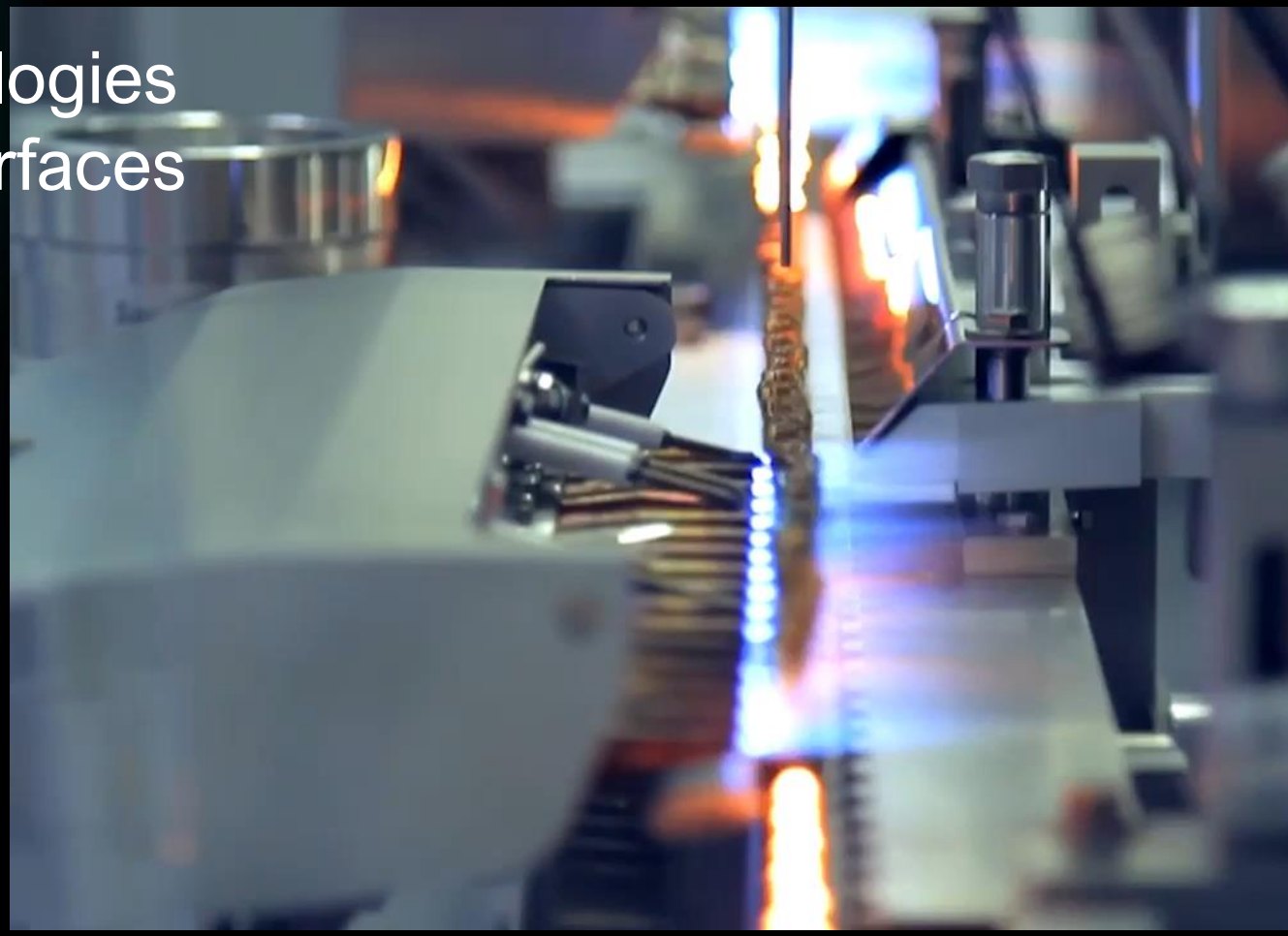



These applications will not only minimise human involvement in the loop but will also exhibit self-improving capabilities.
a X-AIPI is a Horizon Europe Project that will research, develop, test, and experiment on, an innovative toolset of custom and trustworthy self-X AI technologies for the process industries.


S X AIPI
Value Chain
Process Lifecycle
Product Lifecycle
Human in the loop
Use Cases
Steel
Asphalt
Aluminium
Pharmaceutical
Trustworthy self-X AI Applications
for Agile and Sustainable Process Industry
Toolset

The s-X-AIPI toolset of AI technologies aims to offer more simplified interfaces that:

Will [illegible] a [illegible] maintenance.



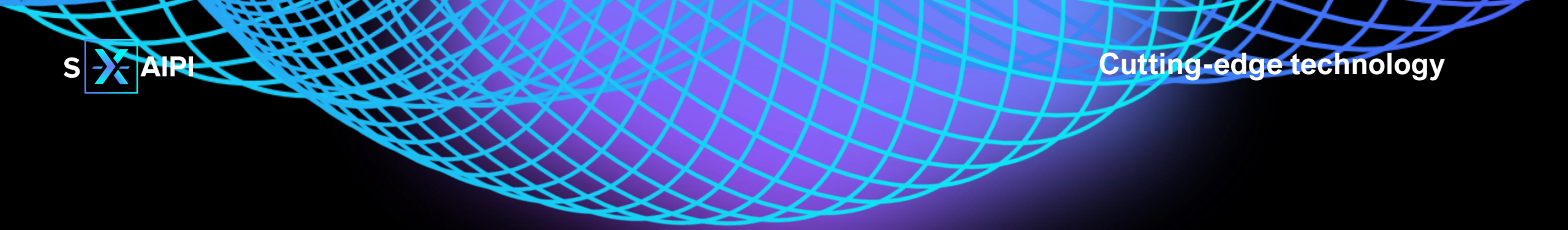
Both existing process industries and their workforce will be equipped with

Operational agility

Performance Optimisation

Cutting-edge AI-based tools

SXAIPI
Cutting-edge
Technology
SXAIPI



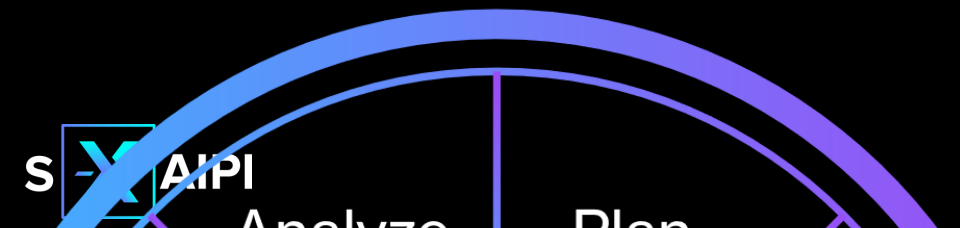
An innovative AI data pipeline

with autonomic computing capabilities (self-X AI and autonomic manager)

AI applications continually updated (self-improving abilities) by integrating data with reduced human intervention.

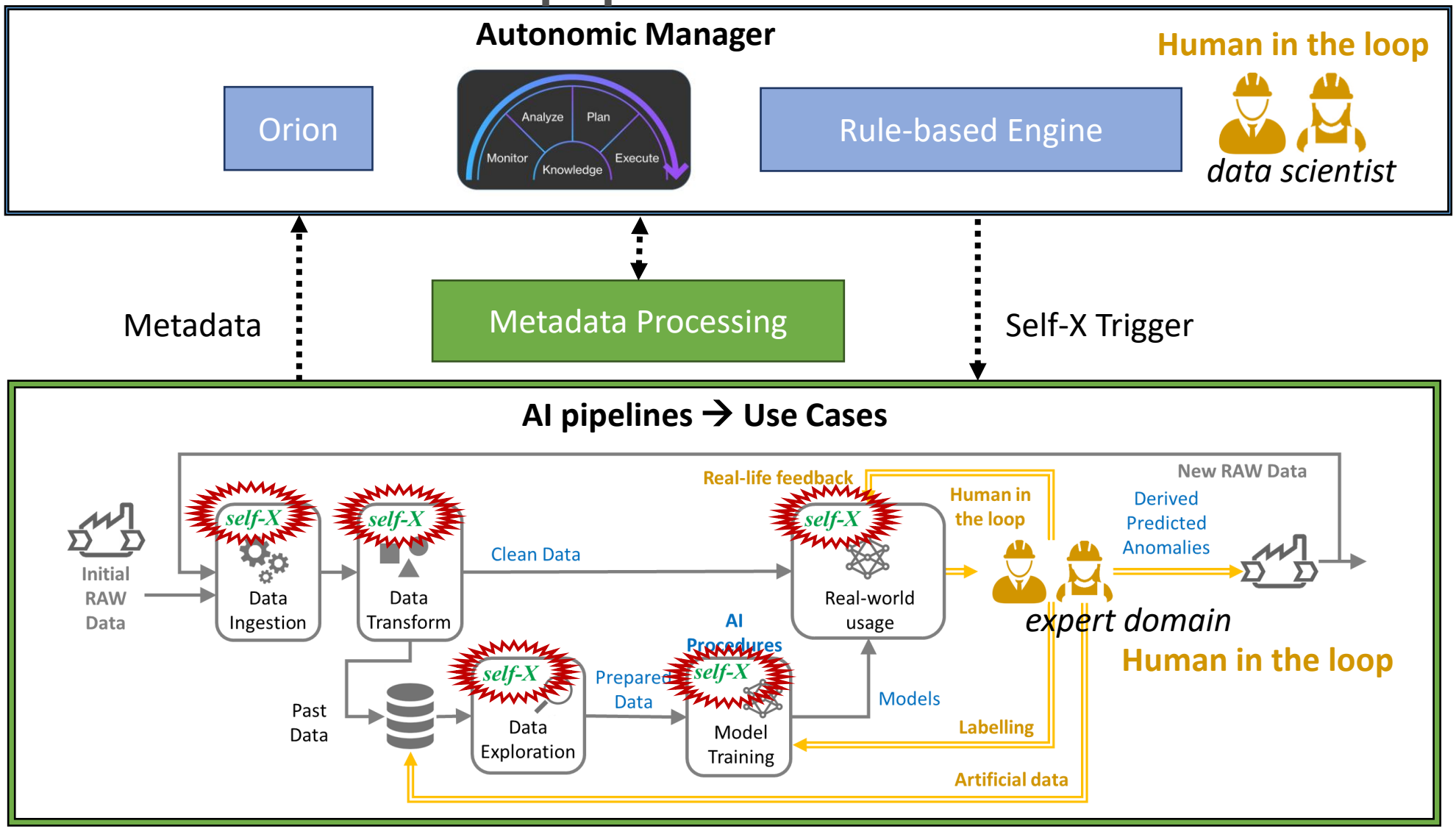
Autonomic Manager supporting human in the loop roles.

Self-X AI represents the fusion of AI as the intelligent processing system and an Autonomic Manager (proposed by IBM), based on the MAPE-K model.



This model encompasses a continuous cycle of Monitoring, Analysing, Planning, and Execution — flow based on the Knowledge of the AI system under control.

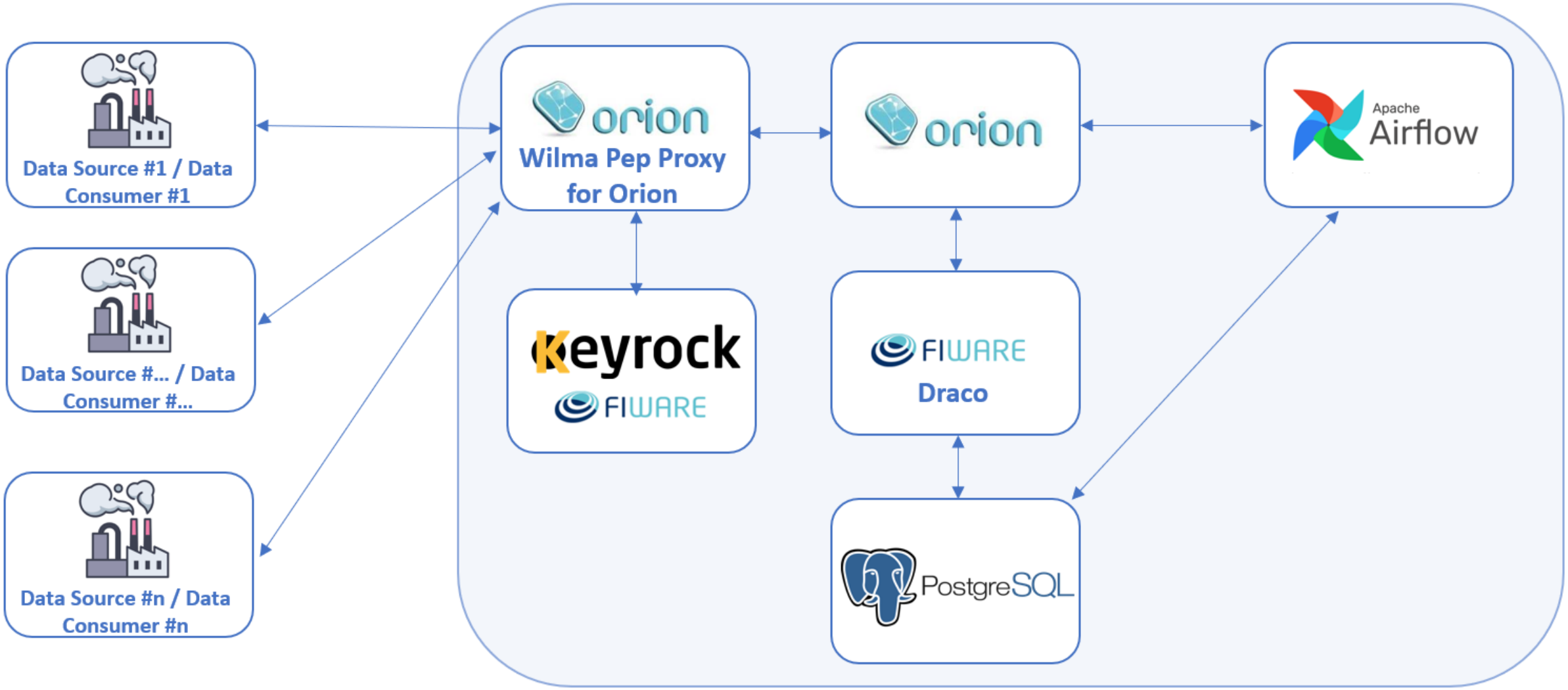
Outcomes: AI data pipeline and AM



SAIPI

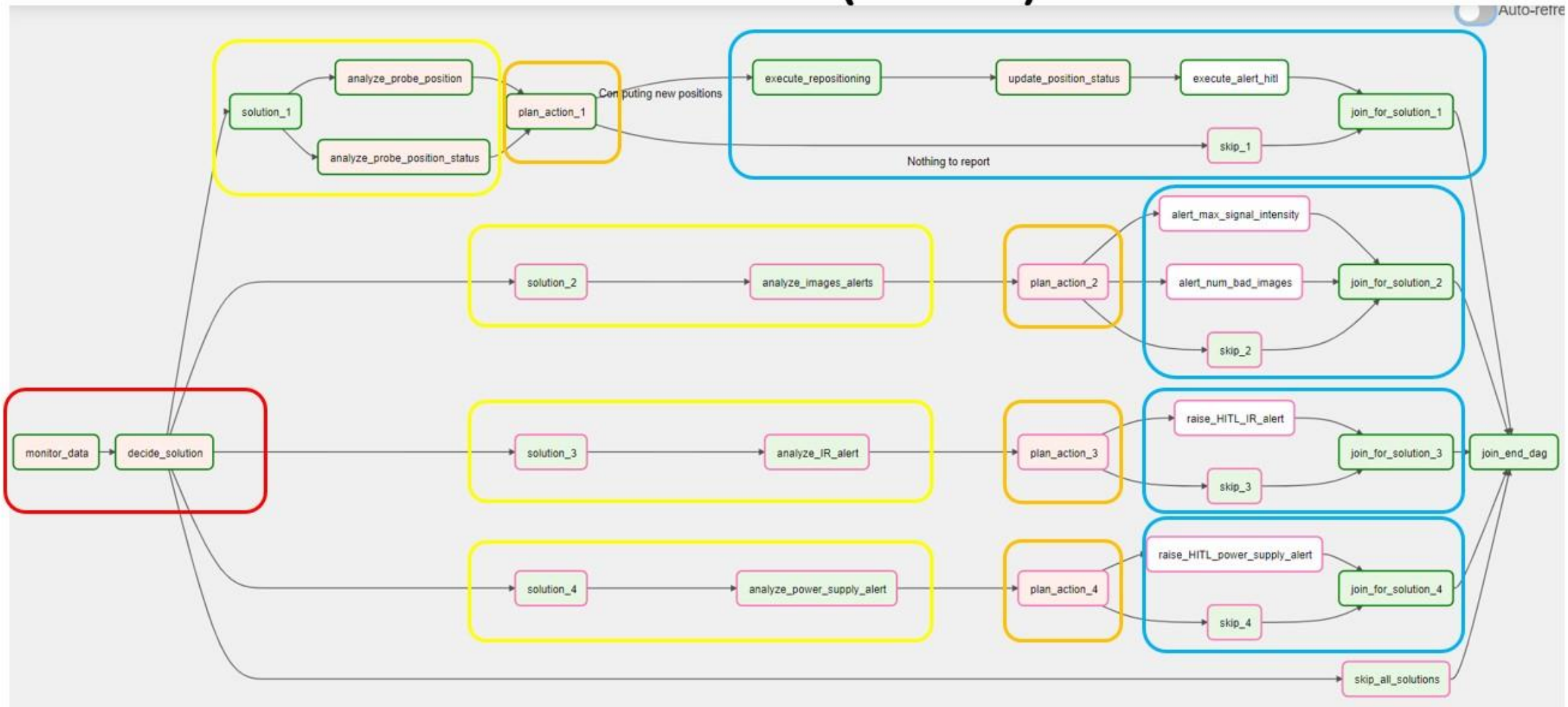
CARTIF

Outcomes: Autonomic Manager (AM)



https://github.com/Engineering-Research-and-Development/s-X-AIPI-Autonomic-Manager

AM MAPE-K Flow in Pharma (demo)



Outcomes: HITL involvement scenarios

User Roles

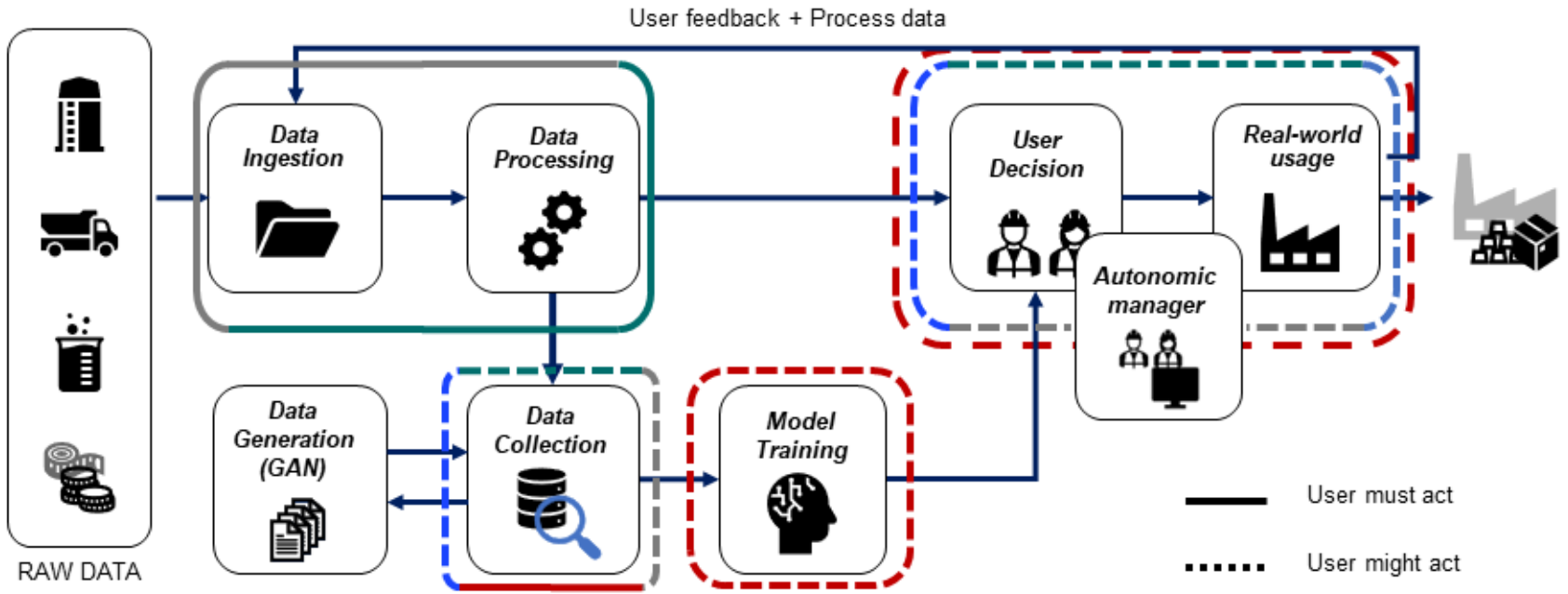
Manager users:

- General Manager (can act everywhere)
- R & D Manager
- Production Manager

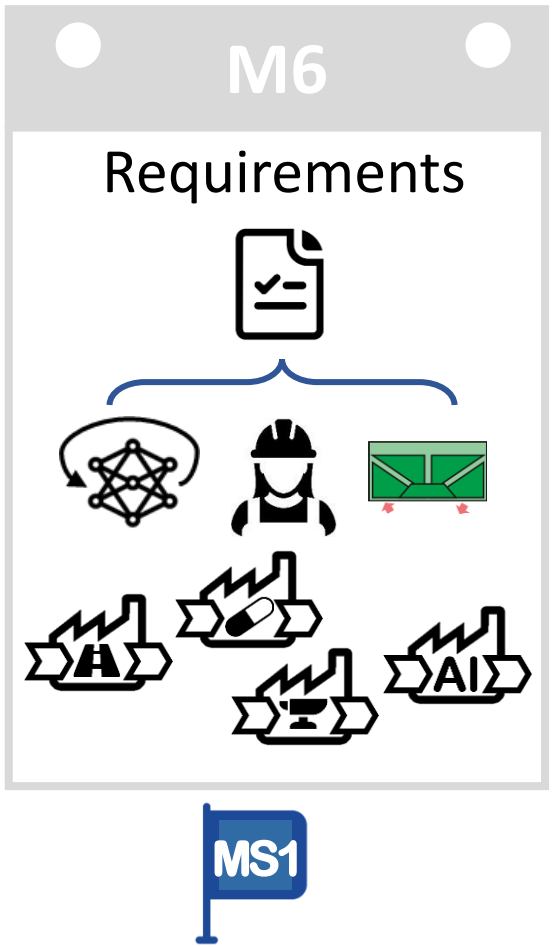
Plant Operators:

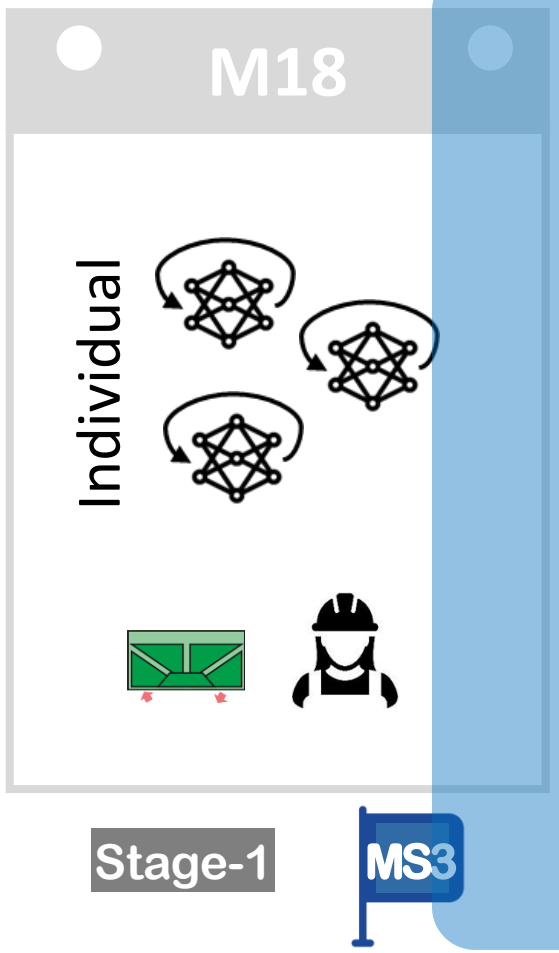
- 2x Furnace Operators
- "Alloying" Operator
- De – Sampling operator

AI Data Pipeline



Activities & Progress





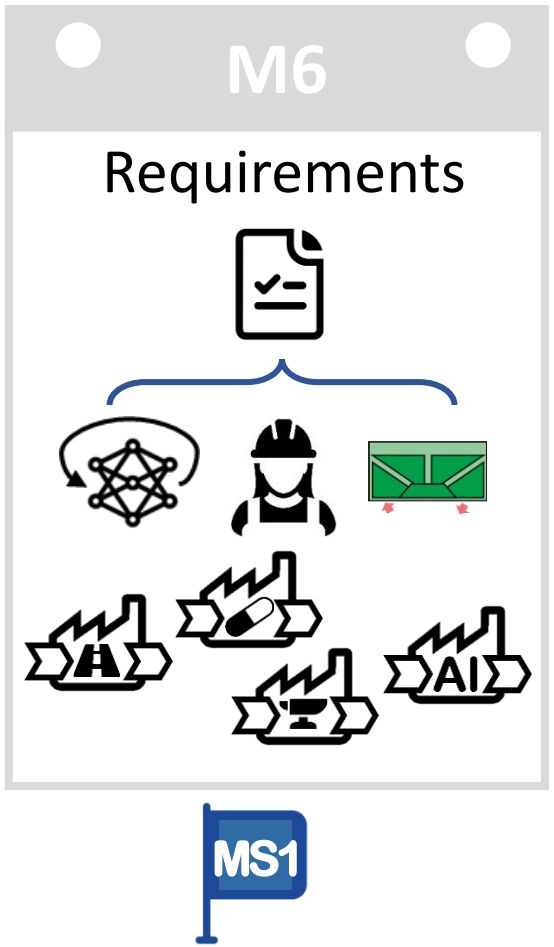
- MS1 - Definitions of the requirements of basic methodology and architecture for self-X AI solutions
  - Agreement on the definition and implementation of the AI-data pipeline blocks
  - Stakeholders
  - self-X abilities and capabilities
  - Architecture
  - Integration

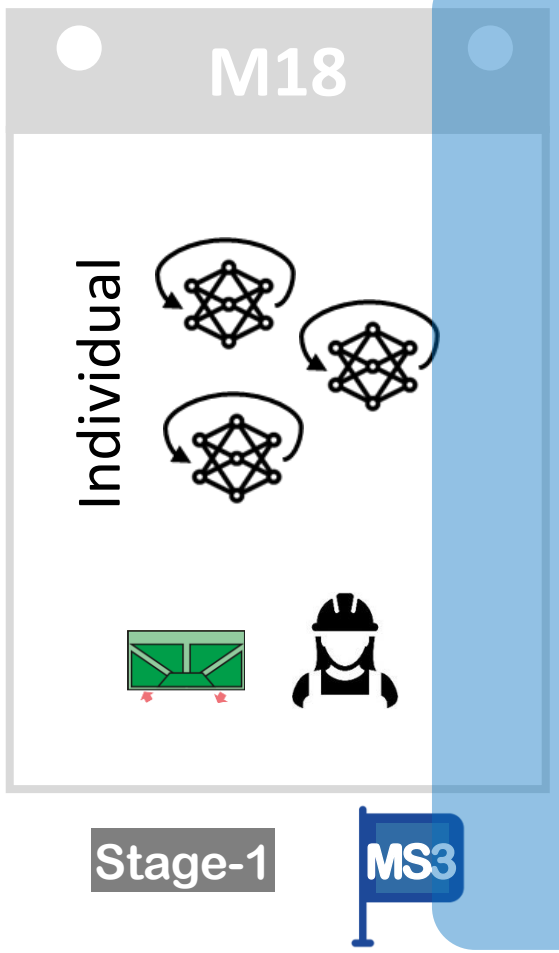
M25
(of 36 Months)
TODAY

S X AIPI

CARTIF

Activities & Progress





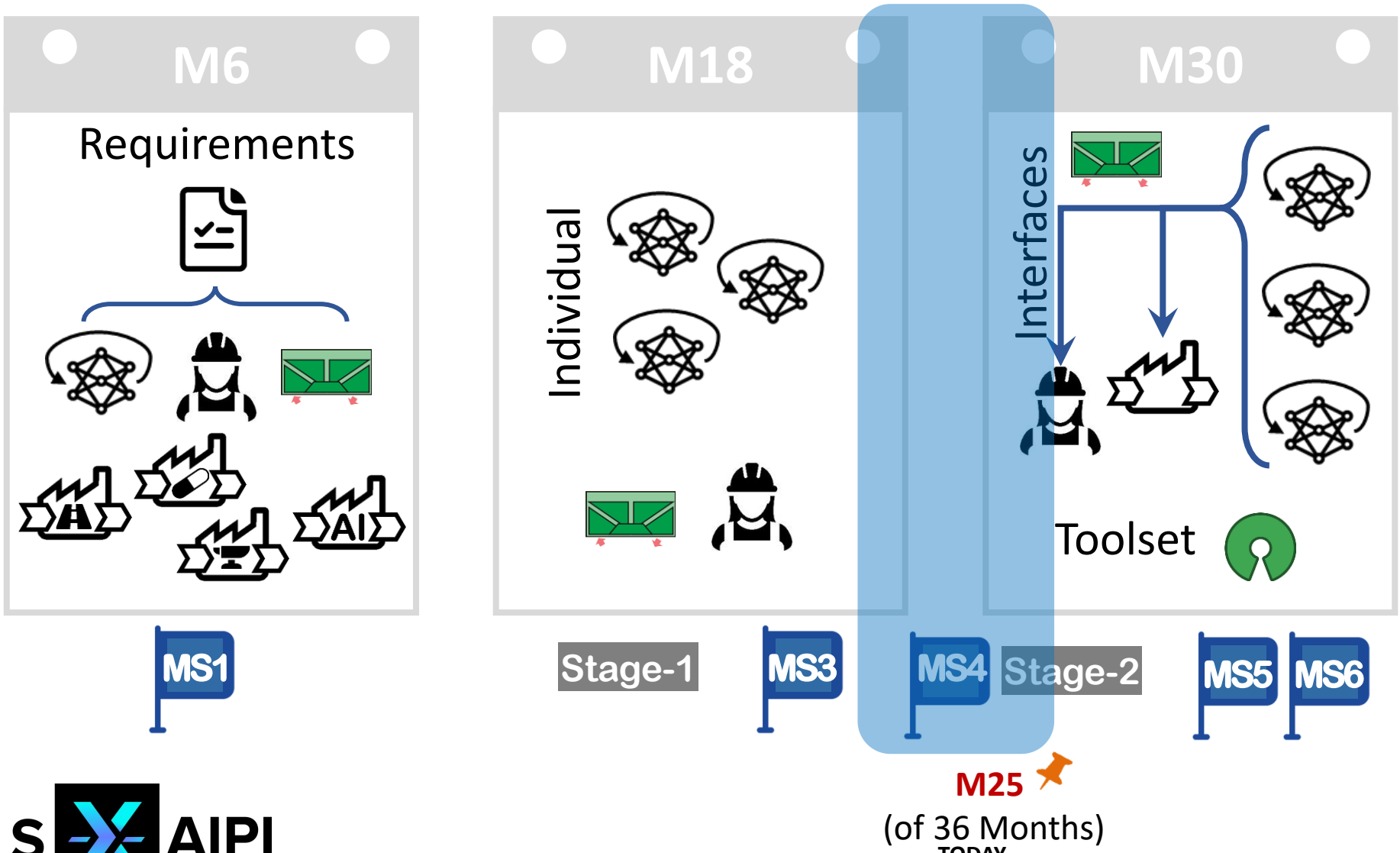
- MS3 - Initial version of the self-X AI solutions involving human collaboration and validation of the autonomic and self-X technology for individual AI modules in laboratory industrial relevant environment
  - Initial AI procedures
    - Model Training
  - Data analytics (ingestion, transformation and exploration) in all use cases
  - Metadata for self-X abilities
  - Perceptors
  - AI Methods for metadata
  - Initial infrastructure (AM)

M25
(of 36 Months)
TODAY

S X AIPI

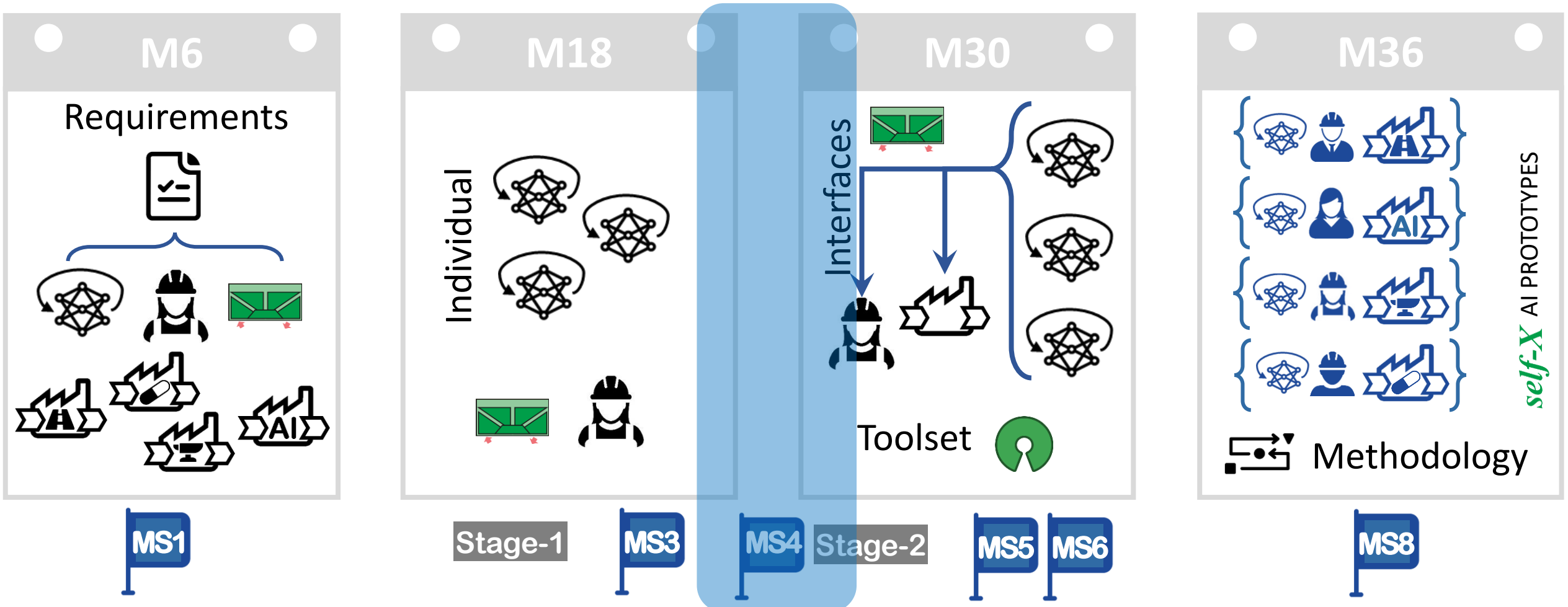
CARTIF

Next Steps



- MS4 - Technology validation of project's Self-X AI data pipeline into industrial use cases
  - Testing of self-X abilities of pipeline components
  - Validation for Data in Motion and human support

Next Steps

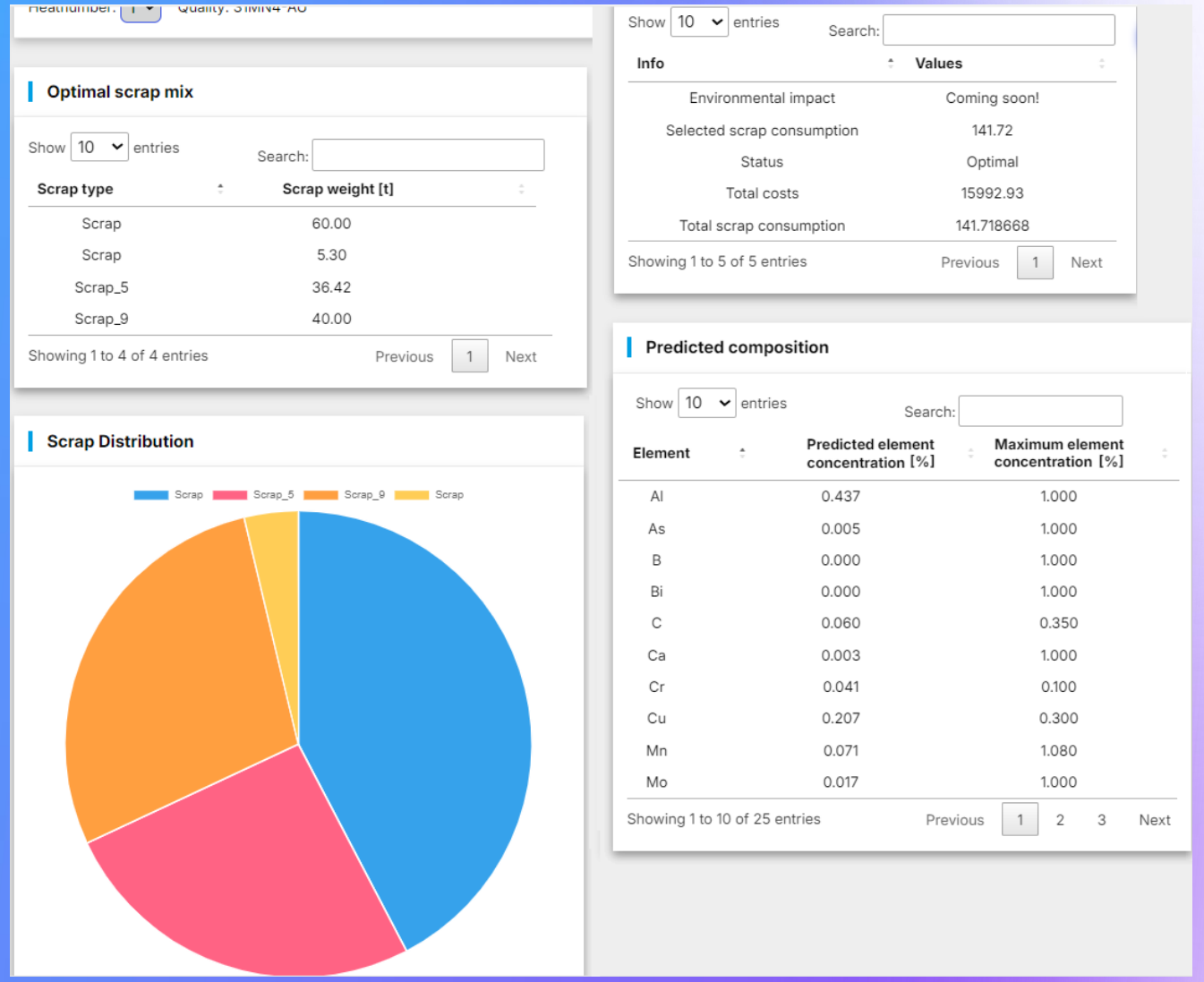

M6
Requirements
M18
Individual
Interfaces
M30
Toolset
M36
self-X AI PROTOTYPES
Methodology
MS1
Stage-1
MS3
MS4
Stage-2
MS5
MS6
MS8
M25
(of 36 Months)
TODAY

Steel use-case

Focuses on optimising the use of scrap to produce **high-quality steel products**, while avoiding downstream surface quality problems and reducing process energy intensity.

Scrap mix optimization

- Optimal charge material mix
- Product quality
- Costs
- Enhance the resilience and quality of raw steel production through Electric Arc Furnace (EAF) operations by detecting early deviations in steel composition and temperature between measured and predicted values.



Optimal scrap mix

Show 10 entries Search:

Scrap type	Scrap weight [t]
Scrap	60.00
Scrap	5.30
Scrap_5	36.42
Scrap_9	40.00

Showing 1 to 4 of 4 entries Previous 1 Next

Scrap Distribution

Show 10 entries Search:

Info	Values
Environmental impact	Coming soon!
Selected scrap consumption	141.72
Status	Optimal
Total costs	15992.93
Total scrap consumption	141.718668

Showing 1 to 5 of 5 entries Previous 1 Next

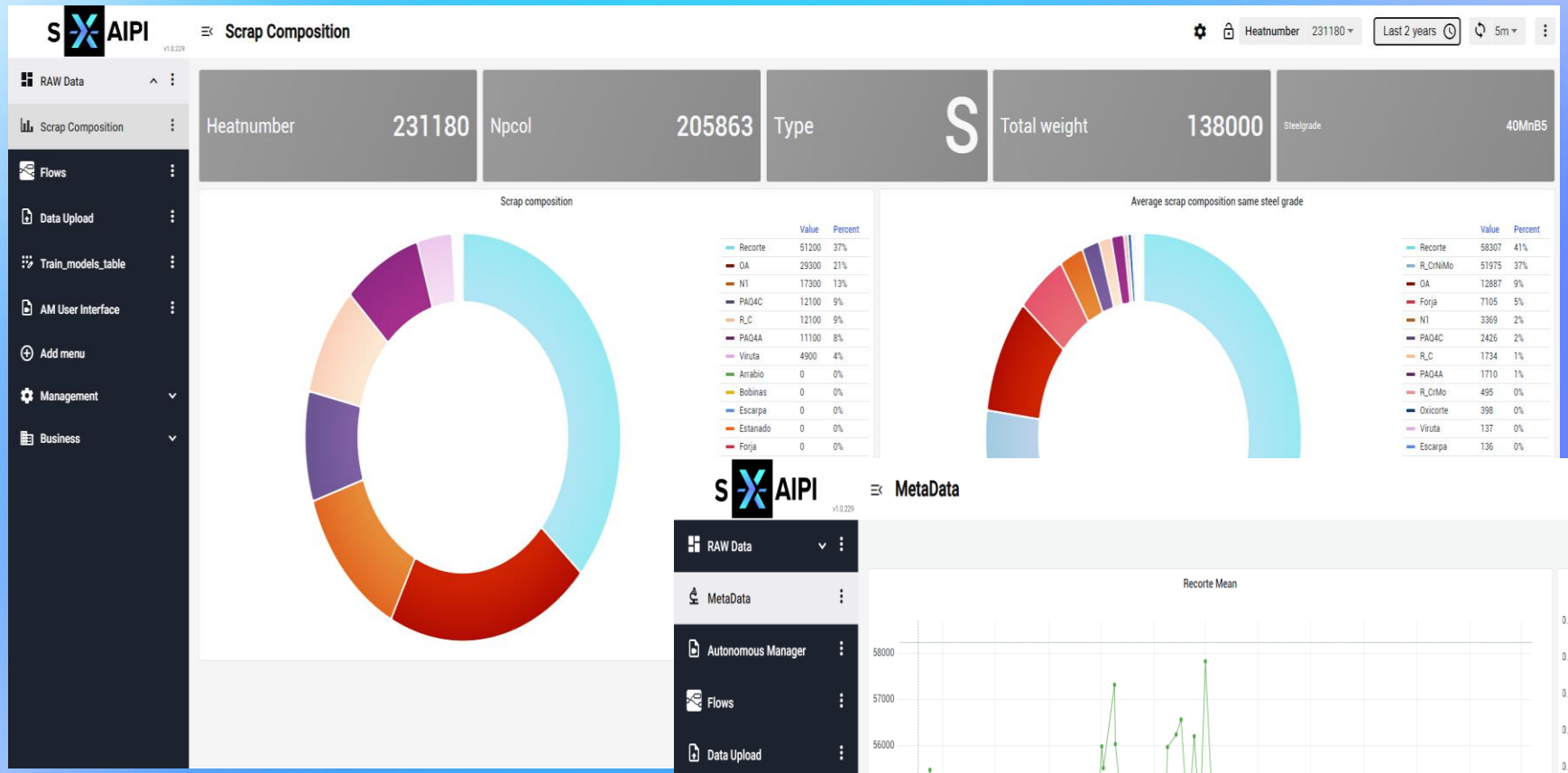
Predicted composition

Show 10 entries Search:

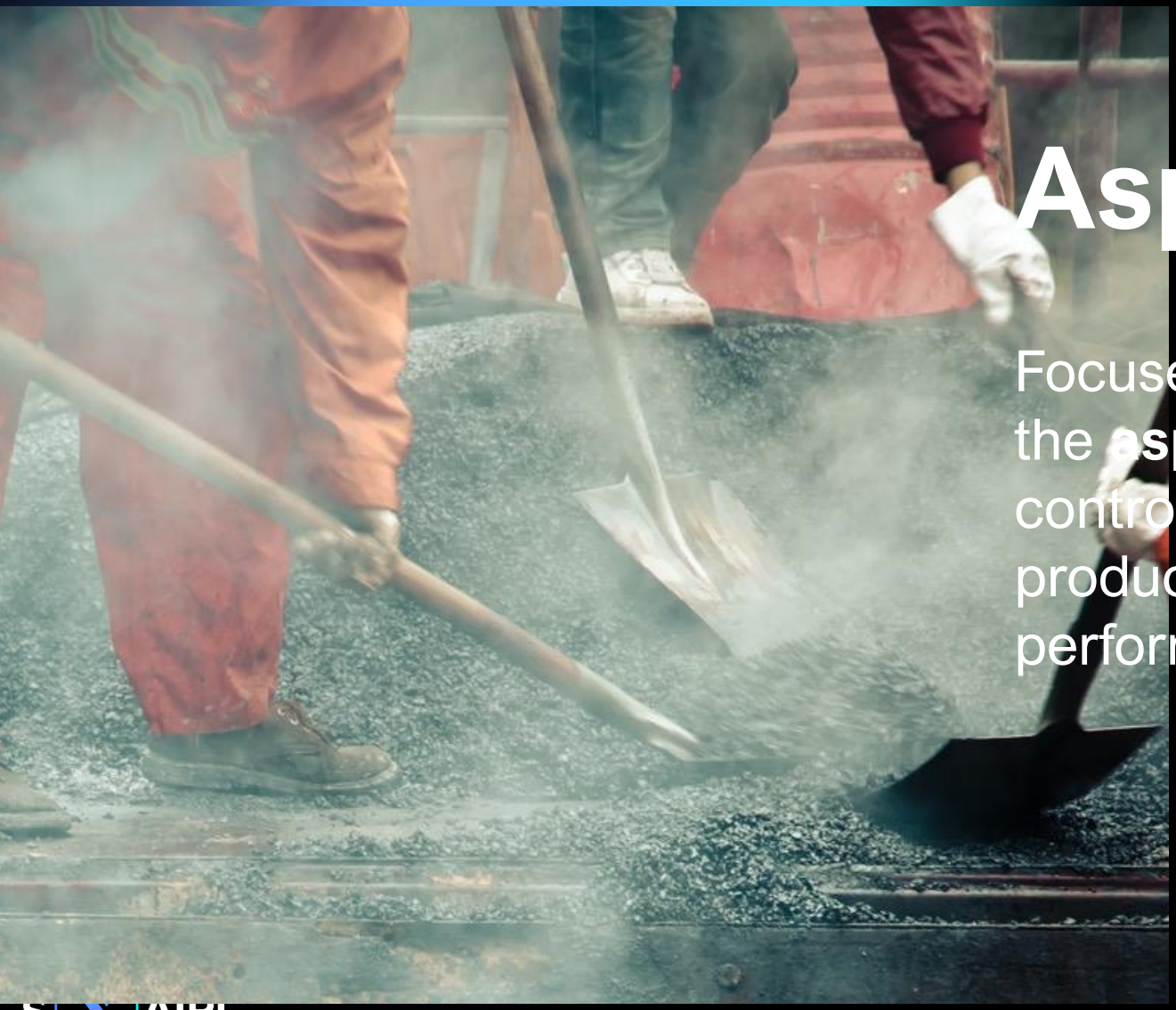
Element	Predicted element concentration [%]	Maximum element concentration [%]
Al	0.437	1.000
As	0.005	1.000
B	0.000	1.000
Bi	0.000	1.000
C	0.060	0.350
Ca	0.003	1.000
Cr	0.041	0.100
Cu	0.207	0.300
Mn	0.071	1.080
Mo	0.017	1.000

Showing 1 to 10 of 25 entries Previous 1 2 3 Next

SAIPI


AIPI
Scrap Composition
Heatnumber 231180
Last 2 years
5m
RAW Data
Scrap Composition
Flows
Data Upload
Train_models_table
AM User Interface
Add menu
Management
Business
Heatnumber 231180
Npcol 205863
Type S
Total weight 138000
Steelgrade 40MnB5
Scrap composition
Value Percent
Recorte 51200 37%
OA 29300 21%
N1 17300 13%
PAQ4C 12100 9%
R_C 12100 9%
PAQ4A 11100 8%
Viruta 4900 4%
Arrabio 0 0%
Bobinas 0 0%
Escarpa 0 0%
Estanado 0 0%
Forja 0 0%
Average scrap composition same steel grade
Value Percent
Recorte 58307 41%
R_CrNiMo 51975 37%
OA 12887 9%
Forja 7105 5%
N1 3369 2%
PAQ4C 2426 2%
R_C 1734 1%
PAQ4A 1710 1%
R_CrMo 495 0%
Oxicorte 398 0%
Viruta 137 0%
Escarpa 136 0%

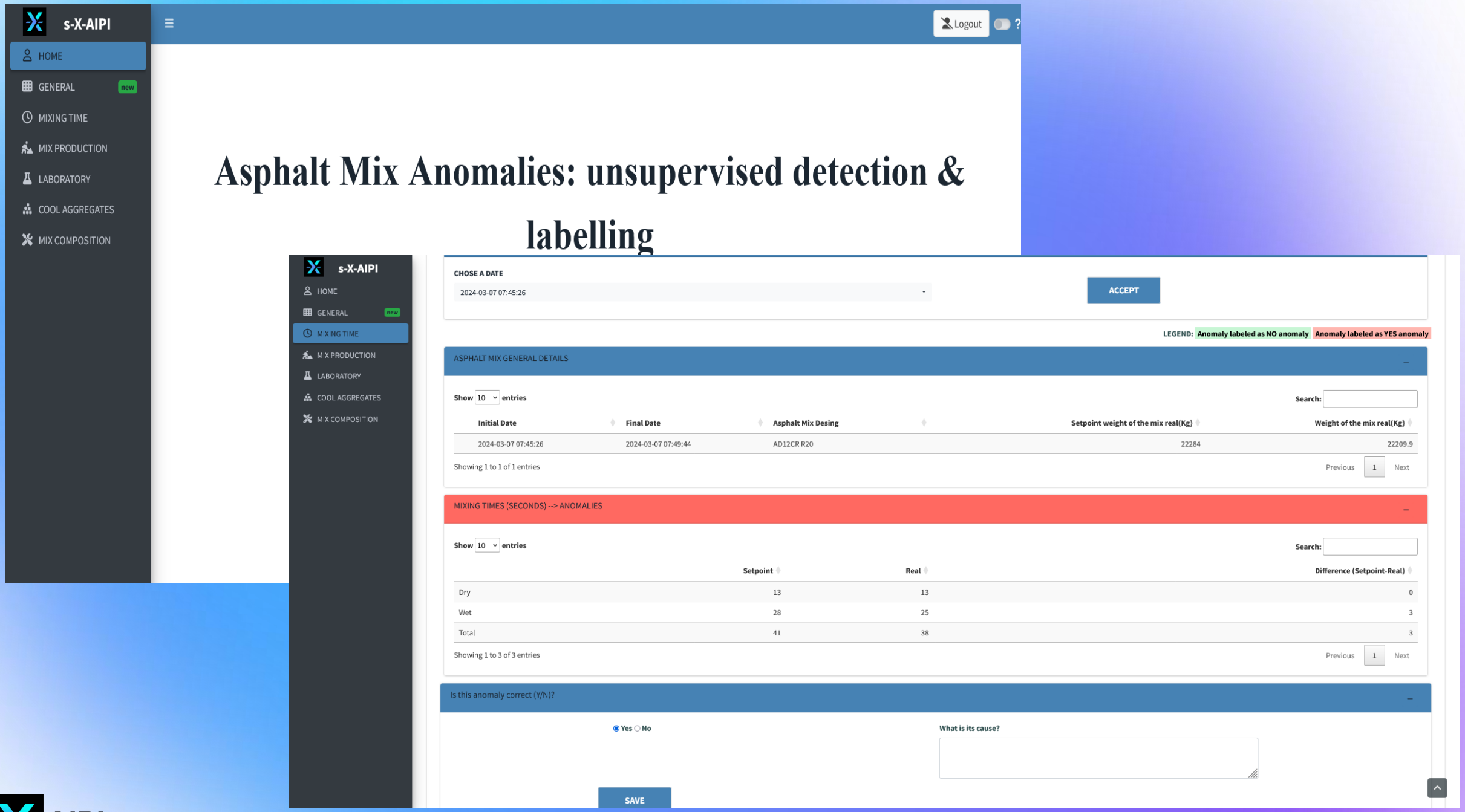
AIPI
MetaData
Last 2 years
1m
RAW Data
MetaData
Autonomous Manager
Flows
Data Upload
Train_models_table
Add menu
Management
Business
Recorte Mean
58000
57000
56000
55000
54000
53000
52000
51000
50000
2022-05 2022-07 2022-09 2022-11 2023-01 2023-03 2023-05 2023-07 2023-09 2023-11 2024-01 2024-03
transformation.mean
Linear Regression MAE
0.0380
0.0360
0.0340
0.0320
0.0300
0.0280
0.0260
0.0240
0.0220
0.0200
0.0180
0.0160
0.0140
2022-05 2022-07 2022-09 2022-11 2023-01 2023-03 2023-05 2023-07 2023-09 2023-11 2024-01 2024-03
modeling.mean



Asphalt use-case

Focuses on the AI use for the circularity of the **asphalt value chain**, the quality control of feedstock and of the final product and the overall sustainable performance of the process.

Asphalt Mix Anomalies: unsupervised detection & labelling



Dashboards Charts Datasets SQL

Filters

+ ADD/EDIT FILTERS

Time Range*

Last quarter

MIX

82 options

Filters out of scope (1)

APPLY FILTERS

CLEAR ALL

Production

Published

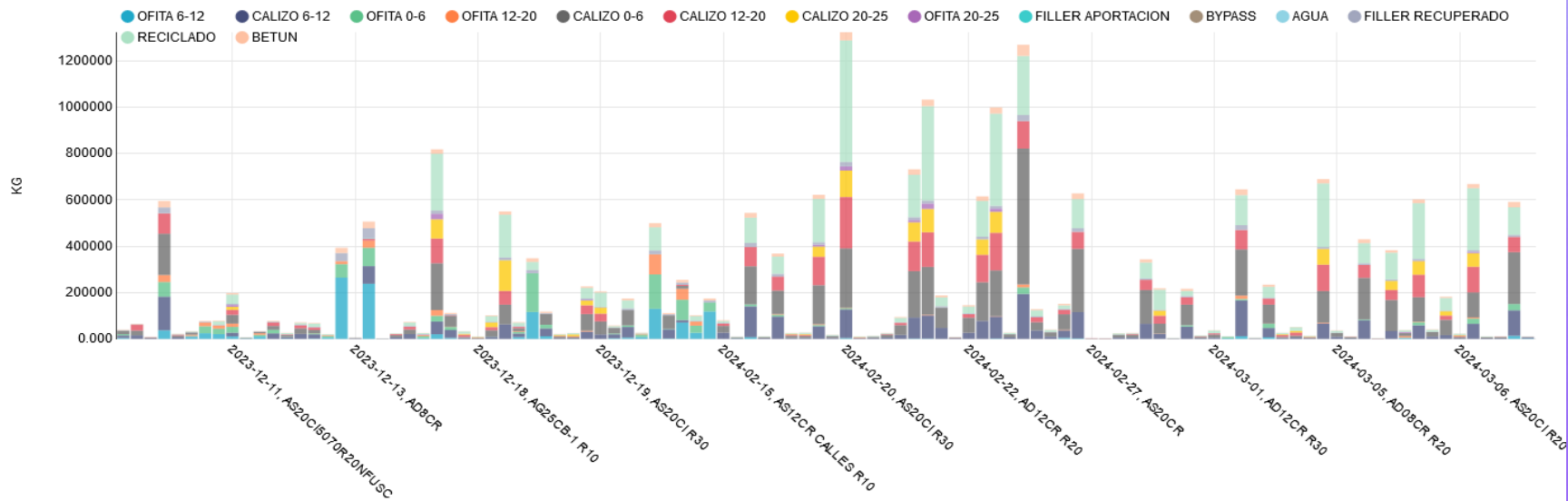
PRODUCTION PROCESS TIMES FUEL

CALENDAR DRYING PROCESS MIXING PROCESS BALANCE

HOT AGGREGATES

Quantity of material used for mixing

You can filter here for specific days and formulas.



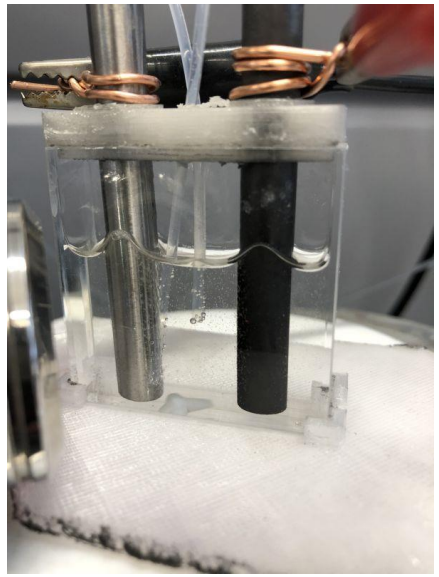
Pharmaceutical use-case

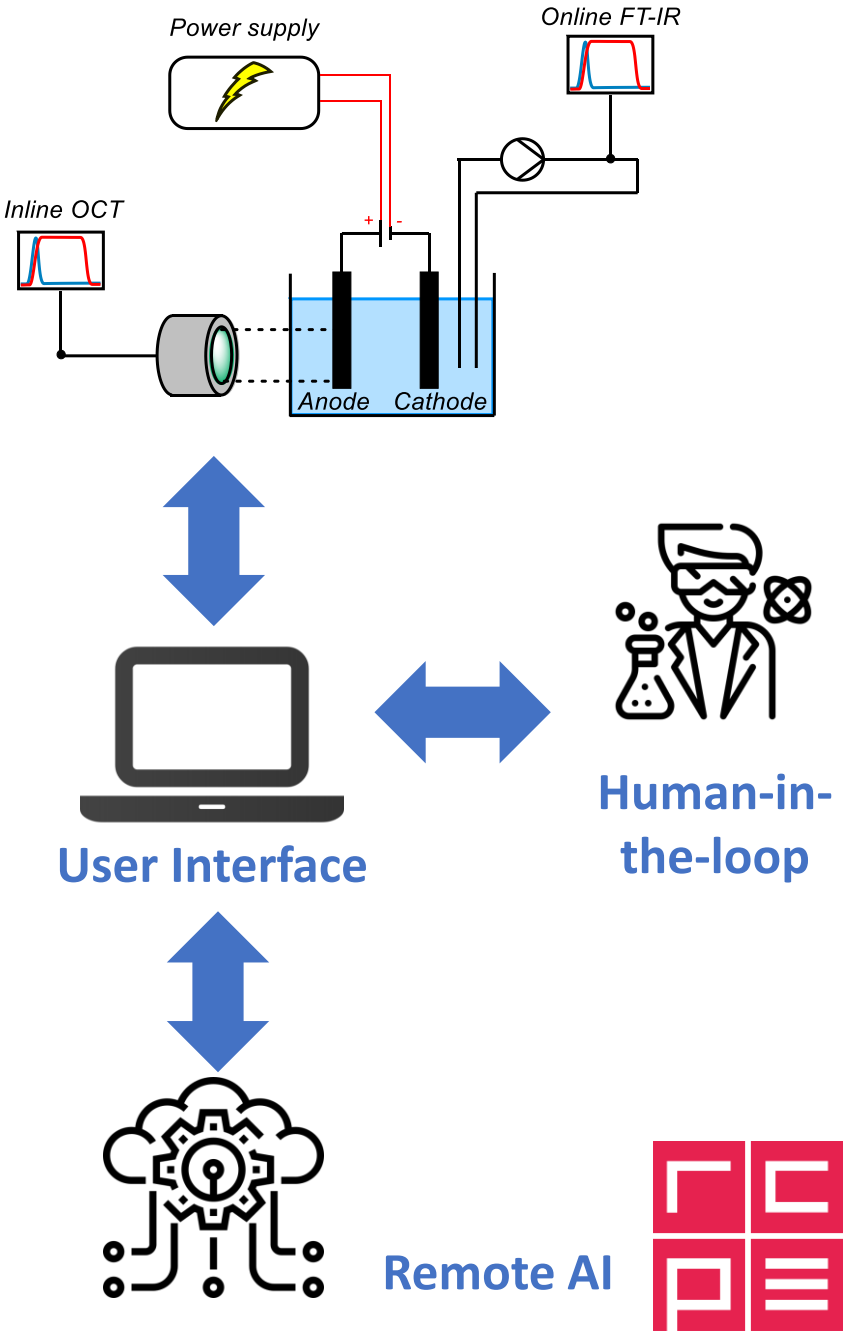
Focuses on predicting the optimal settings for the manufacturing process of **chemicals and active pharmaceutical ingredients** when dealing with solid or liquid suspensions.

It will employ Machine Learning (ML) based control strategies while keeping human experts involved in the decision-making loop.

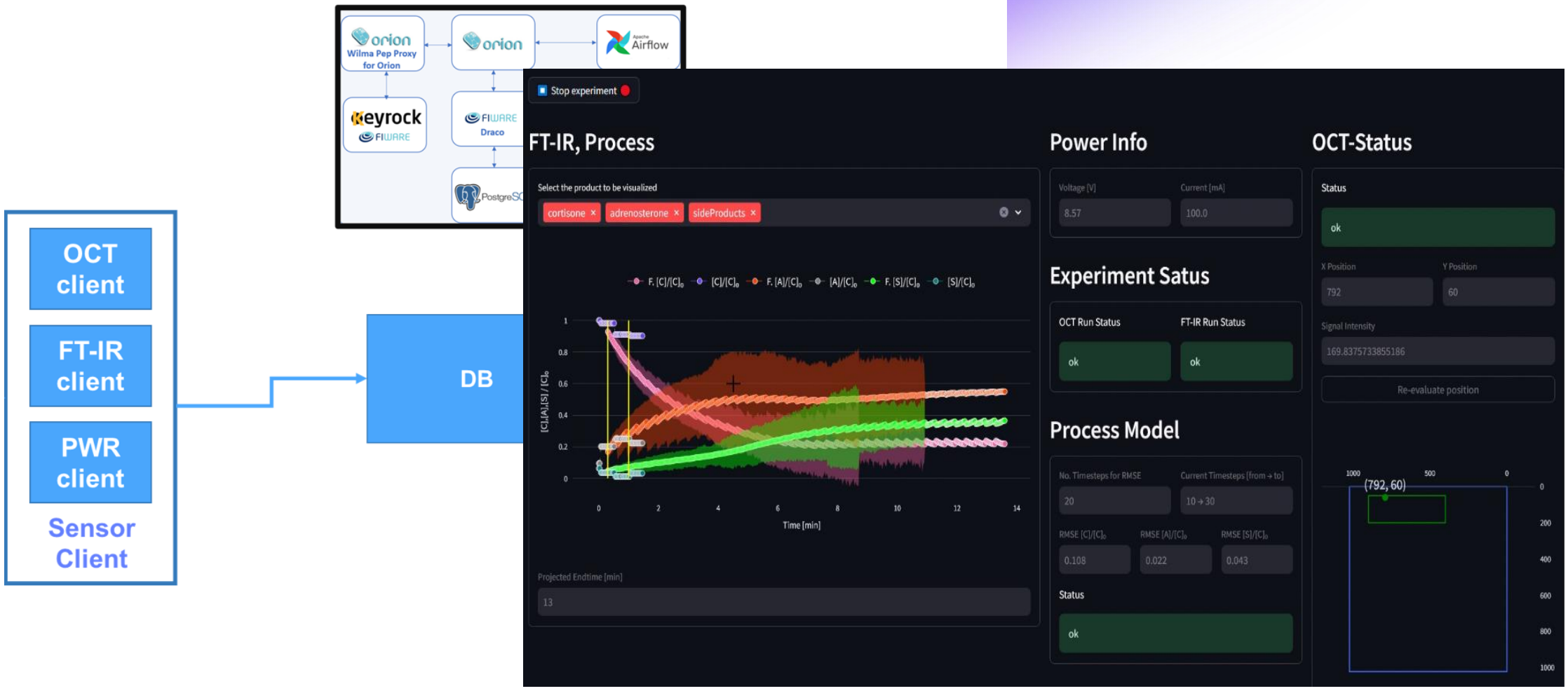
Pharma Use Case

- Electrochemical process
- Three in-line data sources:
  - OCT, IR, power supply
- User-interface for process operator and data scientist
- Human-in-the-loop for critical decisions
- Autonomic manager acts are remote AI component





Pharma Use Case: Current status

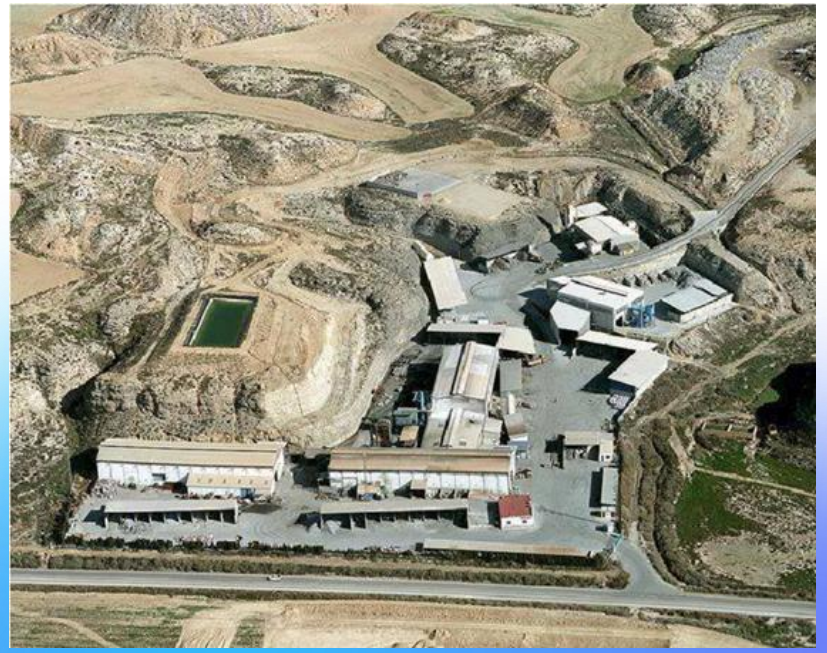


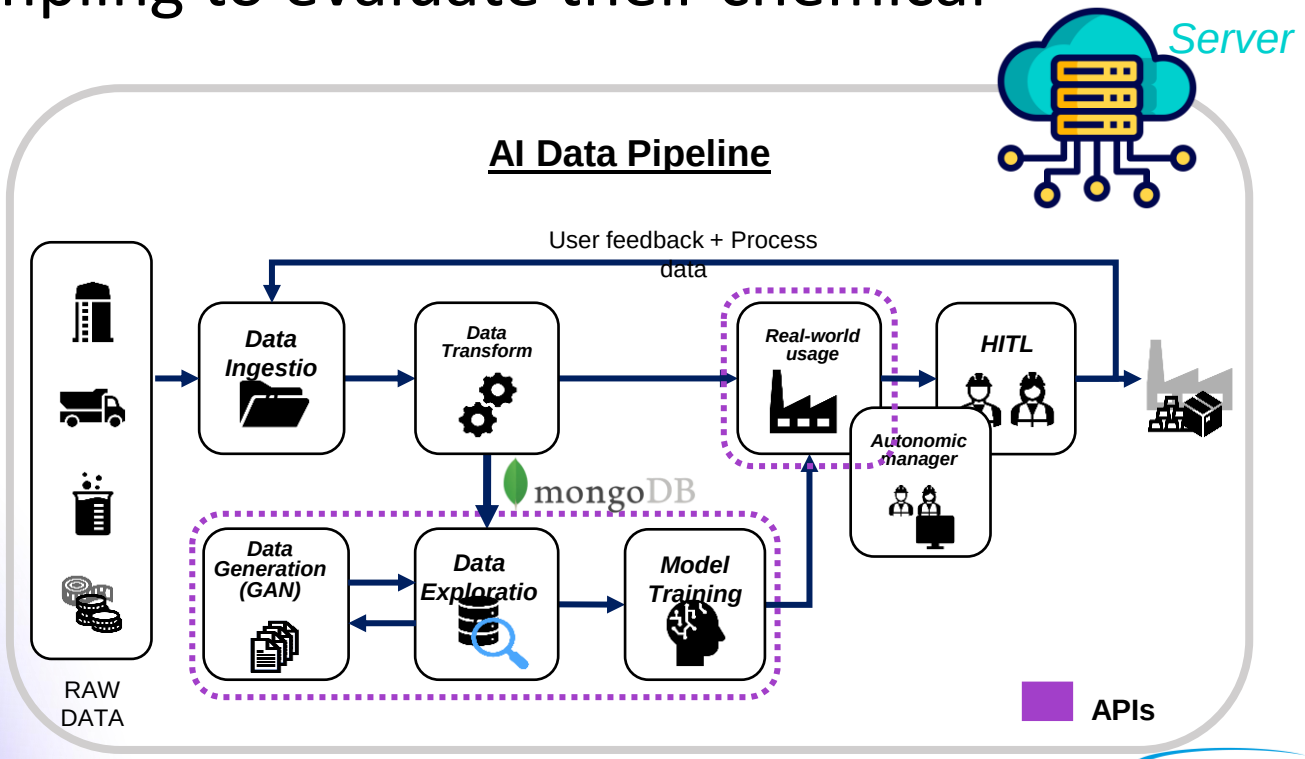
Aluminium use-case

Focuses on optimizing **recycling processes** from scrap, reducing the melting power on time, optimizing metal yield, and improving liquid aluminium quality leading to a decreased rate of downstream quality rejections.

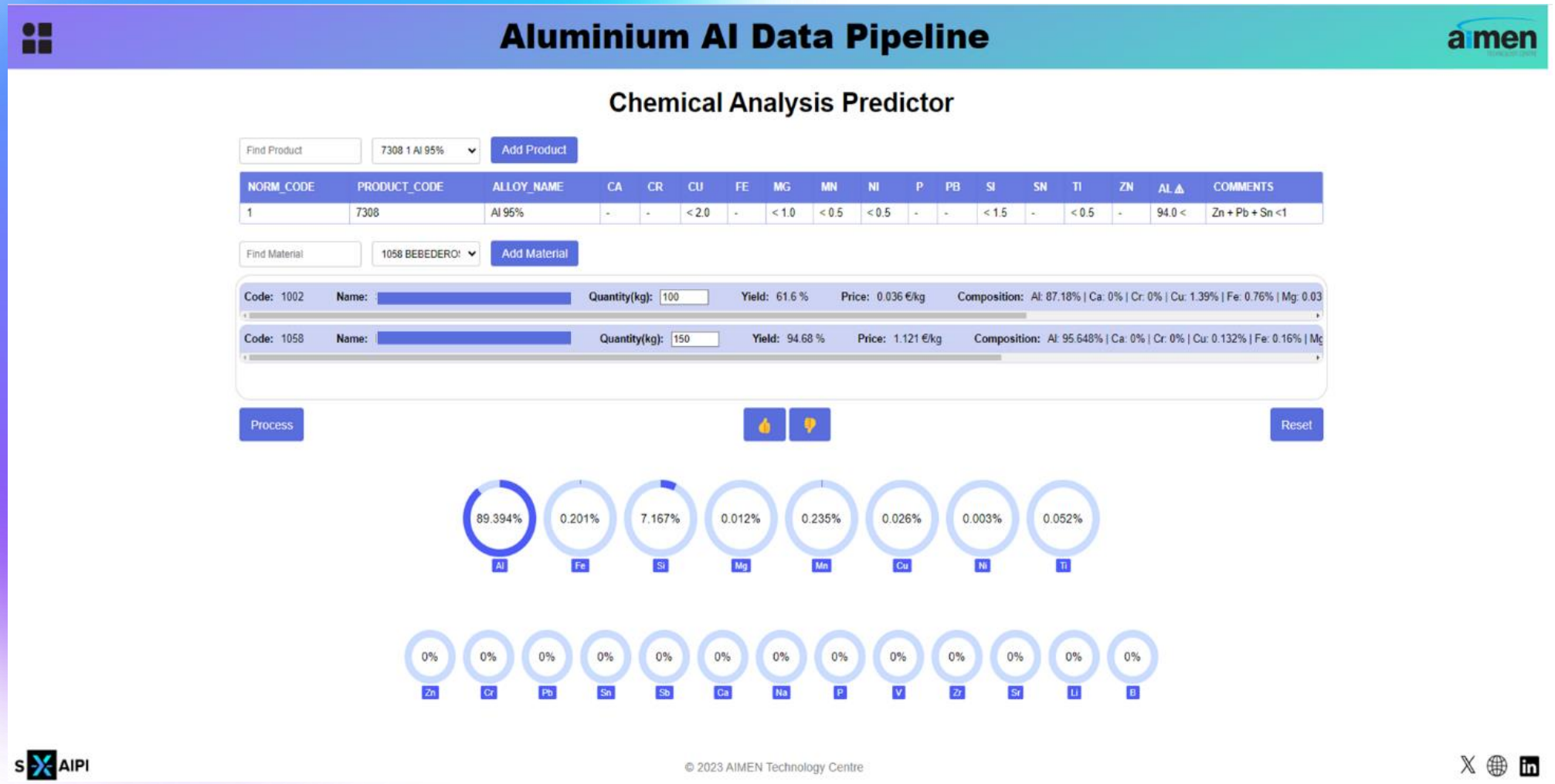
Aluminium use case

- AI solution
- Estimate the final chemical composition of aluminium mixtures
- All scraps undergo an initial sampling to evaluate their chemical composition



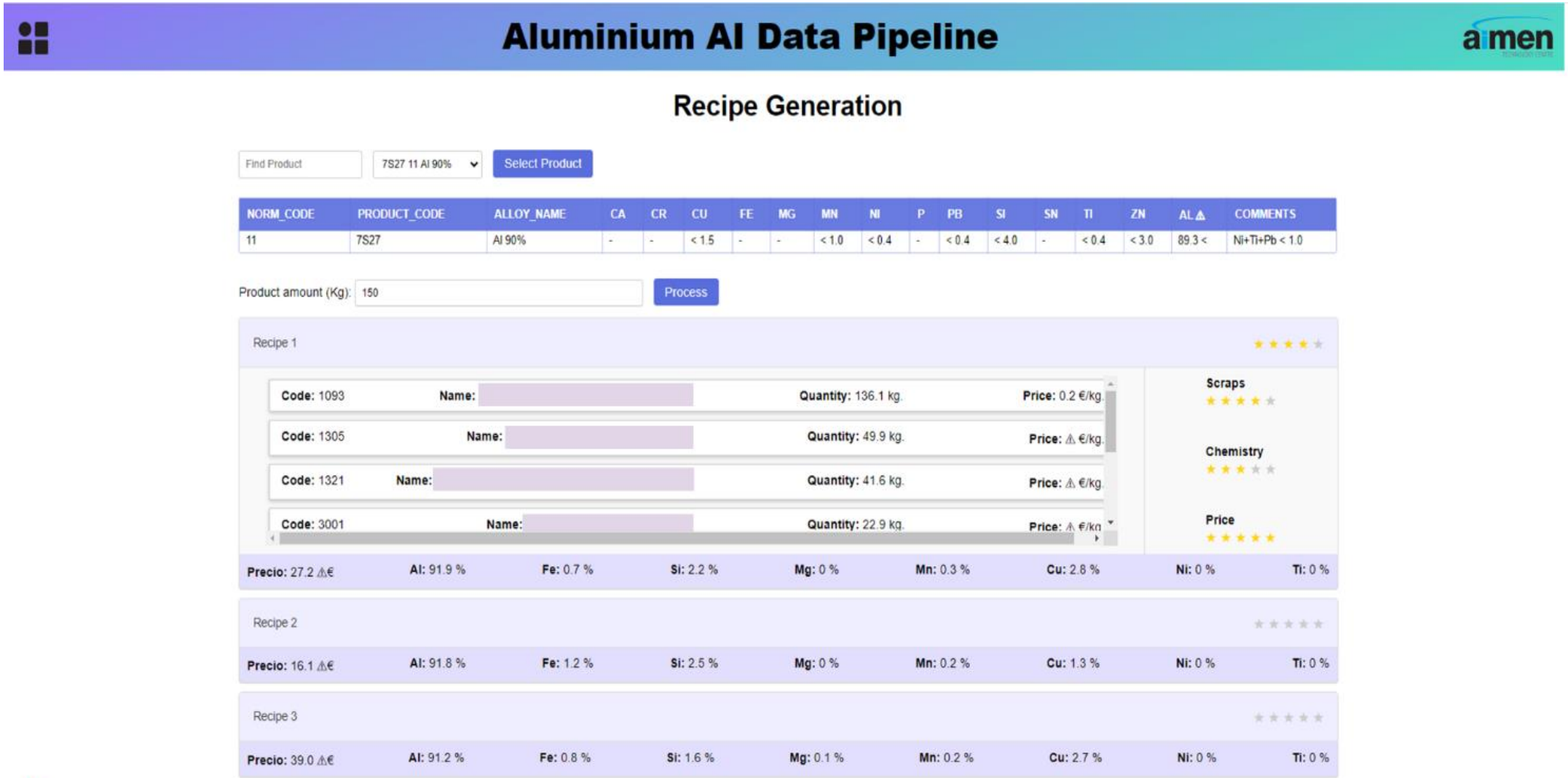


Aluminium use case



© 2023 AIMEN Technology Centre

Aluminium use case



S AIPI

idalsa aimen TECHNOLOGY CENTRE

SAIPI

But there is more

SAIPI

Expected Impact

Position European industry as a leader in the digital transition

Improve the environmental sustainability of industrial production

Expected Impact

Enable circular manufacturing and re-manufacturing systems

Empower and improve the human position in the industrial production

Join us

	WEBSITE	www.s-x-aipi-project.eu
	EMAIL	s-X-AIPI@cartif.es
	LINKEDIN	s-X-AIPI
	TWITTER	@S-X-AIPIPROJECT

SXAIPI

Co-funded by the European Union

Thank you!