Proceedings of the iSteel-Expert Final Workshop

Project co-funded by the Research Fund for Coal and Steel (RFCS)

G.A. 101112102

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1. Introduction

Throughout the whole project duration, the iSteel-Expert Consortium has been committed to communicating and disseminating project results across the European steel sector and beyond as a way to maximize the impact of the project by raising the interest of the European steel industry.

In particular, in the Communication and Dissemination Plan (*Deliverable D6.2*) established at the beginning of the project, the decision was taken to held a Final Workshop presenting and discussing with peers the main outcomes in the last semester of project.

At the end of 2025 the opportunity arose to organise such a final workshop as a Special Session focused on "*Digital solutions for safety in the EAF area*" at the *14th European Electric Steelmaking Conference (EEC 2026)*, which was held in Milan (Italy) on May 11-13, 2026, in conjunction with the *5th International Conference on Energy and Material Efficiency and CO_2 Reduction in the Steel Industry (EMECR 2026)*.

The Consortium decided to catch this opportunity, and the driver for this decision was the possibility offered by this biyearly event, which is highly reputed in the European steel community, to ensure a wide and diversified audience and a lively discussion with researchers and practitioners working on the topics of the project. Therefore, in agreement with the conference organisers, a dedicated call for papers was issued and spread through Linkedin (see **Figure 1**) and through the networks of the partners to gather contributions also from researchers not involved in the project, to encourage a strong participation from industry, research and academia and ensure a lively discussion around the project outcomes and their future exploitation.



Figure 1. Call for papers published on LinkedIn for the Final Workshop of the project.

2. Program of the Workshop

The workshop, whose program is described in **Figure 2**, was attended by about 120 participants (see **Figure 3**) and comprised six presentations, four of which related to the results of iSteel-Expert provided, respectively, by TENOVA, SSSA, SIM4FUTURE and UNIRIO. As expected, the discussion was intense and very interesting, and good feedback on the project outcomes was received.

In this event, the members of the iSteel-Expert consortium provided the following presentations:

- G. Bavestrelli: “Improving Safety in Steelmaking Operations through Advanced Computer Vision and Machine Learning within the iSteel-Expert project.”
- M. Vannucci, S. Pede, M.W. Akram, A. Siddique, R. Girelli, G. Bavestrelli, V. Colla: "Development of an Intelligent Monitoring System for Anomaly Detection in Electric Arc Furnace Steelmaking."
- M. Massei, K. Sinelshchikov: “Simulation Based Training for Industrial Operations: Interactive Learning for Complex Tasks.”
- E. Jiménez, M.M. Pérez de la Parte: “A Cognitive and AI-Based Training Framework for Electric Arc Furnace Workforce Development.”

The present document gathers all the above-listed presentations.

08:30 **mar 12 maggio** 08:30–10:30

Safety and Training

Sessione | **Sede:** Foscolo room | **Convener:** Enrico Malfa (Tenova)

08:30–08:50
Improving Safety in Steelmaking Operations through Advanced Computer Vision and Machine Learning within the iSteel-Expert Project
Relatore
Giovanni Bavestrelli (Tenova)

08:50–09:10
Development of Intelligent Monitoring Systems for Anomaly Detection in Electric Arc Furnace Steelmaking
Relatore
Prof. Valentina Colla (Scuola Superiore Sant'Anna)

09:10–09:30
Simulation Based Training for Industrial Operations: Interactive Learning for Complex Tasks
Relatore
Dr. Kirill Sinelshchikov (SIM4Future srls)

09:30–09:50
A Cognitive and AI-Based Training Framework for Electric Arc Furnace Workforce Development
Relatore
Emilio Jimenez (University of La Rioja)

09:50–10:10 **Enhancing EAF safety and efficiency**
Relatore
Agostino Calogero Gasparo (POLYTEC SPA)

10:10–10:30
Reducing Power-Off Times Through Maintenance, Training, and Standardization
Relatore
Tabea Decker (Badisch Stahl-Engineering)

10:30

Figure 2. Program on iSteel-Expert Workshop held as Special Session of EEC2026.



Figure 3. The audience of the project's final workshop



Improving Safety in Steelmaking Operations through Advanced Computer Vision and Machine Learning within the iSteel-Expert Project

Giovanni Bavestrelli, Tenova

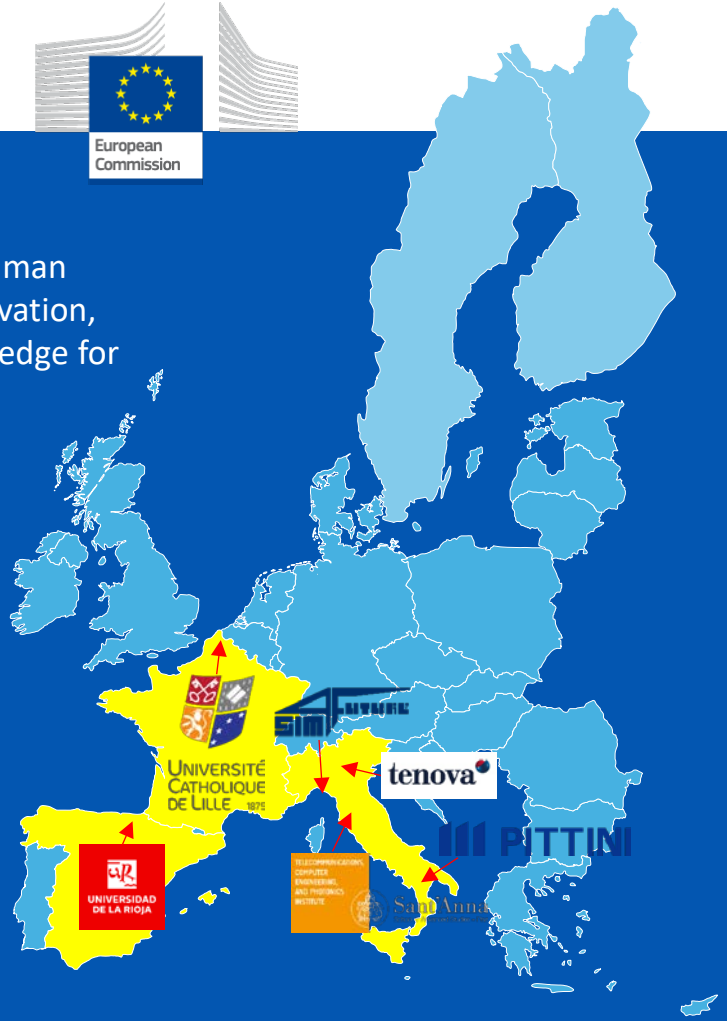
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iSteel-Expert

iSteel-Expert

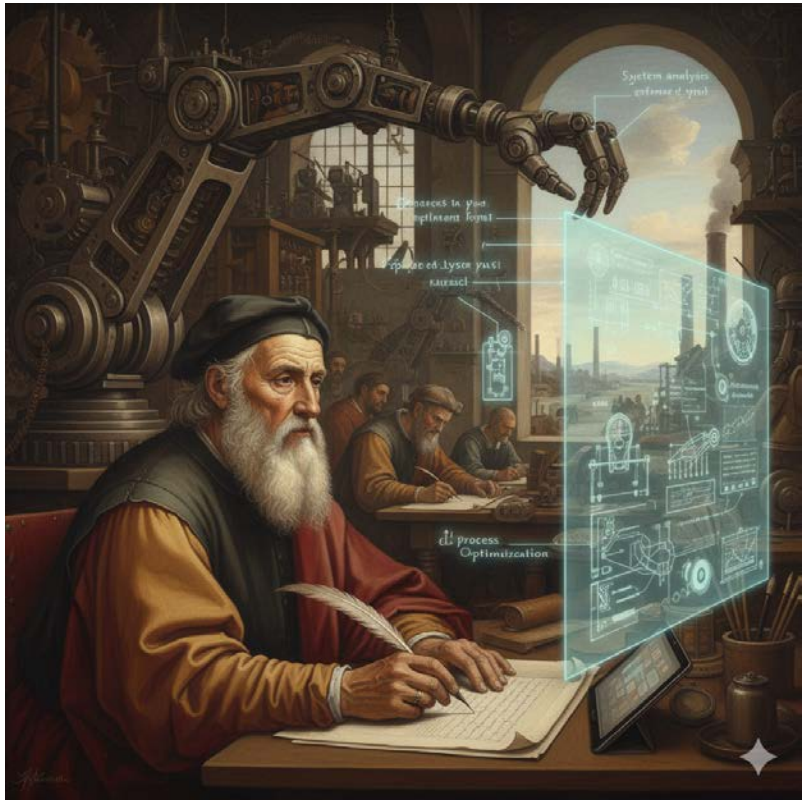
Remote expert virtual system enhancing human management capabilities and favors preservation, transfer and continuous evolution of knowledge for steelmaking operation



Call: *RFCS-2022*
Instrument: *PDP*
(Pilot and Demonstration Project)
Start date: 01/07/2023
End date: 30/06/2026
Budget: 1.845.686,05

Overview

i-Steel Expert Project



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Image generated with AI

Motivations

In the melting area of steelworks **situation awareness** is a key to ensure process reliability, health and safety at the workplace and low environmental impact

The **hemorrhage of highly skilled people** in a sort of ‘war of talents’ is a serious business threat, which can be faced by creating attractive workplaces and stimulating working conditions



Image generated with AI

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Mission

iSteel-Expert implements and demonstrates in industrial environment a **remote expert virtual system** that monitors 24/7 the progress of the process, analyses the information and suggests actions to improve and/or correct steelmaking operations



Image generated with AI

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Objectives

- Preserve and evolve company's **know-how**
- Improving **work force management** and safety
- Increase process **efficiency**
- Improve equipment condition and **maintenance**
- Reduce **environmental impact**



Image generated with AI

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Training Platform

An **interactive immersive training tool** which, through a knowledge-based approach, favors preservation, transfer and continuous evolution of the company's wealth of knowledge

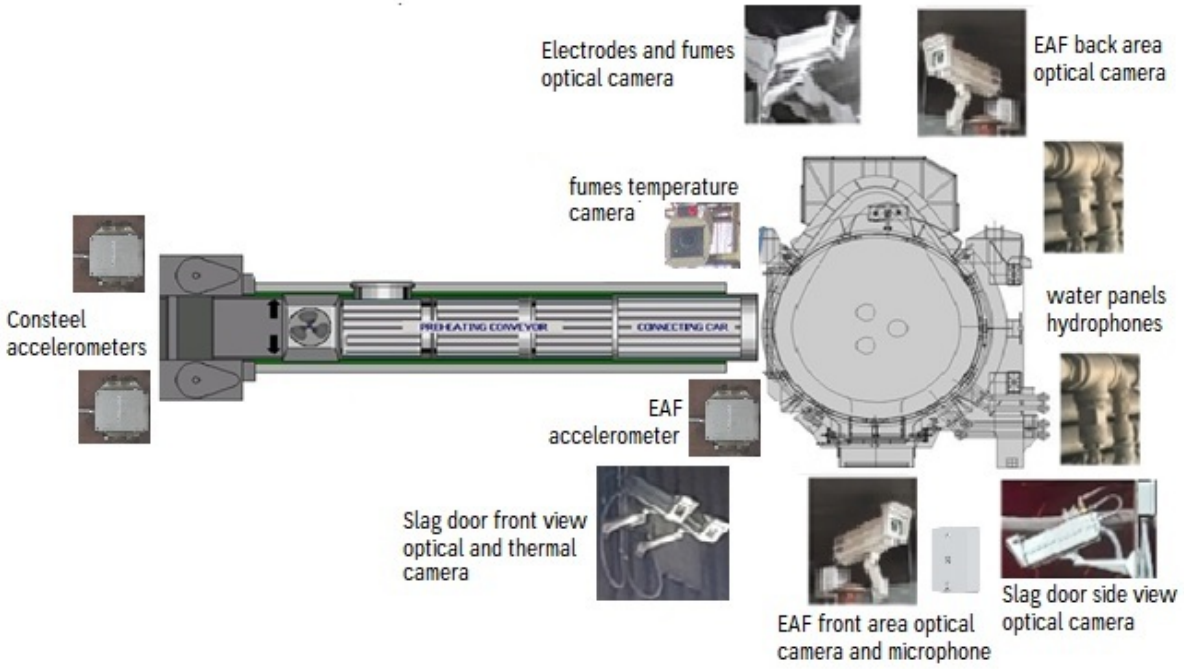


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Infrastructure

Sensors
- Cameras
- Microphones
- Accelerometers

Platforms
- Edge Devices
- Cloud
- Dashboards



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Machine Learning Models

Object Detection and Image Classification



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Object Detection

What it is

Object detection identifies *what* objects are in an image and *where* they are, by combining **classification** and **localization**

Based on convolutional neural networks and transfer learning

How it works

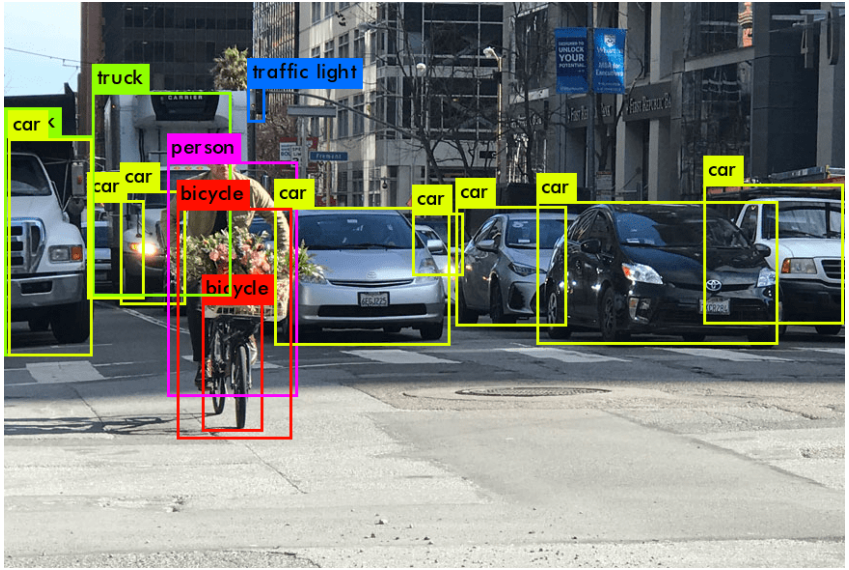
- Use models like **ResNet** trained on **ImageNet** or **YOLO** trained on **COCO** datasets as a backbone
- Attach layers as a detection head to predict object classes and bounding boxes
- Fine-tune model on domain-specific dataset to adapt to new object types while reusing learned visual features

Prediction

- The model outputs class and location of each object in image

Advantages

- Requires fewer labeled images
- Reduces training time and computational cost
- Achieves high accuracy with limited data



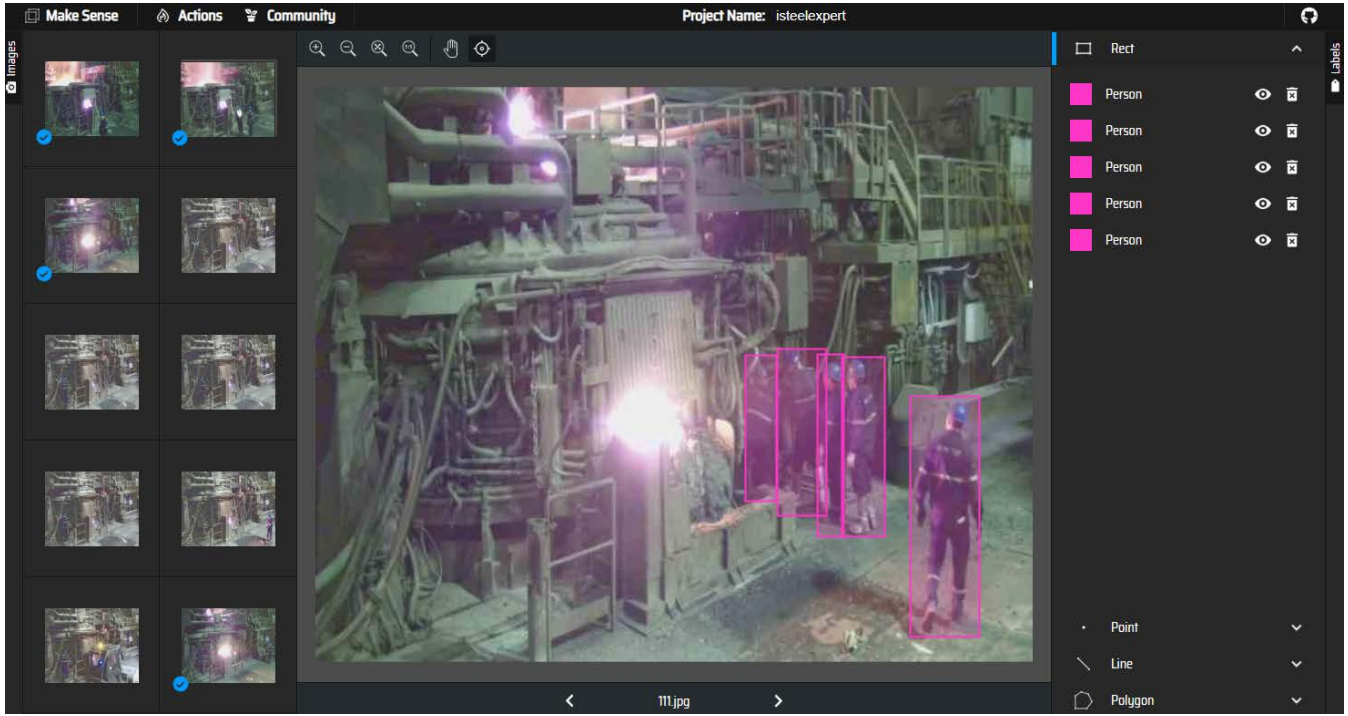
Note that pretrained models, like the one above, do not work in industrial environments

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Object Detection

Images must be tagged to train the model to recognize the object (people in this case) in the specific setting

Manually tagging images is the most time-consuming activity, but it is also the activity with the biggest impact, if done well



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Image Classification

What it is

Image classification assigns a *single label* to an entire image — identifying *what* object or concept it represents

Based on convolutional neural networks and transfer learning

How it works

- Use models like **ResNet** or **EfficienNet** trained on **ImageNet** dataset to extract visual features from images
- Replace the final fully connected (classification) layer with one adapted to your own dataset
- Fine-tune the new layer (and optionally top CNN layers) to learn your specific categories

Prediction

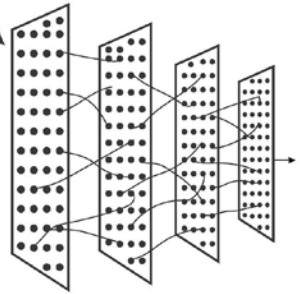
- The model outputs the **most likely class** for each image

Advantages

- Fast convergence and reduced data requirements
- High accuracy even with small datasets
- Reuse of generalized visual representations







Output:
Smoke

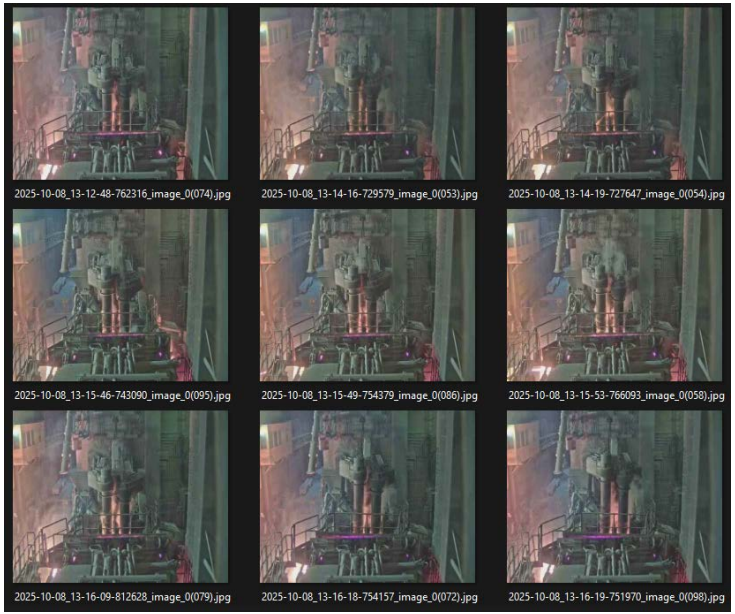
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Image Classification

For image classification it’s easier to tag images

Just separate the images with different classes into different folders

No Smoke



Smoke



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Smoke Detection

Model analyzes images to detect early signs of fumes or flames around the electrodes and roof

Extracts visual cues to flag potential occurrences of dangerous reactions

Smoke:





No Smoke:





?



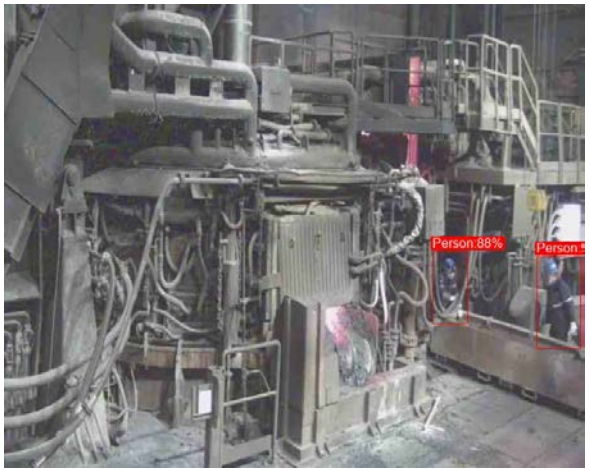
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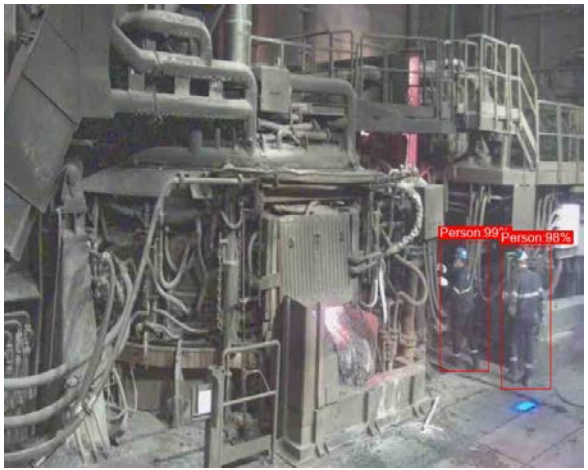
People Detection

The system identifies personnel presence in high-risk zones around the furnace

This ensures that operators are aware of human location relative to hazardous operations, reinforcing safety protocols and minimizing the risk of accidents







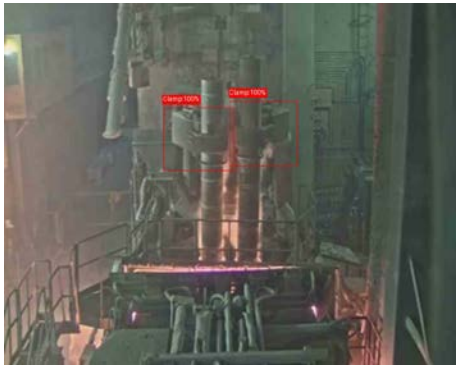
* Images taken while furnace was off

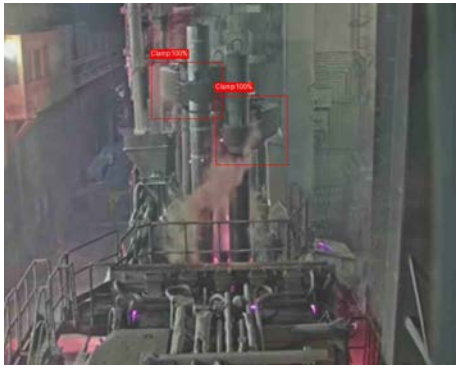
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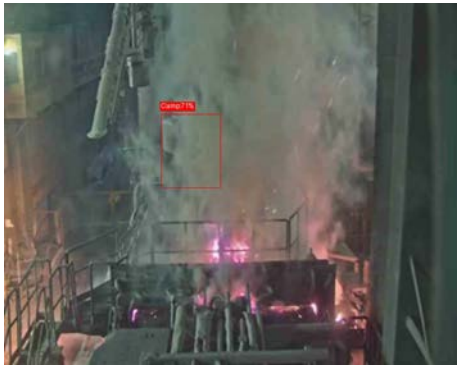
Electrode Clamp Speed Estimation

Applying optical flow and frame-to-frame correlation, the system determines the position of the electrode arm and its up-and-down velocity

Movement monitoring provides critical insights into process control, such as abnormal electrode position profile during the heat which requires to adjust the power profile, as well as highlighting potential mechanical or hydraulic degradation of the electrodes control system









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Slag Door Status Detection

By analyzing camera feeds near the slag door, the system highlights cases in which the slag door is commanded to close but obstructions prevent it from closing properly

This provides feedback on operator compliance with slag door control and cleanliness practices during the heat



Door closed



Door open



Door obstructed



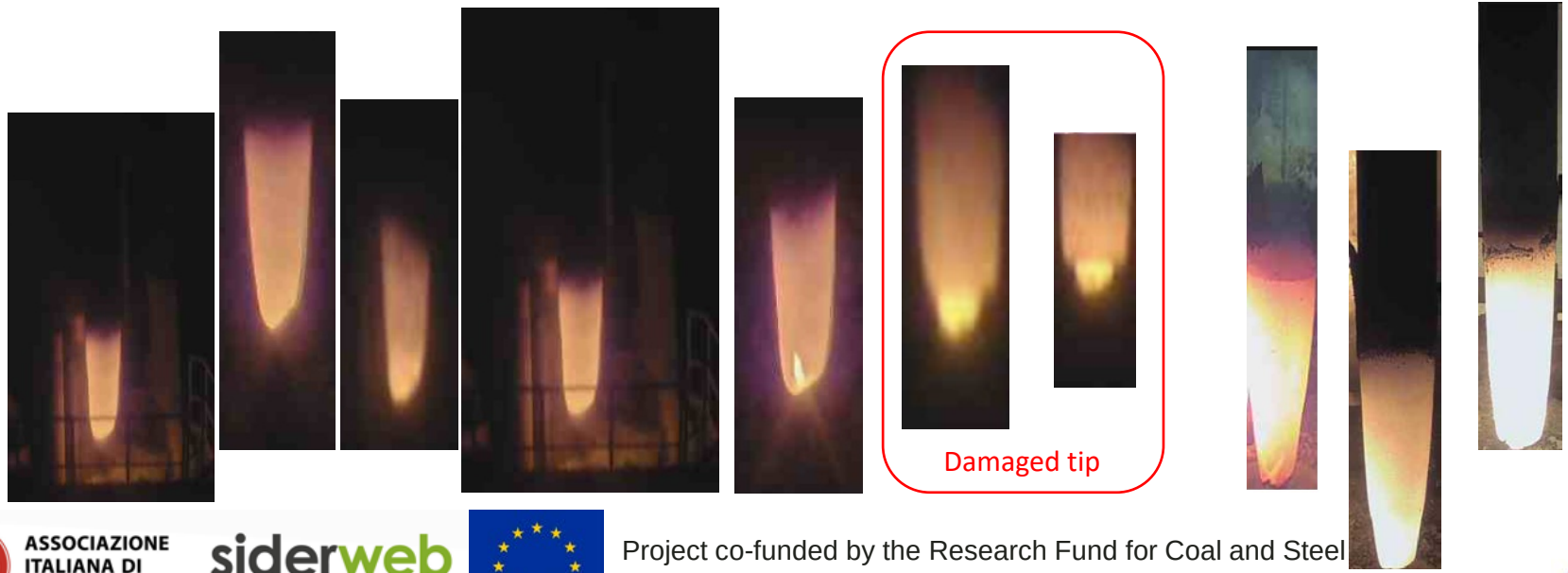
Door state unknown

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Electrode Tip Evaluation

Leveraging convolutional neural network-based segmentation, the system models and periodically assesses the electrode's tip geometry to recognize

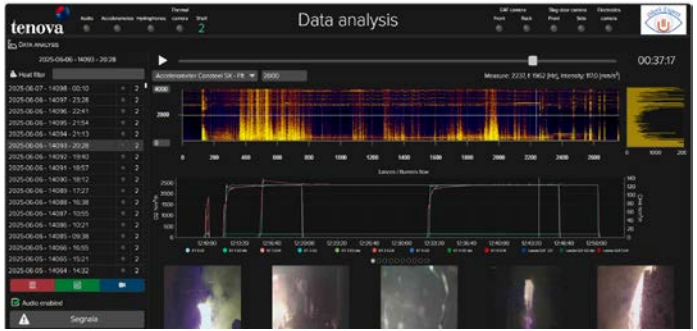
Detecting wear anomalies, such as high side consumption, allows to prompt attention on the control set of both the water cooling and the fume suction, whose right adjustment extends the electrode life



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iSteel-Expert Dashboards

User-friendly easy-to-read dashboards have been created in the Cloud to monitor the status and performance of the iSteel-Expert system and its KPIs









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Conclusions

Traditional AI is still very powerful, it’s not all about Generative AI

Convolutional Neural Networks (CNNs) are very useful in steel plants

Gathering images in a steel plant is very easy

Training CNNs is relatively easy with current tools and technologies

The biggest challenge is manually tagging images, especially edge cases



Image generated with AI

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QUESTIONS & ANSWERS



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Image generated with AI

Just for fun…

Who is the painter inspiring each image?









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Thank You!

Giovanni Bavestrelli

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Development of an Intelligent Monitoring System for Anomaly Detection in Electric Arc Furnace Steelmaking

Marco Vannucci[1], Stefano Pede[1], Muhammad Waseem Akram[1], Arslan Siddique[1], Renato Girelli[2], Giovanni Bavestrelli[2], Valentina Colla[1]

[1]*Scuola Superiore Sant'Anna*

[2]*Tenova S.p.A.*

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Motivation: EAF operational challenges

Electric Arc Furnaces (EAF) represent one of the most volatile industrial environments. Challenges include:

- High energy intensity
- Scrap material variability
- Diverse operator practices

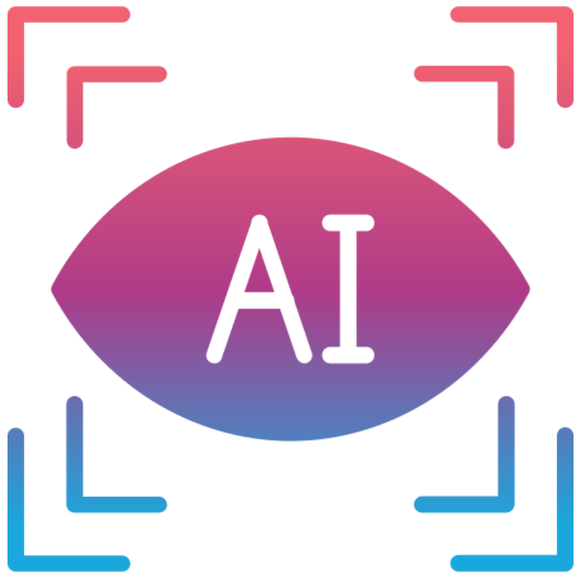


Critical anomalies

- electrode breakage, strong furnace reactions, or roof closing difficulties
- can lead to significant productivity losses, safety hazards, and product quality degradation

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Motivation: AI detection



Strategic Digital Transition: Industry shift toward intelligent manufacturing to meet efficiency, quality, and sustainability demands.

Operational Complexity: EAF steelmaking is a dynamically complex, energy-intensive process with high variability in inputs and conditions.

Monitoring Challenges: Real-time oversight is critical yet difficult due to unpredictable furnace reactions and material variations.

Risk Mitigation: Automated detection of electrode breakage and roof issues prevents productivity losses and safety hazards.

Knowledge Preservation: Reducing reliance on individual experience to combat workforce aging and knowledge attrition.

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Data Collection & Dataset Composition

Source: Real-world data collected from an industrial EAF facility during both normal and anomalous operations.

Heterogeneous Data Integration: Combination of chemical composition measurements, process operational parameters, and electrical signals.

Temporal Resolution: Data recorded throughout the duration of each heat (production cycle).

Anomalies: dataset includes 184 anomalous heats and approximately 1700 normal heats, spanning 7 distinct anomaly categories

ANOMALY CATHEGORY	NUMBER OF EVENTS
High-carbon melt	39
Roof closing trouble	25
Strong furnace reaction	32
Electrode breakage	67
Furnace explosion	4
Oxidized/liquid slag	9
Slag reaction	8

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Data preparation

Feature Engineering:

- Transformation of raw time-series signals into statistical aggregates per heat.
- Computed metrics include *mean*, *standard deviation*, and specific sets of *percentiles*.

Dataset Structure: Tabular format where each row represents a single heat and each column represents an aggregated feature.

Iterative Refinement: Progressive feature selection and refinement based on industrial data availability, evolving from 473 to **368 final features**.



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Methodology

A dual approach

1. **Generic Anomaly Detection**: Binary identification of whether an anomaly occurred during a heat.
2. **Specific Anomaly Classification**: Multi-label classification to distinguish between different types of anomalies.

Models

- Evaluation of two supervised models:
  - **Histogram Gradient Boosting (HGB)**
  - **AdaBoost**.
- Extensive hyperparameter tuning via **Grid Search**.



70-30 data partition **with stratification**

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The class imbalance problem and its metrics

Addressing the challenge of a **highly skewed dataset** where anomalous heats represent only **~10%** of total data.

- **Balancing Strategy:** Application of a strategic **undersampling** approach during the training phase to artificially balance class prevalence.
- Systematic comparison between models trained on the balanced dataset versus the natural class distribution.

ANOMALY CATHEGORY	NUMBER OF EVENTS
High-carbon melt	39
Roof closing trouble	25
Strong furnace reaction	32
Electrode breakage	67
Furnace explosion	4
Oxidized/liquid slag	9
Slag reaction	8

$$Recall = \frac{TP}{TP + FN}$$

$$\text{Precision} = \frac{\text{TP}}{\text{TP+FP}}$$

$$\text{BalancedAccuracy} = \frac{1}{2}\left(\frac{\text{TP}}{\text{TP+FN}} + \frac{\text{TN}}{\text{TN+FP}}\right)$$

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Results: generic anomaly detection

Algorithms were tested both with natural prevalence and with undersampled training data. Later evaluated on validation data.

ALGORITHM	TRAINING PREVALENCE	TEST RECALL	TEST PRECISION	BALANCED ACCURACY
AdaBoost (best model with natural prevalence)	0.10 (natural)	0.634	0.867	0.812
HGB (bets model overall)	0.50 (undersampled)	0.956	0.364	0.902

- With the natural training prevalence (~10% anomalous), the best results were achieved by **AdaBoost**
- When training with undersampled data, **HGB** achieved a recall of 0.96 and balanced accuracy of 0.9, at the cost of a reduced precision (0.364). This reflects the expected trade-off: undersampling dramatically increases sensitivity but generates more false positives.

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Results: specific anomalies detection

Due to the extreme rarity of individual anomaly categories (prevalences between 0.4% and 3.5% in the test set). Without undersampling, most algorithms failed to detect rare anomaly types, defaulting to the majority class → undersampling was applied (50%)

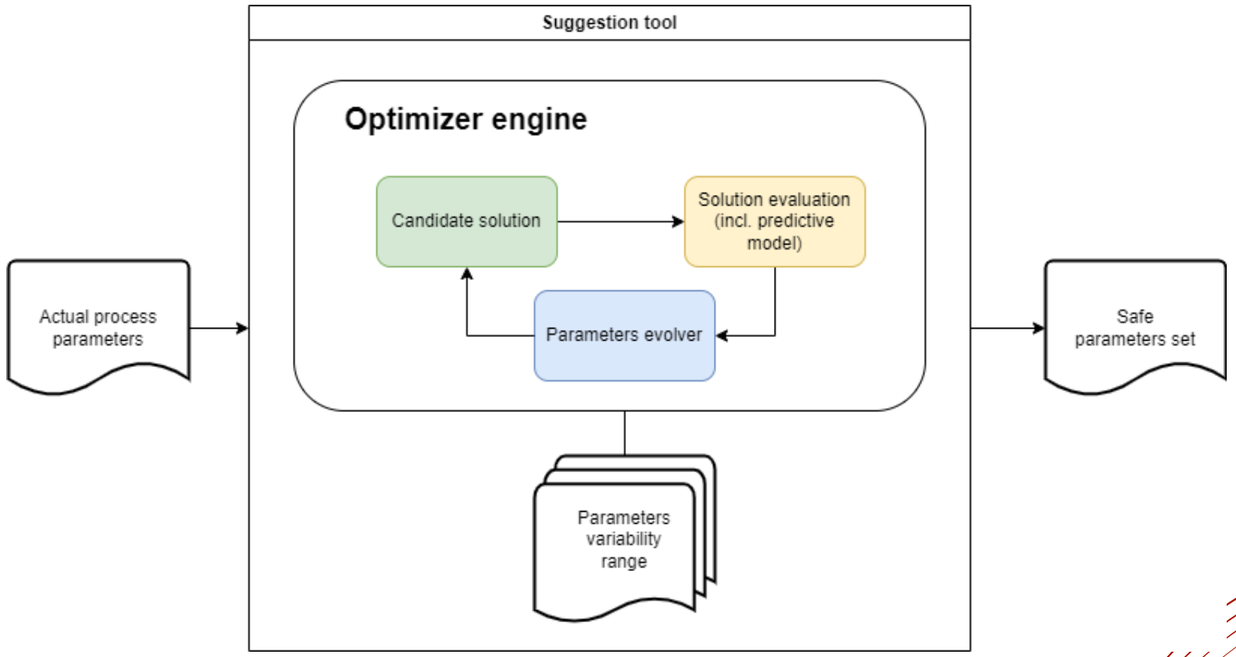
ANOMALY	HGB RECALL (DOWN.)	ADABOOST RECALL (DOWN.)	HGB BAL. ACC.	ADABOOST BAL. ACC.
High-carbon melt	0.800	1.000	0.802	0.932
Roof closing trouble	0.000	1.000	0.500	0.922
Slag reaction	0.000	1.000	0.500	0.789
Strong furnace reaction	0.875	0.875	0.806	0.820
Electrode breakage	0.895	0.824	0.851	0.859
Oxidized/liquid slag	0.000	1.000	0.500	0.709

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Toward a decision support system

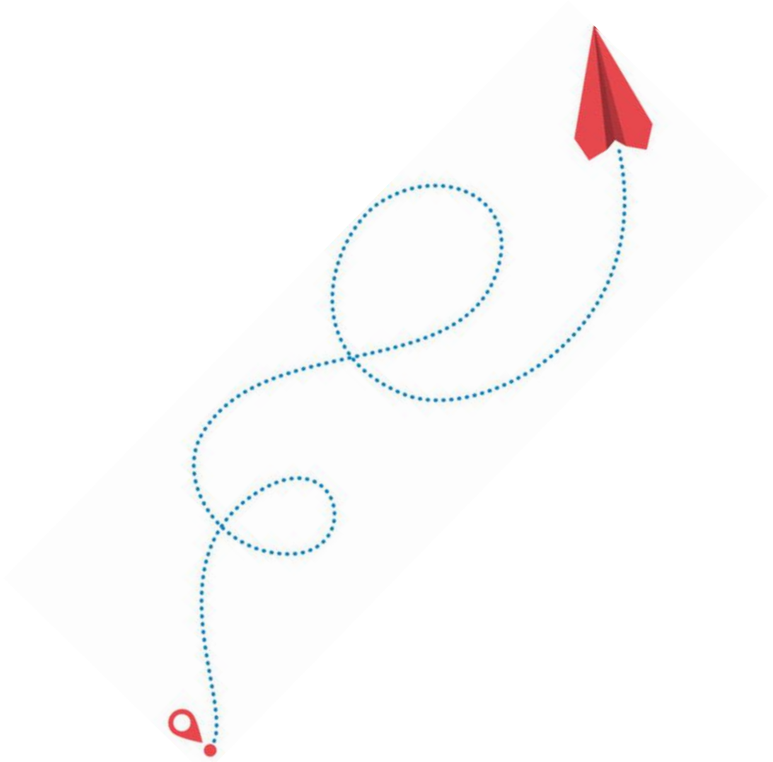
A proof-of-concept **DSS** combining **predictive ML models** with a **Genetic Algorithm (GA) optimization** framework.

- **Actionable Recommendations:** The system provides real-time corrective suggestions
- Dual-Objective Optimization: The GA identifies process adjustments by simultaneously:
  - **Minimizing anomaly probability** as predicted ML model.
  - **Minimizing deviation from current operating conditions** to ensure practical feasibility.
- Optimization explores **only feasible process modifications** within strict physical and safety boundaries.



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Conclusions and future work



- **High Performance:** Demonstrated that ensemble models (HGB) achieve 80–90% balanced accuracy in detecting EAF process anomalies.
- **Effective Imbalance Management:** Proven that strategic rebalancing and algorithms like AdaBoost significantly improve the classification of rare anomalous events.
- **Actionable DSS:** Successfully integrated ML predictions with a Genetic Algorithm to provide feasible, real-time corrective recommendations.
- **Technical Evolution**: Future research will focus on time-series-aware models and advanced synthetic sampling (e.g., SMOTE) to refine detection.

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The work described in the present paper has been developed within the project entitled ”*Remote expert virtual system enhancing human management capabilities that favors preservation, transfer, and continuous evolution of knowledge for steelmaking operations*” (Ref. **iSteelExpert**, Grant Agreement No. 101112102) that has received funding from the RFCS programme, which is gratefully acknowledged. The sole responsibility of the issues treated in the present paper lies with the authors; the Commission is not responsible for any use that may be made of the information contained therein.

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Thank You for Your attention!

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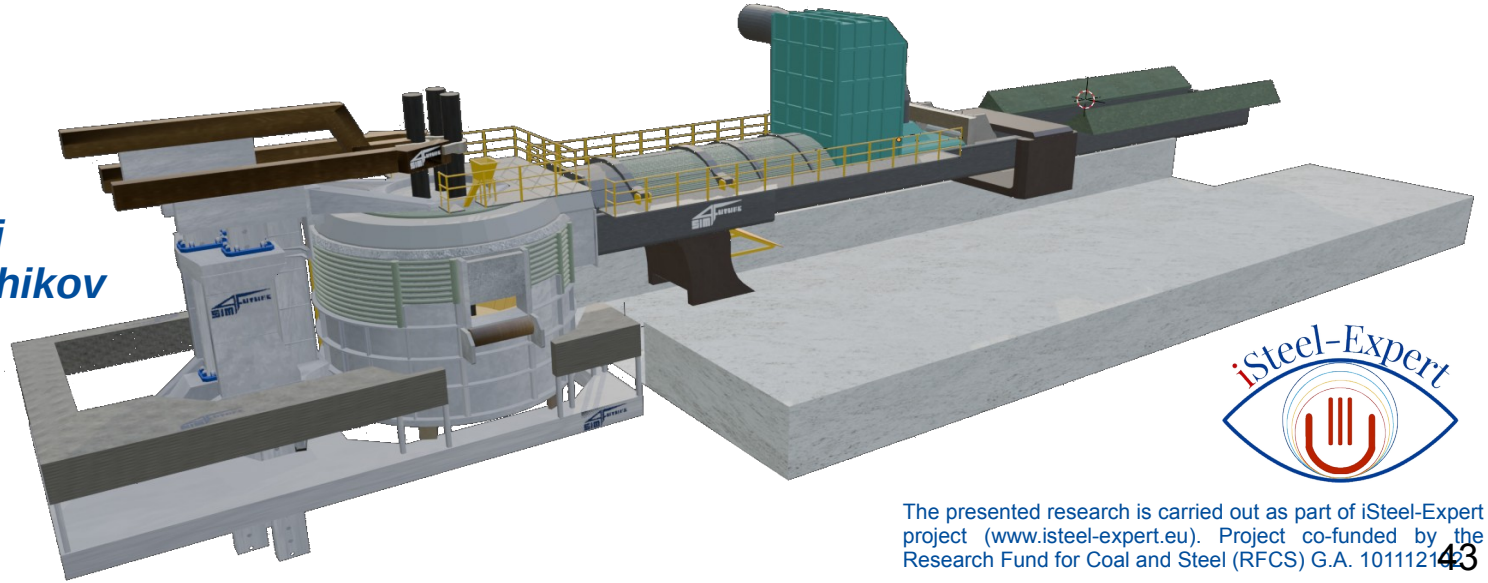
https://www.researchgate.net/profile/Valentina_Colla

https://www.linkedin.com/in/valentina-colla-20aa8321/

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Simulation Based Training for Industrial Operations:

Interactive Learning for Complex Tasks



Marina Massei
Kirill Sinelshchikov

SIM4Future
www.sim4future.com

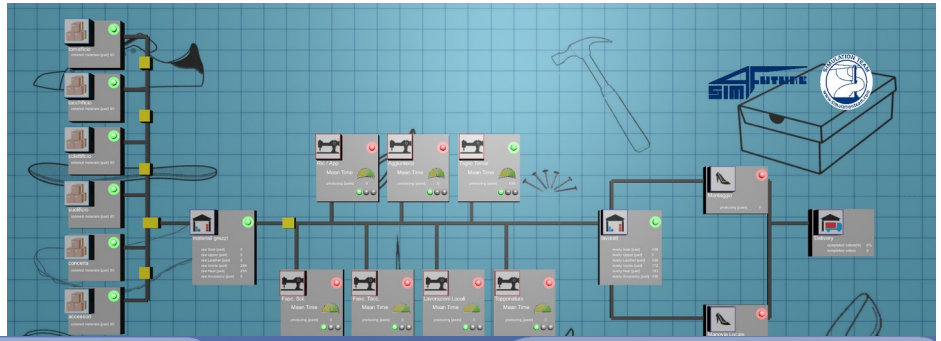
The presented research is carried out as part of iSteel-Expert project (www.isteel-expert.eu). Project co-funded by the Research Fund for Coal and Steel (RFCS) G.A. 101112143

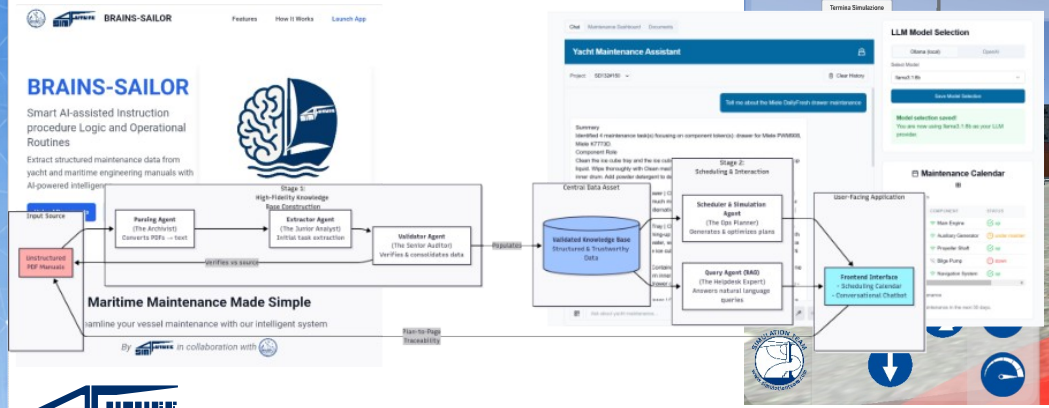
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SIM4Future

MODELING & SIMULATION HI-TECH COMPANY

- AI, Data Analytics, Modeling & Simulation
- Focus on decision support, process optimization, training







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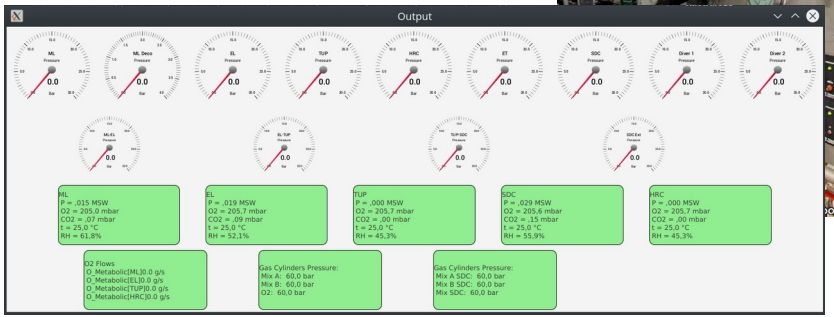
SIM4Future – Simulation-Based Training

Structured learning & simulation-based practice
Reproduction of real operating conditions and edge cases
Safe environment for rare and hazardous scenarios
Continuous performance tracking and evaluation

- Operator & safety training
- Process familiarization
- Industrial demonstrations







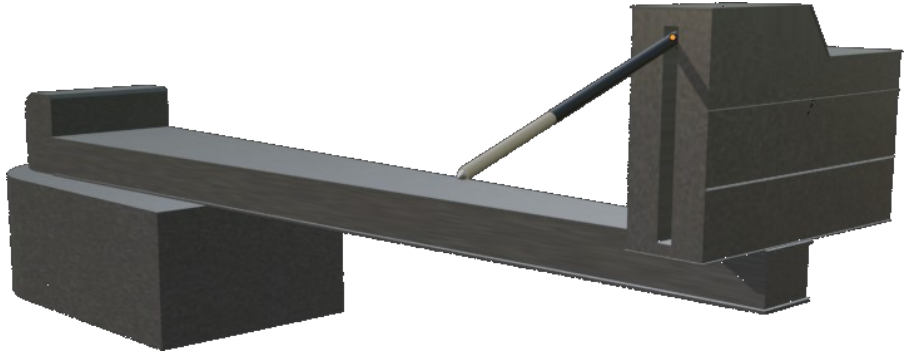


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Training Problem



Traditional training requires equipment
Rare events are difficult to teach due to risk and infrequency: high smoke level, explosions. Standard training covers mostly routine operation but not critical cases.
Operators gain experience slowly



No safe environment to practice abnormal or dangerous situations
Lack of repeatability in training scenarios
Insufficient tools to assess learning curve

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EAF & Training



Operational Complexity

- Multiple coupled process phases
- Simultaneous thermal, chemical, and logistical decisions
- Continuous coordination between operators

Training must focus on operational understanding, not only process description







Images: Čeština: Osrblie, vysoká pec Tri Vody by Daniel Baránek
Metallschmelzung für Guss in der Lokomotivfabrik Datong by Manfred Kopka

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Objectives

Who?

New resources to become 1st and 2nd furnace operators, consteel operator



What?

Normal operations:

Heat cycle management: EBT preparation, melting with consteel loading, superheating & deslagging, tapping

Particular conditions:

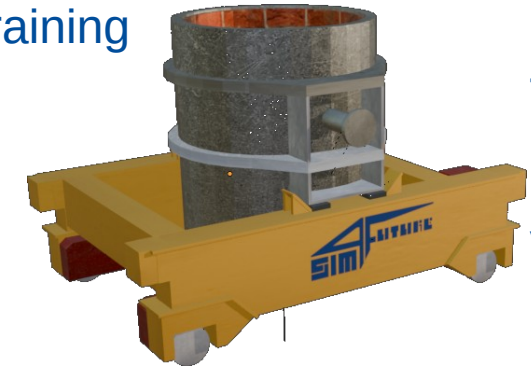
Furnace high noise, high smoke level, furnace reactions, small explosions etc

- Faster onboarding of new resources
- Safe exposure to dangerous situations
- Repeatable training in both normal and abnormal conditions
- Quantifiable trainee evaluation

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Simulation-Based Training

- Use of simulation to reproduce real EAF operation conditions
- Controlled environment for testing operator decisions
- Ability to introduce rare and critical events on demand
- Repeatable scenarios enabling consistent training



Operations | **Physics** | **User Interaction**

In order to be efficient for training, the simulator need to address various aspects of the plant operation, including:

Procedures, execution of principal tasks by the operator

General physics and principal chemical reaction

Visualization and user interactions

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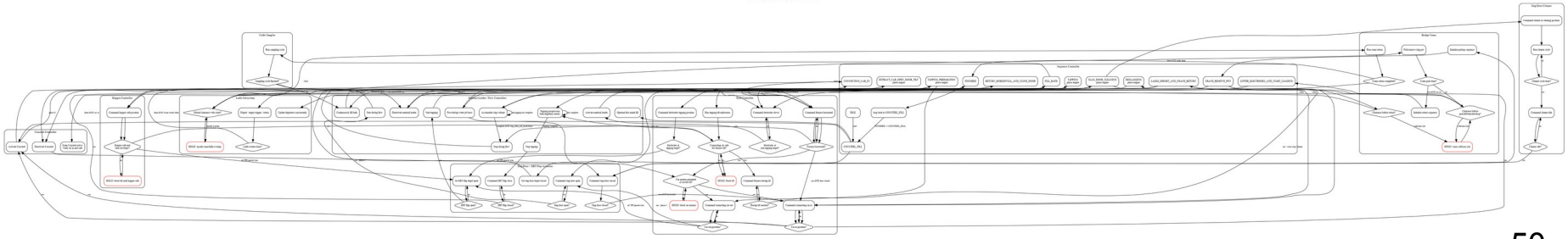
Animation vs Simulation

Animation
- Predefined sequence
- No process logic
- No consequence of wrong actions

→ System **Appearance**
→ Improper behavior
→ Negative training

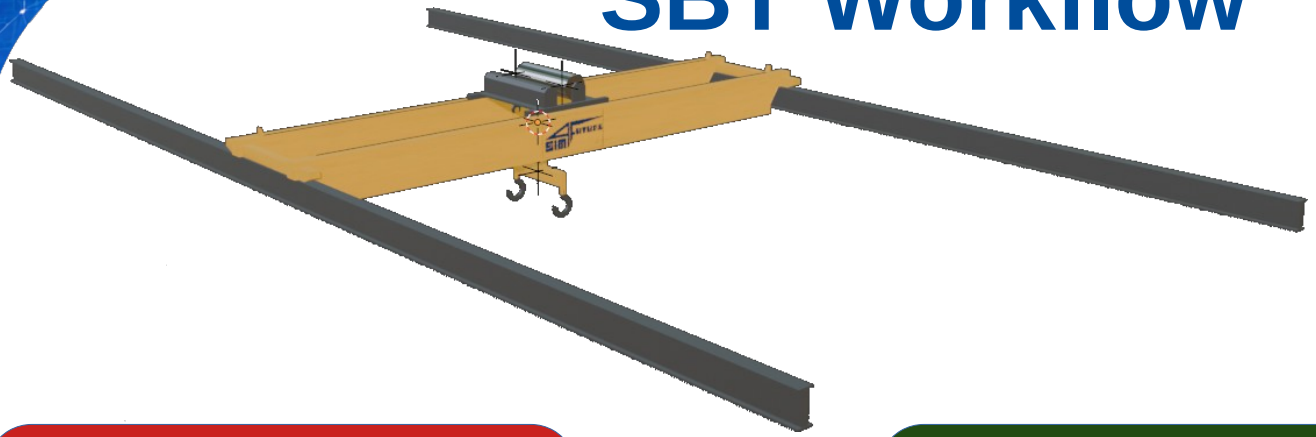
Simulation
- Process reacts dynamically
- Operator decisions modify outcome
- Different conditions produce different behavior
- Performance can be evaluated quantitatively

→ System **Behavior**



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SBT Workflow



1. Learning platform for familiarization with the process
2. Training platform to deal with complete heat cycles
3. AI—based training & decision support tool

Start with theoretical preparation on the platform

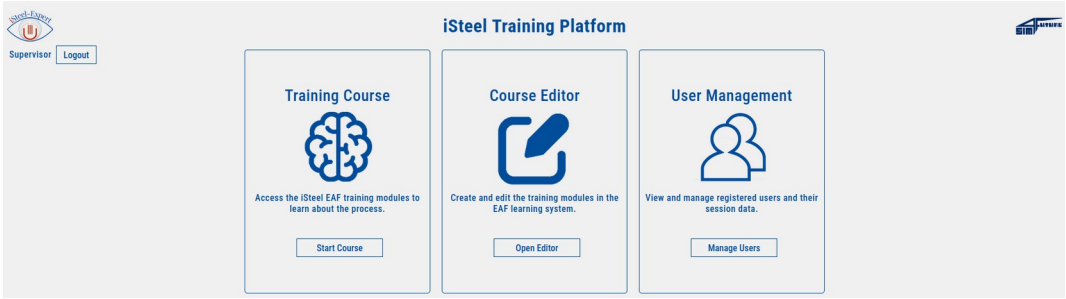
Apply knowledge in simulation scenarios

Validate knowledge through tests & exercises

Iterative loop enabling continuous improvement

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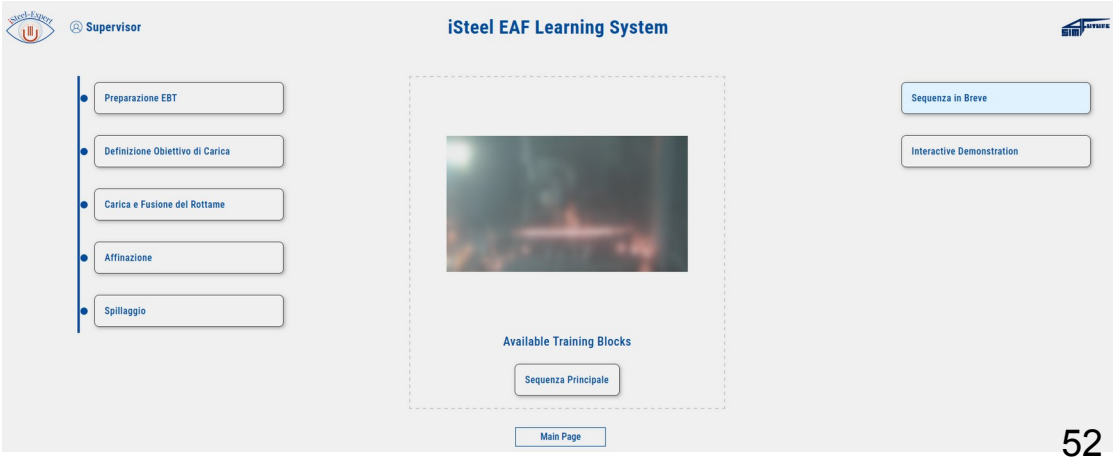
Learning Platform



Structured modules covering EAF operation and heat cycle phases
Interactive content supporting step-by-step understanding
Integrated knowledge verification through exercises

Process-oriented explanation:

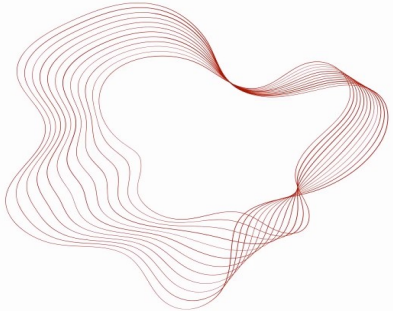
- Interactive demonstrations
- Flowcharts
- Photos & videos
- Descriptions



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Virtual Environment

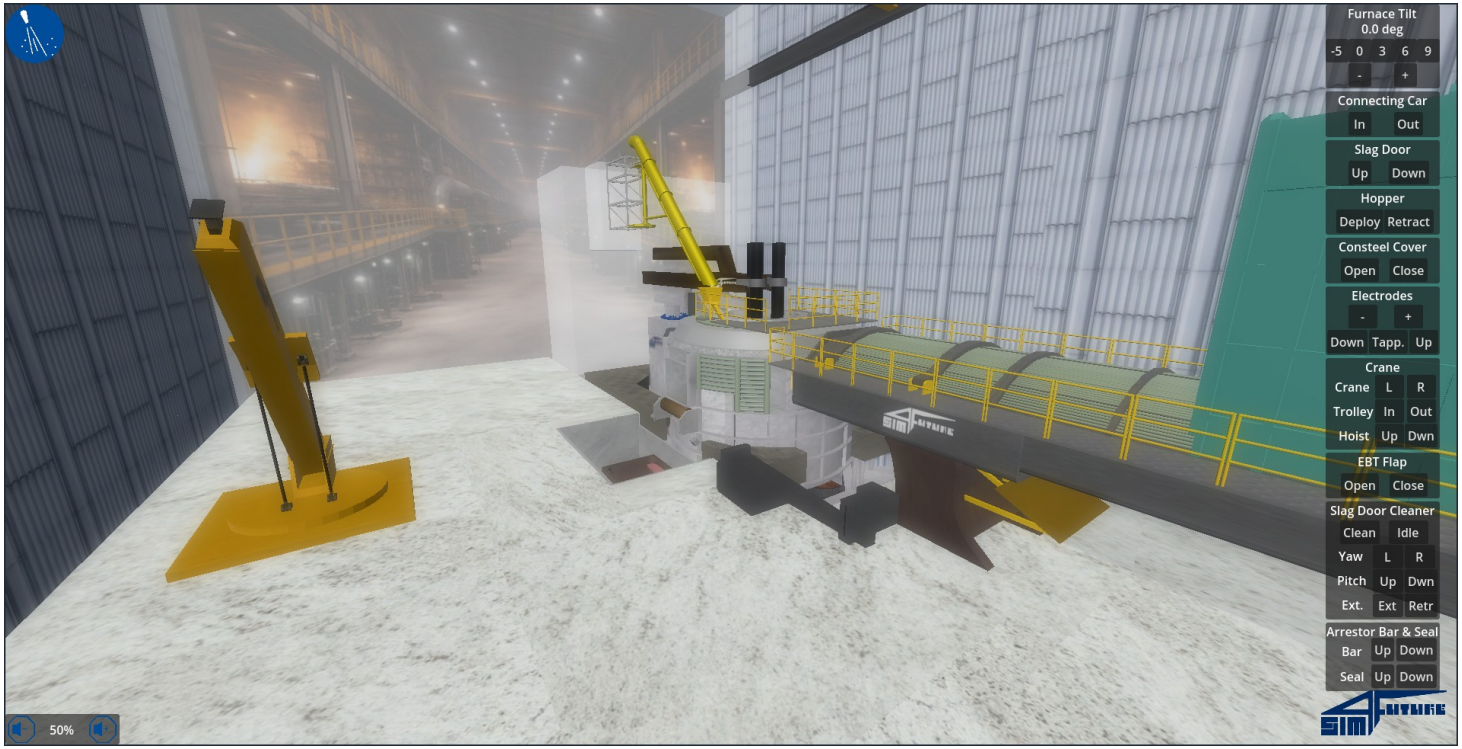
iSteel-Expert Interactive Simulation for Education and Training of Operators



Project co-funded by the Research Fund for Coal and Steel (RFCS) G.A. 101112102

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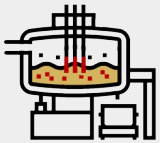
Virtual Environment



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Metrics

Simulated Environment



Log of events & actions



Reference Values



- Training duration and progression per user
- Success rate in knowledge verification tasks
- Response time and correctness in simulation events
- Performance trends across modules and scenarios – learning curve
- Utilization and waste of resources
- Occurrence of critical errors and high risk situations (e.g. explosions, significant spills of materials)

→ Objective quantification of progress

Evaluation



Overall Trainee Analysis



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Conclusions

Simulation enables exposure to conditions not accessible in reality
Integration of learning and practice improves effectiveness
Training becomes measurable and comparable
Approach supports both safety and performance improvement

Simulation-based training addresses core limitations of traditional methods
Scalable solution adaptable to different plants and contexts
Enables systematic development of operator competence
Provides basis for further extensions (AI-driven personalization, advanced analytics)

The presented research is carried out as part of iSteel-Expert project (www.isteel-expert.eu). Project co-funded by the Research Fund for Coal and Steel (RFCS) G.A. 101112156

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Thank you!

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Genoa, 21-23 September 2026

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https://www.msc-les.org/eurosim2026/
https://www.msc-les.org/i3m2026/

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A Cognitive and AI-Based Training Framework for Electric Arc Furnace Workforce Development

Emilio Jimenez, University of La Rioja (Spain)

iSteel-Expert European Project

Digital Transformation in EAF Steelmaking



Increasing automation and digitalization



Higher complexity of operations



Requirements: efficiency, sustainability, safety

The Training Challenge

- Strong dependence on human expertise
- Tacit knowledge difficult to transfer
- Traditional training not scalable
- Risk of knowledge loss

Limitations of Current Training Systems

- Simulation: process-centric
- Documentation: static
- Lack of cognitive support
- Limited decision-making training

Proposed Approach

AI-enhanced training ecosystem

Human-centric perspective

Integration with existing simulators

From Process-Centric to Human-Centric Training



Focus on operator decision-making



Explicit modelling of cognition



Support for reasoning and learning

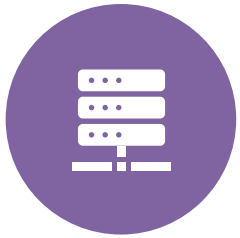
Overall Training Architecture



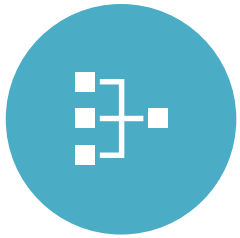
KNOWLEDGE LAYER



COGNITIVE LAYER
(CLEAR AGENTS)



INTERACTION LAYER
(CHATBOT)



INTEGRATION LAYER
(SIMULATORS)

System Components



KNOWLEDGE ENVIRONMENT



COGNITIVE AGENTS (CLEAR)



CONVERSATIONAL ASSISTANT



INTEGRATION WITH SIMULATORS

Cognitive Agents (CLEAR Architecture)



Emulation of expert reasoning



Explainable decision support



Adaptive behaviour

Cognitive Architectures for Advanced Simulation in iSteel

1. Introduction: What Are Cognitive Architectures?

Cognitive architectures are computational frameworks designed to model human-like reasoning, decision-making, and learning processes. Unlike conventional algorithmic systems, which typically follow predefined rules or optimization procedures, cognitive architectures aim to reproduce the internal mechanisms underlying intelligent behavior.

At their core, cognitive architectures integrate:

- **Perception** (interpretation of the environment),
- **Memory systems** (short-term and long-term knowledge),
- **Decision-making mechanisms** (rule-based or probabilistic),
- **Learning capabilities** (adaptation from experience).

Their purpose is not only to solve problems but to **simulate how intelligent agents behave under dynamic, uncertain, and context-dependent conditions**.

From a traditional engineering standpoint, we could say that they are the natural evolution of control systems: we've moved from "controlling processes" to modeling decision-makers. In other words, we don't just simulate the plant... we simulate the operator..

Integration with Industrial Platforms

Cognitive architectures are theoretical and computational frameworks that seek to model the human mind to create intelligent artificial agents capable of reasoning, learning, and acting.

- **SOAR (State, Operator, And Result)** is one of the oldest and most established architectures, focused on problem-solving through rules, while
- **CLEAR (Concise, Logical, Explicit, Adaptive, Reflective)** is a more recent approach focused on integrating language models, knowledge graphs, and supervision.

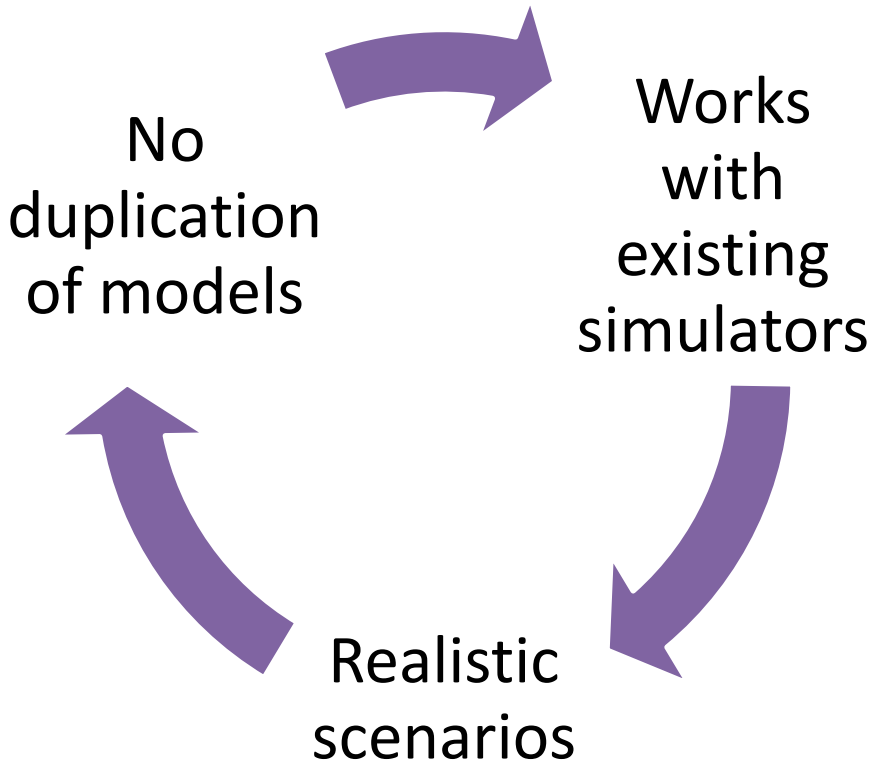
Training Methodology

Progressive learning approach

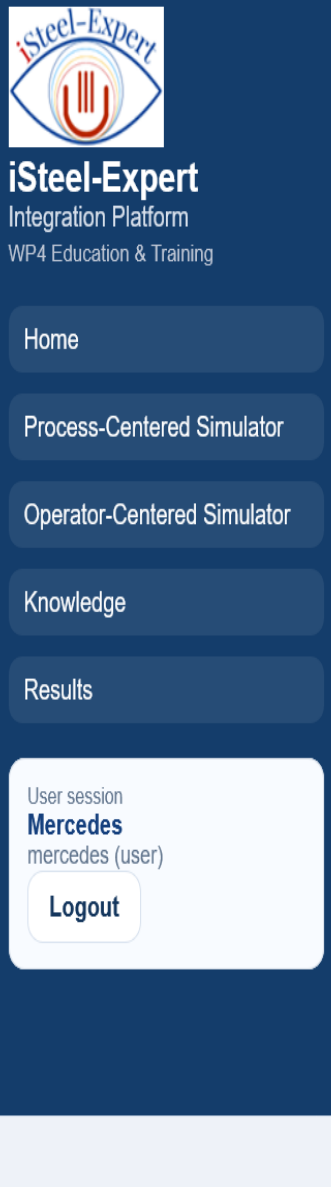
Knowledge → Guided → Scenario → Autonomous

Gradual reduction of support

Integration with Industrial Platforms



Integration with Industrial Platforms



UNIFIED ACCESS

iSteel Integration Platform

Training, simulation and AI-assisted knowledge support for iSteel-Expert

A single entry point for simulation, knowledge, training and AI-assisted decision support.

Three complementary modules developed by **SIM4Future**, **UNICL** and **UNIRIO**.

Integrated access to the Process-Centered Simulator, the Operator-Centered Simulator, and the knowledge and training module.

Open Simulation Hub | Open Knowledge Hub

European Commission

Co-funded by the European Union – RFCS Programme

Process-Centered Simulator (SIM4Future)

3D process simulation environment developed by **Sim4Future (SIM4)**. This module represents the process-centred simulation layer of the iSteel platform.

Operator-Centered Simulator (UNICL)

Operator dashboard and plant-effects simulation developed by **Université Catholique de Lille (UNICL)**.

Knowledge, Education & Training (UNIRIO)

Knowledge base, training resources, cognitive architecture material (SOAR / CLEAR), interactive tests and AI-assisted support tools developed by **University of La Rioja (UNIRIO)**.

SIM4 MODULE

Process-Centered Simulator

SIM4Future Process Simulation Module

This section provides access to the process-centred simulation environment developed by **Sim4Future (SIM4)**, together with its supporting documentation and media resources.

Simulator access

Launch the Process-Centered Simulator from the current SIM4 environment. At this stage, the simulator is treated as an external module connected through the iSteel portal.

Open Process-Centered Simulator

Note: the final access mode may be a controlled link, embedded view, or API-based integration, depending on the deployment agreed with the partner.

User manual (PDF)

Access the current PDF manual of the Process-Centered Simulator.

Open PDF manual

Interactive manual

This area will provide a more interactive and user-friendly version of the simulator manual, including structured navigation, visual support and guided access to the main functions.

Videos

Access video demonstrations and guided usage material for the Process-Centered Simulator.

Open videos page

?

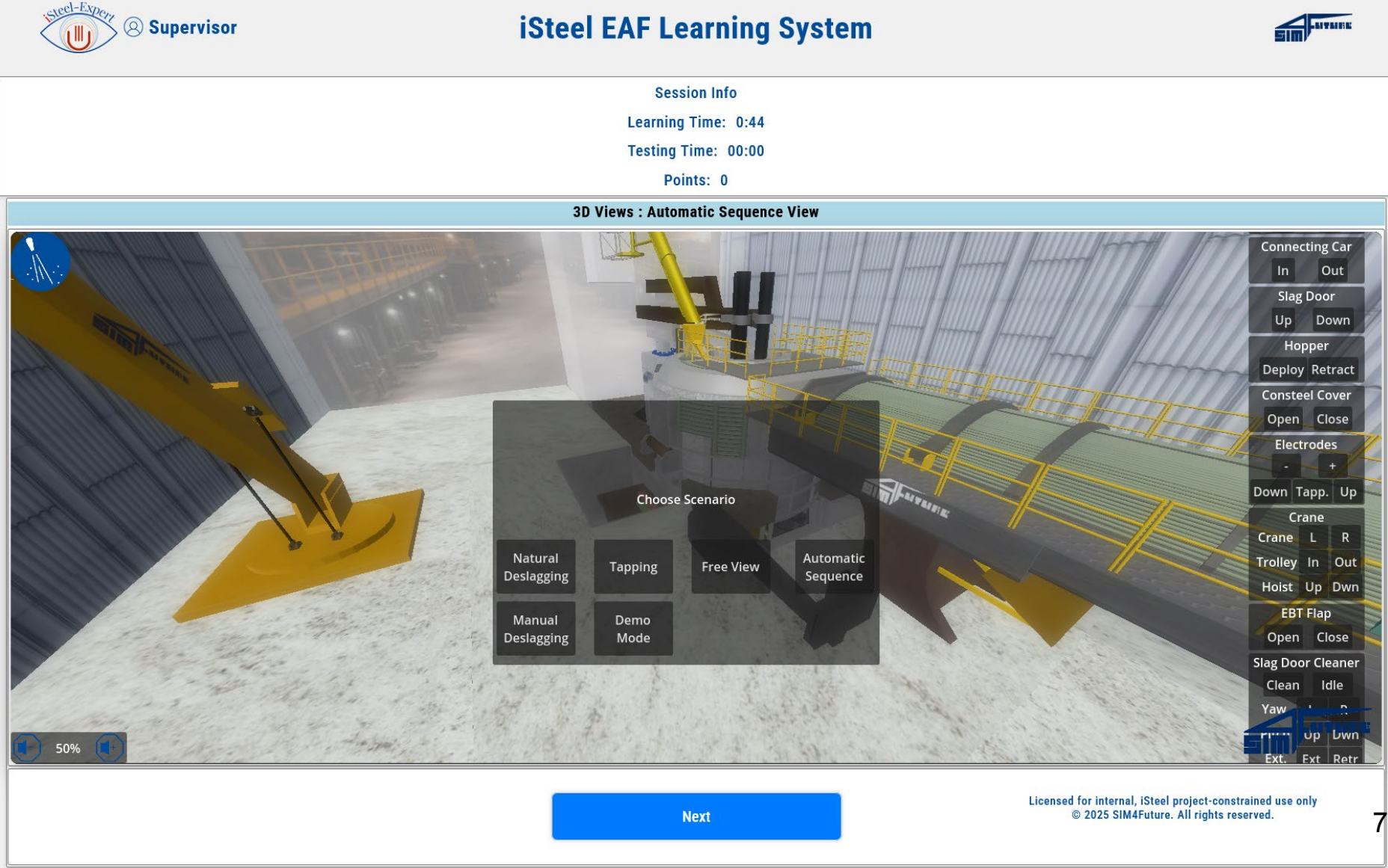
Technical integration note

The SIM4 process-centered simulator is currently deployed as a local Java backend provided by the SIM4Future partner.

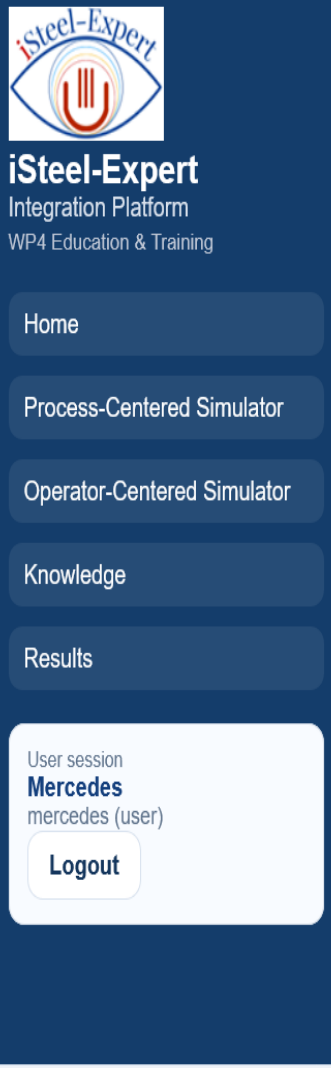
In the current integration prototype, the iSteel portal provides a controlled launcher that starts the simulator and opens its local web interface.

In the final platform architecture, this module will be connected through a controlled external URL, embedded interface, or API-based integration depending on the deployment model agreed with the partner infrastructure.

Integration with Industrial Platforms



Integration with Industrial Platforms



UNICL MODULE

Operator-Centered Simulator

Operator Simulation Module

This module corresponds to the operator-centred simulation environment developed by **Université Catholique de Lille (UNICL)**.

Purpose

Simulation of operator decisions, dashboard monitoring and plant effects.

Integration

The simulator is launched locally through the iSteel portal using a controlled launcher that starts Pitch pRTI and then opens the exported EAF Factory Model runtime.

Status

Current version: simulator running correctly through the local portal integration.

Resources

Access the operator-centered simulator and its supporting documentation.

Simulator running | Open Operator Gateway | Documentation | Interactive documentation

Status: pRTI and simulator are running. Use the Operator Gateway button to access the integration page.

Note: the current AnyLogic exported frontend is locally executable, but remote rendering may be restricted by the AnyLogic runtime/export configuration. The gateway provides a controlled access point and documents this technical limitation.

?

Integration with Industrial Platforms

Operator-Centered Simulator

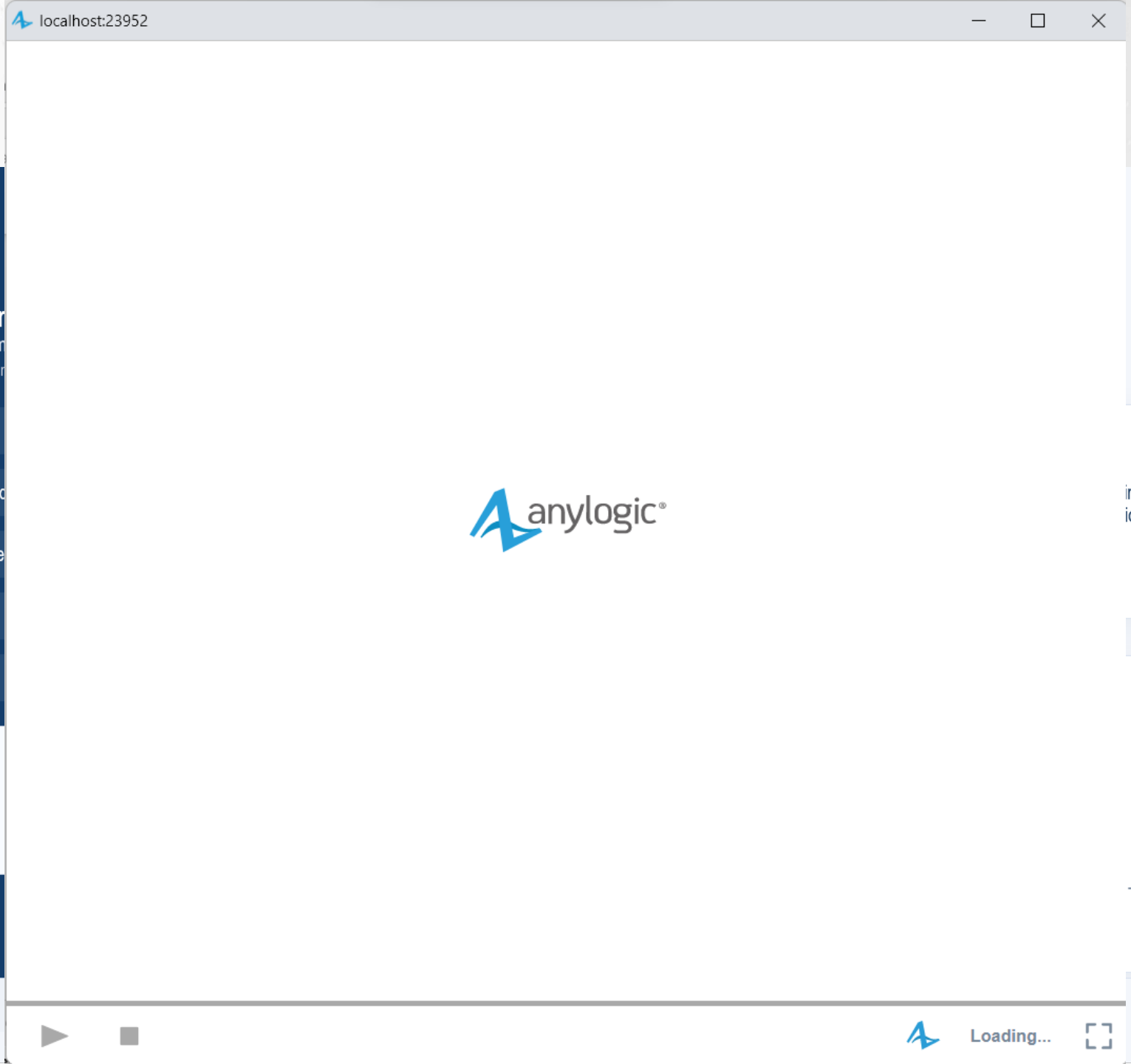
The Operator-Centered Simulator is running locally through an AnyLogic exported runtime.

The current AnyLogic frontend is available locally at:

http://127.0.0.1:23952

When accessed remotely through the iSteel platform, the current AnyLogic export may block or fail to render the frontend. This is a restriction of the AnyLogic exported frontend, not of the iSteel integration platform.

For the project demonstration, the simulator can be shown locally, while the remote access limitation is kept visible as a documented technical restriction to be addressed with the simulator provider/ export configuration.



iSteel-Exper
Integration Platform
WP4 Education & Trair

Home

Process-Centered

Operator-Centere

Knowledge

Results

User session
Mercedes
mercedes (user)

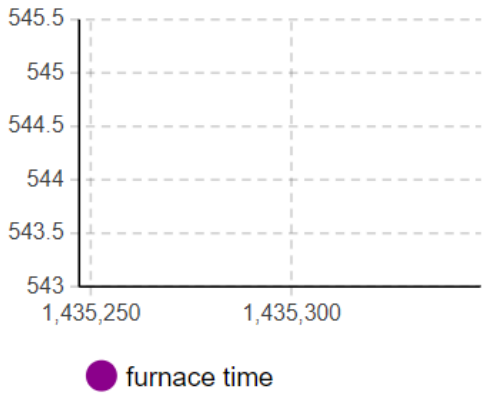
Logout

ing correctly
ion.

The gateway

?

EAF Factory Model : Simulation - AnyLogic Professional



Clean Slag Door

Manual Deslag

FOMPath
.\FOM.xml

sendUpdate
0.529

handleUserInput

simulationFederate
eaf_factory_model.SimulationHLAFederate@564c56a7

x5

Running

iSteel-Exper
Integration Platform
WP4 Education & Trair

Home

Process-Centered

Operator-Centere

Knowledge

Results

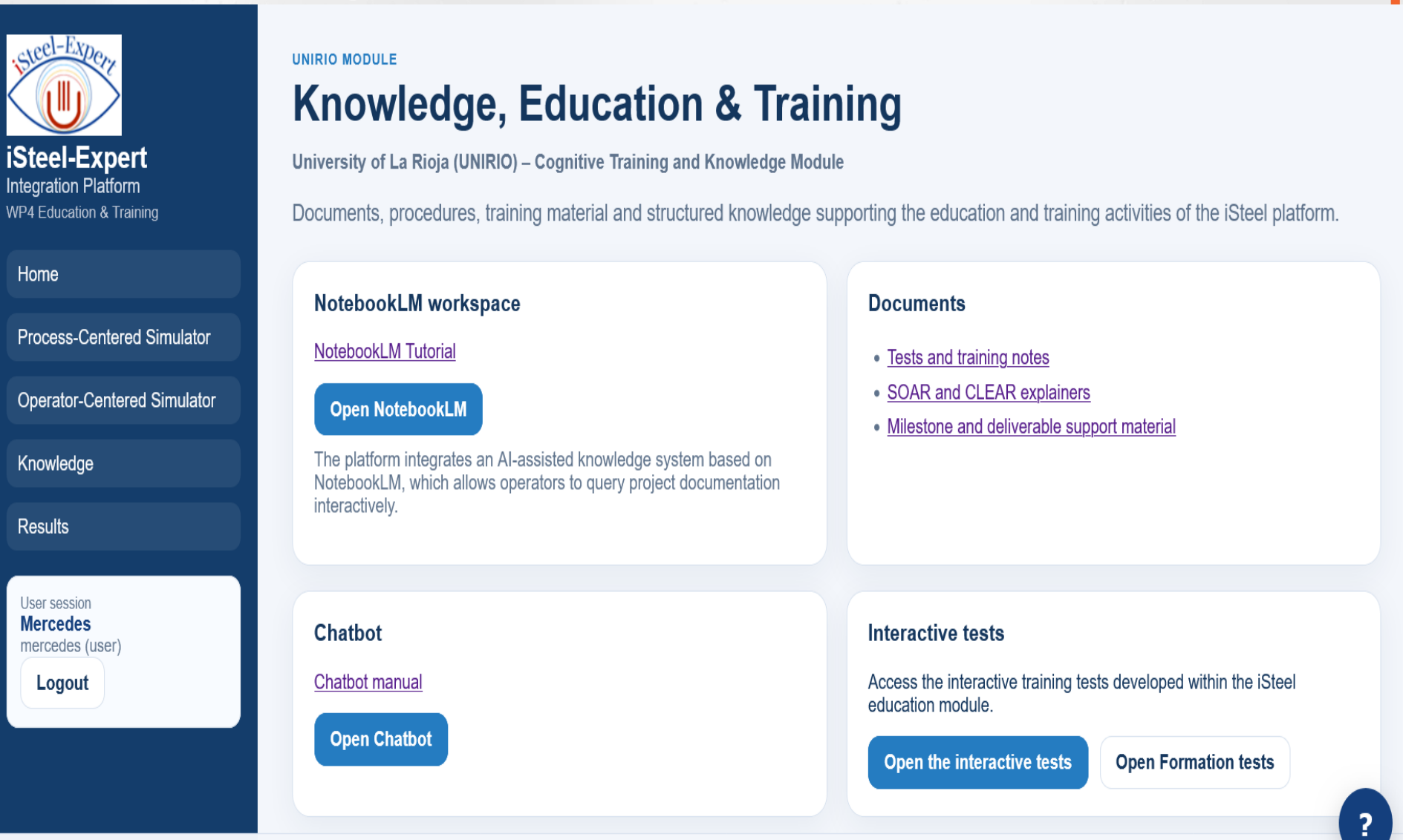
User session
Mercedes
mercedes (user)
Logout

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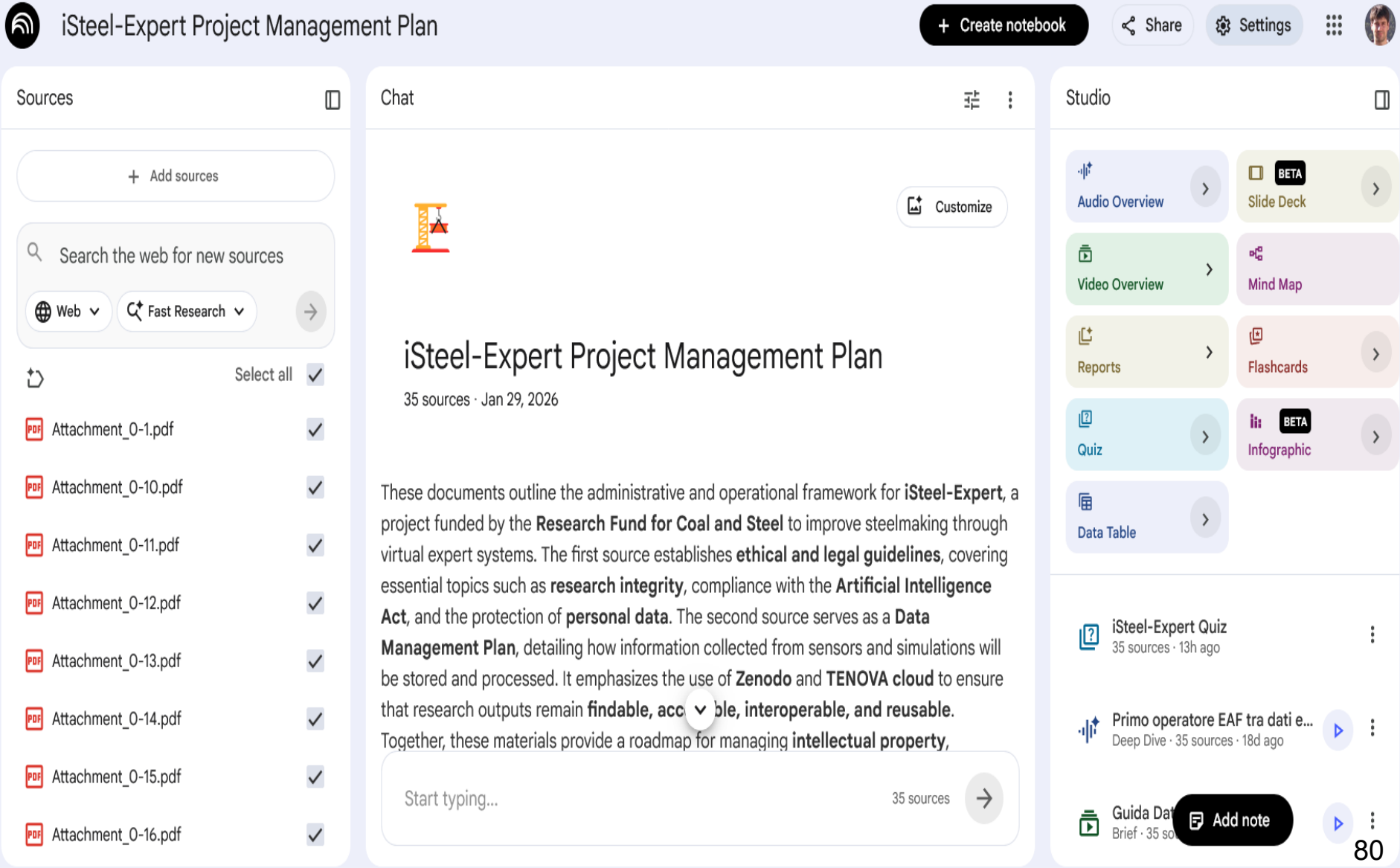
The gateway

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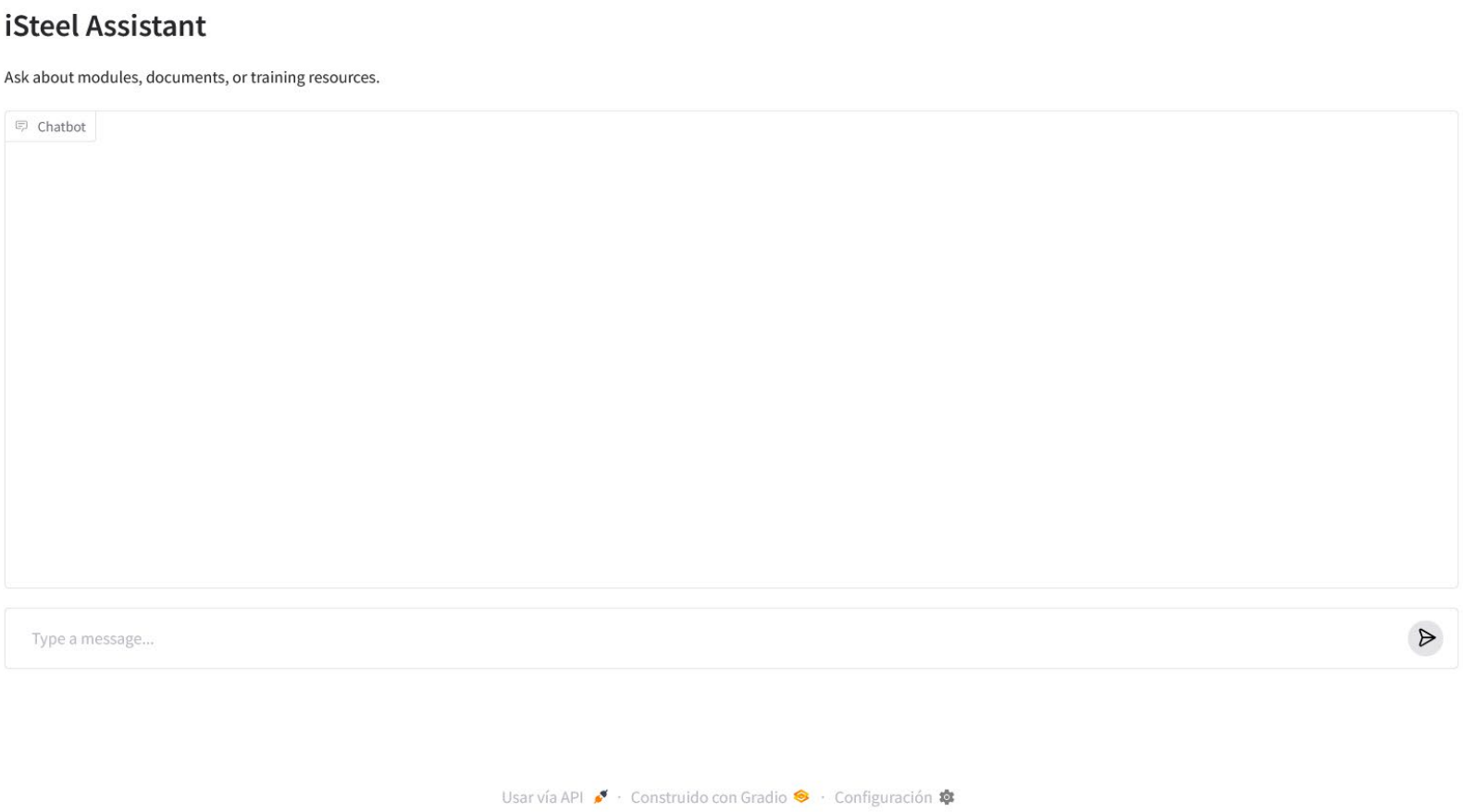
Integration with Industrial Platforms



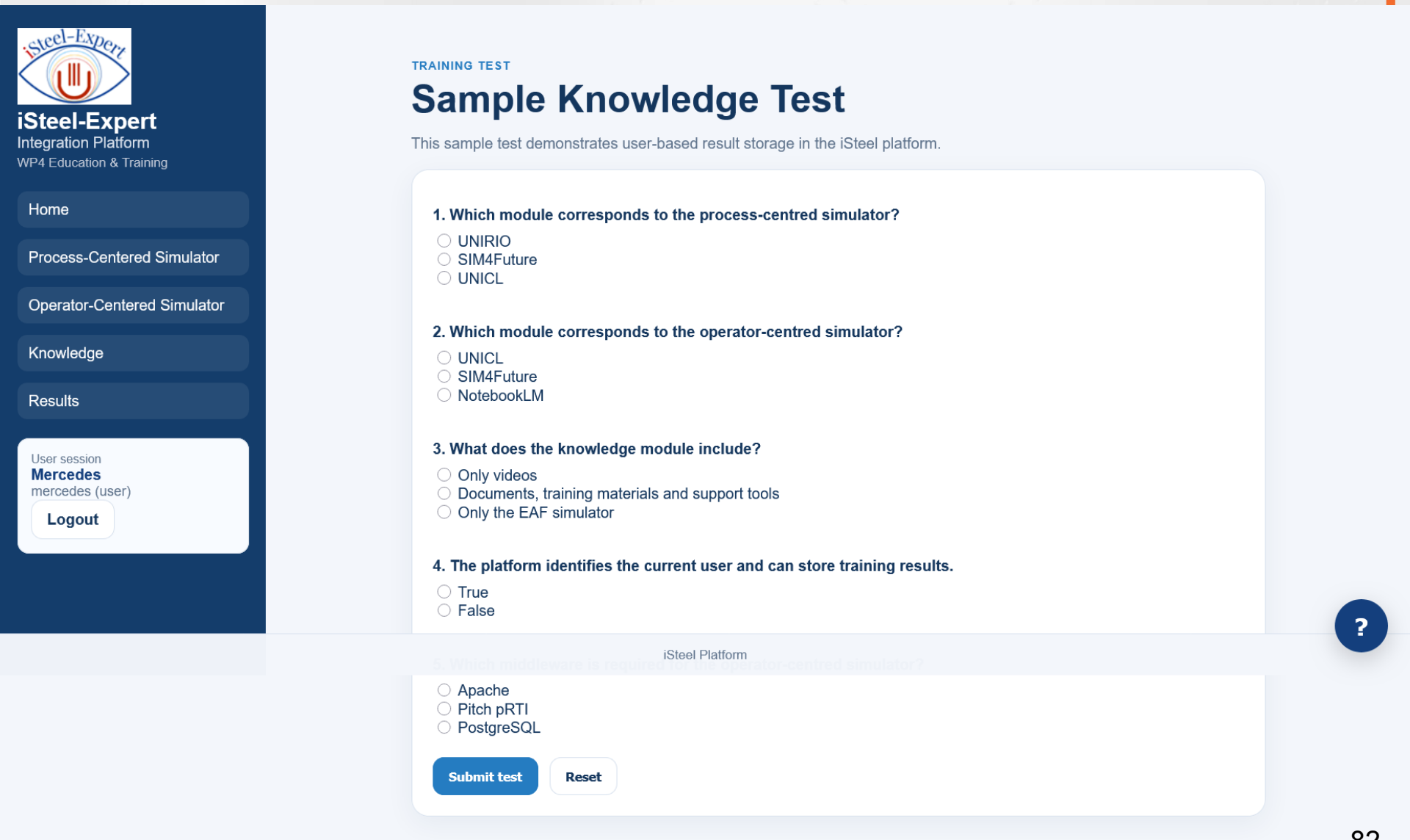
Integration with Industrial Platforms



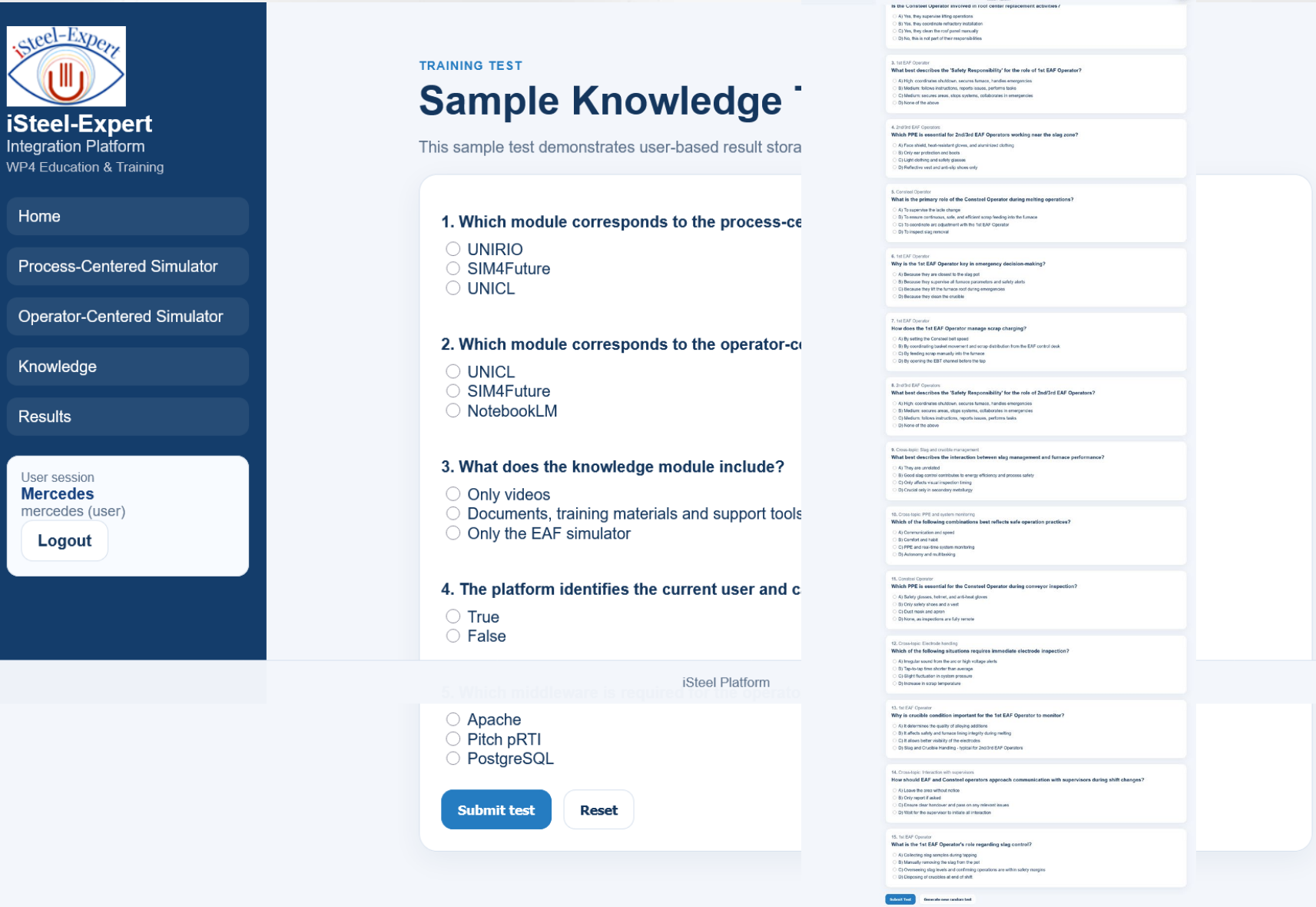
Integration with Industrial Platforms



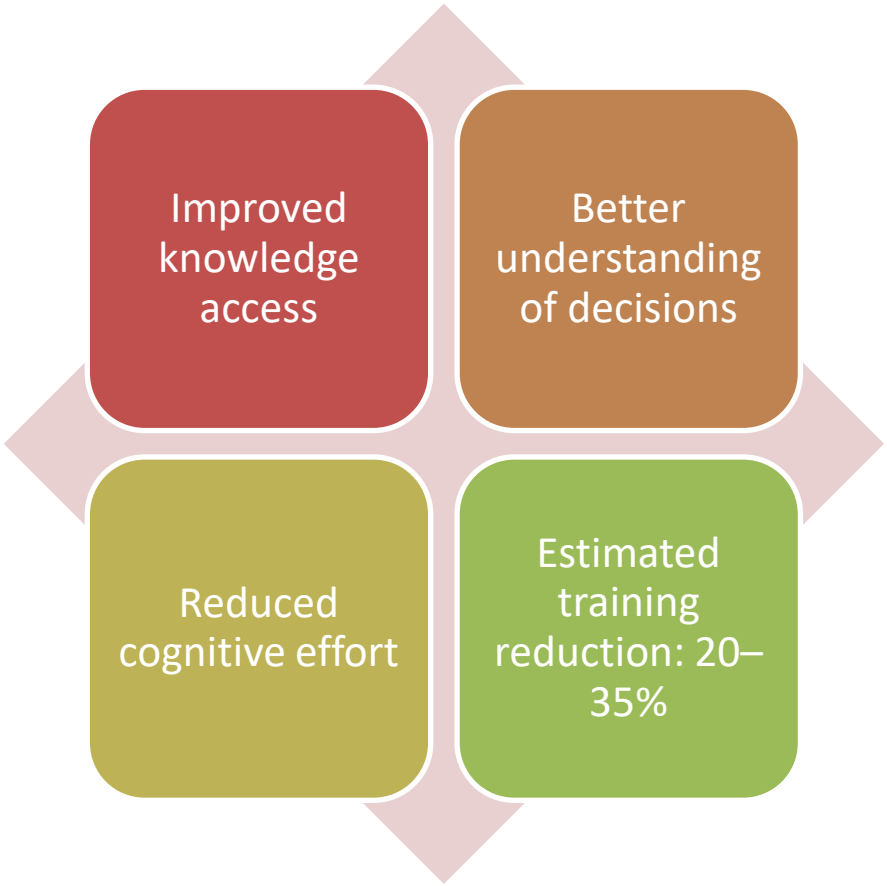
Integration with Industrial Platforms



Integration with Ind ms



Preliminary Results



Expected Benefits

- Faster onboarding
- Reduced errors
- Improved safety
- Knowledge transfer

Conclusions

- Human-centric training approach
- Integration of AI and cognition
- Complement to simulation systems



Thank You

- Questions



Thank You

- Questions?



A Cognitive and AI-Based Training Framework for Electric Arc Furnace Workforce Development

Emilio Jimenez, University of La Rioja (Spain)