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Next-Generation Workforce Training for Electric Arc Furnace Steelmaking

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Abstract:
The growing digitalization of Electric Arc Furnace (EAF) steelmaking demands a workforce capable of operating increasingly complex and highly automated plants. Traditional training methods—shadowing, manuals, and classroom-based onboarding—are no longer sufficient to ensure consistent operational performance, safety, and rapid adaptation to new technologies. Within the EU iSteel-Expert project, we are developing an integrated, AI-enhanced training ecosystem aimed at accelerating the learning curve of new operators, reducing human error, and supporting continuous upskilling.
The proposed ecosystem combines three complementary components:
(1) NotebookLM-style knowledge environments, structured around validated technical documents, safety rules, and plant-specific best practices. These systems enable trainees to query complex information using natural language, facilitating rapid acquisition of process knowledge and reducing dependency on tacit or undocumented expertise.
(2) Cognitive agents based on the CLEAR architecture, designed to emulate expert operator reasoning, attention management and decision-making under stress or uncertainty. These agents serve as "virtual mentors" capable of demonstrating correct action sequences, highlighting risks, and explaining the rationale behind operational choices.
(3) A domain-specific training chatbot, deployed as an always-available conversational assistant for new employees. The system provides step-by-step support for operational procedures, contextual explanations for alarms and process deviations, and interactive quizzes to reinforce learning.
The training architecture is been designed to integrate seamlessly with existing simulators and digital twins developed elsewhere in the project, providing a cognitive layer oriented toward human learning rather than process modelling. Early evaluations indicate the potential to reduce onboarding time, decrease procedural errors in simulated scenarios, and improve retention of complex operational concepts compared with conventional methods.
In addition to supporting new operators, the proposal enables continuous development for experienced personnel through scenario-based training, "what-if"exercises guided by cognitive agents, and automated feedback based on decision sequences. The approach also enhances safety by reinforcing correct responses to abnormal or hazardous operating conditions.
This contribution presents how AI-driven tools, cognitive modelling and structured knowledge platforms can modernize workforce development in EAF steelmaking, addressing a critical need identified by industry stakeholders and aligning with the strategic objectives of EEC-EMECR 2026.
Preferred Topics:
7 –Safety and Workforce Development
1 –Technological Advancements (AI, cognitive architectures)
2 –Process Optimization (human-factor-driven variability reduction)

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