Digital Twin of a Steel Meltshop

Simulation and AI-Powered Reporting in AnyLogic with Visualization via Omniverse

AnyLogic Conference 2025
Presenters: Salman Sangi, Hamid Tikani

ALSANX | anylogic

About ALSANX

ALSANX, situated in Canada, is your dedicated partner for digital progress. We lead in digital innovation, seamlessly integrating technologies like digital twins, AI-tools, image processing, VR, and AR. Committed to enhancing human capabilities, we bring proven expertise in simulation models, production line optimization, and real-time intelligence dashboards. Let ALSANX guide your organization into the future of Industry 4.0

Our Vision

Our vision is to catalyze a fundamental shift towards intelligent production lines. We bring together tools such as Artificial Intelligence (AI), simulation optimization, digital twin technology, intelligent dashboards, extended reality (XR) to create a dynamic ecosystem tailored to your unique manufacturing needs.

Presenters

Salman Sangi is a Business Development Manager at ALSANX Inc., with dual academic credentials in Engineering and International Business from HEC Montréal. He brings more than 15 years of experience in international industrial project management, industrial innovation, and engineering integration across greenfield and brownfield projects. His expertise spans digital twin technologies, simulation, and AI-driven solutions for industrial plants especially Metallurgical and Mining.

Hamid Tikani is Technical Manager at ALSANX Inc. He holds a PhD in Industrial Engineering and brings over seven years of background in simulation modeling, mathematical optimization, and digital transformation of manufacturing and supply chain systems. His expertise includes the development of optimization algorithms in logistics, network design, energy optimization, and plant operations and engineering integration. He also has strong proficiency in data analysis, business intelligence, and economic evaluation of industrial projects.

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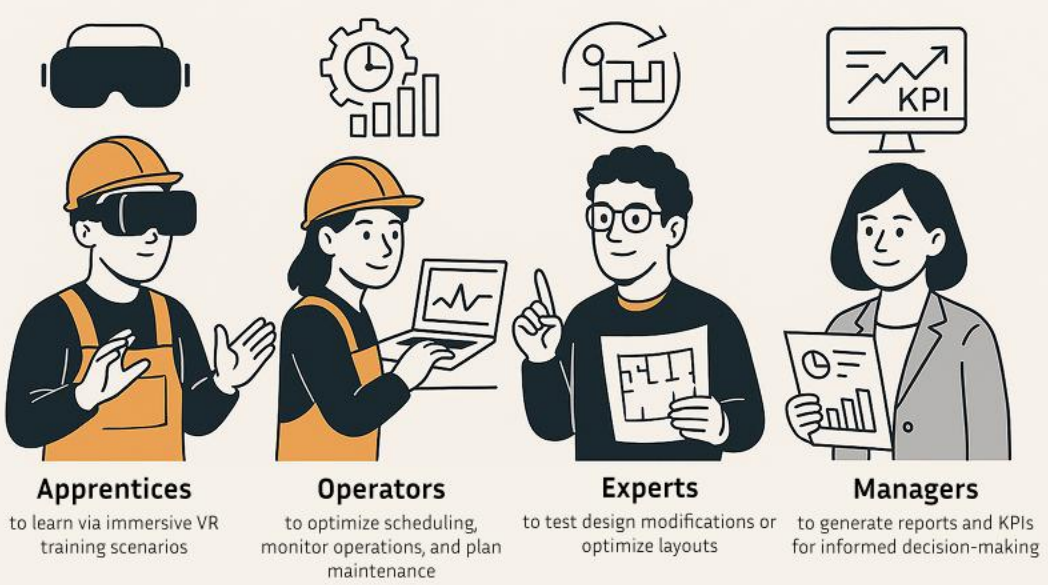
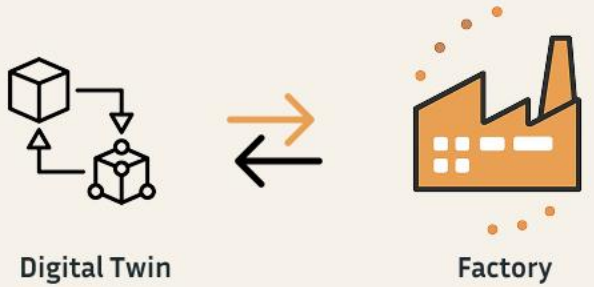
Not only a Simulation tool...

Digital twin for everyday use by all stakeholders





Real-time feedbacks, Bi-directional Impacts

Production should not hold because of delayed decisions...

Digital Transformation as the Foundation, Why it matters

Industries are shifting from automation to data-driven intelligence — enabling better decisions at every stage.

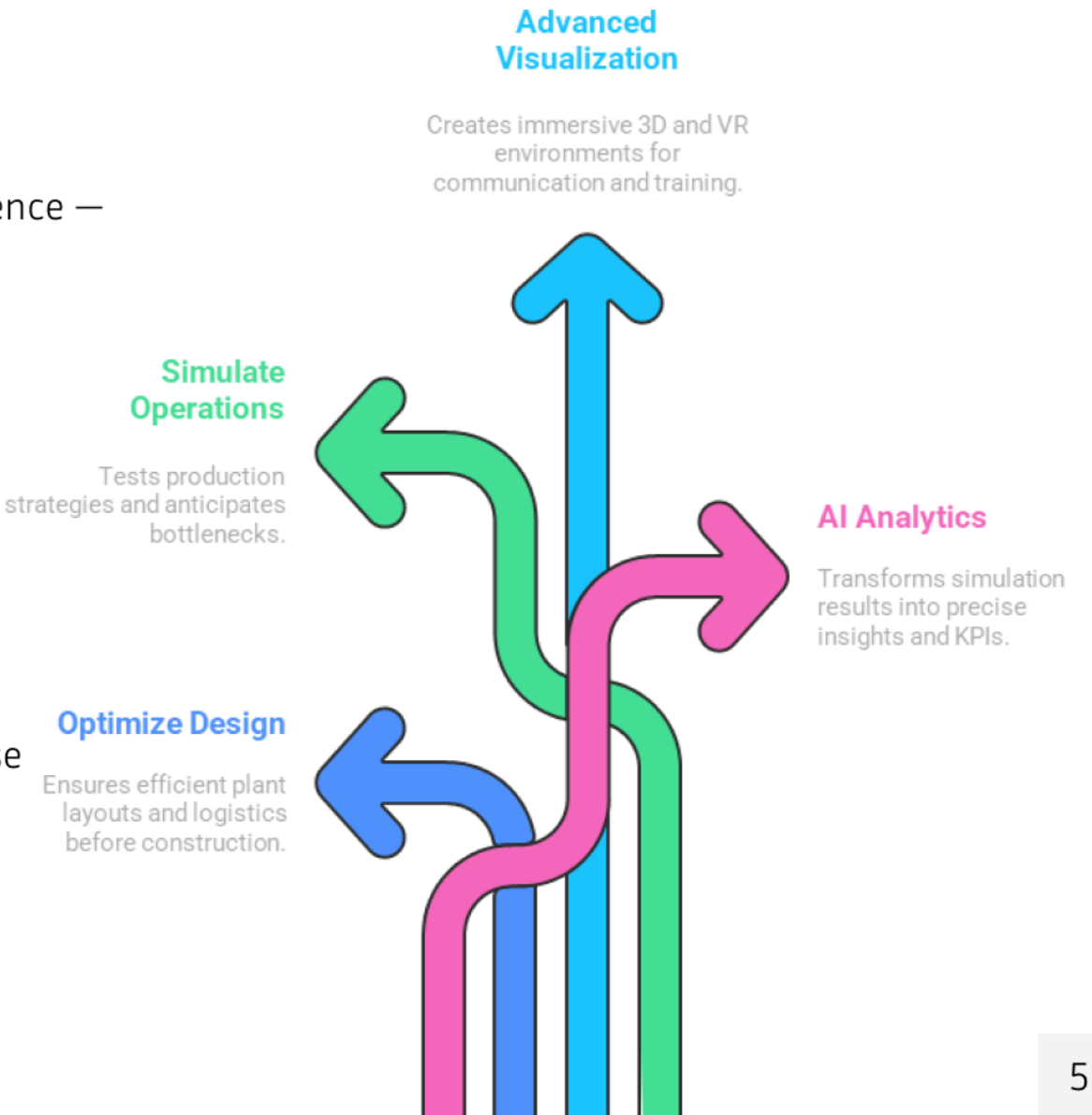
Optimize design: validate plant layouts, logistics, and flow before construction.

Simulate operations: test different production strategies and anticipate bottlenecks to ensure the plant's productivity across various production plans.

Use advanced visualization: create high-fidelity 3D and VR environments for communication and training.

Apply AI analytics: transform raw simulation results into precise insights and KPIs.

Instead of trial-and-error, we use virtual models to cut risk, boost efficiency, and enable sustainable steel production.



From Strategic to Operational Decisions, All in One Model

Simulation connects long-term design choices with day-to-day operations, enabling decisions across all levels in one model.

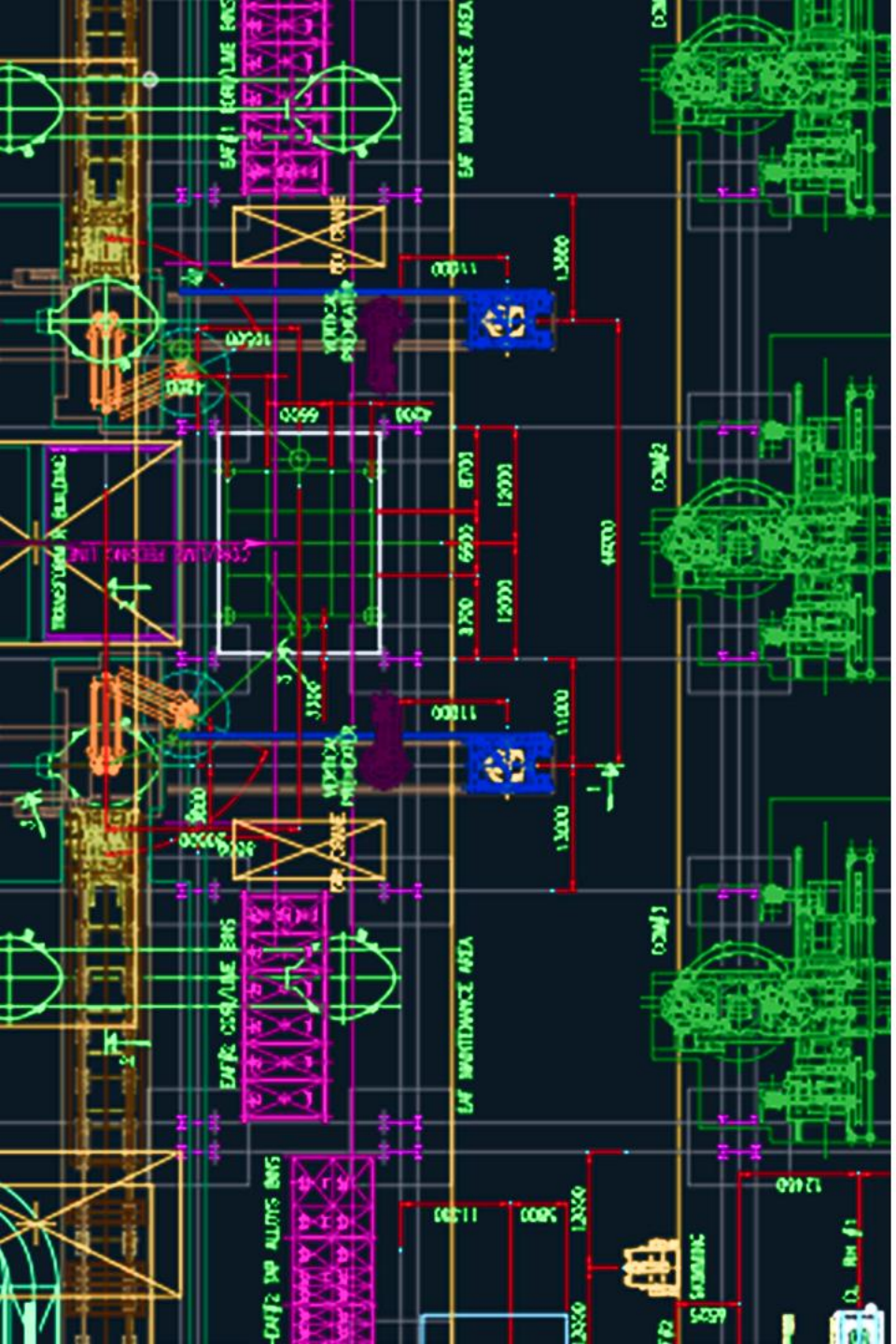
Strategic: plant layout, capacity expansion, technology selection, sustainability targets

Tactical: production scheduling, maintenance planning, workforce allocation, inventory levels

Operational: crane dispatching, ladle sequencing, real-time adjustments, energy monitoring

Training: XR Visualization of the equipment and plant, Operation of plant and devices, Trial and Error scenarios.

In traditional approaches, these layers are studied separately, but with a digital twin, all levels are tested together to optimize trade-offs and see how strategic choices impact daily operations.



The Context & Challenges

Operating a modern meltshop means balancing complexity, efficiency, and reliability under constant constraints.

Challenges in an Arc Furnace Meltshop Operations

- Multi-stage flow (MHS → EAF → LF → RH → CCM → Storage&Logistics)
- Crane & transfer cars logistics as a critical bottleneck
- Thermal & energy losses during transfers
- Scheduling conflicts between continuous casting & batch processes
- Maintenance windows disrupting production rhythm
- Unexpected Physical constraint in reality which should interact with the model real-time for an immediate analysis and decision.
- Ensuring equipment efficiency: Ensuring continuous operation of key equipment like EAF

Architecture of the Digital Twin

INPUTS

Engineering data, Layouts, 3D equipment drawings

PROCESSORS

Analytical Processor: Anylogic, Python + AI (data analysis, reporting, optimization)

Graphics Processor: NVIDIA Omniverse (VR/3D visualization)

Voice API: Enables real-time, conversational updates to the simulation

OUTPUTS

- Online dashboard in AnyLogic
- AI-generated reports (scenario-based KPIs & insights)
- High-quality 3D visualization with VR support

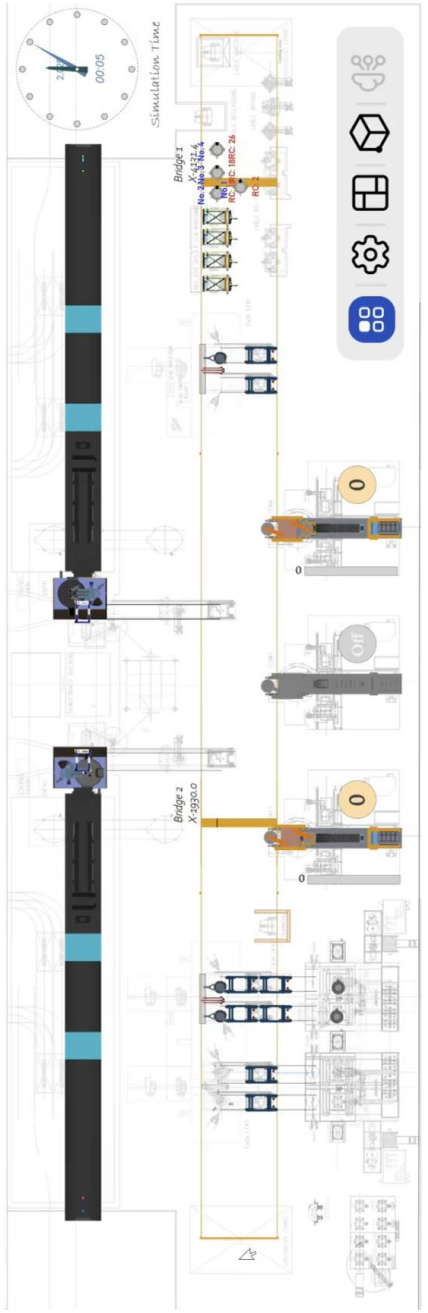
Design-Phase Optimization

Save Before You Build

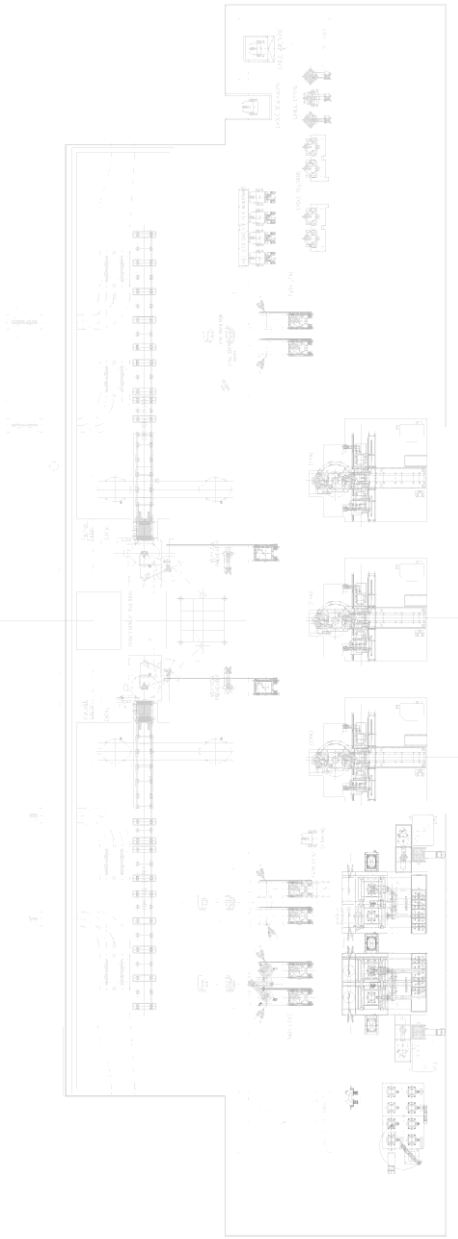
Simulation acts as a virtual testbed — allowing us to experiment with layouts, flows, and resource allocation before committing to construction.

- Evaluate layout alternatives (furnace placement, casting line arrangement, bay design)
- Analyze station allocation & crane paths
- Monitor queues, waiting times, crane utilization — minute by minute

Ask “What if?” questions safely in a digital environment



Dynamic / Simulation-based Layout



Static Layout

Production Scheduling Continuous Casting & Maintenance Planning

MELTSHOP LOGISTICS SIMULATION

This simulation supports the planning and optimization of core steelmaking operations, with a focus on material handling, crane movements, and the coordination of melting and casting. It addresses the complexity of operating a dual-bridge overhead crane under strict schedules and varied steel grades. By simulating real-world constraints, it helps validate layout and flow, optimize scheduling, ensure timely molten steel delivery, and improve decision-making during plant design and operation.

Intro Video ▶ Continue →

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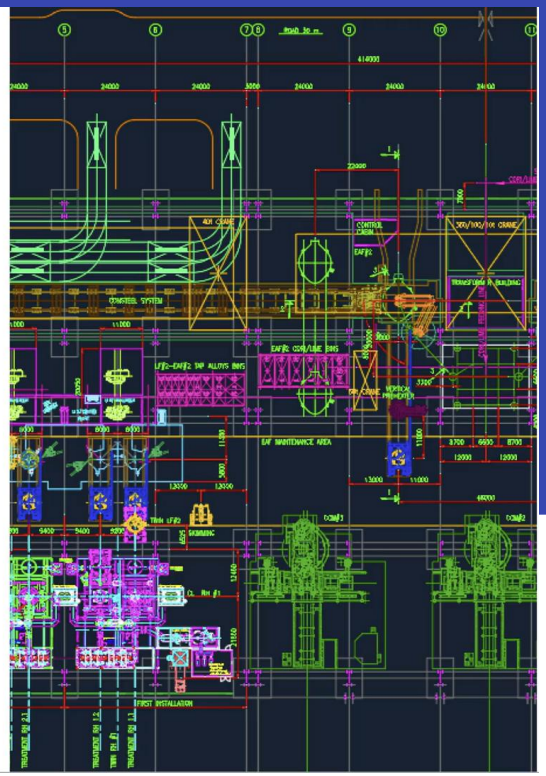


Balancing continuous casting with upstream batch processes is the core scheduling challenge in any meltshop.

Key Points

Build efficient schedules balancing:

- Ladle readiness
- Furnace cycle times
- Casting continuity

Analyze planned maintenance windows and their impact on throughput

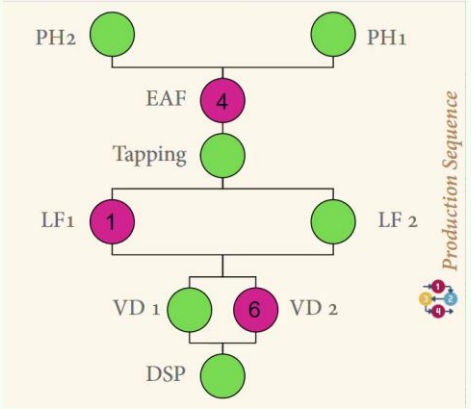
Anticipate conflicts → avoid production rhythm disruption

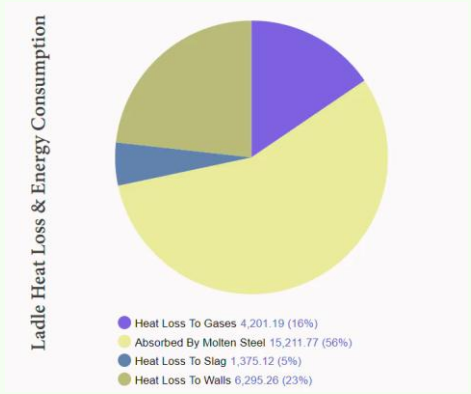
Thermal Behavior & Energy Usage

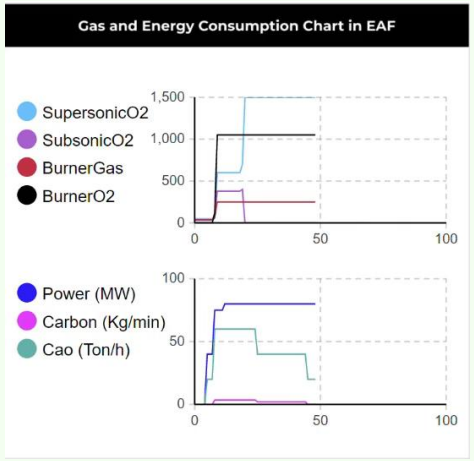
Every delay means heat loss — simulation helps us track temperature and optimize energy efficiency.

Key areas of study include

- Full visibility of ladle flow
- Track temperature drop across the handling path
- Compare routes, layouts, and handling strategies
- Minimize energy consumption and maximize thermal efficiency
- Especially valuable for alloy steel production



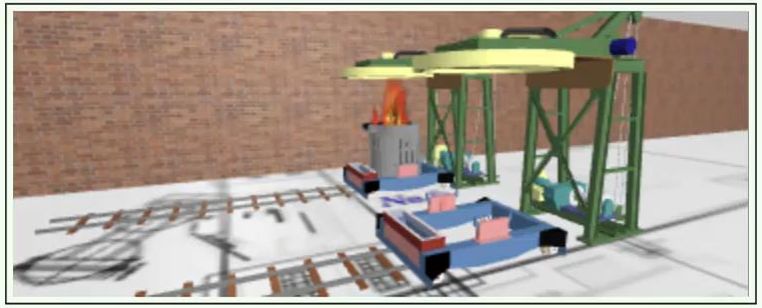




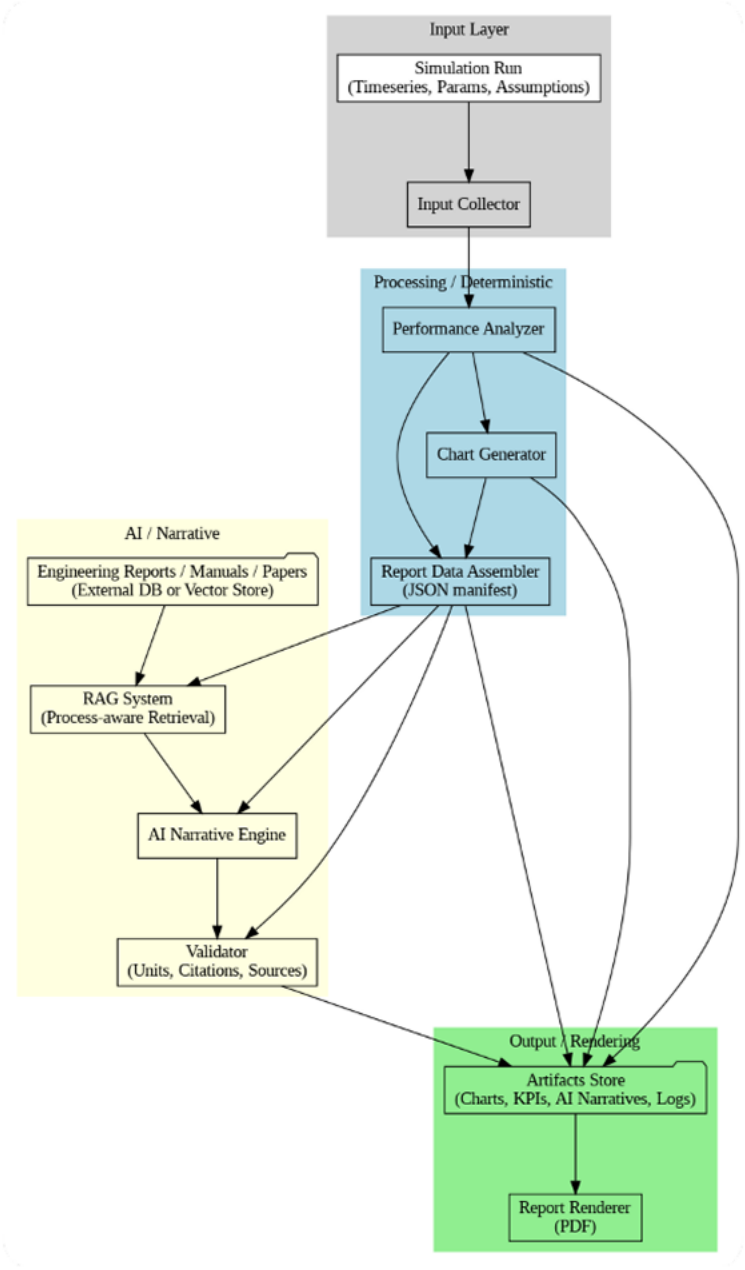
Closed-Circuit Television (CCTV)

Camera on Ladle No. : **5**

Camera on Ladle No. : **6**



Camera on one of active stations/equipment: **Preheater 2**

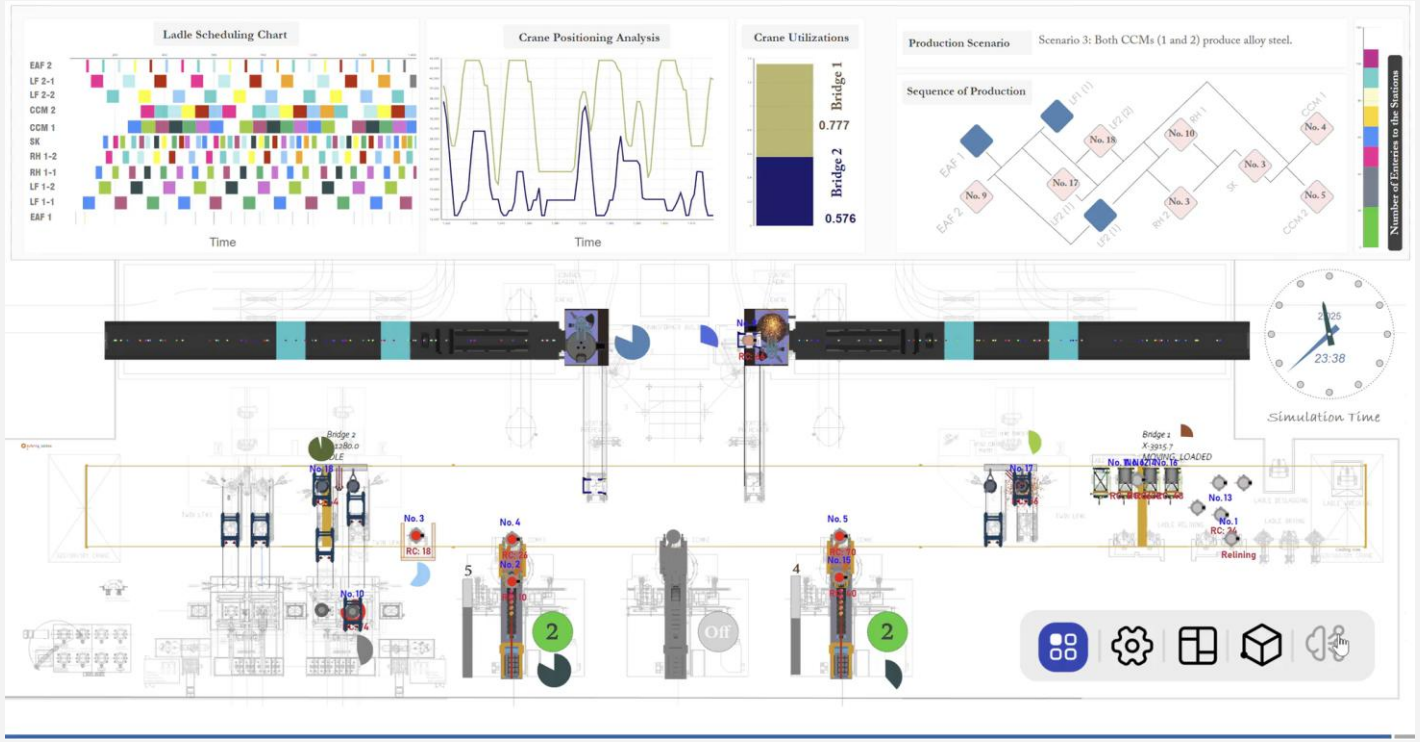


AI Report Generator Process

- **Input Collector:** Gathers and normalizes raw simulation data (KPIs, timeseries).
- **Performance Analyzer:** Calculates core KPIs, detects bottlenecks, and flags issues.
- **Chart Generator:** Converts KPIs into clear, visual charts (heatmaps, histograms, etc.).
- **AI Narrative Engine:** Transforms data into human-readable insights, recommendations, and executive summaries.
- **Validator:** Ensures accuracy, consistency, and proper citations of sources.
- **Report Renderer:** Assembles a professional PDF report with all validated data and narratives.

AI-Driven Reporting & Online Analytics

AI transforms raw simulation output into clear, decision-ready insights.

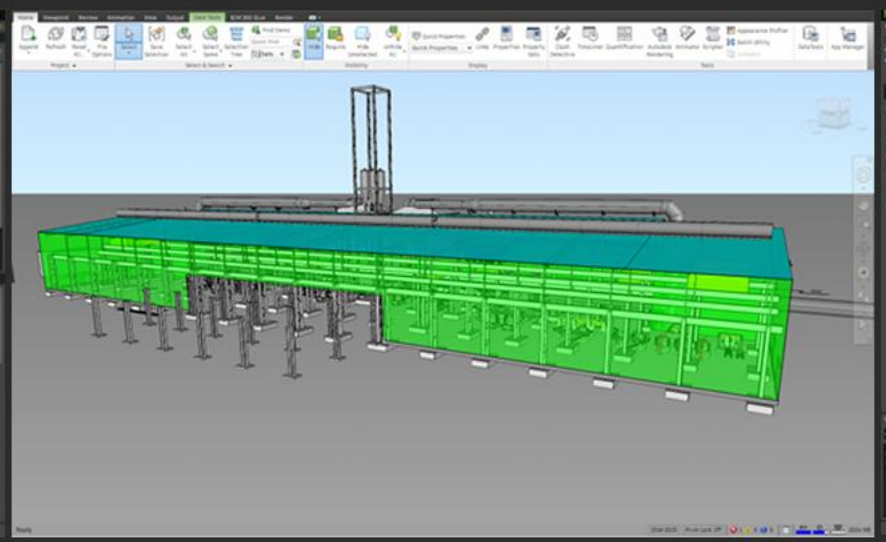


- Automatic KPI extraction after each simulation run
- Bottleneck detection & anomaly highlighting
- Generate structured reports & dashboards without manual effort
- Bridge between technical simulation results and business decision-making

Optimizing for Omniverse VR

Using NVIDIA Omniverse for high-quality, real-time VR simulations of the meltshop.

- Model Optimization: Reduced model complexity from millions of vertices to under 40,000 for smooth performance in VR.
- High-Quality Rendering: Maintains visual fidelity while optimizing for real-time simulation.
- Real-Time VR Experience: Ensures a seamless, immersive training environment for operators and stakeholders.



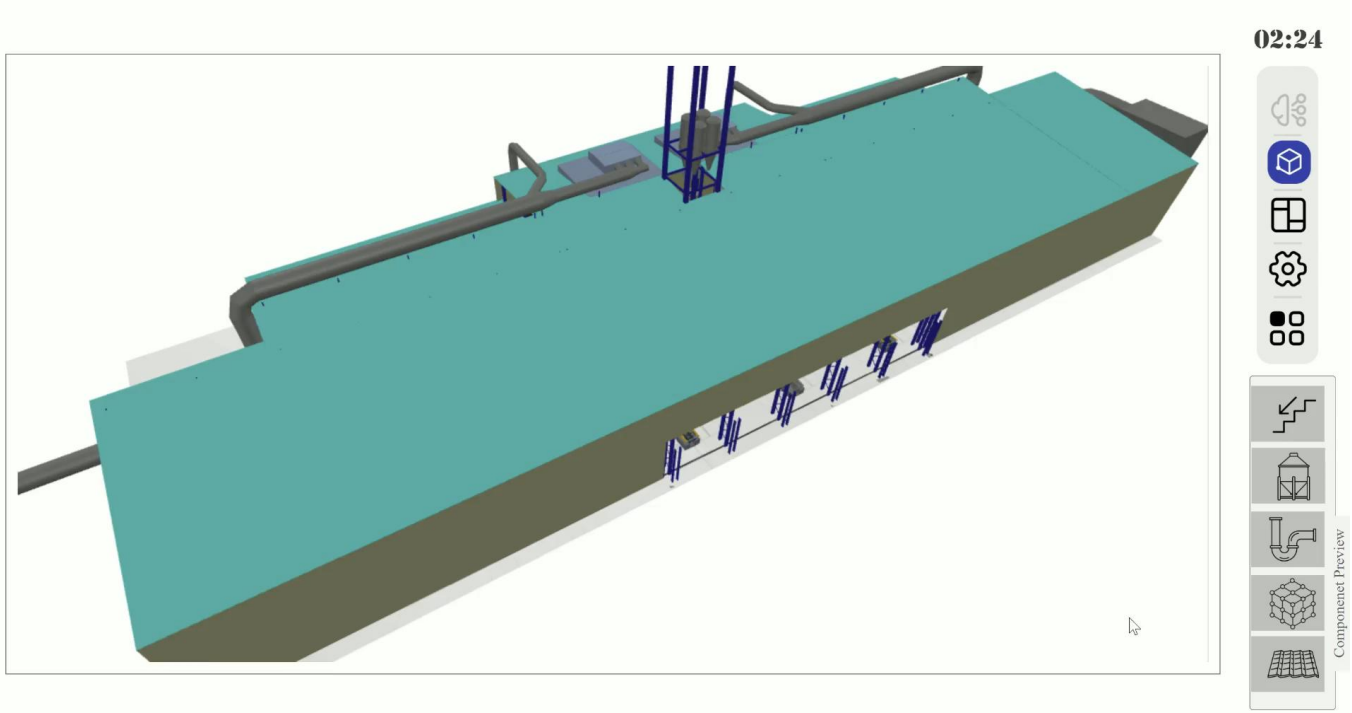
Training & Scenario Exploration with Virtual Reality

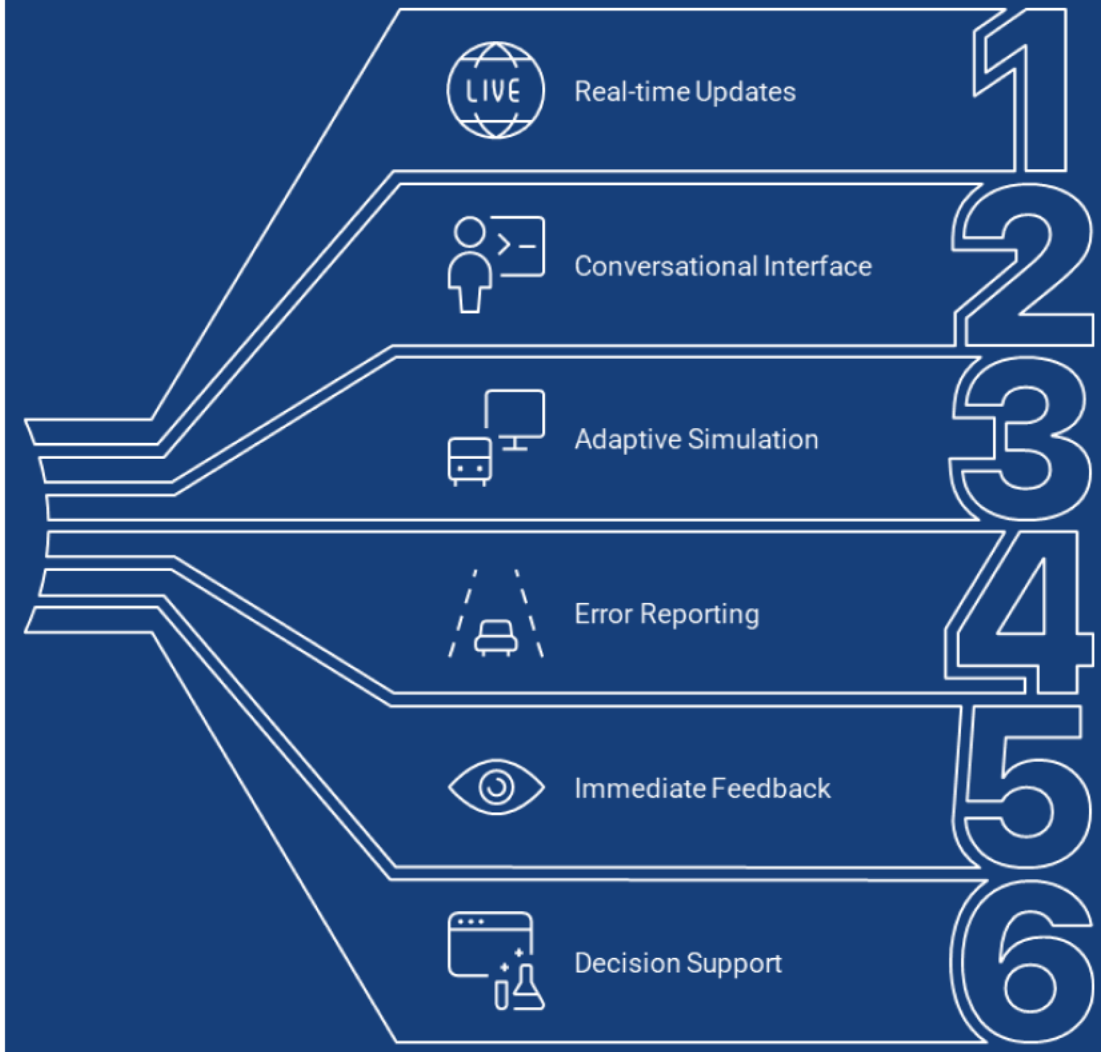
Immersive VR turns the meltshop into a safe, interactive training ground.

- High-fidelity virtual meltshop built with NVIDIA Omniverse
- Users can walk through the facility in VR
  Simulate real production scenarios: workload peaks, delays, crane conflicts
- Risk-free environment for operator training & stakeholder engagement

Interactive Digital Twin of a Steel Meltshop

Talk to your digital twin. See your plant respond in real time.





Case Study Results & Insights

Simulation allowed us to optimize various components, ultimately confirming the throughput targets

Production Scenarios Tested:

Normal carbon steel

Mixed (carbon + alloy, with/without skimming)

Full alloy steel

Throughput: ~8,800–9,000 tons/day → up to 2.79M tons/year

Crane Utilization: Bottlenecks identified; efforts were made to distribute the operational load as evenly as possible.

Skimming Impact: For certain grades, skipping skimming reduced complexity with minimal effect on throughput.

Process Balance: All scenarios feasible within equipment limits; no major bottlenecks detected.

Reduced Design Risks via simulation-based testing

Improved Throughput and scheduling robustness

Enhanced Energy Efficiency and thermal control

Safer & Faster Training with VR

Smarter & Faster Decision Making with AI Analytics

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Thank You & Q&A

Thank you for your attention

We're now open for any questions.

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