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EVALUATING CRANE CAPACITY AND AVOIDING CAPITAL COSTS: A SIMULATION CASE STUDY AT NOVELIS

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ABSTRACT

In complex aluminum manufacturing systems, optimizing interdependencies is critical to avoiding unnecessary capital investment and costly inefficiencies. At Novelis remelt and recycling plants, crane operations are central to metal movement and production flow, creating challenges when operational capacity is limited. To address this, the Novelis simulation team developed a 3D flow model in AnyLogic that mirrors crane operations, incorporating factors like processing times, schedules, and downtime. The innovative simulation combined real-world data with dynamic modeling to evaluate crane capacity under varying conditions. Unlike static methods, the cloud-deployed model featured an intuitive interface, allowing plant teams to test scenarios and identify capacity thresholds. Initial results showed the existing crane could meet increased production goals through reliability improvements and staffing changes, avoiding multimillion-dollar capital expenditure. The extended abstract will outline the simulation methodology, model architecture, interface features, and outcomes that enabled the plant's successful adoption of the tool.

1 INTRODUCTION

In high-throughput industrial environments, operational efficiency and informed capacity planning are essential for sustaining growth and reducing capital risk. This crane simulation supported a strategic decision at Novelis's remelt and recycling facility: whether to reintroduce a second overhead crane or optimize operations with existing equipment. Traditional analysis methods could not fully capture the dynamic interactions between material flow, crane scheduling, and downtime variability. To address this, the simulation team at Novelis developed a simulation tool that replicates real plant operations and brings them to life through high-resolution animations, using AnyLogic and NVIDIA Omniverse. The model included a cloud-based interface, allowing plant engineers to run scenario tests and visualize outcomes under varying assumptions. What distinguishes this crane simulation is its alignment with modern industry practices—using a digital twin and data-driven methods to provide insights without requiring users to interact directly with simulation scripts. In the following sections, we will present the model design, scenario testing and validation, as well as the results and visualizations that empowered leadership to make data-driven decisions and avoid a costly equipment investment.

2 SIMULATION MODEL DESIGN

Novelis's Crane Simulation is a hybrid AnyLogic simulation, combining discrete event and agent-based modeling to emulate ingot handling and crane operations within a manufacturing environment. The model reads all configuration inputs dynamically from user-defined spreadsheets, allowing flexible scenario setup without editing the model itself. Users start a simulation by selecting an input spreadsheet via the AnyLogic cloud environment. These spreadsheets define key parameters such as crane processing times, storage configurations, ingot dimensions, crane downtimes, and production schedules. The simulation uses these inputs to create a 3D virtual flow environment that reflects real operational logic. During execution, the model tracks performance metrics to assess if the crane can meet production targets. Metrics such as crane utilization, frequency of movement types, storage usage, and throughput are monitored in real time. These metrics are displayed live in an AnyLogic dashboard with charts and graphs and are also exported as raw data tables for post-run analysis and decision-making.

3 MODEL VALIDATION, EXPERIMENTATION STRATEGY, AND OPERATIONAL USE

To ensure simulation accuracy and business relevance, an in-depth site visit was conducted at the Novelis facility. During this visit, simulation engineers gathered operational data, observed physical processes, and held interviews with subject matter experts across scheduling, crane operations, casting, receiving, storage, and safety. These conversations not only shaped stakeholder trust but also revealed which operational parameters were flexible and where realistic adjustments could be made. Following the visit, a series of model validation iterations were executed using real production data to align the simulation output with historical plant performance. Once validated, simulation engineers used this model to explore targeted scenarios, varying parameters such as crane downtime, utilization, storage configurations, and production schedules. These experiments led to a data-driven insight: the plant could meet increased demand without purchasing a new crane, provided improvements were made to crane reliability and operational staffing. After these findings were delivered, the model was deployed in a cloud-based environment, allowing the Novelis team to run their own scenarios as business needs evolve.

4 DECISION SUPPORT AND BUSINESS IMPACT

This Novelis simulation model has become a vital tool for informed decision-making across engineering, operations, and leadership. Its ability to replicate complex crane, casting, and storage operations with high fidelity has given stakeholders confidence in its outputs. The model was also built with scalability in mind, using standardized coding techniques for easy adaptation to other Novelis manufacturing lines, ensuring flexibility across different operational contexts. A key element in effectively communicating results to leadership and supporting operational decisions was rendering the simulation in NVIDIA Omniverse. This enabled enhanced, realistic visualizations of the 3D simulation, helping gain validation from executives. A significant impact of this simulation came from analyzing whether the plant required a costly new crane investment to meet increased production demand. By testing operational parameters such as crane availability and staffing adjustments, the model demonstrated that performance targets could be achieved without additional capital expenditure—resulting in an avoided multimillion-dollar capital cost. In addition to the capital savings, the model revealed that continuing current operational practices would have led to millions of dollars in annual throughput losses. These findings showed the value of targeted improvements in staffing, crane reliability, and downtime management. Beyond these results, the simulation deployment to a cloud environment ensures that the Novelis operations team can continue to explore evolving what-if scenarios independently, in a no-code environment. This access to simulation-based insight represents a scalable approach to operational planning and high-impact decision support across the organization.

5 CONCLUSION

The Novelis crane simulation shows the potential of combining simulation tools with cloud-based deployment to tackle complex operational challenges in high-throughput industrial settings. Designed with scalability in mind, the model provides a structure for continuous improvement and can be adapted to address evolving challenges, such as automation and demand variability. By combining process understanding with flexible input-driven designs, the model allows users to run realistic, data-driven scenarios without needing simulation expertise or software licensing. The integration of real-time dashboards, cloud deployment, and intuitive interfaces allows the operations team to explore strategic what-if questions and adapt to evolving business needs. Most notably, the model supported a data-driven decision that avoided millions of dollars in capital expenditures while safeguarding annual throughput, demonstrating its value as a critical tool for informed decision-making.