Global Cement Manufacturer Minimizes Equipment Downtime with Advanced AI

A global cement company is a leading producer of cement, aggregates, concretes, and construction materials, distributing its products in over 70 countries. The company's top priority is to deliver best-in-class product offerings to customers with efficient production operations, including minimal unplanned downtime in manufacturing processes.

Cement manufacturing is a highly interconnected process that relies on the seamless operation of critical assets, most importantly the vertical roller mill. Unexpected failures of the vertical roller mill and other assets can halt the entire production line, leading to millions of dollars in revenue loss and significant maintenance costs.

Prior to engaging C3 AI, the cement manufacturer had attempted to develop its own in-house predictive maintenance application. However, the application was not well adopted by internal users like manufacturing experts and reliability engineers. The solution struggled with poor AI performance and to scale across all assets and all facilities globally. For the small number of assets being monitored, technicians in the company's plants were flooded with false positive alerts and did not have time to investigate each alert properly.

The company partnered with C3 AI and deployed C3 AI Reliability to predict vertical roller mill failures in ten of its largest manufacturing plants. With C3 AI Reliability, the company has achieved its goal to improve production operations with a scalable and user-friendly predictive maintenance solution.

C3 AI Reliability reduced the number of false positive alerts by 96% and achieved 100% precision in predicting potential failures for vertical roller mills with 7 days advance notice. Technicians can now accurately anticipate failures in advance and efficiently plan maintenance activities ahead of shutdowns.

Project Objectives

- Improve accuracy and precision of predicting equipment failures with early warning

- Integrate and unify data from disparate data sources to improve actionability of ML-generated insights

- Enable technicians to mitigate potential failures and avoid production delays

- Configure the C3 AI Reliability application to visualize and interact with ML insights in a user friendly interface

Results

$10M

annual economic benefit across manufacturing operations

96%

reduction in false positive alerts

100%

of asset failures predicted over 3 years of historical data and in production on new live data

50+

end users onboarded across 10 plants

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Challenges

The global cement manufacturing company had previously developed an in-house predictive maintenance solution. However, the application was not widely adopted due to its high number of false alarms and insufficient early notice of real issues. Further, architectural limitations of the software prevented the company from scaling AI across their global manufacturing sites.

The high alarm rate was due to the underlying ML approach, which relied on univariate sensor-based algorithms. This approach was overly sensitive to small variations in sensor data, resulting in hundreds of false alarms per month.

The performance of in-house software was constrained for several reasons:

- The absence of an end-to-end AI development platform and application meant that data scientists had to manually prepare and cleanse datasets, an unscalable and time-consuming task

- Insufficient machine learning operations (ML Ops) capabilities resulted in quickly outdated models that were unrepresentative of current operations and did not account for user feedback

- Limitations of deployment architecture prevented the in-house team from deploying ML models locally at the plants, meaning technicians could not use the application at all facilities

About the Company

- $30+ billion annual revenue in 2022
- 70+ countries of operation
- 100+ manufacturing plants worldwide
- 70,000+ employees

Project Highlights

- 26 weeks from project kickoff to production-ready application
- 50 ML models configured and deployed to predict asset failures and detect anomalies
- Deployed on the edge
- 3 years of historical data integrated, comprising 867 million rows of data
- 50 end users onboarded from 10 different plants
- 20 customer data scientists and data engineers trained to onboard assets and deploy ML models
- Configured the C3 AI Reliability application user interface, including 2 new customer-specific screens

Approach

Over 26 weeks, C3 AI partnered with the cement company to configure and deploy C3 AI Reliability to monitor 10 vertical roller mills across 7 countries. The team started by ingesting, cleansing, and unifying three years of historical and live data. The data image, which combined sensor data, asset hierarchy, maintenance history, asset diagrams, and external weather feeds, enabled the company to deploy and operate C3 AI Reliability on up-to-date data. This data image also served as a foundation for novel AI use cases, including free lime quality prediction and supply chain visibility.

The joint customer and C3 AI data science team applied a multivariate virtual sensor approach to detect anomalous events for vertical roller mills. Due to a lack of failure history, the team developed an automatic way to detect and mask faulty sensors, overcoming a previously manual and time-consuming task. Within 10 weeks, the team developed, validated, and deployed 50 machine learning models, one for each subsystem within the 10 vertical mills. Each model was validated with technicians to ensure that predictions with detailed evidence packages were sufficient to drive action.

During the project, the team trained 11 customer data scientists and data engineers to deploy ML models to new assets. After training, customer data scientists were able to independently configure and deploy new models in less than 3 hours to continue to scale the application globally. Finally, the team configured the C3 AI Reliability user interface, developed two custom screens, and onboarded 50 end users across the 10 plants, driving widespread adoption of the new AI application.
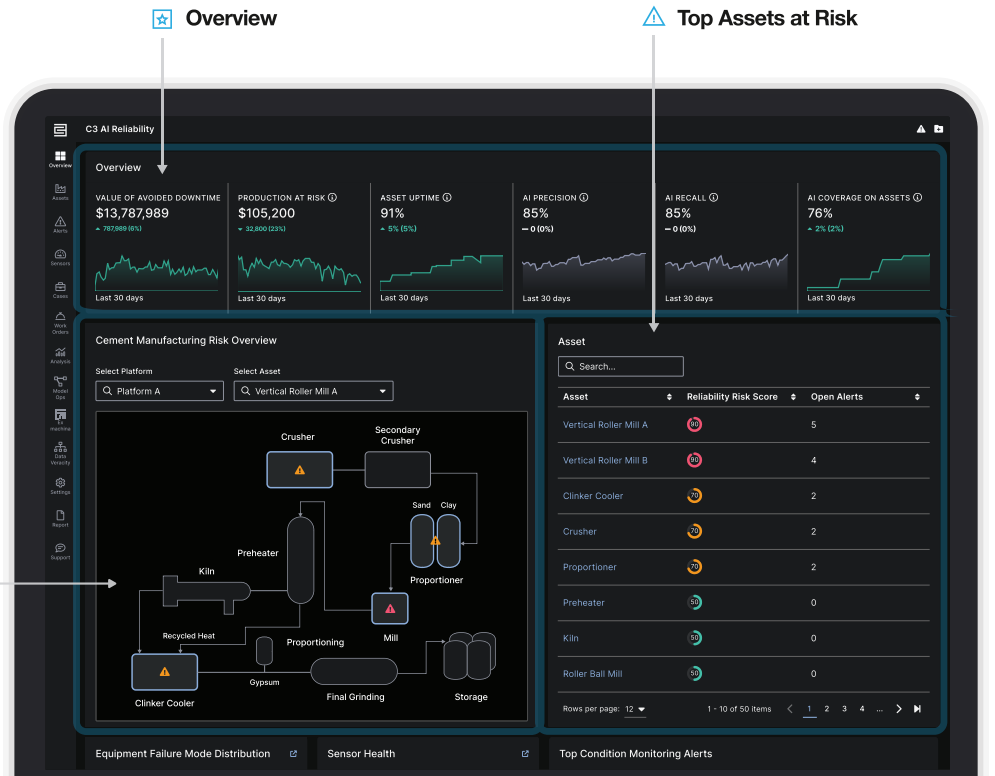
Solution Architecture

C3 AI Reliability

Enterprise Data

- Sensors
- Maintenance Data
- Failure Event History
- Asset Hierarchy
- Asset Configuration
- Weather Data

Overview

Top Assets at Risk

Process Flow Diagram

Benefits

With the C3 AI Reliability application, the global cement manufacturing company can now:

Generate
$10 million in annual economic benefit across all plants by minimizing unplanned downtime

Reduce
false positive alerts by 96% and improve the productivity of technicians

Predict
100% of failure events with at least 7 days advance warning for vertical roller mills

Drive
preventative action with detailed evidence packages

Guide
troubleshooting and maintenance activities to accelerate operations tasks

Scale
AI applications globally to every plant with a solution that can be locally deployed onsite

Configure
validate, and deploy new ML models in less than 3 hours to dramatically improve data science productivity

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Proven Results in 8-12 Weeks

Visit C3.ai/get-started