

# Sugar Manufacturer Increases Sugar Yield with AI-Driven Setpoint Recommendations



One of the largest sugar manufacturers in Latin America produces over 1 million tons of sugar and byproducts each year and distributes its products in over 35 countries worldwide. The company's top priority is to optimize yield across its harvesting and manufacturing process, allowing it to maximize sugar production and revenue.

Sugar manufacturing is a complex process. Optimizing yield requires maximizing the recovery of sugar in byproducts such as molasses and alcohols. To achieve this goal, the manufacturer's engineers and operators choose process setpoints for hundreds of assets across 5 processes amidst changing operating conditions. However, changing one process directly affects downstream processes, making it challenging to optimize across the entire production plant. As a result, the company experienced loss in sugar production.

Prior to engaging C3 AI, the manufacturer tried to increase yield with a traditional machine learning (ML) approach that identified process variables contributing most to sugar recovery. However,

it struggled to unify sensor and lab measurement data recorded at different frequencies and had to rely on daily averages for process variables. This approach did not provide operators with timely insights to adjust setpoints and optimize yield.

The company chose to partner with C3 AI and deployed C3 AI Process Optimization hosted on Google Cloud at its largest plant. In the first 6 months, the application was configured to recommend optimal setpoints and increase sugar recovery.

With C3 AI Process Optimization, the manufacturer estimates it could increase its annual yield by 1.85% compared to historical results, representing \$2.9 million in potential economic value per year when deployed at its largest plant.

The company can now maximize yield with more frequent and actionable insights. Engineers and operators can maximize sugar recovery throughout the manufacturing process by viewing and implementing setpoint recommendations as operating conditions change.

## Project Objectives

- Increase frequency and impact of setpoint changes with timely recommendations
- Unify data from disparate sources collected at different frequencies to improve ML insights
- Enable engineers and operators to optimize yield as operating conditions change
- Configure the C3 AI Process Optimization application to interact with ML insights in a user-friendly interface

## Results

**\$2.9M**

potential annual economic benefit when deployed at largest plant

**1.85%**

estimated increase to annual yield compared to historical results

**6-12x**

increase in frequency of insights, from daily to once every 2 to 4 hours

# Challenges

The amount of sucrose in sugarcane begins to decline almost immediately after harvest. Consequently, the company operates 24 hours per day during the peak harvest season to maximize yield in its manufacturing process. Engineers and operators need timely insights in this period to optimize setpoints across hundreds of assets and to maximize sugar recovery from cane entering the plant.

The manufacturer had previously developed an in-house solution that used a traditional ML approach to understand which process variables contributed most to sugar recovery. However, the solution provided limited value because it did not allow engineers and operators to optimize control setpoints at a high enough frequency. Instead, users could only update setpoints once per day.

The performance of the in-house solution was constrained for multiple reasons:

- Real-time sensor readings, setpoints, and lab measurements were stored in disparate databases, making it challenging to correlate high frequency data with lab measurements recorded every 2 to 4 hours.
- Lack of a robust data integration and normalization engine meant data scientists could only work against records from 2 or 3 data sources at a time, which was insufficient to train accurate AI models.
- Statistical outliers, invalid timestamps, and system downtime were difficult to detect and mask, making it challenging to train AI algorithms with accurate data.
- Legacy tooling did not allow for comprehensive time-series analytics, failing to provide complete evidence for AI recommendations.

# Approach

In 5 months, the manufacturer partnered with C3 AI to configure and deploy C3 AI Process Optimization to reduce sugar loss in byproducts before the next harvest season. The team started by ingesting, cleansing, and unifying 1 year of historical data. This data image combined sensor, lab measurement, and production line data, enabling the company to deploy the application on up-to-date data from all relevant sources.

The joint customer and C3 AI team configured and tested 16 ML models that predicted key variables in the manufacturing process, including yield, humidity, and transmittance. The team also generated metrics for over 100 constraints to ensure that mass balance, system, and historical bound constraints were captured by the optimizer.

The project team developed an optimizer that produces setpoint recommendations for 7 key control settings, accompanied by updates on more than 100 variables that are monitored to stay within designated upper and lower bounds. Now in production,

## About the Company

- 1+ million tons annual production of sugar and byproducts
- 4+ countries of operation
- 4 manufacturing plants worldwide
- 15,000+ employees

## Project Highlights

- 5 months from project kickoff to production-ready application
- 16 ML models configured and tested across a two-stage optimizer to maximize yield
- 1 year of historical data integrated, comprising 50 million rows of data from over 1000 sensors and lab measurements
- 250+ timeseries analytics developed for ML models and application user interface
- Configured C3 AI Process Optimization application user interface
- Hosted on Google Cloud



the optimizer runs every 2-4 hours to provide engineers and operators with recommendations at a cadence that matches changing operating conditions. This allows users to continuously adjust setpoints and maximize yield.

Finally, the team configured the C3 AI Process Optimization user interface so engineers and operators can visualize and accept recommendations alongside clear evidence packages. The team onboarded end users at the company to drive adoption of the new AI application.

# Solution Architecture

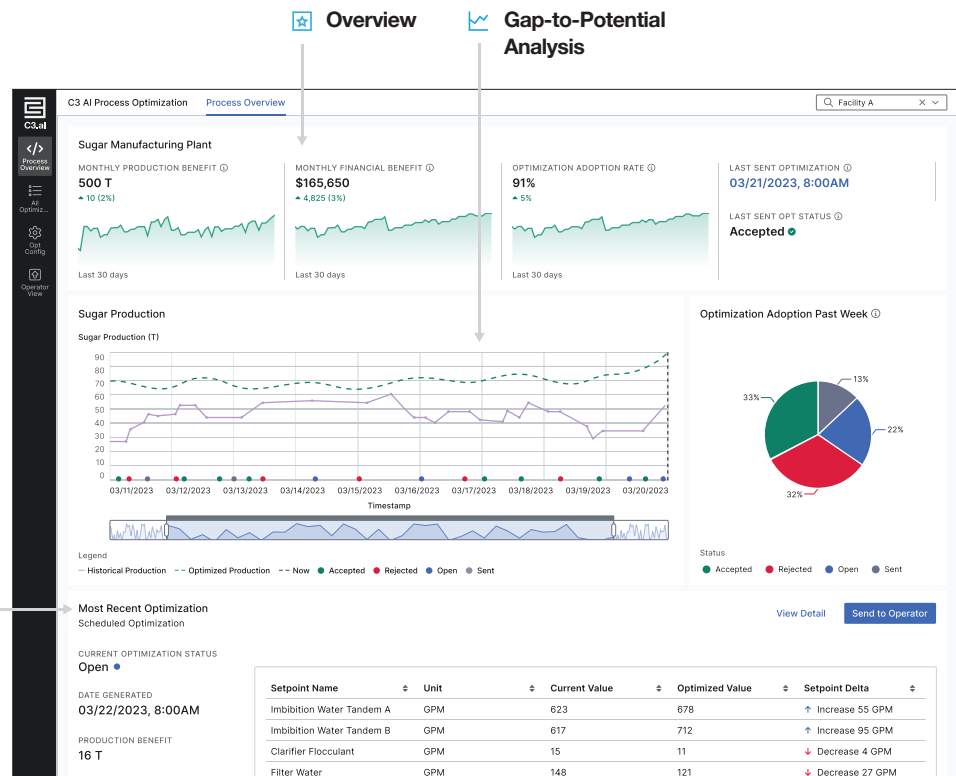


## Enterprise Data

- Sensors
- In-line Analyzer Data
- Control Parameters
- Production Line Data
- Lab Test Data
- P&ID Diagrams
- Linear Programs
- Flow Models
- Physics-based Models



## Process Setpoint Recommendations



# Benefits

## Create

\$2.9 million in potential annual economic benefit at largest facility by maximizing yield

## Improve

yield by an estimated 1.85% per year via optimized setpoints

## Increase

frequency of insights from once per day to every 2-4 hours

## Monitor

over 105 process variables to stay within designated upper and lower bounds

## Provide

actionable setpoint recommendations to engineers and operators

## Unify

data from disparate systems collected at different frequencies from over 130 sensors

## Scale

AI applications across global facilities leveraging a new data foundation

Proven Results in 6-Month Pilot

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