FICEM

EL ROL DEL CEMENTO & CONCRETO DE CARA AL CAMBIO CLIMÁTICO

CONGRESO
Cemento & Concreto Verde 2050

11 AL 15 MAYO 2026

Santiago, Chile

Aplicaciones de la digitalización e inteligencia artificial en la industria cementera.

Nombre: Javier Meza Jofré
Cargo: Digital Manager ABB

The path forward for the cement industry

Embrace digitalization to achieve operational excellence & sustainability targets

Challenges

Energy-intensive processes

License to operate, penalties due to emissions & safety

Skilled labor shortages

High production cost

Ageing assets, frequent shutdowns & reduced capacity utilization

Lack of transparency over the value chain and performance across sites

Adapting to changes in customer demand, supply chain and regulations

Priorities

Costs

Quality

Reliability (including plant availability and safe, consistent, energy-efficient processes with least environmental impact)

Flexibility

Speed

Operational Excellence Software

Enterprise Data Management IT OT, Visualization and Advanced Analytics

Advanced Control Process + IA

Process and Production Information Management System (PIMS)

Manufacturing Execution System (MES)

Laboratory Information Management System (LIMS)

Production Scheduling

Focus Areas

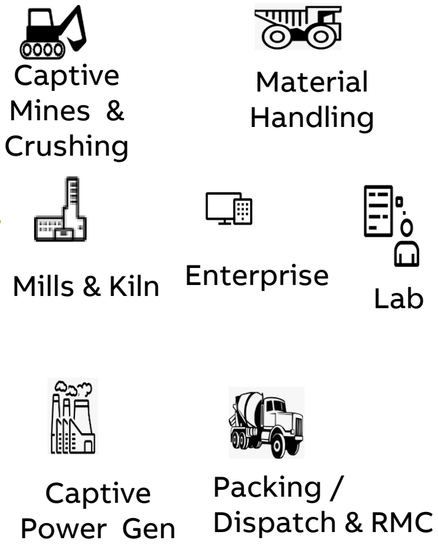


ABB Ability™ solutions for cement – breaking down operational silos

L4

Advanced Analytics, AI / ML / Deep Learning

Generative AI/Agentic AI

Ecosystem Partners

EMS

Energy Anomaly Detection

Genix

Datalyzer

Enterprise Dashboards

AI/ML Analytics

Next-Gen Predictive Maintenance

Industrial Knowledge Vault

Document repository

AI-driven Procedure Manager

GenAI Assistants

L3

Operations Management and Planning

Knowledge Manager

Plant/Enterprise Dashboards

PIMS

Downtime Management

LIMS Quality Management

Cement Production Scheduler

EMS

Energy Forecast & Optimization

Expert Optimizer

Advanced Process Control: MPC, Fuzzy Logic, Soft Sensors

History Asset Twin

Scalable Predictive Maintenance

Industrial Knowledge Vault

Work instructions mobile app

Task Manager

Job overview Dashboard

800xA

Remote Operation

L2

Execution Control

OMS

Short-Term Planning, Short Interval Control

Production Control

800xA Platform

Process Control

Minerals Library

Advanced Process Control (MPC)

Power Control

Advanced Power Control

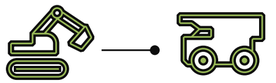
Camera Control

Computer Vision

Condition Monitoring

L1
L0

Limestone quarrying



Excavator

Dump truck

Conveyor

Crushing

Storage & blending

Drying & grinding

Preheater & calciner

Kiln

Cooler

Smelter

Cement storage

Existing cement production plan

Loading & shipping

Cloud

Genix

Edge

Edgenius/Genix Edge

Inbound
Outbound

Knowledge Manager

Historian / Data Platform

Industry trends and relevance of advanced analytics solutions in cement

Why predictive analytics is increasingly critical in modern cement manufacturing

ENERGY EFFICIENCY MANDATES

DIGITAL TRANSFORMATION, GROWING USE OF AI/ML

REAL-TIME OPTIMIZATION / DIGITAL TWINS

FEWER LAB TESTS, IN-PROCESS QUALITY MONITORING

ADVANCED ANALYTICS SOLUTIONS

CONSISTENTLY IMPORTANT

INCREASINGLY CRITICAL TO SUCCESS

CUSTOMER BENEFITS

NO_X PREDICTION

Reduced environmental impact

BLAINE PREDICTION

Uniform product quality

HEAT BALANCE

Thermal efficiency, fuel savings

CYCLONE JAMMING

Less unplanned shutdowns

ABB Ability™ Expert Optimizer for Cement

Decarbonization through Advanced Process Control

INDUSTRIAL SOFTWARE – PROCESS PERFORMANCE

Reducing Electrical Consumption

Maximize feed / maintain stable load and product fineness

Dedicated Milling Modules

- ✓ Raw Mill
- ✓ Cement Mill
- ✓ Coal Mill

- Electrical energy savings in kWh/t can directly be converted into CO_2 savings
- 0.9kg CO_2 emitted per kWh of power generated in a thermal power plant
- 0.3 – 1.1 kWh/t power saved from Expert Optimizer

- **> 1,000 tons CO_2 / year for an average plant**

Reducing Thermal Consumption

Maximize throughput whilst ensuring efficient combustion and reducing overfiring of fuels

Dedicated Pyro Modules

- ✓ Calciner
  - Fuel Management sub-module
- ✓ Kiln
- ✓ Cooler

- Fossil fuels and Pet Coke with Carbon content ranging from 60% to 80%
- Fuel savings in kcal/kg clinker can be converted to CO_2 savings
- 2% fuel saved per year on average

- **> 6,000 tons CO_2 / year for an average plant**

Maximizing Alternative Fuels

Maximize alternative fuels, minimize Coal / Pet Coke

Dedicated Fuel Management Modules

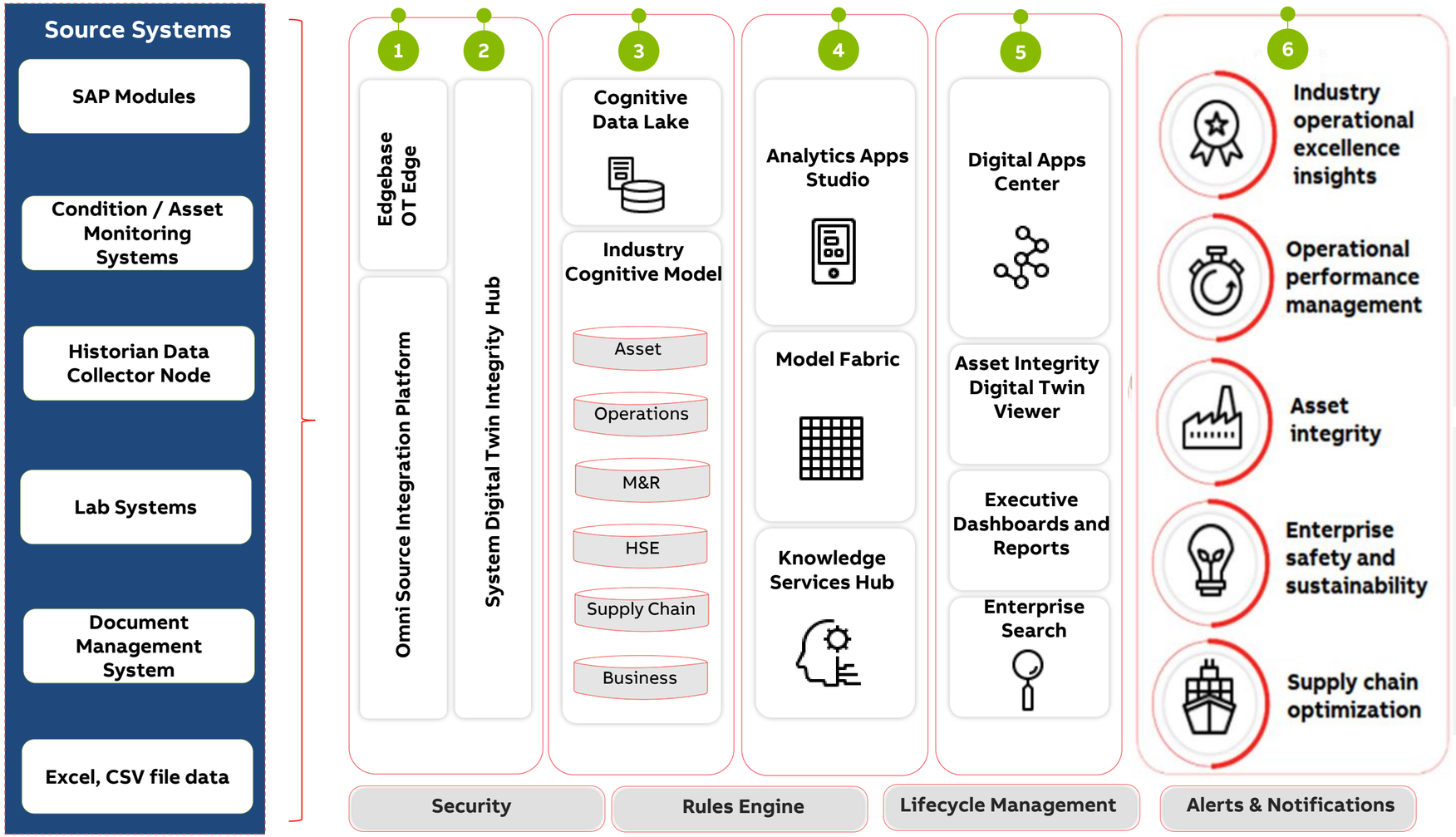
- ✓ Animal meal
- ✓ RDF
- ✓ Solid refuse / sewage sludge
- ✓ Whole tires
- ✓ Etc.,

- Indirect reduction on CO_2 due to using a fuel that would otherwise be dumped or simply incinerated
- Reduction in coal usage is also included
- Up to 50% coal reduced due to alternative fuels

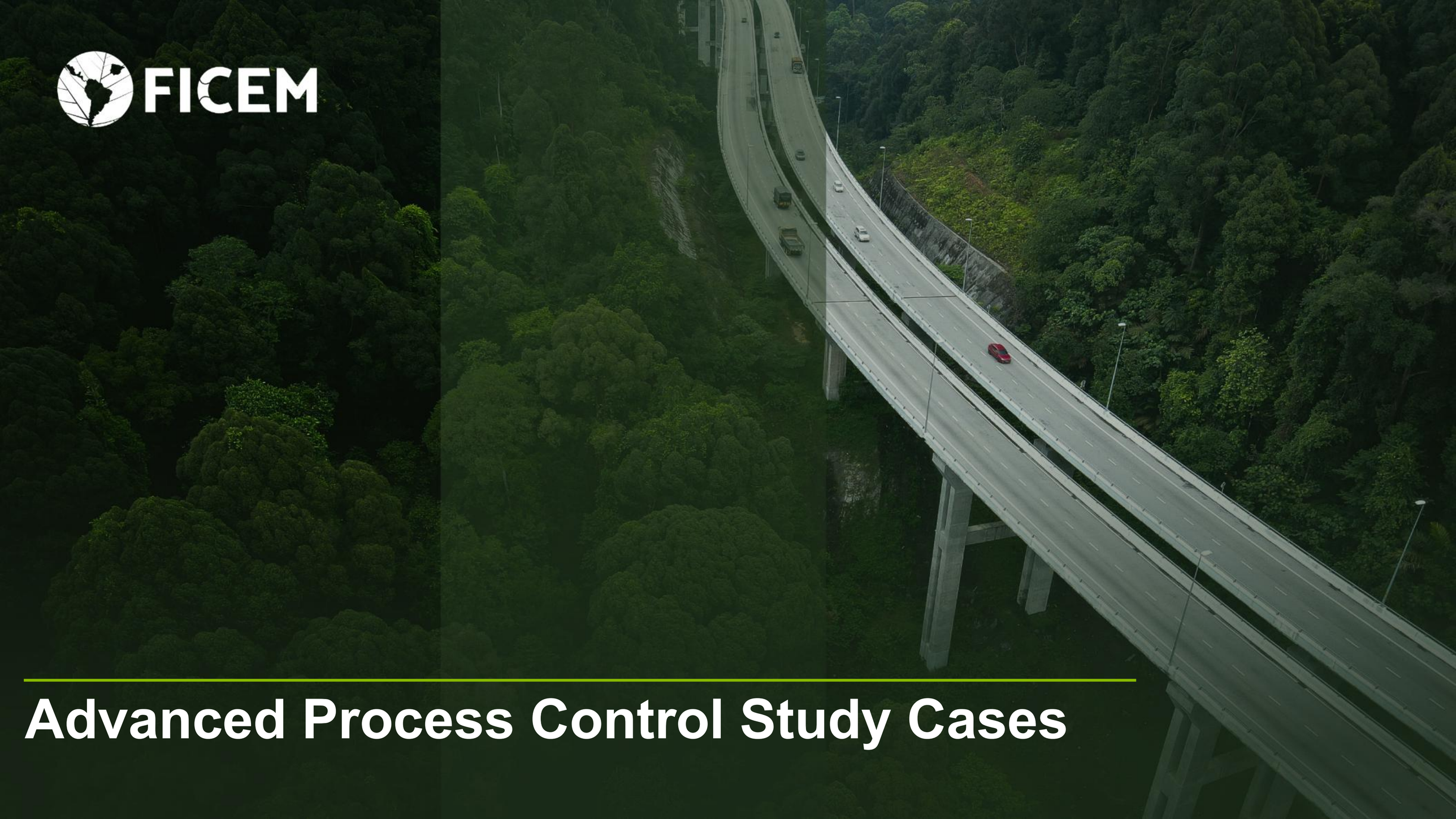
> 100,000 tons CO_2 / year for an average plant

ABB Ability™ Genix Industrial Analytics and AI Suite

Enterprise grade modular, open standards based, deployment across edge, on-premise and multi-cloud



1. **INTEGRATE** - automates Big Data integration of heterogenous source systems (ABB & non-ABB systems)
2. **CONTEXTUALIZE** - automates building enterprise and plant wide asset information model
3. **MODEL** – pre-built & extensible Industry standard system information model for advanced analytics
4. **ANALYZE** - comprehensive environment for AI/ML models, 3D twins, analytics services and apps
5. **DELIVER** - pre-built and self-service value driver applications and insights
6. **OPTIMIZE** - operational excellence through integrated suites & deeper cross-functional actionable insights



Advanced Process Control Study Cases

A cement producer maximizes alternative fuel usage with ABB Ability™ Expert Optimizer

Challenge

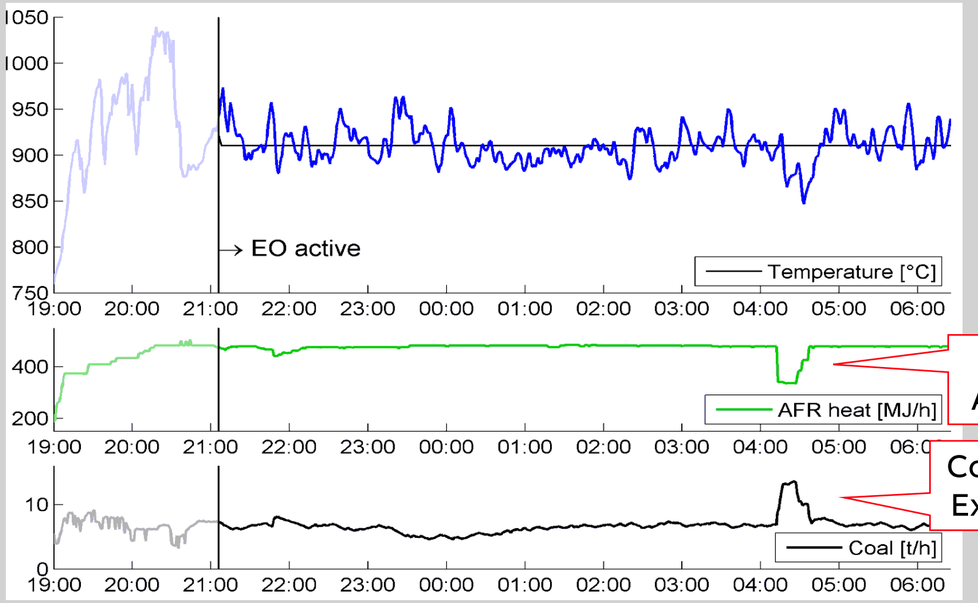
Difficult to maintain the use of alternative fuels within the allowed percentage determined by local authorities. Operators had to change the values of each fuel manually. To avoid significant fluctuations in temperatures, operators tend to limit AFs over the more consistent fossil fuels, leading to higher costs and CO2

Solution

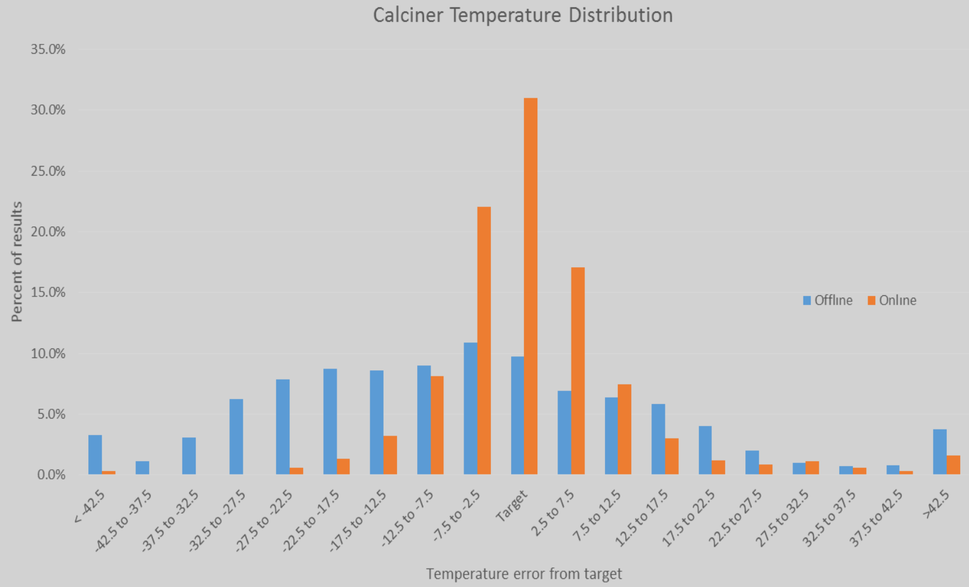
ABB Ability Expert Optimizer Advanced Fuel Management On-Line using simple Energy MPC Model and Neural Networks for faulty signals

Outcomes

- Maximization of AF usage with multiple control fuels
- Respects limits defined by local authorities
- Lower overall energy consumption
- Less variability in product quality
- Lower risk of cyclone blockage
- Less trips of the system due to high CO levels
- More stable kiln and higher overall production



Temperature stabilization whilst maximizing alternative fuels



Votorantim in Brazil increases process stability and improves the bottom line with ABB Ability™ Expert Optimizer

Challenge

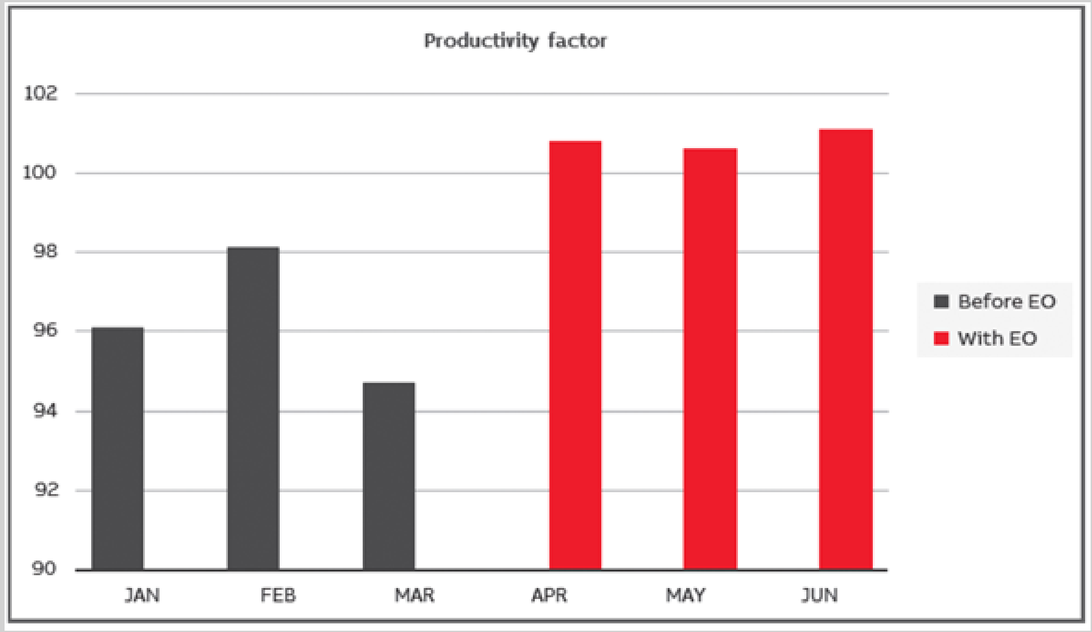
Due to variability in feed and fuel sources, coupled with complex processes, manual operators with PID control tend to remain at “safe distances” from process constraints. The goal was to takle the complexity of cement processes, minimize the effect of variability in feed and fuel for 1 Raw Mill, 1 Coal Mill, 1 Kiln, 1 Calciner, 1 Cooler, 2 Cement Mills.

Solution

After individual implementation of ABB Ability Expert Optimizer in each of the plant areas, a connection is made between all applications to further compliment plant-wide optimization. The solution is integrated with existing third-party control system. Mills have been modeled with MPC, calciner, kiln and cooler - with fuzzy logic.

Outcomes

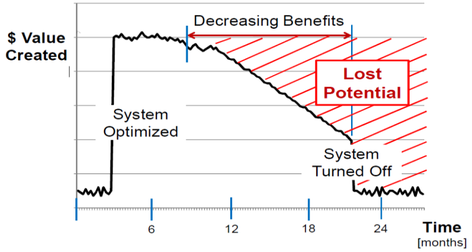
Reduction in standard deviation of:
raw mill power - 62%, raw mill bed depth - 60%,
kiln motor load - 24%, free lime - 27%,
liter weight 16%, burning zone temperature - 5%
Reduction in consumption of grinding media in ball mill

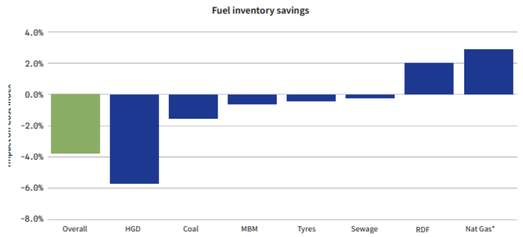


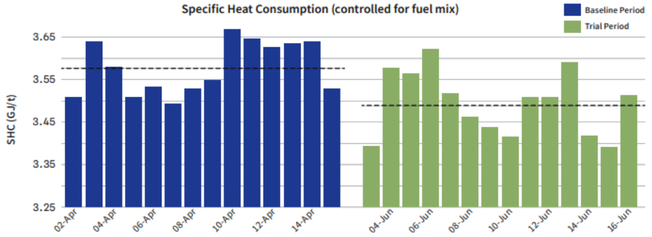
“The cement mill’s productivity gain had a positive impact that reflected on a reduction of 1.15 kWh/t of energy consumption”

Production manager at Votorantim Cimentos

Heidelberg Materials improves performance with ABB Ability Expert Optimizer (EO) and Carbon Re's AI – EO evolution at Czech site







Fingerprint

2019

Step 1: Fingerprint

- Define Business Case + ROI
- Identified EO opportunities on:
  - Raw Mills
  - Kilns
  - Cement Mills

EO Commissioning

2020

Step 2: EO Implementation

- **Raw mill 2** specific energy consumption reduction of **3.2%**
- **Kiln 2** (cooler, calciner) specific heat consumption reduction of **3.19 %** + AF rate of **2,14%**
- **Cement mills**, depending on the cement type production increase of **3.14%** to **3.44%**
- Standardized opinion on the process control
  Reducing shift to shift variation = smooth operation
  Reduction of the operator's workload!

Reference: Webinar link

CarbonRE

2023

Step 3: Extended AI - CarbonRE

- Total **5.4% SHC** reduction
  - 3.19% EO + 2.2% CarbonRE
- **33% reduction** in C_3S (Alite) variation
  - Additional savings through grinding process activated and non-activated filler use.
- Alternative Fuel Rate increased
  - **2.14%** EO + **2%** CarbonRE

Reference: Case Study

Maintain

2025

Heidelberg Materials improves performance with ABB Ability Expert Optimizer and Carbon Re's AI

Challenge

- Lag in quality metrics due to sampling and lab processes
- Process engineering resource expended in adapting APC targets to changing plant environment
- Data signals under-utilised in decision making

Solution

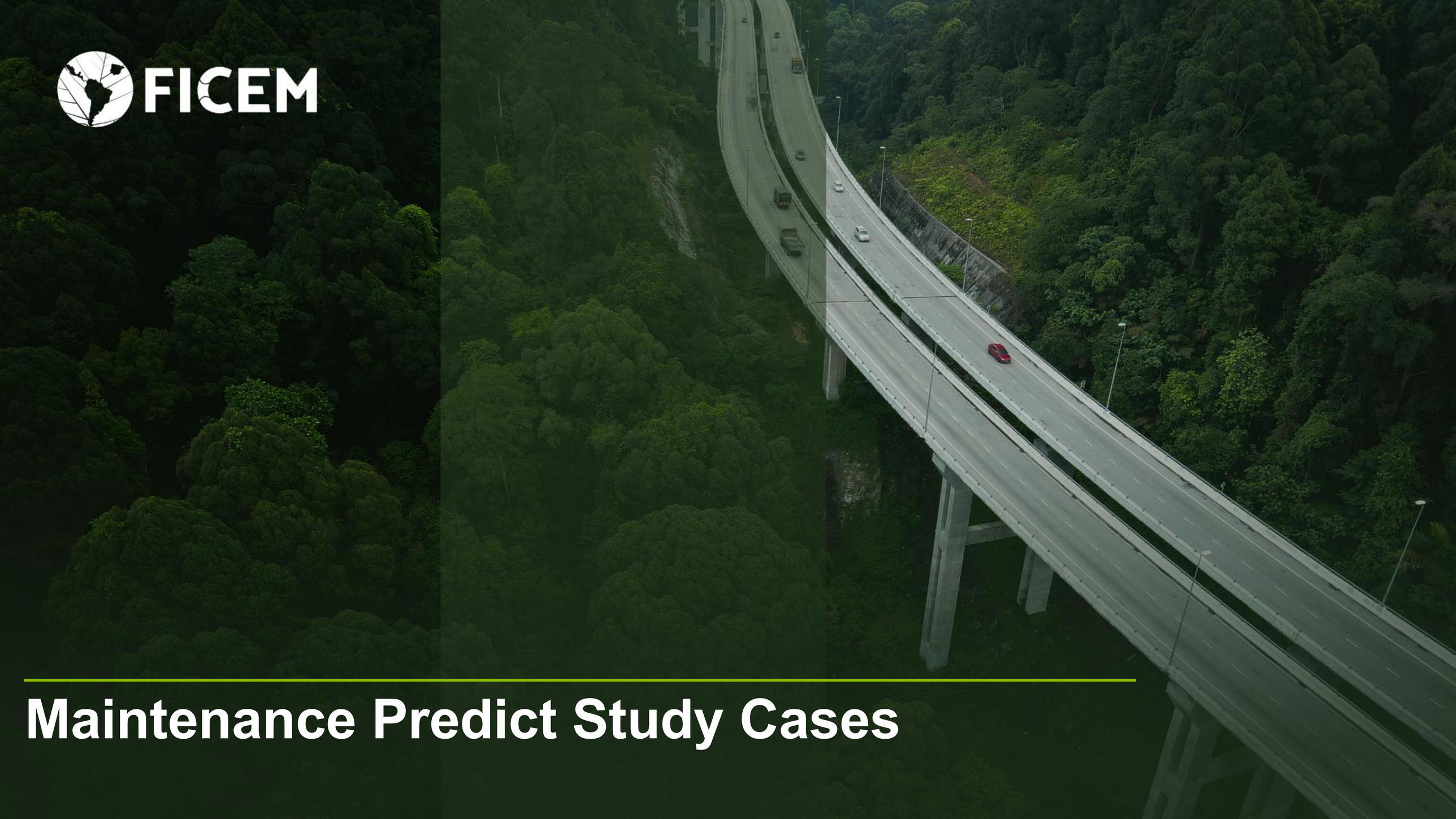
Building upon the strength of ABB Ability™ Expert Optimizer, Carbon Re integrated real-time process, chemistry, and control data into AI models that directly informed Expert Optimiser's strategic targets.

Outcome

	SHC Reduction	Variability Reduction	Carbon Reduction
ABB	2-3%	30-50%	5-50 kg/tonne
Carbon Re	2-3%	30%	5-20 kg/tonne
ABB+Carbon Re	**4-6%**	**60-80%**	**10-70 kg/tonne**

"We had been searching for a system to enhance our Expert Optimizer with AI for a long time and Carbon Re's AI platform looked promising. ABB's confidence in the company along with Carbon Re's understanding of the challenges of cement production and their expertise in AI were key to us working together. Not only did they deliver on time, the real-time insight we gained into our operations was incredibly valuable from day one"

Mokra Plant Director



Maintenance Predict Study Cases

Case 1: VRM – Asset Performance Management

Genix Models

- ✓ Rule-based models,
- ✓ Time-series forecasting,
- ✓ Change-point detection
- ✓ Condition indicators
- ✓ Unsupervised fault detection
- ✓ Supervised fault detection
- ✓ Remaining Useful Life (RUL)
- ✓ Expert Fault Models,
- ✓ Digital twin

List of indicative Failure Modes :

System Blockage
1. Motor Current
2. Mill Inlet
3. Mill Outlet
4. Feed Rate_
5. Mill Discharge Temperature

Efficiency Degradation
1. Motor Power kW
2. Mill Outlet
3. Specific Power kWh/kg
4. Mill Discharge Temperature

Mill Gear Box Issue
1. Gearbox Low Oil Pressure
2. Gearbox High Vibration
3. Gearbox Bearing High Temperature
4. Gearbox Oil High temperature

Filter Clogging
1. Mill Inlet
2. Mill Outlet
3. Air Flow
4. Filter DP
5. Separator Speed

Feed Loss
1. Motor Current_
2. Mill Inlet
3. Feed Rate
4. Mill Discharge Temperature
5. Separator Speed

Mill Hydraulic System
1. Hydraulic Low Pressure
2. Hydraulic Cylinder sluggish
3. Hydraulic Oil High Temperature

Mill –Main Motor Drive Issue
1. Motor Overload /High Current
2. Motor High Vibration
3. Motor High Temperature
4. Motor High winding temperature

Time-series prediction vs. threshold alarm: 1st alarm ~10 hours earlier

RULE-BASED

Fixed threshold: Thrust bearing pressure low

Alert fires only when the physical limit is already breached.

Detection timing

At breach

Zero lead time for maintenance planning

Context provided

Single parameter

“Pressure is low" — no root cause

→

GENIX PREDICTION

Time-series forecasting: APM PMW & EFM Models

Advanced models monitor trends to identify deviations before they reach critical levels.

Detection timing

9 hrs 50 mins before breach

First diagnostic alert triggered on July 15th at 20:15 Hrs.

Context provided

Expert Fault Monitoring (EFM)

Identified root cause: **Hydraulic leakage** in the thrust tilt pad bearing.

Use Case: VRM

Perform 360

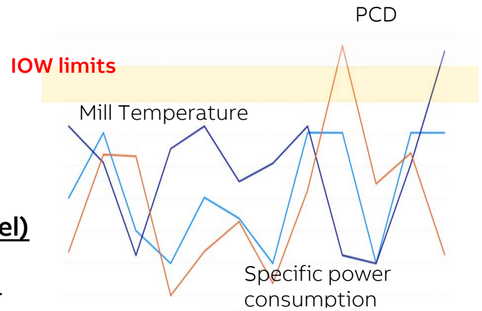
Performance

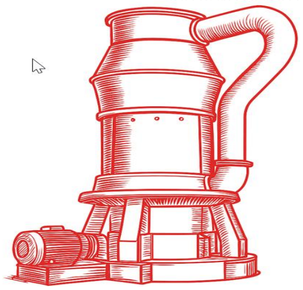
Operational

- Mill Outlet Pressure
- Outlet Temperature
- Mill Inlet Pressure
- Feed rate

Derived (Physics Model)

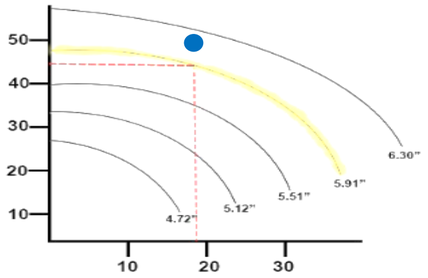
- Specific Power Cons.
- Output Feed
- Mill DP





Performance Curve

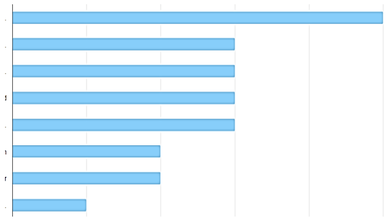
Current Operating Point



- Efficiency Deviation – 5.25%

Damage Analysis

Damage Analysis

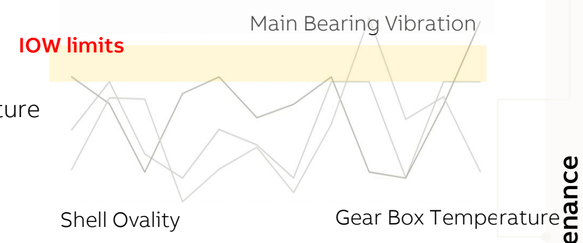


- Damage Mode
- Damage Mode - Object
- Damage Mode - Cause

Health

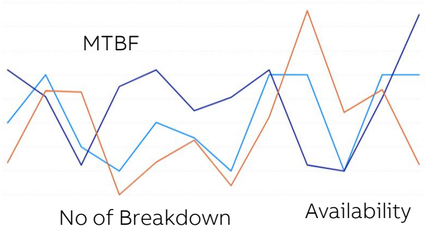
Operational

- Main Bearing Vibration
- Grinding Roller Temperature
- Gear Box Temperature
- Hydraulic Oil Pressure



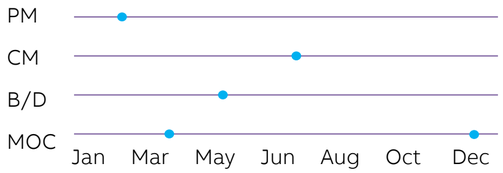
Failure Metric

- MTBF
- MTTR
- No of Breakdown
- Availability



Maintenance

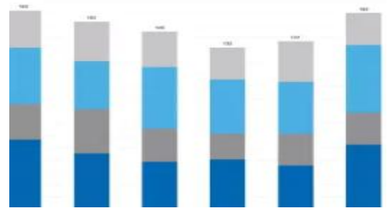
Maintenance Intervention & Planning



- Last 20 Workorders
- Overdue Workorders
- Spares Availability
- Frequently Consumed Material

Life Cycle Cost

Planned vs Actual



- Cost - Planned vs Actual
- Material & Service Cost
- Cost Vs Work Order Type
- Cost Vs Failure Mode
- Cost Vs Planned Group
- Cost Vs Work order

Predict 360

Reliability/ Technologist Engineer

Using this information, can I develop a forecast model to predict efficiency loss over the next 48 hours

Can I establish some rules to identify when efficiency loss deviates and approaches a target limit

Can I build a performance model to calculate the efficiency loss into monetary terms and alert me

Use Case: VRM

Perform 360

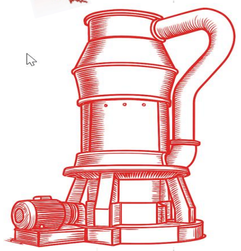
Performance

Operational

- Mill Outlet Pressure
- Outlet Temperature
- Mill Inlet Pressure
- Fuel Consumption, Average

Derived (Physics Model)

- Specific Power Cons.
- Output Feed
- Mill DP



Health

Operational

- Main Bearing Vibration
- Support Roller Vibration
- Gear Box Temperature
- Oil Temperature

Predict 360

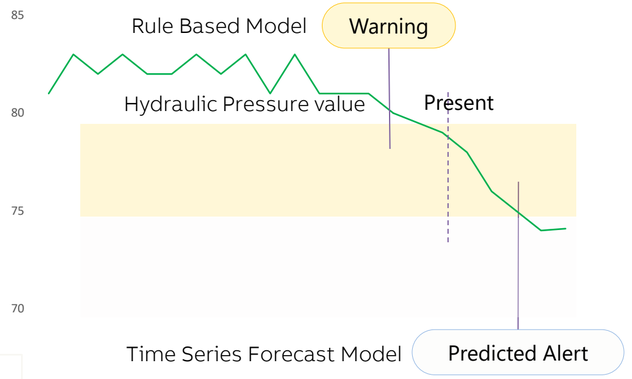
Failure Mode

Hydraulic Pressure

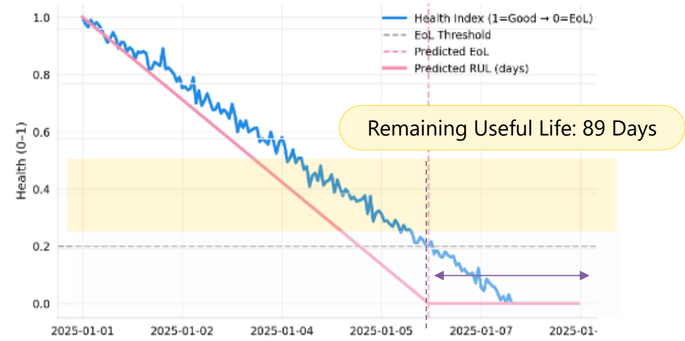
- Rule Based Model
- Time Series Forecast Model

Alert: Hyd. Prs >15%

Warning: Hyd. Prs >10%

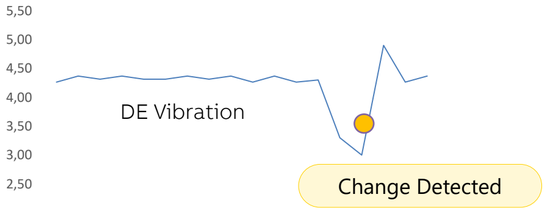


- Remaining Useful Life



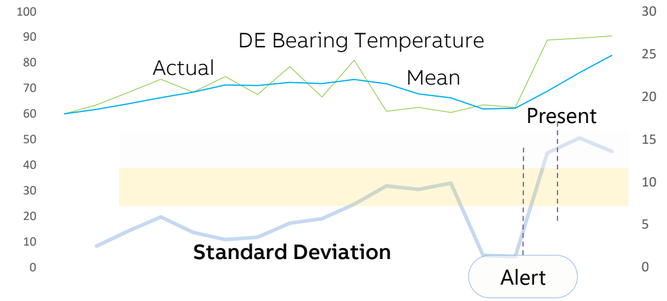
High Vibration

- Change Point Detection Model



High Bearing Temperature

- Condition Indicator Model
  - Crest Factor
  - Impulse Factor
  - Kurtosis
  - Margin Factor
  - RMS
  - Shape Factor
  - Skewness



Expert Fault Modelling (Multivariate)

	Filter Clogged	System Blockage	Liner Wear
Inlet Pressure	7	9	
Outlet Pressure	7	4	
Air flow	9		
Roller Pressure Bar			9
Mill Discharge Temp		3	9

Fault Severity Indicator/ Fault Probability Indicator

FSI Warning

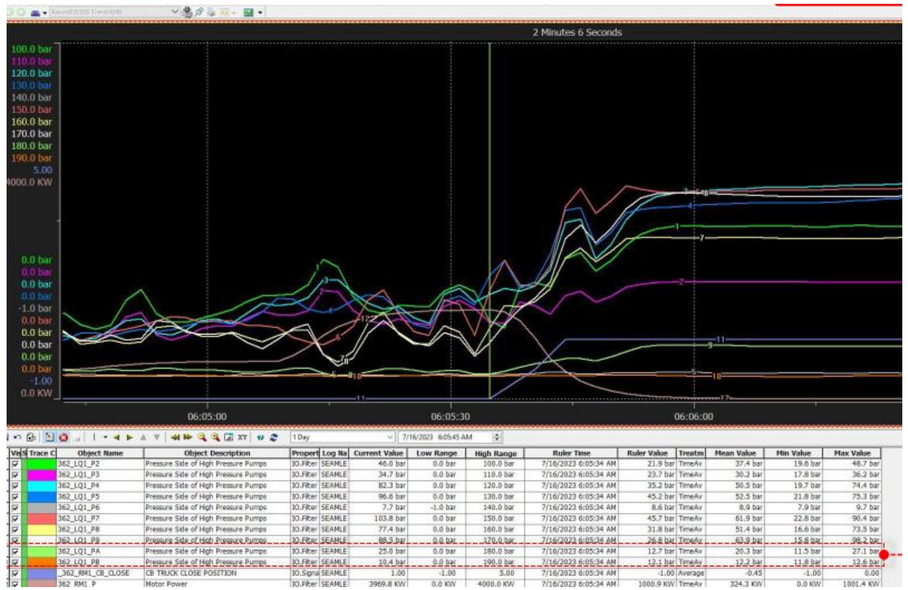
Key Diagnostic Indicator

KDI Alert

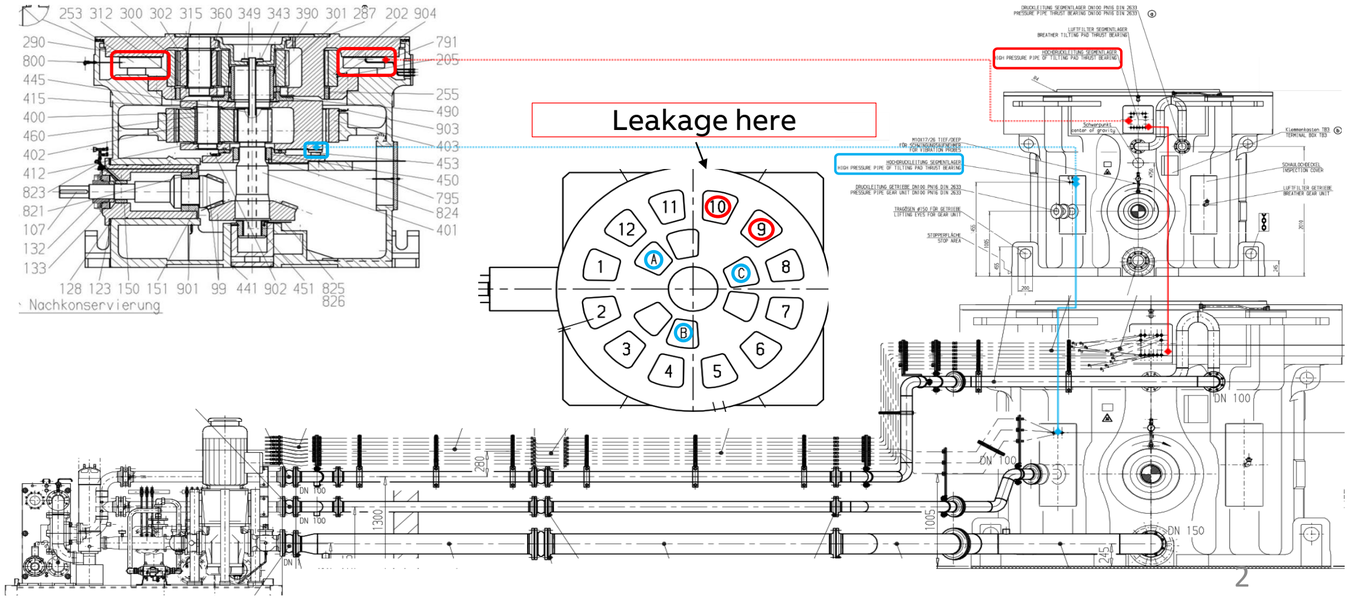
VRM Actual Failure Event (Reported by Customer)

Failure Mode: Thrust Tilt Pad Bearing Issue

What happened?
Raw Mill 2 tripped due to “Thrust tilt pad bearing pressure low”. On 16th July 06:05 Hrs

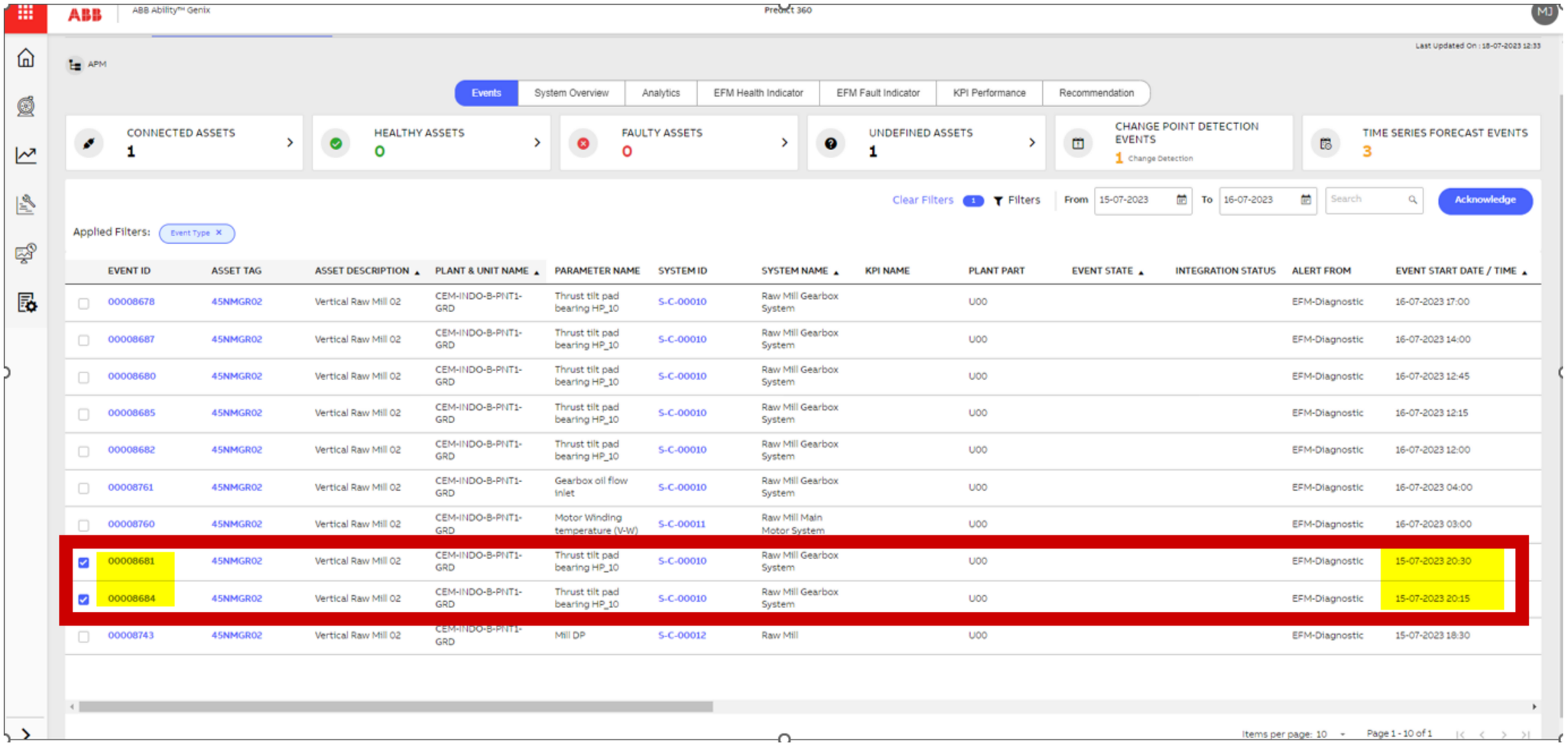


Vis	S	Trace C	Object Name	Object Description	Propert	Log Ra	Current Value	Low Range	High Range	Ruler Time	Ruler Value	Treatm	Mean Value	Min Value	Max Value
☑			362_LQ1_P2	Pressure Side of High Pressure Pumps	IO.Filter	SEAMLE	46.0 bar	0.0 bar	100.0 bar	7/16/2023 6:05:34 AM	21.9 bar	TimeAv	37.4 bar	19.6 bar	48.7 bar
☑			362_LQ1_P3	Pressure Side of High Pressure Pumps	IO.Filter	SEAMLE	34.7 bar	0.0 bar	110.0 bar	7/16/2023 6:05:34 AM	23.7 bar	TimeAv	30.2 bar	17.8 bar	36.2 bar
☑			362_LQ1_P4	Pressure Side of High Pressure Pumps	IO.Filter	SEAMLE	82.3 bar	0.0 bar	120.0 bar	7/16/2023 6:05:34 AM	35.2 bar	TimeAv	50.5 bar	19.7 bar	74.4 bar
☑			362_LQ1_P5	Pressure Side of High Pressure Pumps	IO.Filter	SEAMLE	96.6 bar	0.0 bar	130.0 bar	7/16/2023 6:05:34 AM	45.2 bar	TimeAv	52.5 bar	21.8 bar	75.3 bar
☑			362_LQ1_P6	Pressure Side of High Pressure Pumps	IO.Filter	SEAMLE	7.7 bar	-1.0 bar	140.0 bar	7/16/2023 6:05:34 AM	8.6 bar	TimeAv	8.9 bar	7.9 bar	9.7 bar
☑			362_LQ1_P7	Pressure Side of High Pressure Pumps	IO.Filter	SEAMLE	103.8 bar	0.0 bar	150.0 bar	7/16/2023 6:05:34 AM	45.7 bar	TimeAv	61.9 bar	22.8 bar	90.4 bar
☑			362_LQ1_P8	Pressure Side of High Pressure Pumps	IO.Filter	SEAMLE	77.4 bar	0.0 bar	160.0 bar	7/16/2023 6:05:34 AM	31.8 bar	TimeAv	51.4 bar	16.6 bar	73.5 bar
☑			362_LQ1_P9	Pressure Side of High Pressure Pumps	IO.Filter	SEAMLE	88.5 bar	0.0 bar	170.0 bar	7/16/2023 6:05:34 AM	26.8 bar	TimeAv	63.9 bar	15.6 bar	99.2 bar
☑			362_LQ1_PA	Pressure Side of High Pressure Pumps	IO.Filter	SEAMLE	25.0 bar	0.0 bar	180.0 bar	7/16/2023 6:05:34 AM	12.7 bar	TimeAv	26.3 bar	11.5 bar	27.1 bar
☑			362_LQ1_PB	Pressure Side of High Pressure Pumps	IO.Filter	SEAMLE	10.4 bar	0.0 bar	190.0 bar	7/16/2023 6:05:34 AM	12.1 bar	TimeAv	12.2 bar	11.8 bar	12.6 bar
☑			362_RM1_CB_CLOSE	CB TRUCK CLOSE POSITION	IO.Signa	SEAMLE	1.00	-1.00	5.00	7/16/2023 6:05:34 AM	-1.00	Average	-0.45	-1.00	0.00
☑			362_RM1_P	Motor Power	IO.Filter	SEAMLE	3969.8 KW	0.0 KW	4000.0 KW	7/16/2023 6:05:34 AM	1000.9 KW	TimeAv	324.3 KW	0.0 KW	1001.4 KW



Genix APM

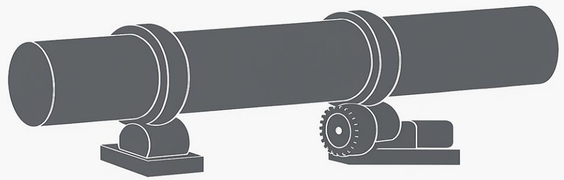
Prediction Alerts



Case 2: Kiln – Asset Performance Management

AI -Powered Analytics to avoid unplanned downtime and Reduce maintenance cost

Equipment



Kiln | **Gearbox** | **Lube Oil system** | **Motor**

Genix Models

- ✓ Rule-based models,
- ✓ Time-series forecasting,
- ✓ Change-point detection
- ✓ Condition indicators
- ✓ Unsupervised fault detection
- ✓ Supervised fault detection
- ✓ Remaining Useful Life (RUL)
- ✓ Expert Fault Models,
- ✓ Digital twin

Failure Modes

Parameters /Failure mode Matrix	Ring Formation Ring	Thrust bearing issue	Support Roller Bearing issue Roller	Gearbox Issue	Motor Issue	Efficiency Degradation
Kiln Performance Monitoring						
Kiln Feed Rate Clinker Output Specific Heat Consumption Kiln Inlet/Outlet Pressure Differential Pressure	✓					✓
Kiln and Gearbox Health Monitoring						
Support Roller Bearing Vib (1-3) Pinion Gear to Girth Gear Vib Gearbox Vibration	✓	✓	✓	✓		
Motor and Drives						
Motor Current & Power Motor Winding Temperature Motor Bearing Vibration and temperature					✓	
Lubrication						
Lube Oil Pressure Lube Oil Temperature Gearbox Oil Temperature Hydraulic Pressure (Main/Thrust)				✓		

Use Case: Kiln

Perform 360

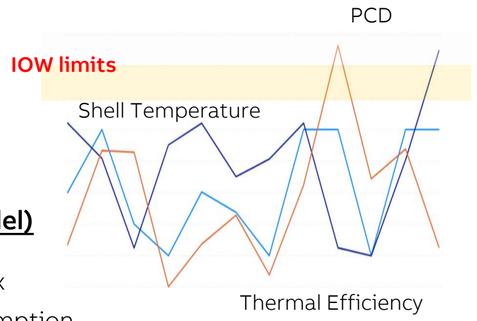
Performance

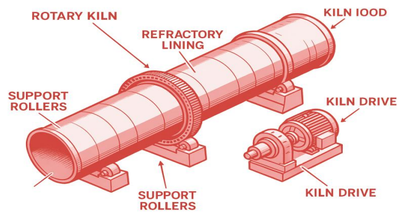
Operational

- Shell Temperature
- Inlet Gas Temperature
- Kiln RPM
- Fuel

Derived (Physics Model)

- Draft Efficiency Index
- Specific Heat Consumption
- Kiln Yield

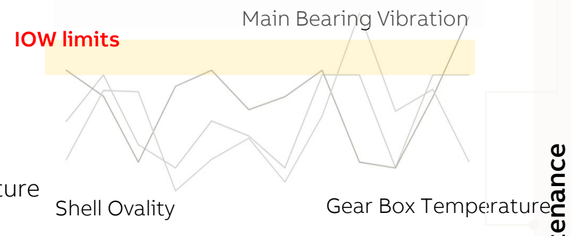




Health

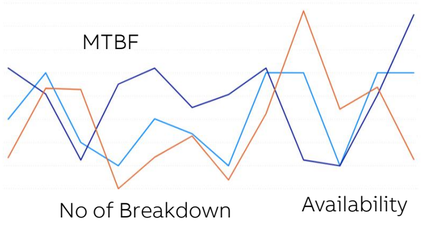
Operational

- Main Bearing Vibration
- Support Roller Vibration
- Gear Box Temperature
- Thrust Bearing Temperature



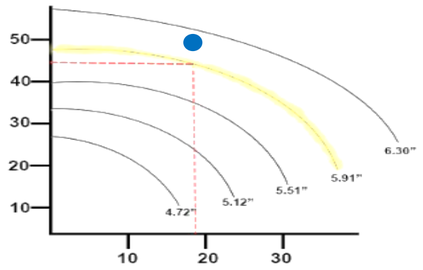
Failure Metric

- MTBF
- MTTR
- No of Breakdown
- Availability



Performance Curve

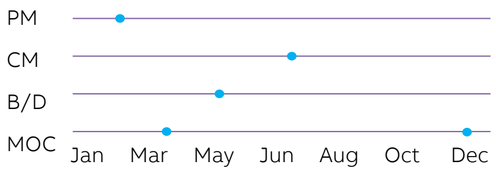
Current Operating Point



- Efficiency Deviation – 5.25%

Maintenance

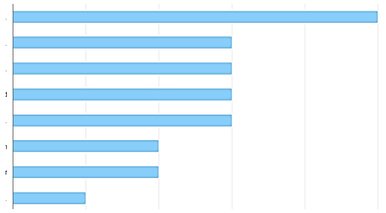
Maintenance Intervention & Planning



- Last 20 Workorders
- Overdue Workorders
- Spares Availability
- Frequently Consumed Material

Damage Analysis

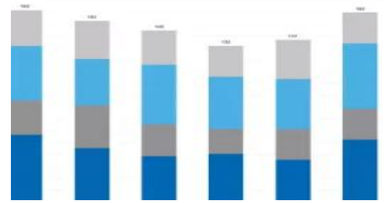
Damage Analysis



- Damage Mode
- Damage Mode - Object
- Damage Mode - Cause

Life Cycle Cost

Planned vs Actual



- Cost - Planned vs Actual
- Material & Service Cost
- Cost Vs Work Order Type
- Cost Vs Failure Mode
- Cost Vs Planned Group
- Cost Vs Work order

Predict 360

Reliability/ Technologist Engineer

Using this information, can I develop a forecast model to predict efficiency loss over the next 48 hours

Can I establish some rules to identify when efficiency loss deviates and approaches a target limit

Can I build a performance model to calculate the efficiency loss into monetary terms and alert me

Use Case: Kiln

Perform 360

Predict 360

Performance

Health

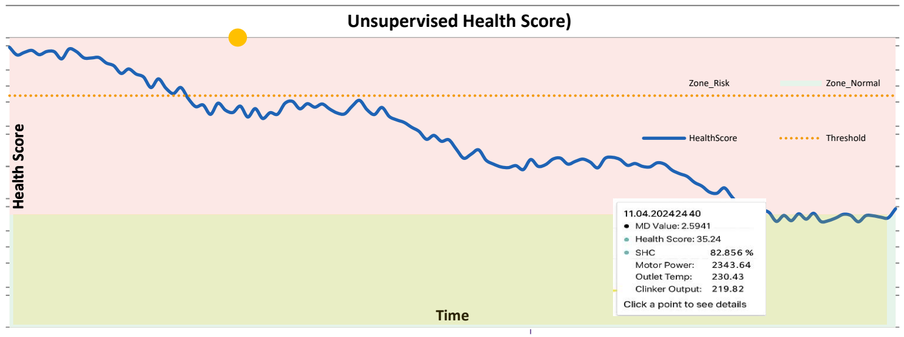
Operational

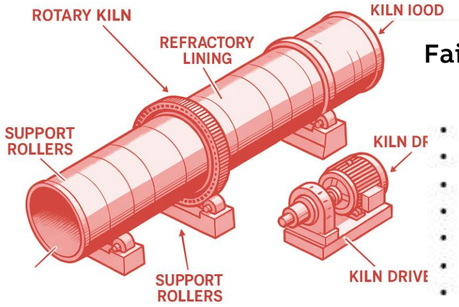
- Shell Temperature
- Inlet Gas Temperature
- Kiln RPM
- Fuel Consumption, Average

Derived (Physics Model)

- Draft Efficiency Index
- Specific Heat Consumption
- Kiln Yield

Failure mode: Efficiency degradation



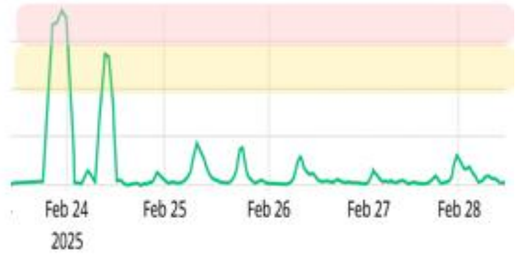


Failure mode: Ring Formation

- Crest Factor
- Impulse Factor
- Kurtosis
- Margin Factor
- RMS
- Shape Factor
- Skewness

Condition Indicator Model

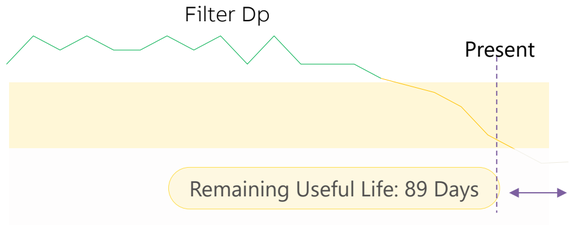
Alert



Failure mode:

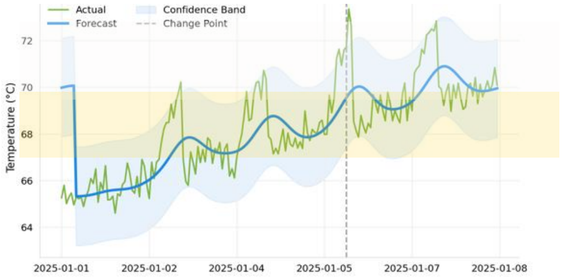
Lube Oil Filter Clogging

Remaining Useful Life



Failure mode :High Bearing Temperature

Time Series Forecast Model

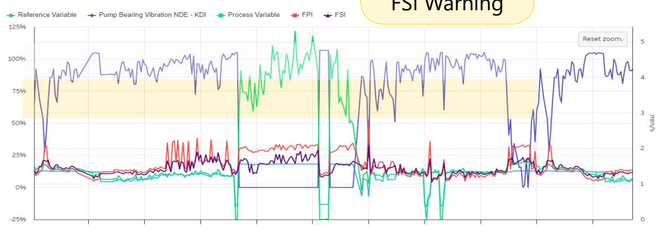


Expert Fault Modelling (Multivariate)

	Ring Formation	High Vibration	High Temperature
Dp	7		
Output Temp	7		
Power	9	3	5
Support Bearing Vibration		3	9
Thrust Bearing Vibration		4	9

Fault Severity Indicator/ Fault Probability Indicator

FSI Warning



Key Diagnostic Indicator

KDI Alert

Operational

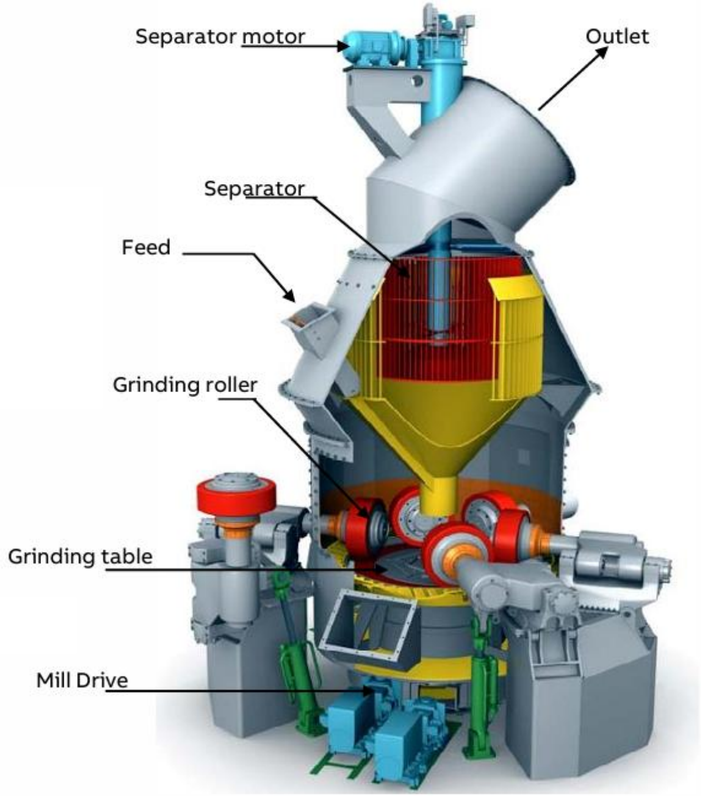
- Main Bearing Vibration
- Support Roller Vibration
- Gear Box Temperature
- Thrust Bearing Temperatur

Energy Optimization by Blaine Prediction

Eliminating the "Blind Spot" in Quality Control

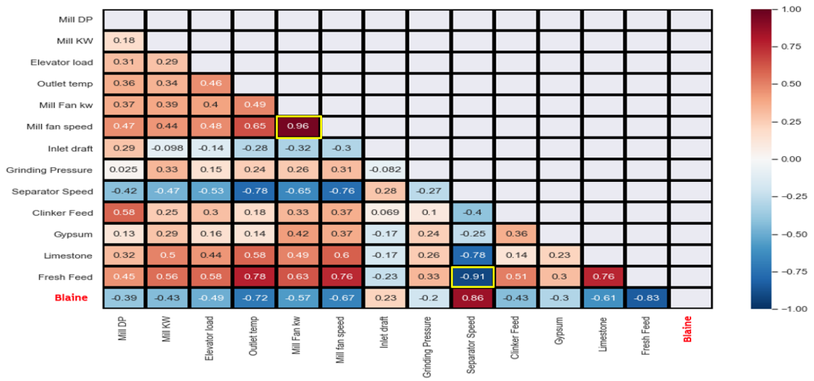
Transitioning from reactive to real-time quality management.

- **The 120-Minute Delay:** Traditional Blaine fineness is measured in a lab every hour, meaning operators react to process changes with a 120-minute lag.
- **Introducing the "Soft Sensor":** A Virtual Sensor powered by Genix AI that predicts cement fineness instantaneously based on live mill parameters.
- **Strategic Value:** Eliminates operational uncertainty, allowing for immediate corrections and preventing out-of-spec production before it happens.

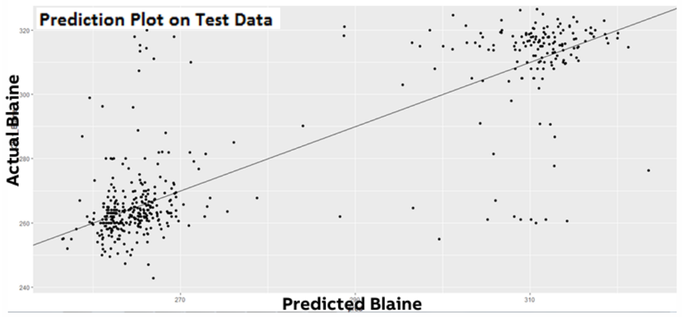


Industrial Intelligence: Understanding Your Mill's DNA

Data-driven insights that identify the true levers of productivity.



Model	RMSE	RSQUARED
Extreme Gradient Boosting	8.5	0.75

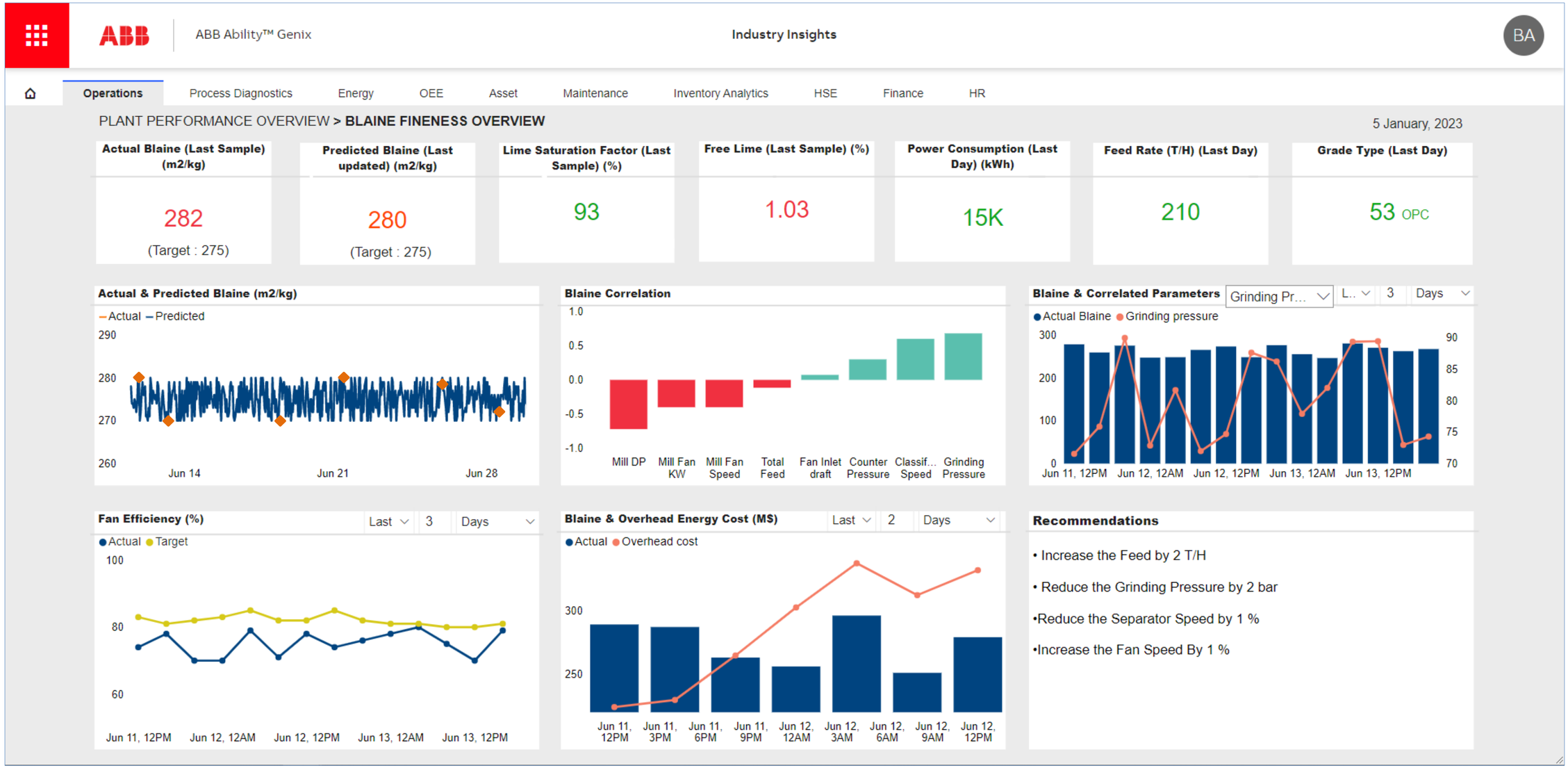


OPC 43

OPC 53

- **Critical Variable Mapping:** Our algorithms identify exactly which parameters—such as **Separator Speed** and **Grinding Pressure**—have the highest impact on your specific quality targets.
- **Proven Accuracy:** After training on historical data, the model achieves a prediction error of only **3-8%**, ensuring high reliability for executive decision-making.
- **Seamless Grade Transitions:** Automatically adapts to different cement types (e.g., OPC 43, OPC 53, or PPC), maintaining stability during product switches.

Genix Industry Insights: The Future of Mill Operations



FICEM

EL ROL DEL CEMENTO & CONCRETO DE CARA AL CAMBIO CLIMÁTICO

CONGRESO Cemento & Concreto Verde 2050

11 AL 15 MAYO 2026

Santiago, Chile