IPPTA Zonal Seminar-1, 2026

Jaipur, India

TRANSFORMING PAPER MILL OPERATIONS THROUGH AI-POWERED DIGITAL SOLUTIONS

Technology Integration: From Process Control to Smart Manufacturing

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ENGINEERED TO OUTRUN

Digital Solutions for Pulp and Paper

Asset Performance	Process Performance	Operational Excellence	Sustainability	Connected Workforce
Maximize **uptime,** peak performance Reduce maintenance costs	Improve **quality**, throughput and process **profitability**	Deliver **flexible** execution of industry-specific value chain	Save **energy** costs, optimize consumption and **ESG** reporting	Retain operational **knowledge**, drive workforce competency and **safety**

Cyber Secure

Scalable Applications
Next Generation APM
Asset Twin

Loop Performance Managemer
Expert Optimizer (EO)
Plant Optimizer (MWO)

Manufacturing Execution System
(Continuous Improvement)
ABB Ability History for MIS

Energy Management
Water Treatment Optimization

Digital Workflows
Remote Assistance
Training Simulator
Industrial Knowledge Vault

Reliability and Uptime | **Performance and Optimization** | **Operational Integrity Quality and Profitability** | **Environmental and Compliance** | **Knowledge and Safety**

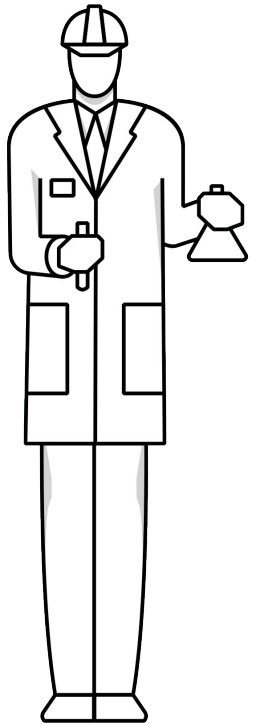
Typical Day for a Paper Mill Process Operations Persona

Production

- Order received
- Start production
- SOP compliance
- Jumbo made

Quality

- Quality check
- Quality reject
- Check trends
- Identify issue and solve



Shopfloor Dynamics

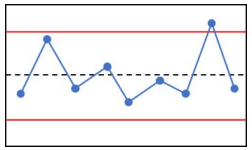
- Paper Break
- Grade change
- Pulp availability
- Equipment Maintenance

External Dynamics

- Customer complaints
- Cost Pressures
- Raw material variability
- New product Trials

Initiatives to Address these Issues

Identify critical PID loops , equipment's and keep close watch on performance, include in **daily check lists, regular calibration**, etc., etc.



Do statistical analysis develop **control charts** and keep a close monitoring

Run **All loops in Auto** Campaigns

Take up a **focused improvement projects**, improve performance and Celebrate

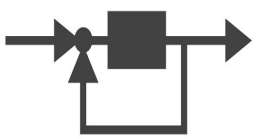
Result:

- ❖ After few months or in a year there is high chance that the issues repeats

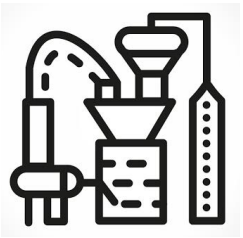
Reason:

- ❖ Reactive actions
- ❖ Manual interventions
- ❖ Non Closed loop controls

How AI can Help



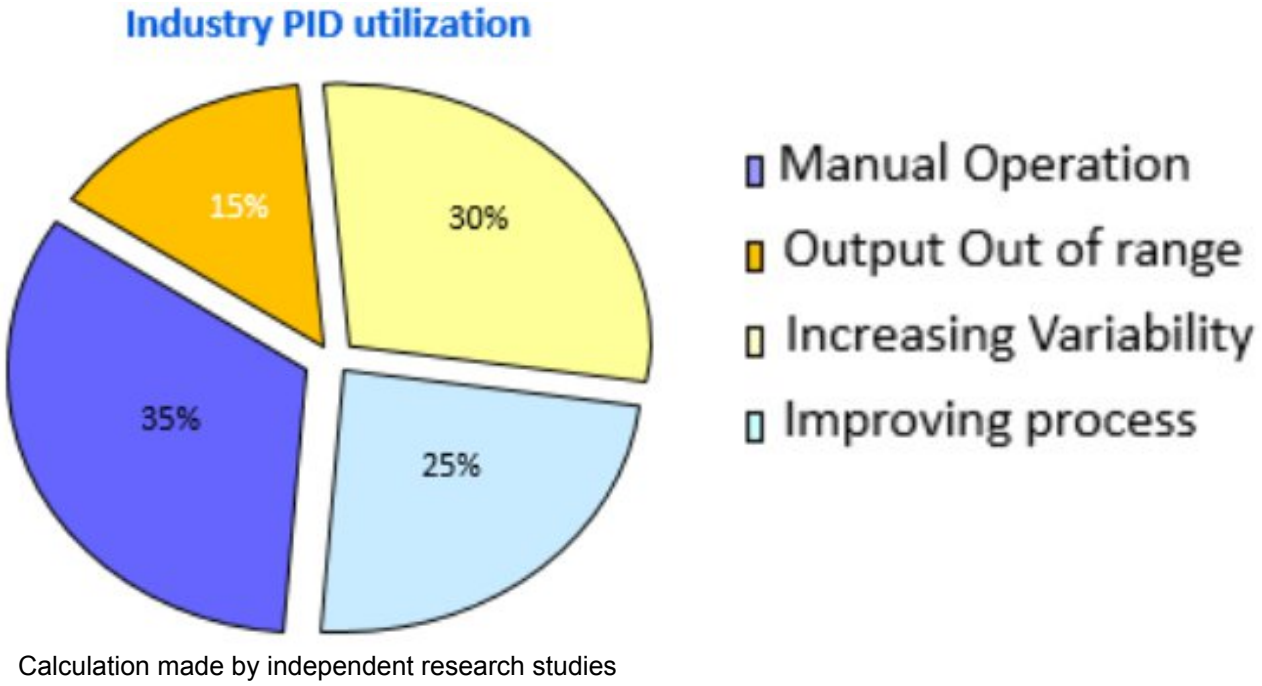
- ✓ Connects with PID loops throughout mill processes
- ✓ Scans all PID loops in real time and **identifies issues**
- ✓ Categorizes problems and **recommends corrective actions**
- ✓ Loop tuning with prebuilt algorithms and Simulation



- ✓ Uses **dynamic models to predict future** states in process
  Automatically **performs closed loop** controls
  Replaces manual adjustments with frequent automatic setpoint updates
  Delivers faster, accurate responses to process changes

- ✓ Act as **Digital Twin** for cross-process optimization
  Bridges production, asset, and raw material variability with standardized processes
  Improves coordination and **enables simulations**
  Provides **actionable recommendations** for better results

Criticality of Control Loops

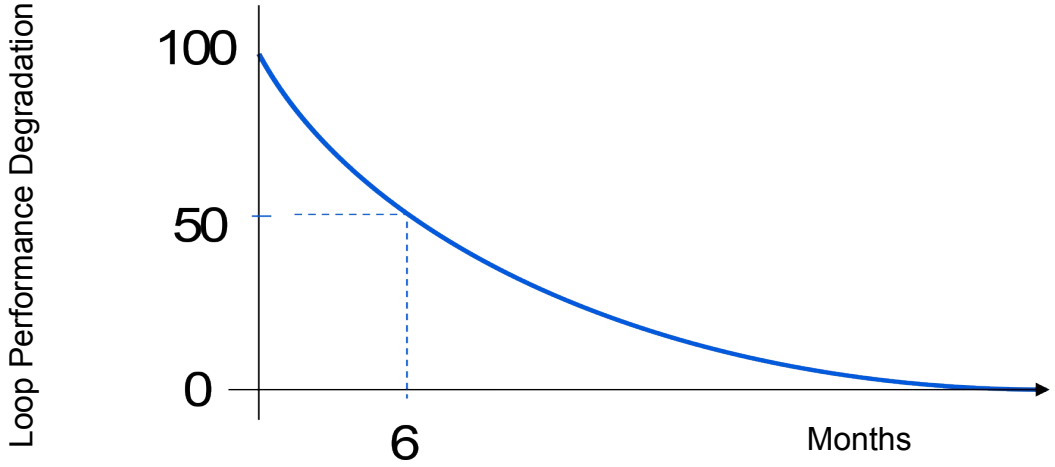


Calculation made by independent research studies

Half Life of Process Controllers

Given: 100 PID loops all tuned at once.

Then: Within six months, 50 of these loops will degrade in performance.

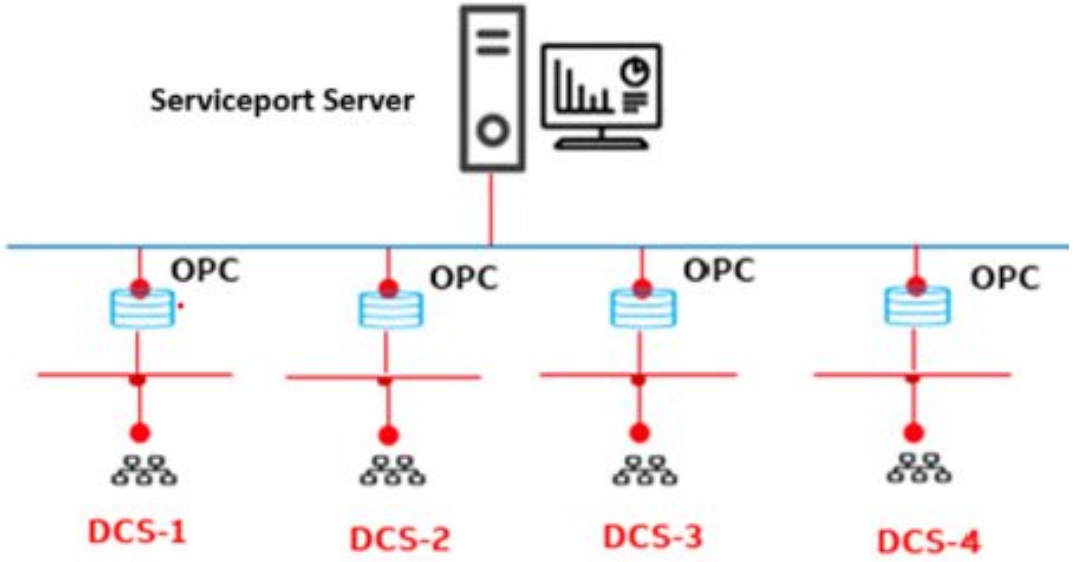


Results

- Unstable processes
- Inefficient production
- Significant quality problems
- Excess usage of raw materials

Loop Performance Manager

- IoT platform
- Integrates with any DCS / PLC through OPC
- Multiple Paper Machines / Fiber lines / Power plants PID loops can be Monitored simultaneously
- PID Loops across factories can also be monitored all at once



Loop Auditing with advanced AI models

Provides timely indication of equipment/automation/process problems to keep the loop at their optimal performance

Loop Tuning with Simulations

Enables the plant engineers to reach loops optimum performance with significant time savings (vs. manual tuning)

Plant Wide Disturbance Analysis

Searches for data pattern in time and frequency to identify oscillations and Interactions between various PID loops

Loop Performance Manager - in Action

ABB | ServicePort Explorer Demo | Application | Help

Loop tuning and simulation

Model type	Integrating Lag	Controller setpoint (SP)	408-LIC-417.SP
Process gain	0.0042	Process variable (PV)	408-LIC-417.PV
Time constant [sec]	5.2107	Controller output (OUT)	408-LIC-417.OUT
Process delay [sec]	0.0595	Identification start date	05/25/2017 10:15:54
		Identification end date	05/25/2017 10:32:53

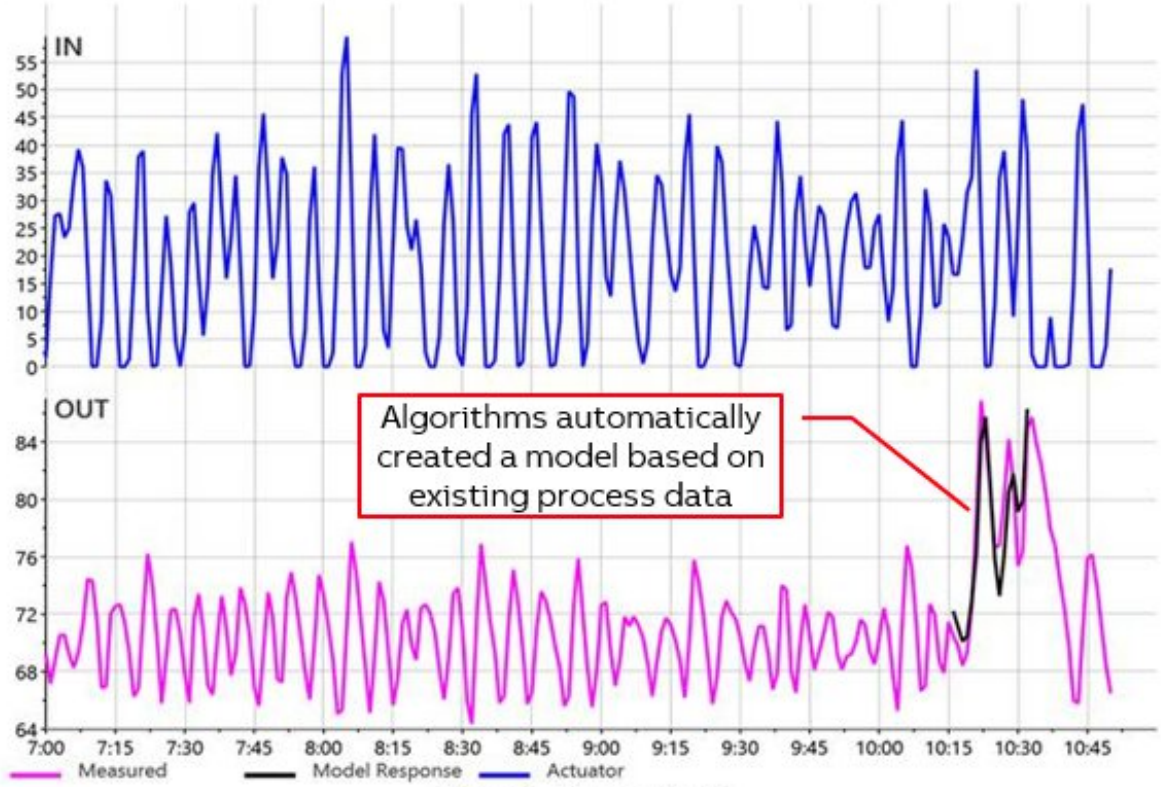


Figure 1 - Process Model

Simulation sample period (Ts) [sec]	6.0000	Controller gain (Kc)	3.9808
Simulation duration [sec]	17020.0000	Integral time (Ti) [sec]	240.0000
Controller type	Standard PID (Non-interacting)	Derivative time (Td) [sec]	0.0000
PV high limit	100.0000	Derivative filter time (Tf) [sec]	0.0000
PV low limit	0.0000	Controller action	Reverse
OUT high limit	100.0000	P on error	Yes
OUT low limit	0.0000	D on error	No
		Arrest time	120.0000

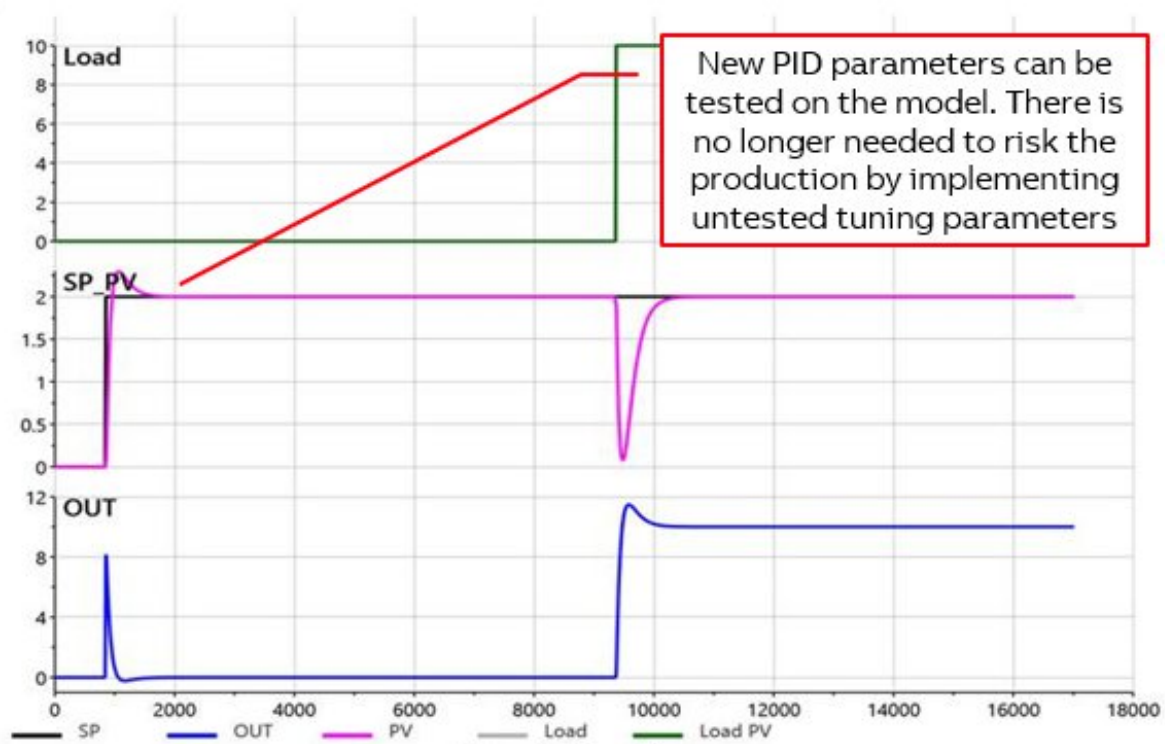


Figure 2 - Simulation

Loop Performance Manager - Implementation

FINGERPRINT

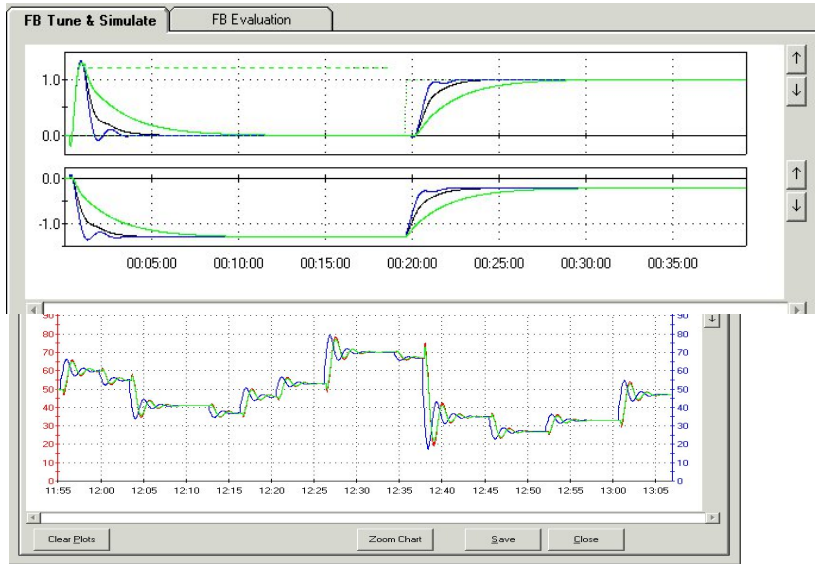
LOOP AUDITING
IDENTIFY FAULTY LOOPS

- ✓ Connect all PID loops to Loop performance Manager
- ✓ Analyze performance and identify issues
- ✓ Asses potential opportunity loss

FIX THE ISSUES

EXECUTION
PHASE WISE LOOP TUNING

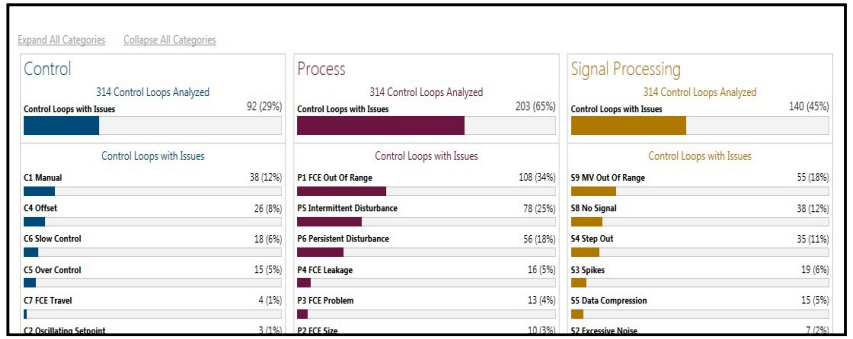
- ✓ Prioritize loops with issues and fix physical problems
- ✓ Perform loop tuning with prebuilt algorithms and Simulations to finalize the best fit parameters
- ✓ Set new tuning Parameters



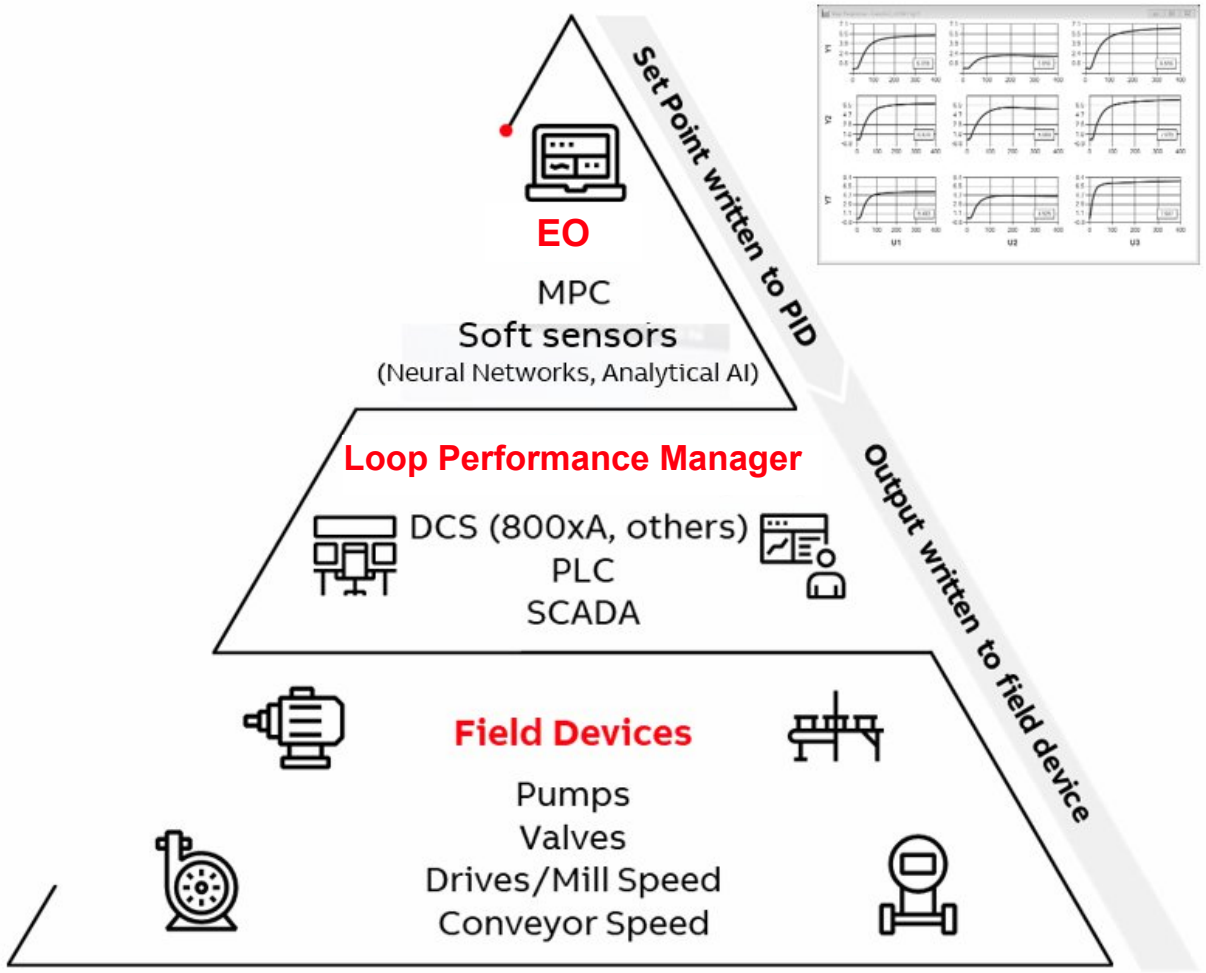
SUSTAIN THE BENEFITS

LONG-TERM SUSTENANCE
TRAINING AND PERFORMANCE MONITORING

- ✓ Real-time monitoring and performance analysis through dashboards
- ✓ Documentation and Report
- ✓ Training Programs for Automation and Process Engineers



Level up



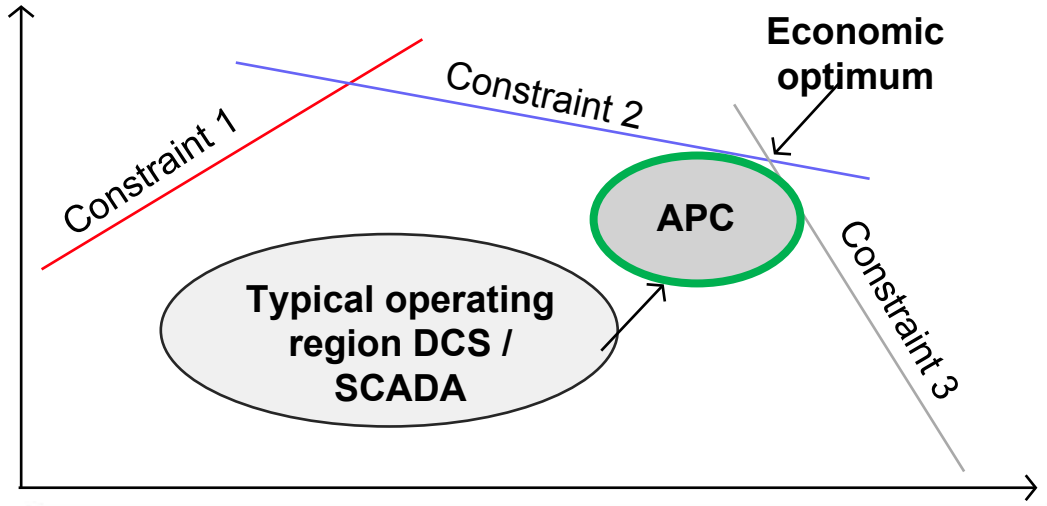
An autopilot for a specific process area:

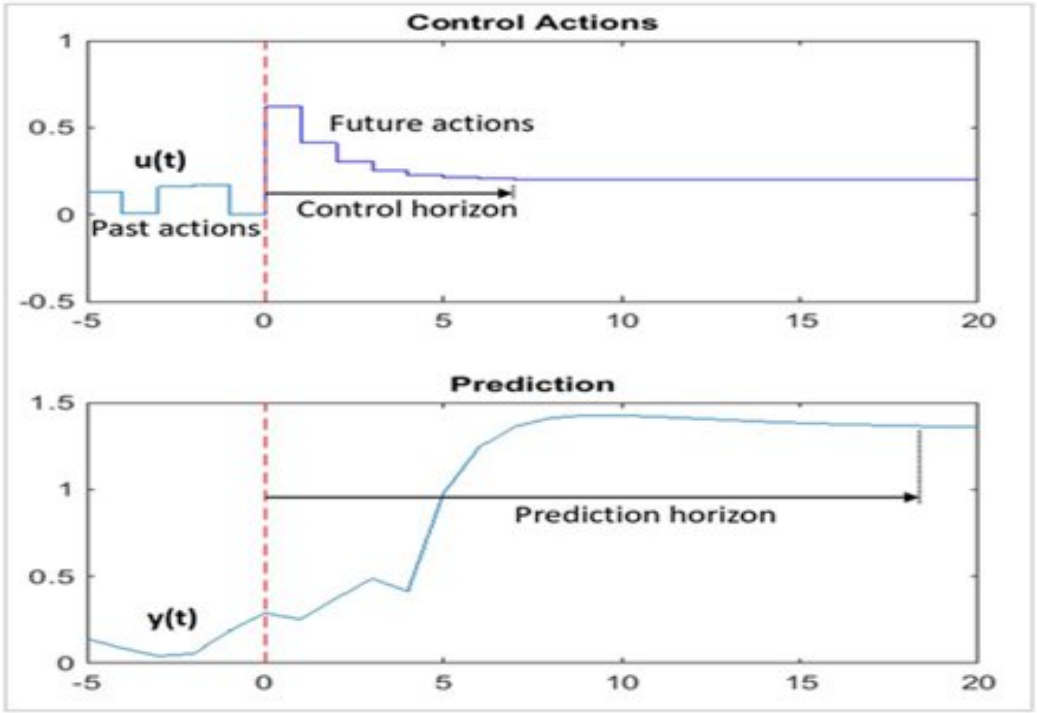
- Does not get distracted like human operators
- Does automatic, frequent setpoint updates for faster, more accurate response to changes
- Uses explicit process model
- Allows more flexible strategies – multi objective with explicit priorities
- Constantly monitors and manipulates the process to drive it to the optimum state
- Consistent control strategy 24/7

Expert Optimizer

Features & Objectives

- Predictive Process control platform
- Optimization through constraints handling
- Economic optimization
- Reposition key process variables (constraints) closer to specification limits
- Consistently push a specific process area to its economic optimum
  - Production maximization
  - Product quality improvement
  - Chemicals savings
  - Energy efficiency increase

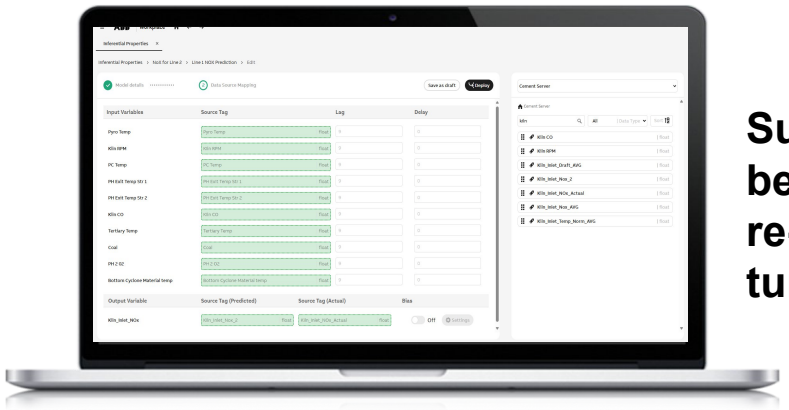




Expert Optimizer ML Analytics

Leverages AI with EO Edge ML Analytics – Edge architecture, inferential modeling applying domain knowledge along with advanced machine learning algorithm

Collect historical data for model training	Data cleansing	Create ML training model automatically	Deploy the model and test its accuracy	Trigger retraining of the model	Predicted value output for further control
Production parameters and lab data	e.g. removal of data during mill stoppages, etc.	selecting the best fit from the library of models	using the real-time online data	if the accuracy is not met	



Sustaining the benefits via adaptive re-modeling and tuning

Quality Parameters prediction

Improve quality
Minimize costs

Real-Time Monitoring
Enables operators to act immediately on deviations.

Process Optimization
Through closed-loop control

Expert Optimizer Solutions for Pulp and Paper

Woodyard

Digesters

EO Cook
Production ↑ (1-5%)
Kappa variation ↓ (60%)
Alkali consumption ↓ (2-5%)

Washing

EO Wash
Alkali losses ↓ (5-10%)
Water consumption ↓ (1-5%)

Bleaching

EO Bleach
Brightness variation ↓ (20-30%)
Chemical consumption ↓ (10-20%)

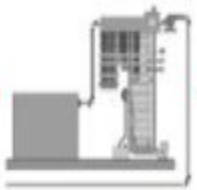
Storage

Paper Machine

Wet end control APC
Sheet Breaks ↓ (10-15%)
Chemical consumption ↓ (10-20%)

Evaporation

EO Vapor
BL Production ↑ (1-5%)
BL Dry Solids Variation ↓ (20-30%)
Steam consumption ↓ (5-10%)



Recovery Boiler

Causticizing

EO Caust
Causticity variation ↓ (20-30%)
Lime consumption ↓ (3-5%)

Lime Kiln

EO Lime
Energy consumption ↓ (3-8%)
Lime quality variation ↓ (30-50%)

EO = Expert Optimizer Suite of APC Solutions for Pulp & Paper Mills

Expert Optimizer: Bleach - Real-Time Adaptive Modelling

If any important process condition or property changes, the models can be updated automatically

Expert Optimizer Bleach

Feedforward Variables
- Incoming Kappa
- Brightness between Stages
- Production Rate

Controlled Variables
- Final Brightness
- Brightness Profile
- Kappa
- pH
- ClO2/H2O2 Residual

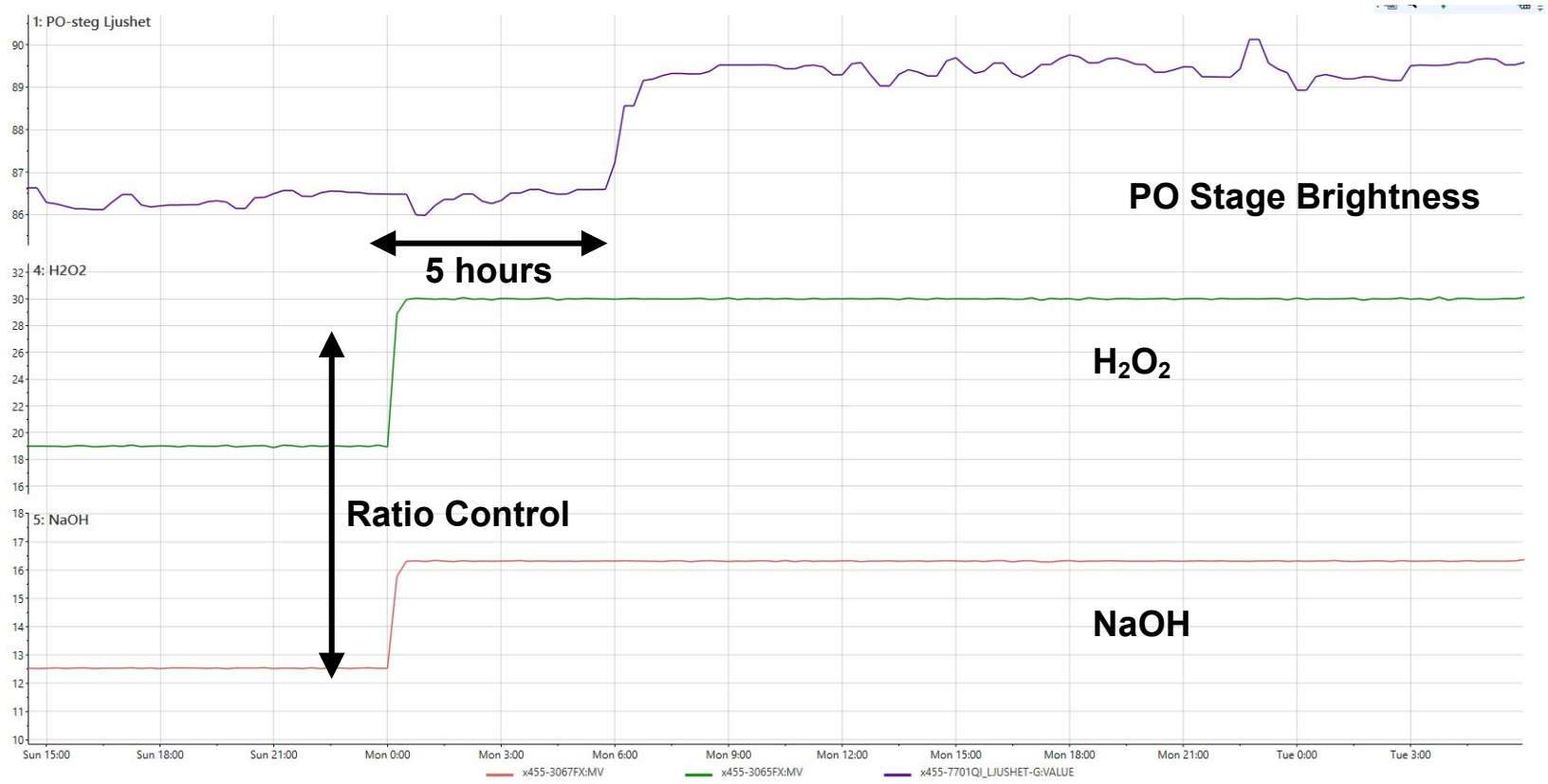
Manipulated Variables
- Ozone Dosage
- Peroxide Dosage
- ClO_2 Dosage
- NaOH/KOH Dosage
- H_2SO_4 Dosage
- Reactor Temperature*

Predictive Process Control - in Action

Expert optimizer can optimize multivariable processes with long delays and the chemical ratios

Challenges

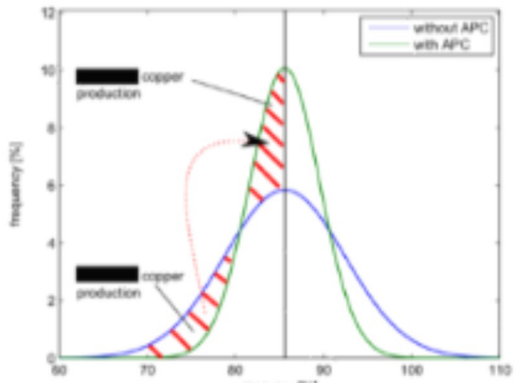
- Large delays (~5 hours)
- Lack ability to predict and optimally schedule grade changes
- Non-optimal ratio between NaOH and H_2O_2
- Huge effort is required to manually identify optimal ratio for each grade



Expert Optimizer - Implementation

IDENTIFY POTENTIAL?

A FINGERPRINT STUDY
TO QUANTIFY SAVINGS



Assess improvement potential based on current plant operation

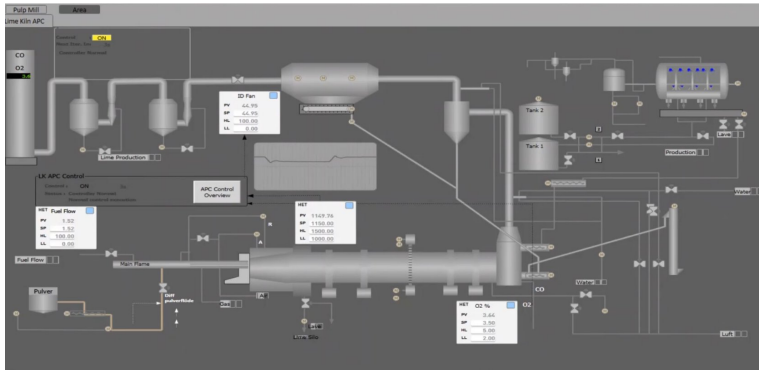
- ✓ Data gathering
- ✓ Feasibility assessment
- ✓ ROI and Roadmap

GET TANGIBLE RESULTS?

EXECUTION
DESIGNING THE BEST CONTROL STRATEGY

Possibility to use different control approaches in the same application, allowing to design the best control strategy

- ✓Model Predictive Control
- ✓Fuzzy Logic
- ✓Rule blocks & logic



SUSTAIN THE BENEFITS?

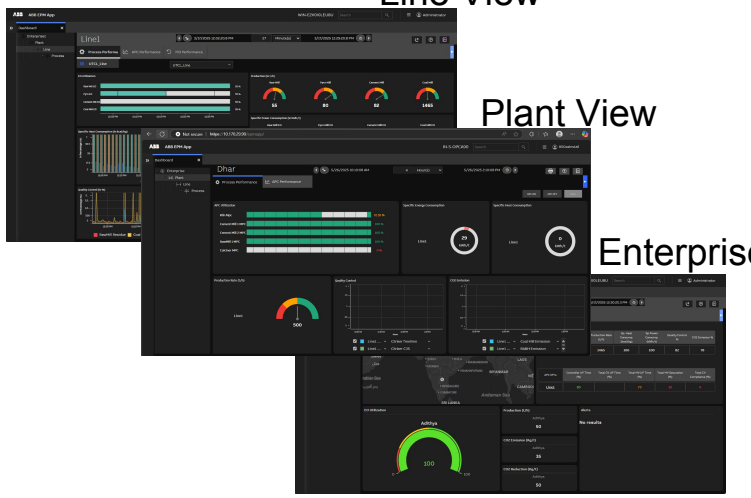
LONG-TERM SUSTENANCE
TRAINING AND PERFORMANCE MONITORING

- ✓ Training Programs for Operators
- ✓ Training Programs for Process Control Engineers
- ✓ Realtime performance monitoring through dashboards

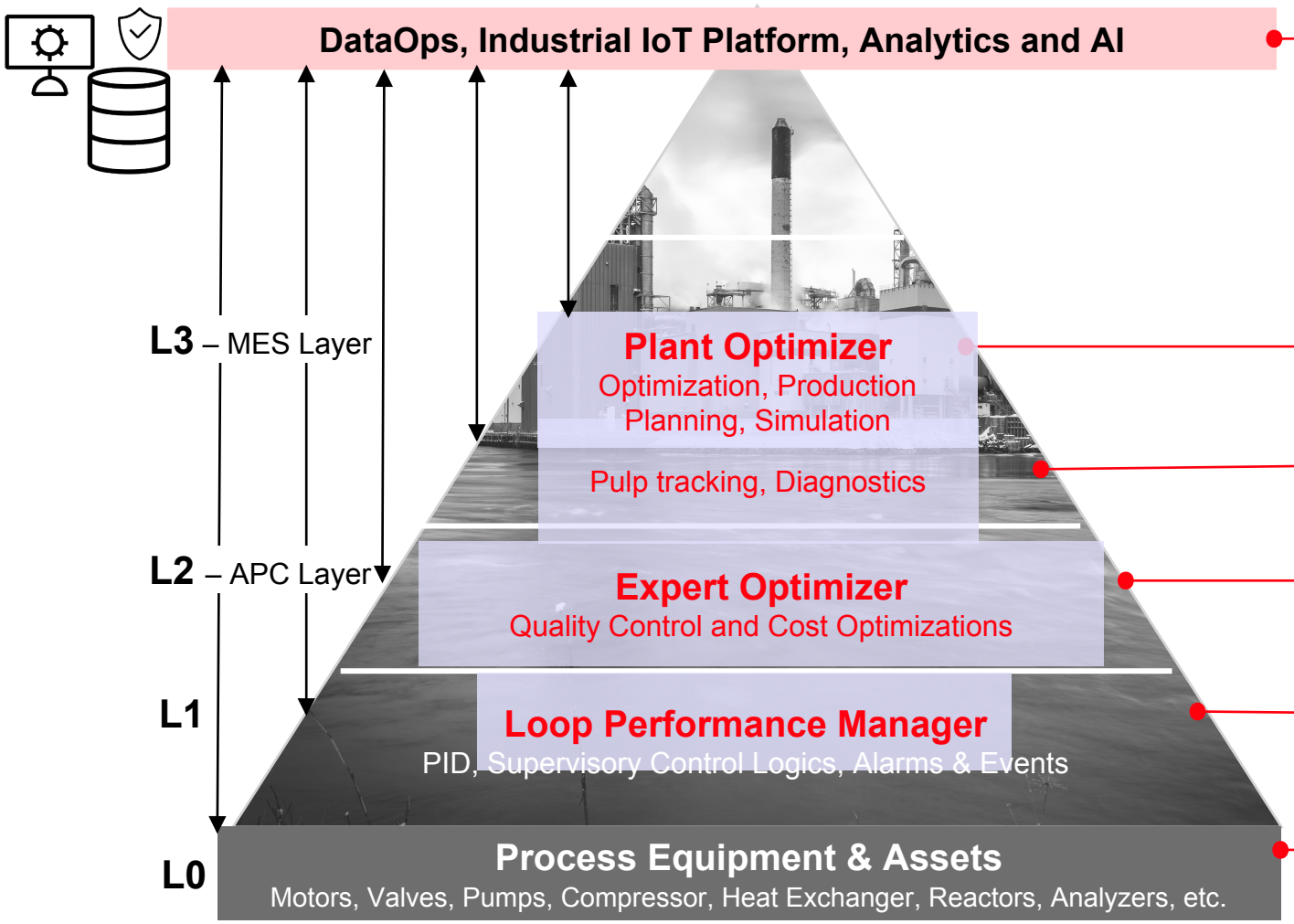
Line View

Plant View

Enterprise View



Another Level up



DataOps, Industrial Analytics, AI/ML
Operational Intelligence, Centerlining, Predictions,.

Digital Twin for entire Pulp Mill and Recovery process

Automated Grade Change & Material/Quality Traceability

Automated Quality Control and Cost Optimization for Each Area

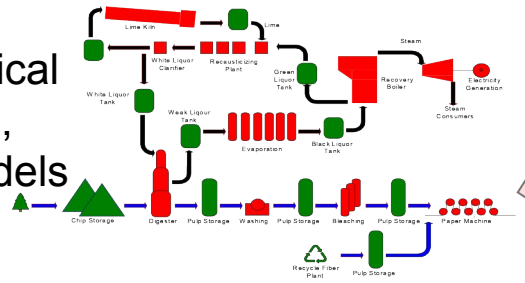
Ensure Regulatory Control of the Process

Ensure High Availability of Basic Equipment & Measurements
Asset Performance Management & Predictive Maintenance
Fingerprint & Audit Services, Smart Sensors

Plant Optimizer

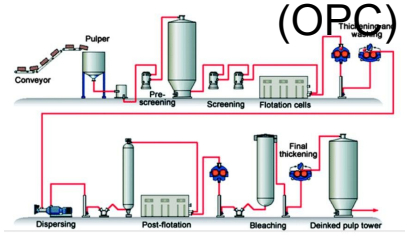
Software that coordinates real-time decisions across the entire pulp mill — not just individual process areas

Mathematical Models, Hybrid models



Linking production planning, mill information and control systems

Process Data (OPC)



Model

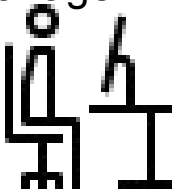
Mill state

Constraints

Non-linear Programming Problem

Configuration

Production Manager



Objectives

dashboard

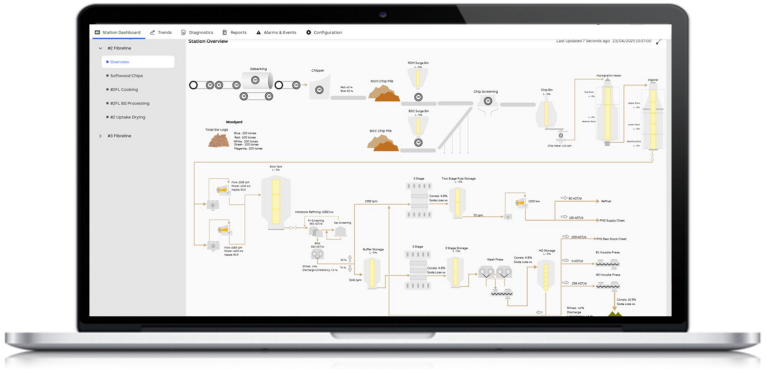
Operations Dashboard

Open Loop Advisory System
Closed Loop Control (write back to DCS)
Debottlenecking, Process simulations, What-if analysis

Plant Optimizer Modules

Pulp Tracker

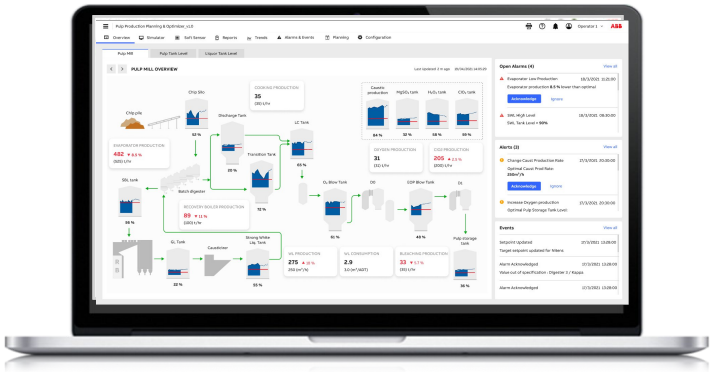
Gain real-time process visibility, driving more consistent quality



- Tracking dashboards
- Recipe management and automated grade change
- Advanced diagnostics
- Trends, alarms and events, reports

Economic Optimization

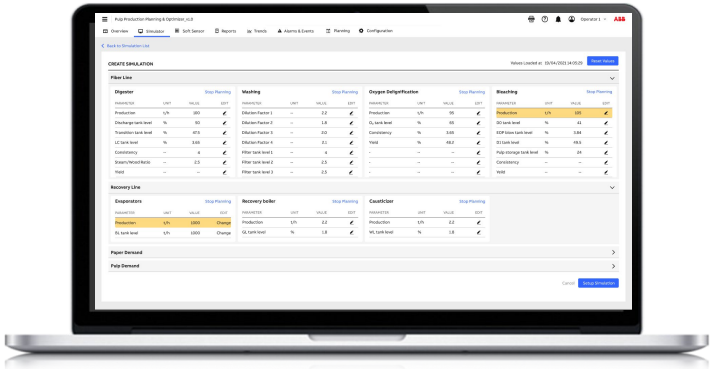
Reduce margin erosion, preparing for autonomous operations



- Dynamic models
- On-demand optimizer
- Continuous optimizer
- Soft sensors, trends, reports, alarms and events

Operational Resilience

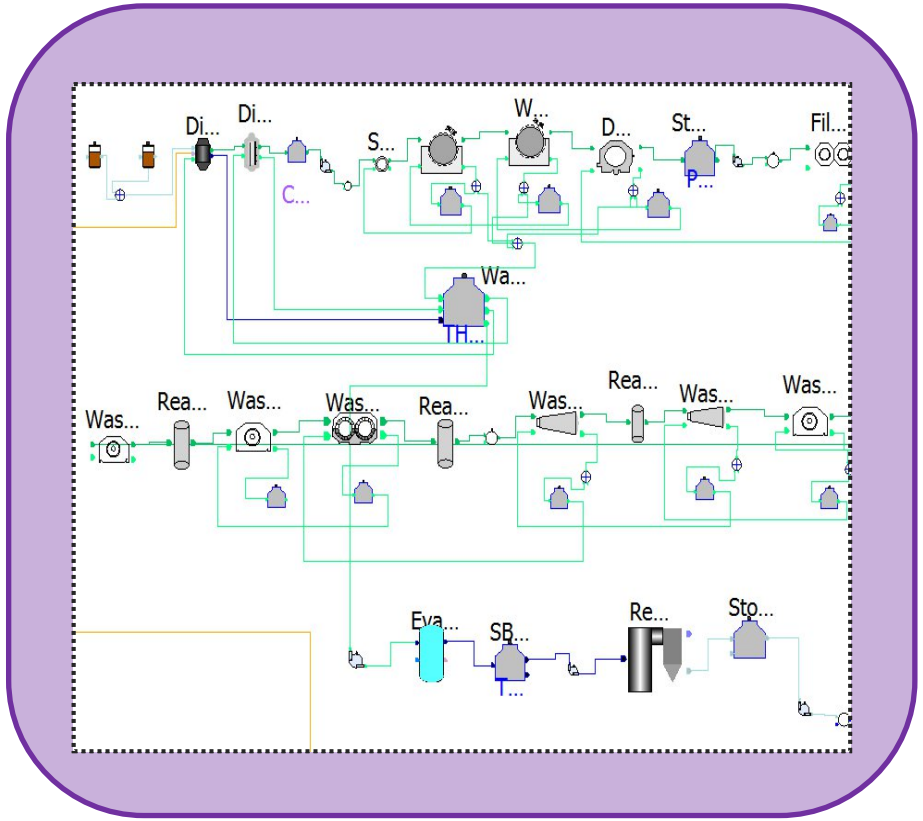
Ensure business continuity, staying on target despite upsets



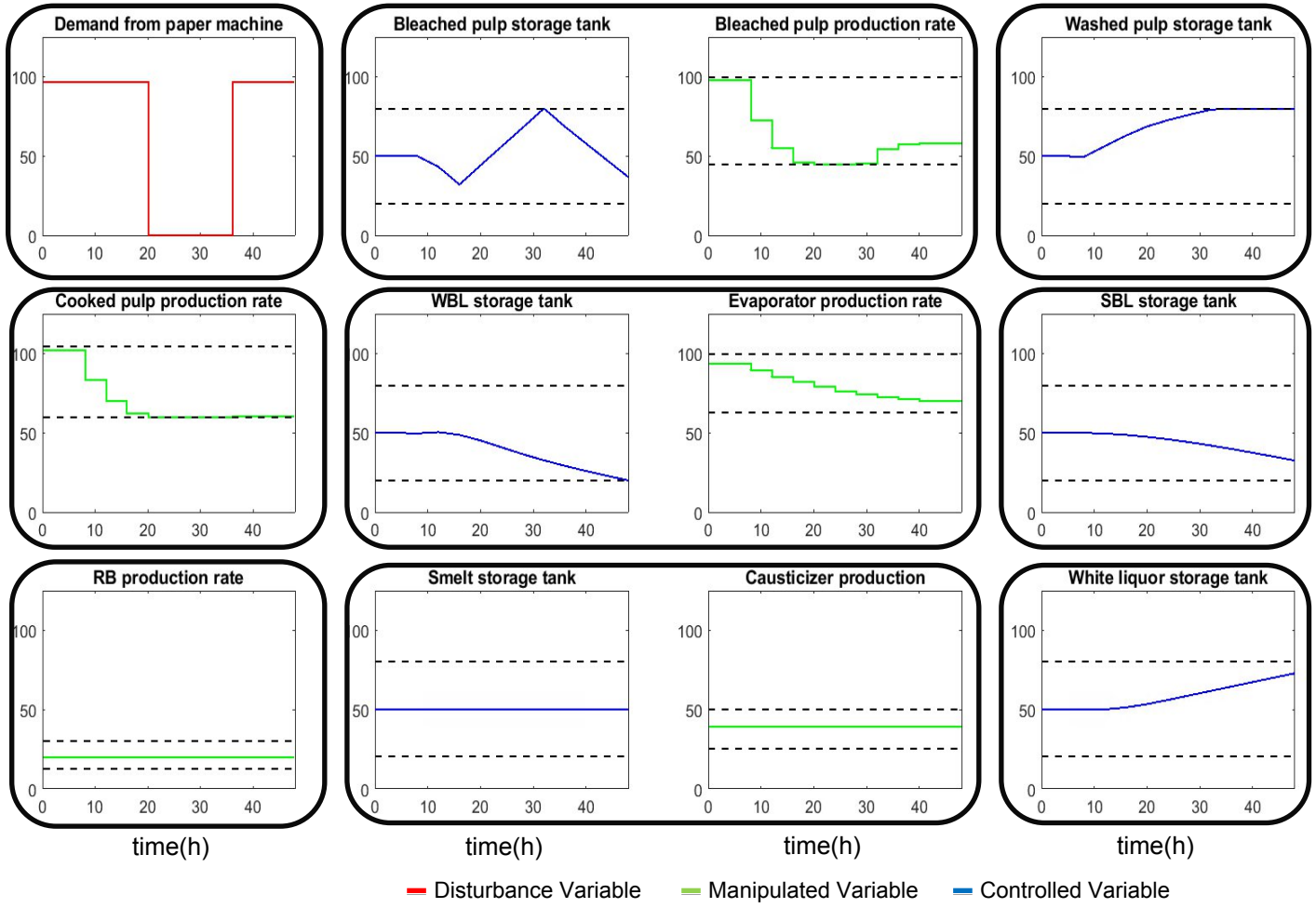
- Pulp production planning
- Stop planning
- Bottleneck analysis
- Simulation and what-if analysis

Plant Optimizer use case: Adapting to Demand side Fluctuations

Objective: Meet the variable demand while respecting process delays and constraints on inventories



Co-ordinates the production rates (MVs) to meet the objective



Case Study 1

Integrated Pulp and Paper Mill – North India

Scope & Objective:

Optimizing PID control loops across various units and processes.

To enhance operational efficiency, minimize process variability, and improve product quality through optimized PID control loops

Technology Solution: Loop Performance Manager

- DL 400 for PID loops data configuration and logging

for 300 PID Loops

- LA 300 and LT 100 tool for PID loops analysis and tuning
- Service port explorer for data analysis

Results

Name	Description	Unit	Scale	Minimun	Maximum	Function	Period	Offset
313-QIC-001:me	TOP SKT IN CONS	%	Manual	3.186619	3.9	Trend	00:00:12.3	
313-QIC-001:pos	TOP SKT IN CONS	%	Manual	-0.47789	25	Trend	00:00:12.3	
313-QIC-001:spa	TOP SKT IN CONS	%	Manual	3.186619	3.9	Trend	00:00:12.3	

- 300 PID loops analyzed and tuned across Processes such as Pulp Mills, evaporators, lime Kiln, Paper Machines automated with **different makes of DCS**
- >50 % **variability reduction** observed in various critical loops
- **Time to target reduced** up to 50% in various critical loops

Case Study 2

Lime Kiln in a Kraft Pulp Mill – South India

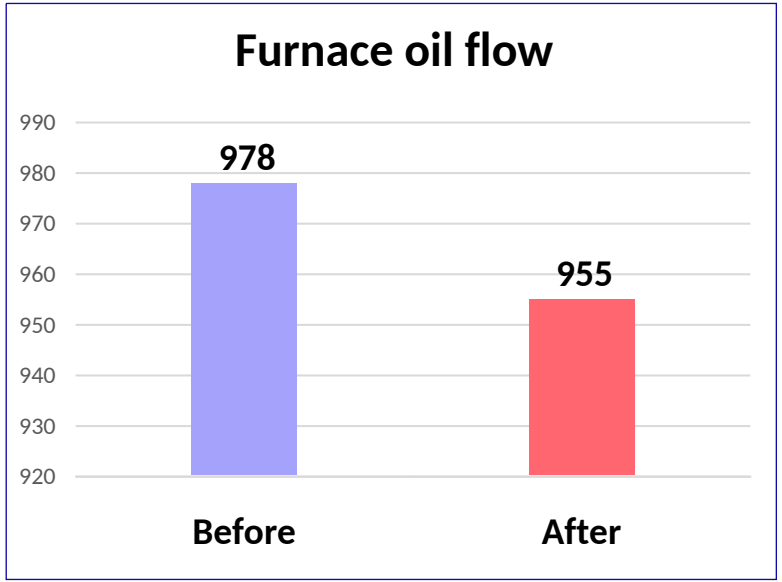
Challenges:

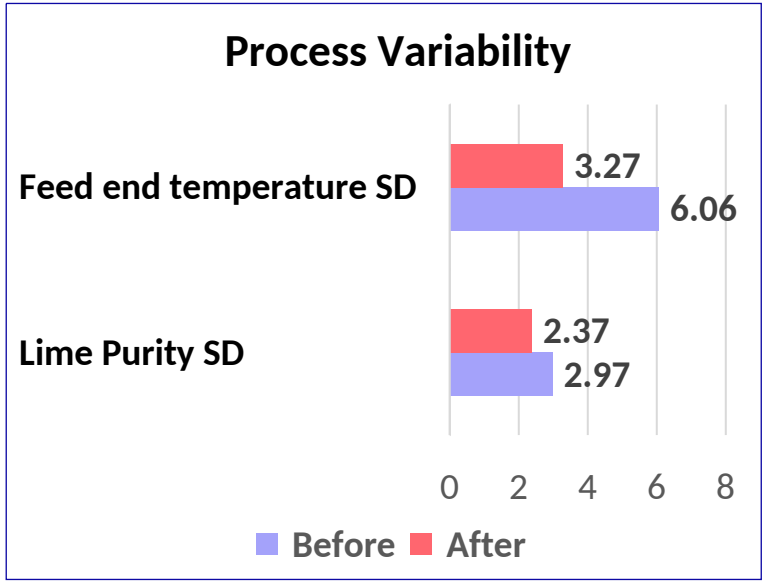
- High fuel consumption,
- Low thermal efficiency,
- Process delays
- Ring formation and dust
- Overheating of refractory,
- Poor quality of lime and increased emissions

Technology Solution: Expert Optimizer Lime

- Model Predictive Control
- Closed-loop APC solution
- Multivariable control through data driven Machine Learning Models

Results





- APC utilization > 90%
- 5% reduction in specific fuel Consumption
- 45% reduction in variation in feed end temperature
- 20% reduction in variation in lime purity
- Low excess oxygen, higher efficiency point of operation

How to Start Your AI Journey for Process Performance Excellence

5. Integrate to Level 4 – Smart Manufacturing

4. Establish Level 3
   – Large / Specialty paper mills – Implement **MES** to start Smart Manufacturing journey
   – Integrated Paper mills - Implement **Mill wide optimization** to enable Smart Manufacturing

3. Improve level 2 controls – Optimize important processes – **ML based APC** solutions available

2. Focus on level 1 stability – ensure all controls are fully functional – **AI Solutions** available

1. Integrate your data sources, Store all “Process Data” long term for at least 5 to 10 years – **IoT Platforms** available