Enhancing Process & Operations through Digitalization

A Blueprint for Utilizing Advanced Data Analytics, Model Predictive Control, and Remote Monitoring.

Shankar Das G | BTG India

26th July 2024

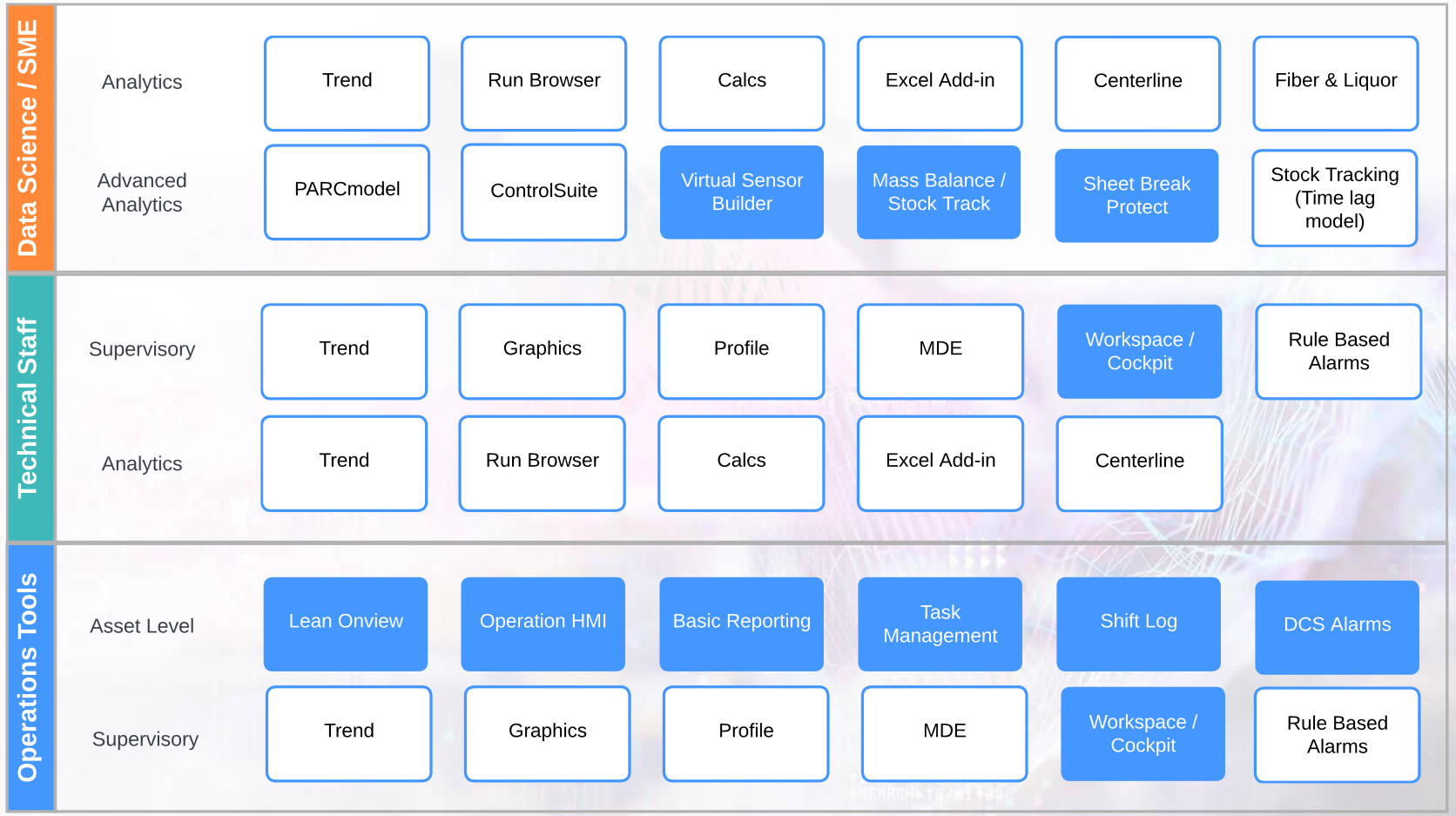
BTG
A Voith company

Agenda

1. Digitalization & Transformation (what, why, & who?)
2. The Digital Transformation Journey (where are you?)
3. Technologies Driving Digital Transformation
4. Success Stories – data Analytics, Control Loop Monitoring, Model Predictive Controls
5. Blueprint for Digital Transformation

Digitalization (what)

- Collecting data
- Connecting data
- Analyzing data
- Operationalizing data
- Using data for Controls
- Minimize Manual Intervention



Digitalization (why)

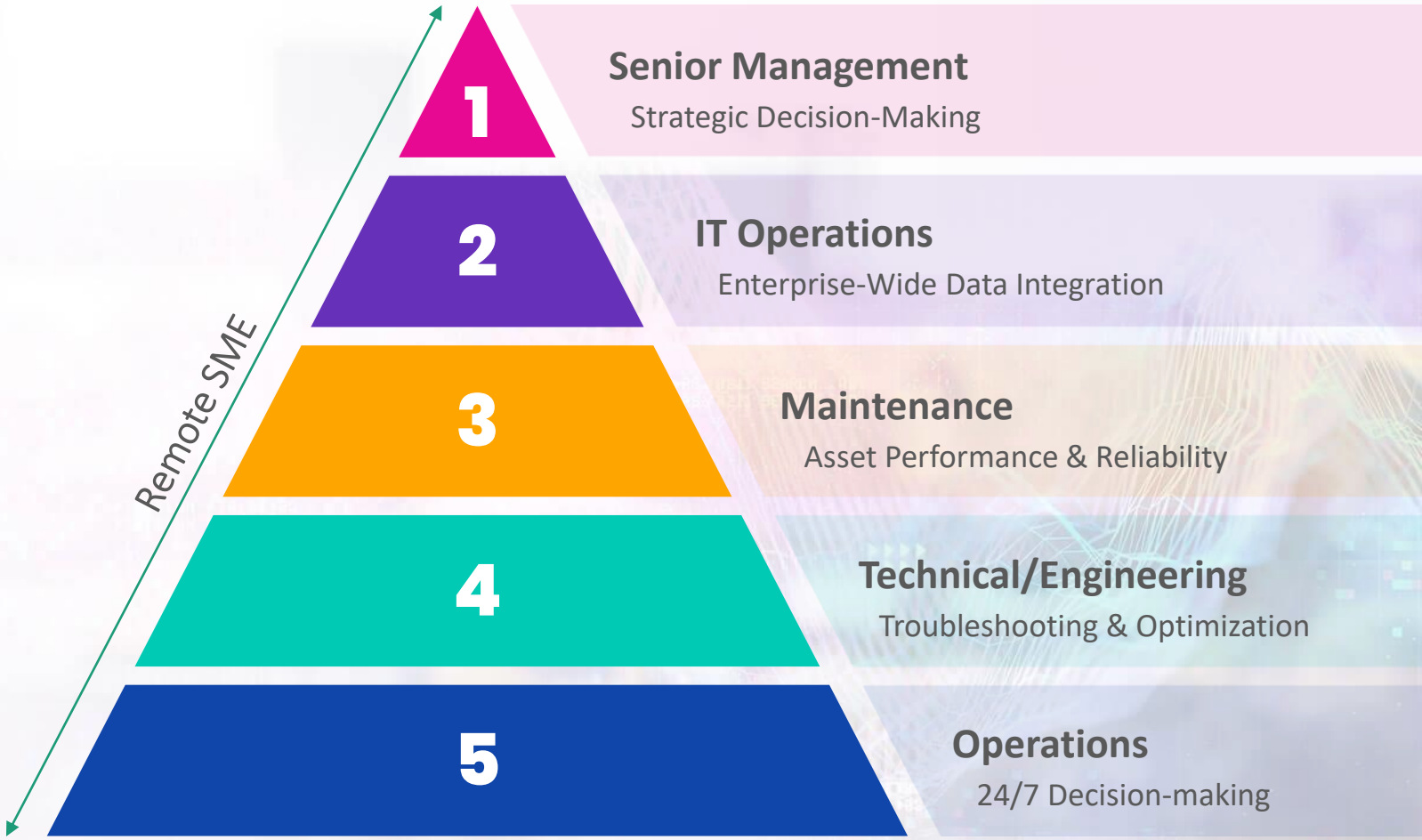
- Enhance operational efficiency
- Improve decision-making
- Stay competitive
- Sustainability

Pulp & paper operations need to be more efficient (profitable) to compete.

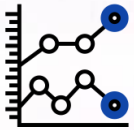
Digital transformation results in a data-driven approach to production optimization.

Digitalization (who)

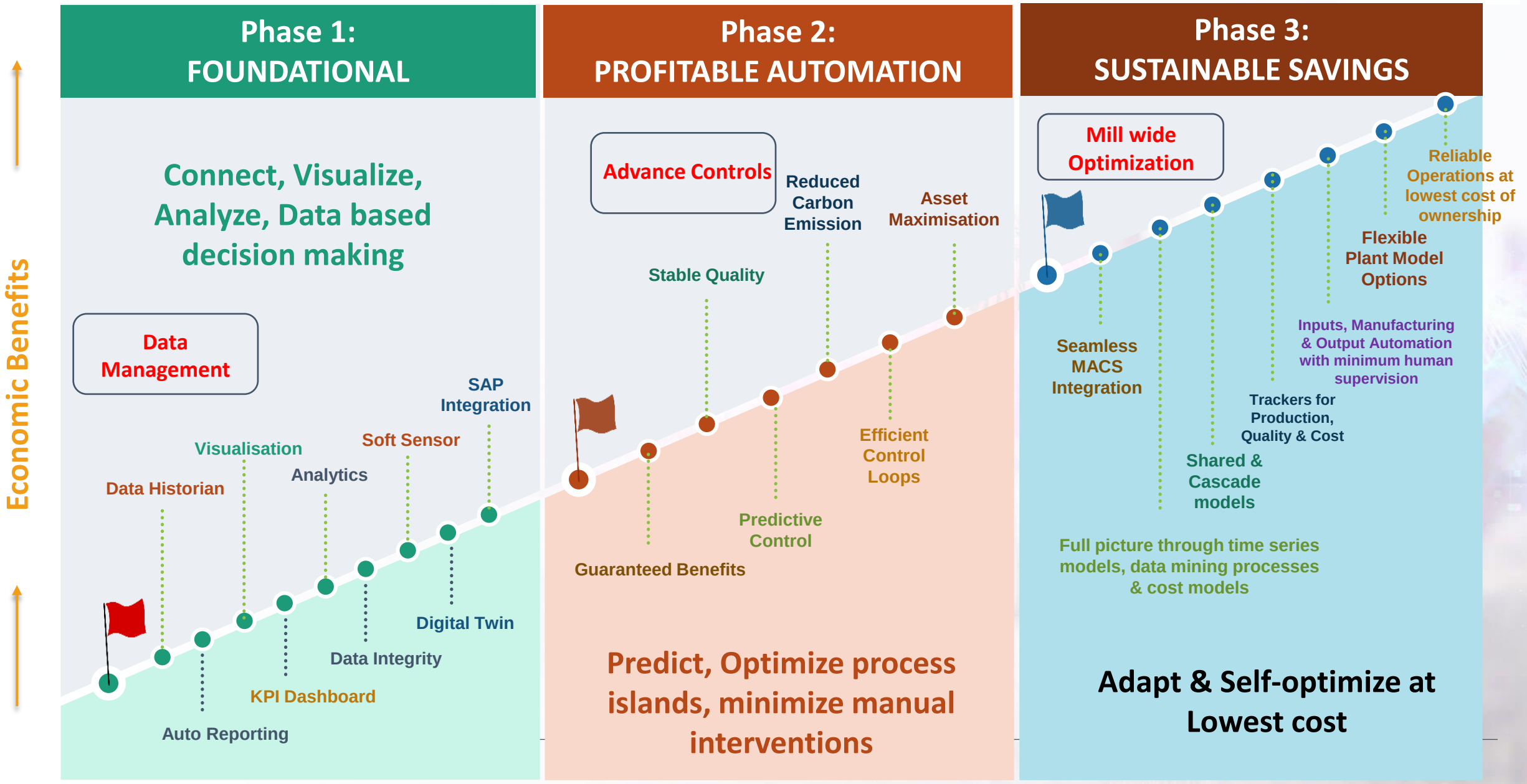
- **Senior Management** – Strategic, data-driven decisions
- **IT** – Admin, Security, Data Ops
- **Maintenance** – Asset performance & reliability
- **Technical** – Troubleshoot, optimize and subject matter expertise
- **Operations** – Make every operator your best operator
- **Remote SME** (Spans all levels)



Digital Transformation Journey (where are we)

STAGE 1	STAGE 2	STAGE 3	STAGE 4	STAGE 5
				
Stage 1 Decision Making	*Stage 2 Decision Making*	*Stage 3 Decision Making*	*Stage 4 Decision Making*	*Stage 5 Decision Making*
No Data	Some Data	Reflective Decision Making	Data-Driven Culture	Data-Driven DNA
Decisions are driven by the way it's always been done.	***Digital transformation enablement has begun. Reactive decision making is still driven by hunch.***	***Begins to change the data driven culture. Having data easily available creates more time for analysis.***	***Proactive decision making is embraced, yet many decisions are still reactive. Confidence in data is growing.***	***Universal data platform - data from all sources.***
Lots of manual operations and limited or no automation	Plant has automation & mainly manual data, little to no historian usage for decision making.	Historian usage exists, but not fully utilized. Many data silos exist.	Digital data is growing, data silos continue.	Proactive and predictive decision making & Control

INDUSTRY 4.0 - DIGITALIZATION JOURNEY



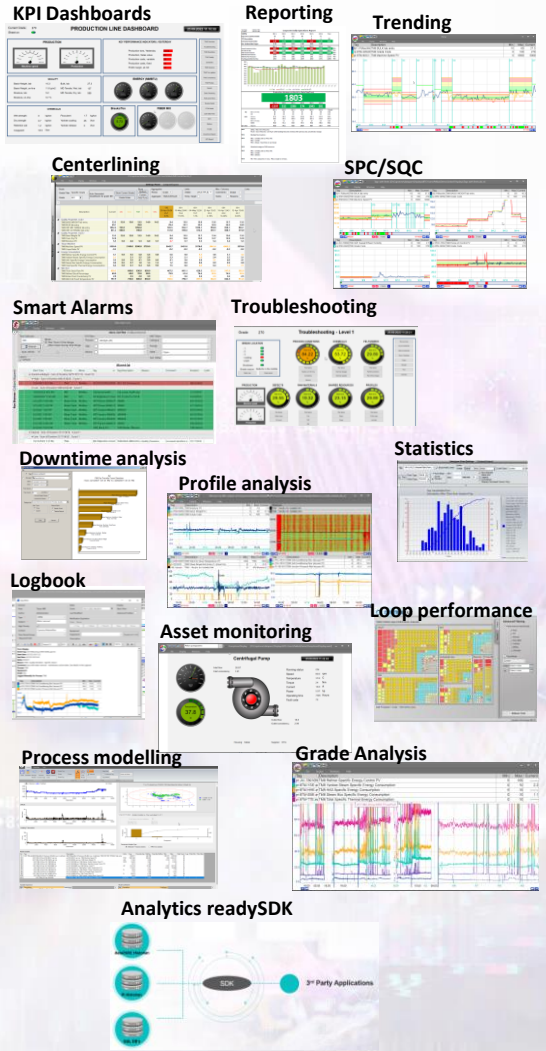
Technologies Driving Digital Transformation - dataPARC

Business Need	Strategy	Tactics
Increase production output	Increase speed	Operations Management
	Reduce downtime	Centerlining
	Reduce quality rejects	Statistical Process Control
		Smart Alarms
		Advanced Troubleshooting
Reduce variable costs	Reduce quality variation	Energy Monitoring
	Reduce energy costs	Knowledge Management
	Optimize raw material consumption	Asset Monitoring
		Predictive models
Increase operational efficiency	Speed, context, integration and automation of data flows	AI/ML Tools

Increase revenues

Reduce costs

Tools & Applications



Results

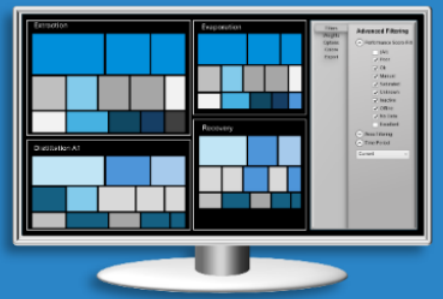
- Increased Production (1 - 6 %)
- Increased Human Capital Efficiency (25%)
- Savings in fiber cost (0.5 to 3 %)
- Energy Savings (0.4 to 1.6 %)
- Chemical Savings (0.3 to 1.9 %)
- Reduced Operating Costs (1 - 5 %)

Technologies Driving Digital Transformation - CONTROLsuite

- 60% of the Control Loops are NOT functioning to its full potential
- Software to monitor loops on a predefined schedule, providing actionable information.
- Making Control Loop healthy brings significant Energy & Chemical Savings
- It is a Continuous effort and Not a One time exercise

CONTROLsuite provides a complete overview of loop performance throughout the entire facility. It identifies and prioritizes the loops that are not performing satisfactorily and identifies the root causes of loop issues. It also provides user friendly toolbox for accurate and repeatable loop tuning

Loop tuning



Performance mapping

Performance report

Technologies Driving Digital Transformation – MACS / APC (AI)

- MACSsuiteTM (Multivariable Advanced Control System) is a proven autopilot for industrial processes.
- Helps to automatically (Closed loop) optimize your process across all operating ranges
- Results improving control consistency ,minimizing energy consumption and maximizing yield.
- Visible Savings between $3 to $10 / Ton of Pulp / Paper. ~ 12-18 Months ROI Program

		Manipulated variables											Feed Forward variables								
		D0	ClO_2 E1	NAOH E1	H_2O_2	$E1O_2$	$E1O_2$	D1	NAOH D1	ClO_2 E2	NAOH D2	NAOH D2	ClO FF D0	BLT FF D0	Cl= FF E1	BLT K FF E1	BLT Br FF D1	ClO_2 FF D2	BR In FF D2	ClO_2
Control Variables	E1 BLK Kappa	-			-	-							+								
	E1 BLT Brightness	+			+	+							-								
	E1 pH													-							
	D1 pH							+									-				
	E2 pH									+							-				
	D2 Brightness in								+						-	+					
	D2 pH										+									-	
	D2 Brightness out											+						+			

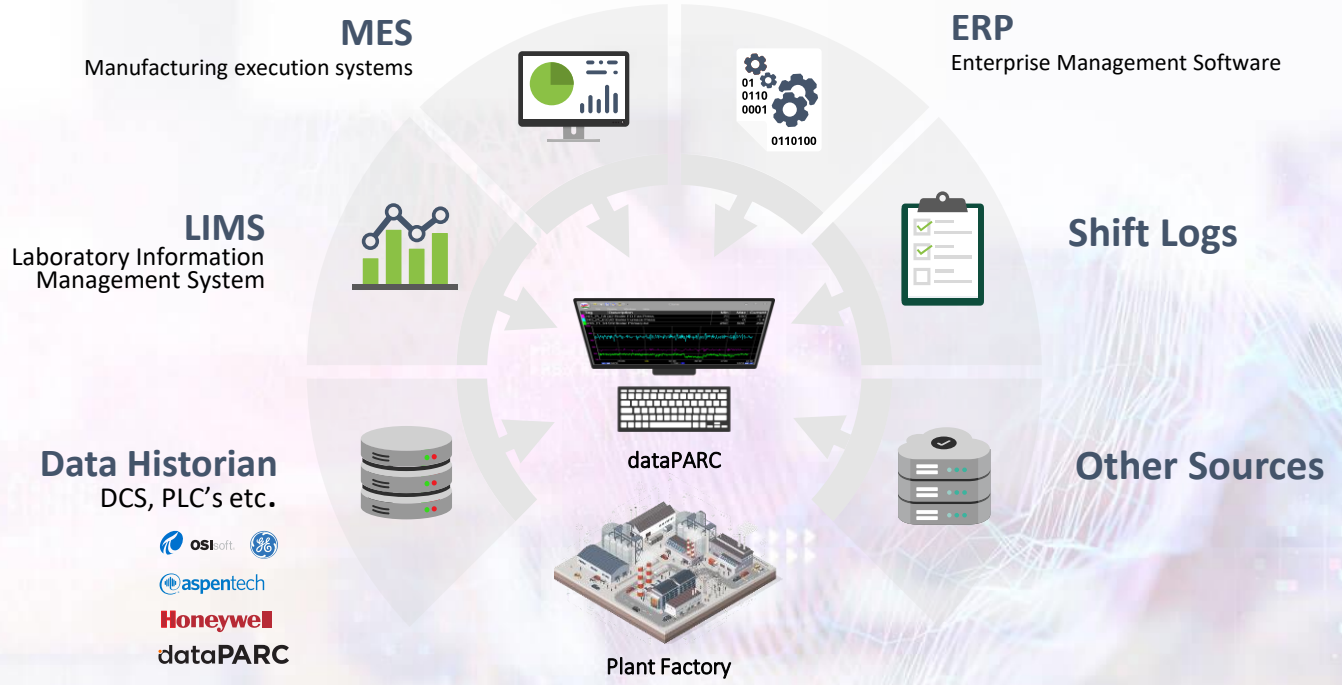
A Blueprint for Success – Step by Step approach

1. Collect data
2. Transform & optimize data
3. Integrate data
4. Make data easily accessible
5. Establish decision-making infrastructure
6. Find quick wins through Advanced Controls

Step 3 : Integrate Data

Creating a “single source of truth”

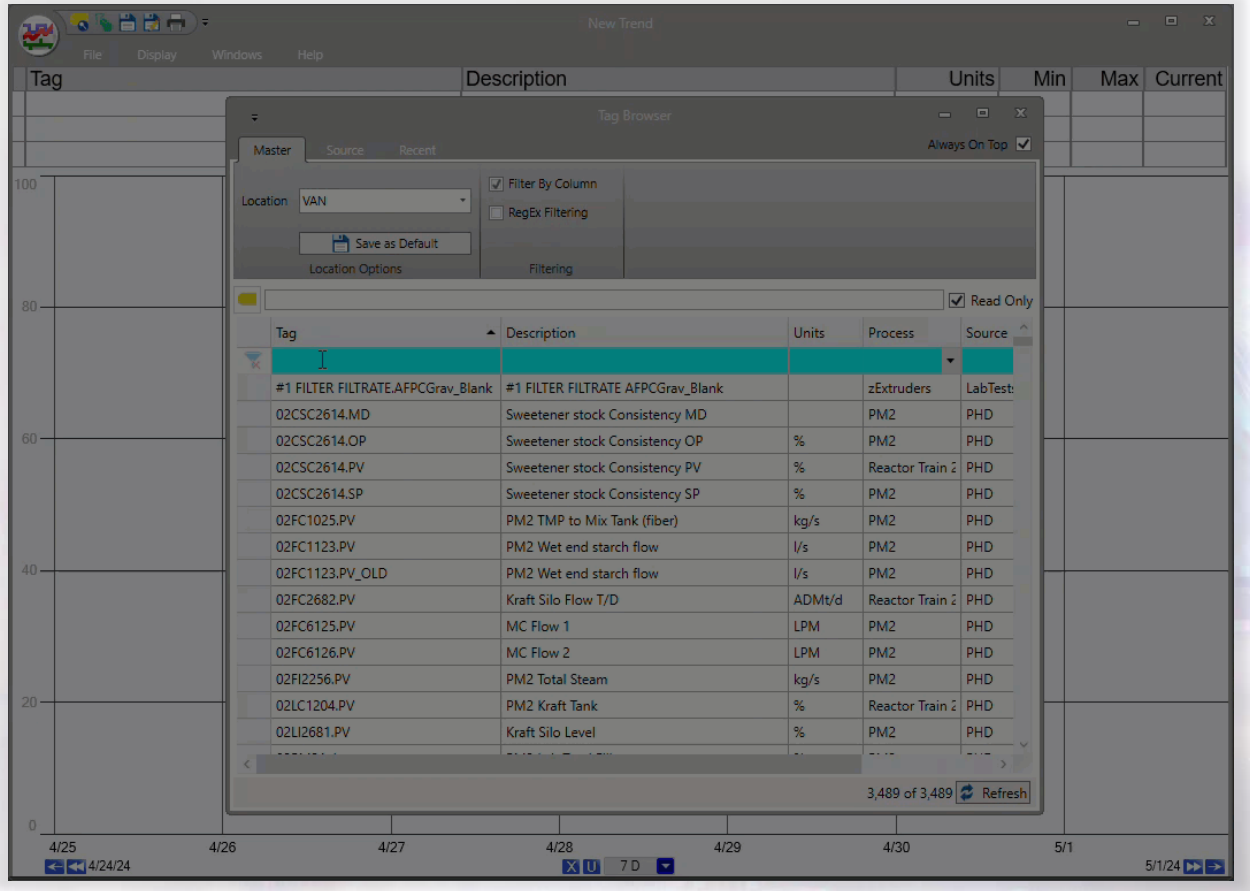
- “Single pane of glass”
- Data from all sources in one place
- Create a shared understanding of data
- Begin with a few critical reports & KPIs



Step 4 : Make data Easily Accessible

“Democratizing” data

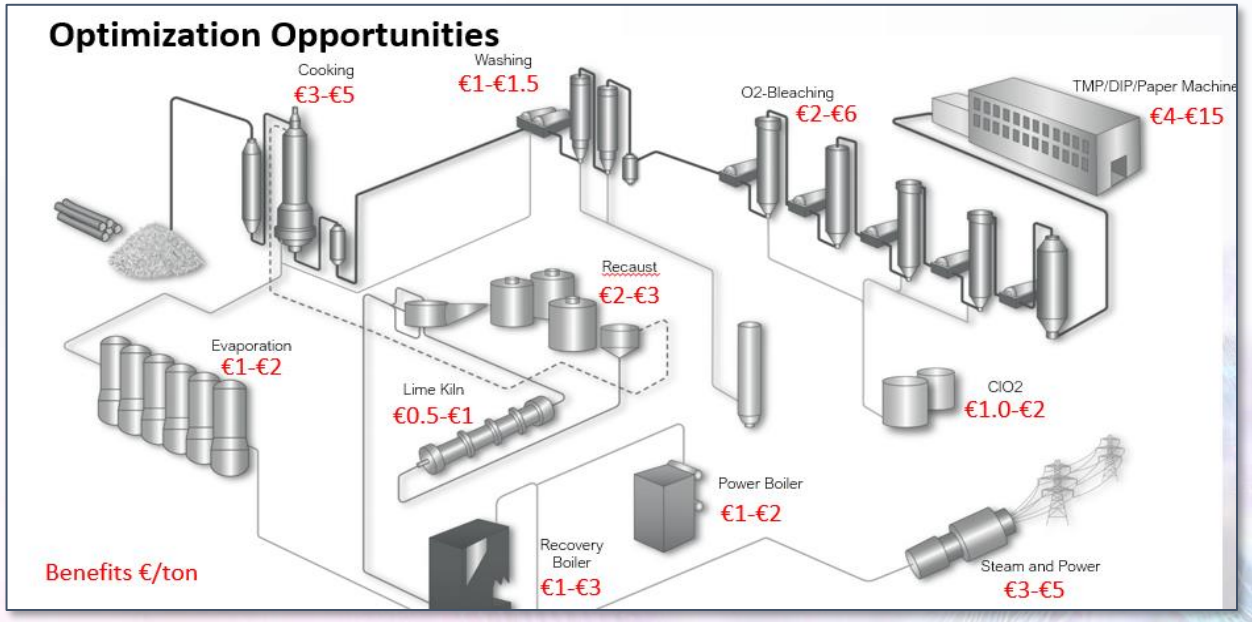
- Leverage existing data infrastructure
- Get important data all in one place
- Get that data in the hands of anyone in a position to make decisions
  - Operators
  - SMEs
  - Engineers,
  - Etc.
  - Unlimited user licenses?
- Make it **very easy** for them to use

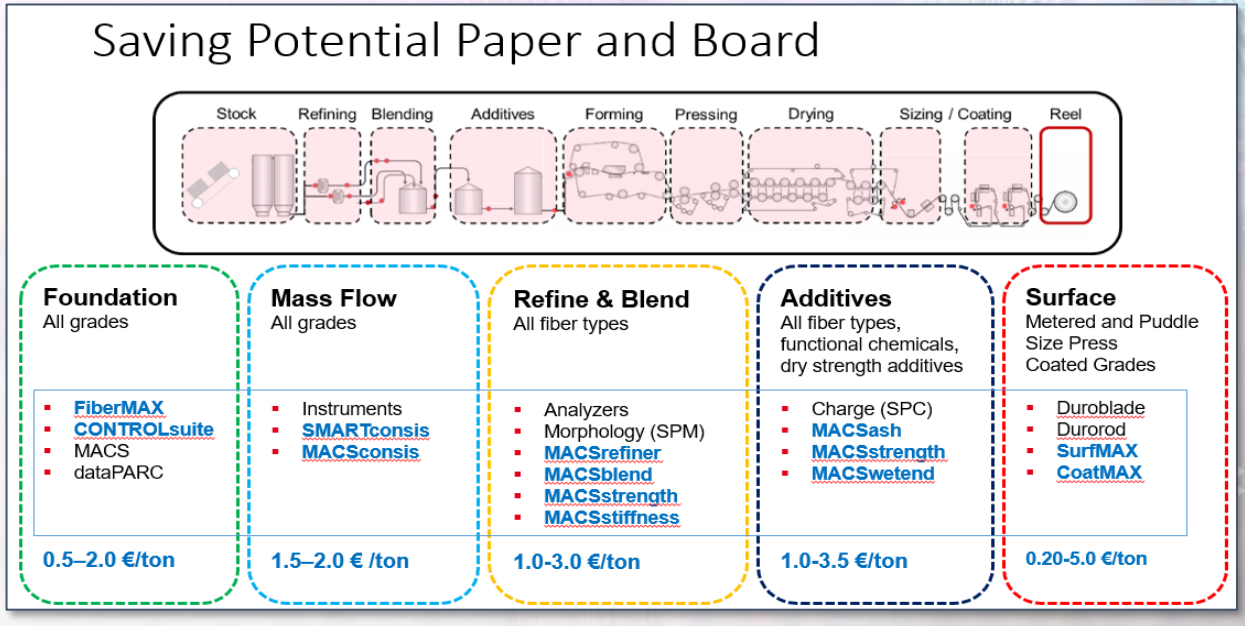


Step 6 : Finding Quick wins for Predictive Controls

Important to Find Early Success

- Identify “Low hanging fruit”
- Establish proof of concept – Practicality
- Generate return on investment
- Increase stakeholder buy-in
- Support for future digital transformation goals





Case Study 1

Integrated P&P Mill Site – India (North)

Mill wide dataPARC implementation – 35,000 Tags

More than 15 data sources connected including SAP

MACS (AI) Model Predictive Control Implementation at 6 areas

- **Centerline the process :** Applied grade-specific center lining on paper machines, and with center lining by production rate in the pulp mill and power and recovery, driving consistency.

- **Golden batching:** Streamlined papermaking processes, allowing engineers to effectively adjust recipes and formulas based on long-term, grade-based quality data.

- **Faster Troubleshooting :** Combined paper run schedules and raw material inventory trends into unified centerline displays, helping operators manage current grades and production rates.

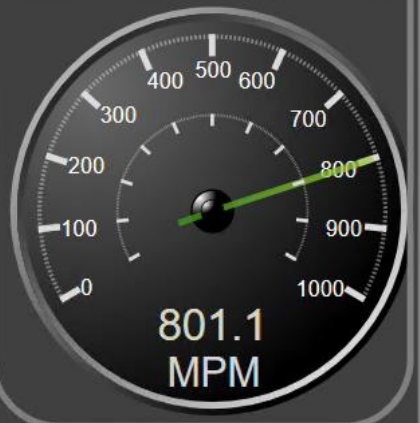
- **Finding the Low hanging fruit through GAP analysis :**

  AI based Advanced Process Control implementation at 6 Process Islands .

PM4 Summary

Wednesday, July 24, 2024 1:54:27 PM

Machine Speed



Production

Today Prod MT	141.2
Yesterday MT	131.6

Current Manf Plan No:
23059

Sheet Break

02

Current

70 KRESTO

Reel: 1	Start: 01:52:55 PM
Grade Change DT Hrs	00:36
Lost Time Hrs	03:48
Yesterday Lost Time Hrs	11:23

Quality

Basis Weight	67.98	GSM
Moisture	3.98	%
Ash	19.11	%

UTag	KPL.PM4._ASH_005.VALUE/PLOT
Description	ASH FOR DISPLAY BOARD - VALUE
Units	%
Value	19.10665
Time	7/24/2024 1:54:29 PM
Quality	good

Chemistry

		Value	SP
AKD	Kg/T	20.02	
Retention Aid	G/T	219.8	
Fixer	G/T	348.9	
Bentonite	Kg/T	1.41	
Micropolymer	G/T	221.0	
Service Tank OBA	Kg/T	1.71	
Service Tank PAC	Kg/T	5.89	
Filler Flow	LPM	228.3	230.0
Surface Sizer	Kg/T	33.36	

g

Flat Box Header Vac mmhg	266
1 No Chamber m³/hr	66

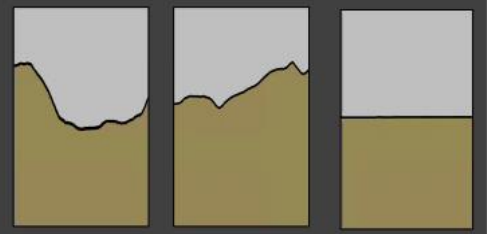
Steam Water Power

Steam mt/mt of paper	1.95
Water m³/mt of paper	7.1
Power kwh/mt of paper	500.3

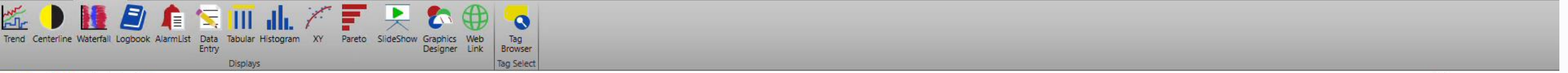
	Shift A	Shift B	Shift C	Total
Fresh Water	68.5	67.2	34.5	137.5

Pulp Mixing

	Agro	HW	SW
Flow m³/hr	133.4	126.8	0.3
Cons. %	3.2	3.5	3.3



	Agro	HW	SW
Level %	58.4	71.9	51.2



Name	Date Modified	Type
All Rake Torque load Treands	5/12/2024 1:49:17 PM	PARCview Trend Display
Black liquor tank level Treands	4/29/2024 5:50:30 AM	PARCview Trend Display
CRP Lab	1/8/2024 12:23:56 PM	Shortcut
CRP MDE	7/19/2024 12:09:15 PM	PARCview Data Entry Display
CRP Process Centerline	6/20/2024 5:24:51 PM	PARCview Centerline Display
CRP_LAB_CenterLine	4/8/2024 9:06:27 AM	Shortcut
Czr Flow & tank Level Treands	5/9/2024 8:29:08 AM	PARCview Trend Display
Daily QC Water Report	1/8/2024 12:23:56 PM	Shortcut
EVAPORATOR CENTERLINE_1	6/4/2024 2:49:57 PM	PARCview Centerline Display
Lime cons	7/1/2024 11:47:20 AM	PARCview Histogram Display
Lime cons	7/2/2024 11:48:12 AM	PARCview Trend Display
New & old RB Steam Parameters	5/5/2024 9:54:29 PM	PARCview Trend Display
New Data Entry	4/23/2024 4:00:24 PM	PARCview Data Entry Display
Totalizers_CRP	7/9/2024 10:16:15 AM	PARCview Centerline Display
White Liquor	11/6/2023 8:37:32 AM	Shortcut

Visible Benefits

- Reducing Shift to Shift variability.
- Faster Decision Making Helps optimising the manpower usage.
- Storing the “Brain Power” for the Future.
- Organisational Integrity.
- 18 Inhouse Improvement Projects using data - running by customer’s inhouse team.
- Identified 6 Projects with quick payback for AI/ML controls.

Case Study 2

Hardwood Pulp mill – India (South)

Implemented MACSbleach. Model Predictive Bleach plant control

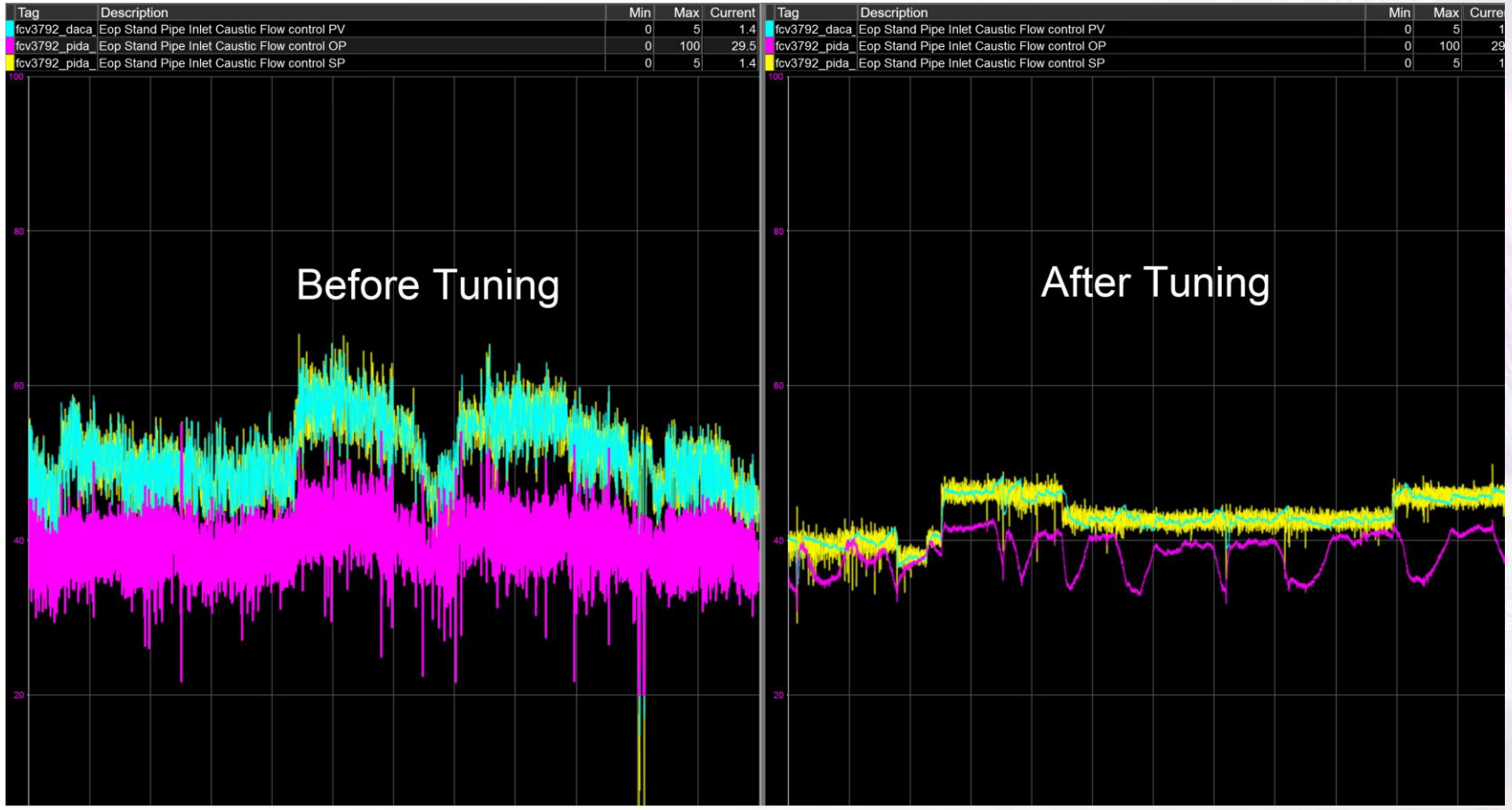
Reduced Bleach Chemical Consumption ~ 7% to 12%

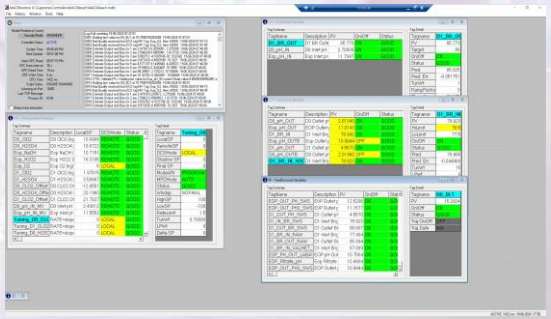
Final Brightness variability reduction

- **Model Predicative Control :** Software Predicts the upcoming changes in the process based on the customized model and take corrective control actions .
- **Chemical Reduction :** Significant reduction in ClO2 and NaOH based on the Total Kappa Entering the bleach plant. Constrain controls are connected with stage wise optimization and Final Quality stability
- **Integrated Solution Approach :** Deliverables included Specialty Measurements, ControlSUITE , dataPARC Historian (Bleach plant) , MACS Suite Software with perpetual model licensing
- **Savings Sustainability:** Committed agreements to sustain the control benefits by providing knowledge sharing and continuous monitoring support

System Results - Model Improvements and Tuning

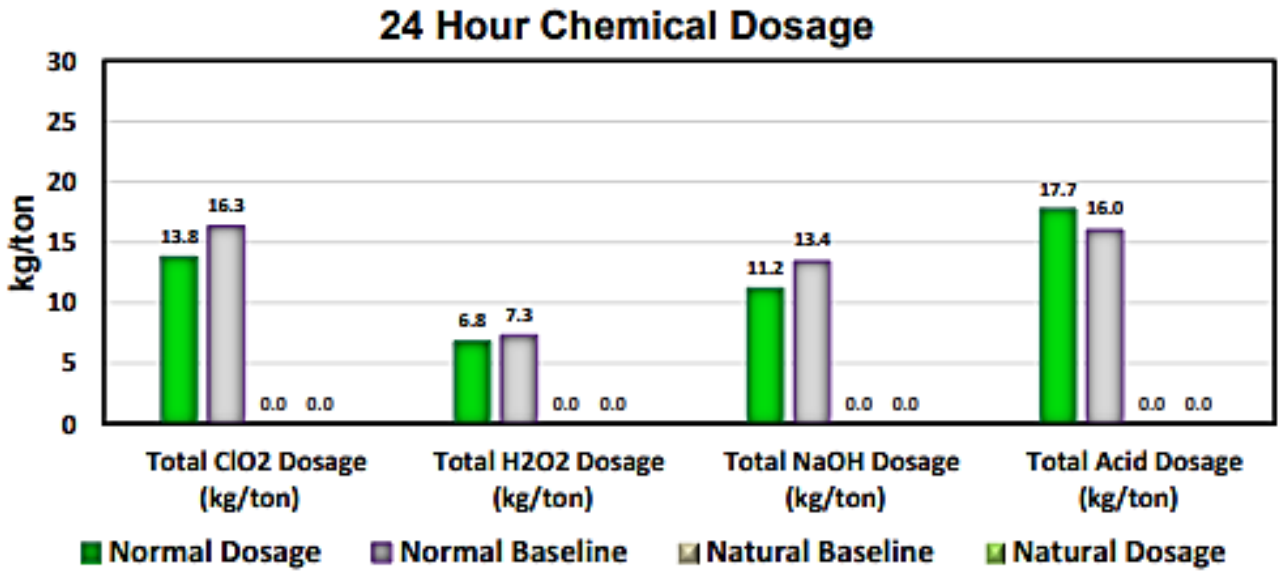
- Dynamics limit based on Kappa factor for D0 ClO2, to address the sudden swings in incoming kappa / Rawmaterial
- Eop NaOH to outlet pH control, key improvement was using Eop filtrate pH in controls.
- D1 feed forward and feedback control to achieve maximum variability reduction in Final Brightness.

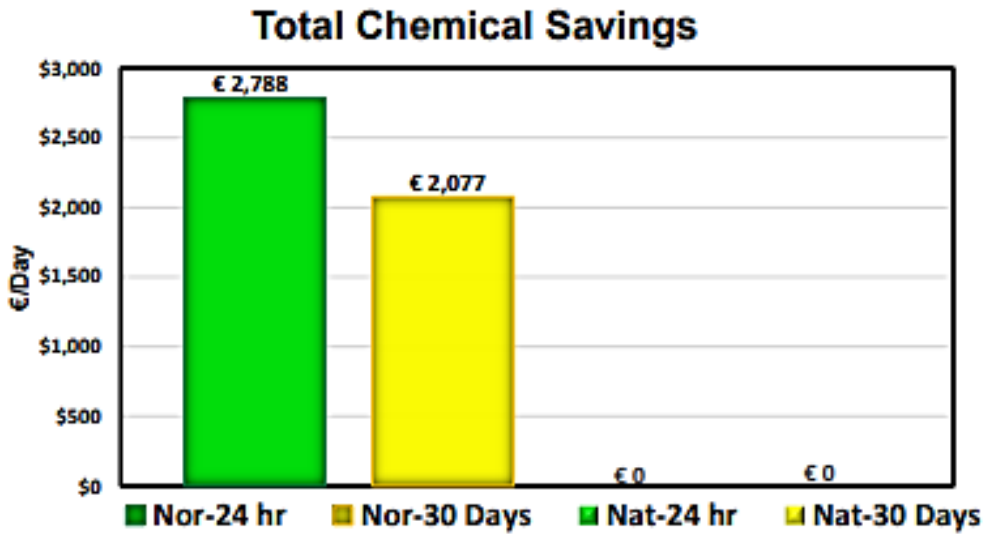




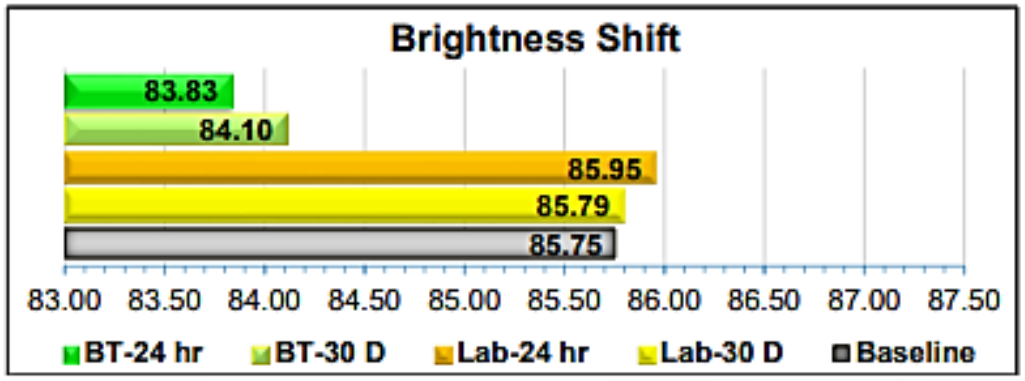
Quantified Results

Chemical Savings





Brightness



Brightness Improvements Summary

	Baseline	Lab-24 hr	Lab-30 D	BT-24 hr	BT-30 D
LAB Brightness Avg	85.75	85.95	85.79	83.83	84.10
LAB Brightness SD	0.49	0.20	0.51	0.18	1.69
LAB Brightness COV	0.58	0.24	0.60	0.22	2.01
Brightness Variability Reduction		59 %	0 %	62 %	0 %

Summary

1. **Profitable Digitalization**
   - Optimize processes to reduce costs & increase yield, etc.
2. **Cultural Transformation**
   - Organization using data to drive decision-making
   - Everybody is part of the solution, from operator on up
3. **Operators become Process Engineers**
   - We have created a learning culture
   - Empowering existing Big Data machines
4. **Transformation of Meetings to Work sessions**
   - Eliminate what is not the problem
   - Identify critical few

dataPARC MACSsuite BTG A Voith company