Digitalization on its way to Industry 4.0 Blessing or curse?

DITP Bled 2018

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BTG Process Solutions

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Outline

- Introduction
- Model Predictive Control
- Challenges
- Requirements
- Opportunities and Obstacles
- Solutions
- Cases

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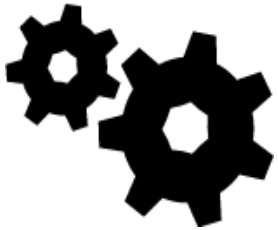
BTG and Capstone Technology

- Acquisition of **Capstone Technology** Corporation, USA by Spectris, the parent company of BTG, in 2016
- Capstone **dataPARC** and **MACS** provide BTG with software tools such as data historians, data visualization and advanced process control (APC) or model predictive control (MPC)
- Capstone MACS and BTG Instruments form the business unit **BTG Process Solutions**

PLANT INFORMATION
dataPARC



PLANT AUTOMATION
MACS

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Model Predictive Control (MPC)

What we want to achieve

- The most efficient and knowledgeable operator
- Who understands the plant dynamics
- Who is able to predict the plant behavior
- Who controls the process
- Who utilizes every opportunity to optimize within hard and soft constraints

… 24/7 !

BTG MACS: Model Predictive Control (MPC) is an APC that realizes it!

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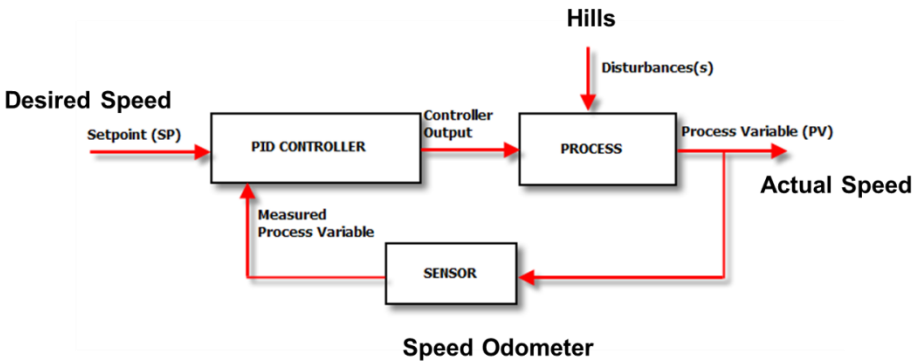
PID Regulatory vs MPC

Cruise Control vs Self Driving



CV \ MV	Gas	Brake	Emergency Brake	Steering Wheel
Distance				
Velocity				
Lane				
Bracking				
Location				

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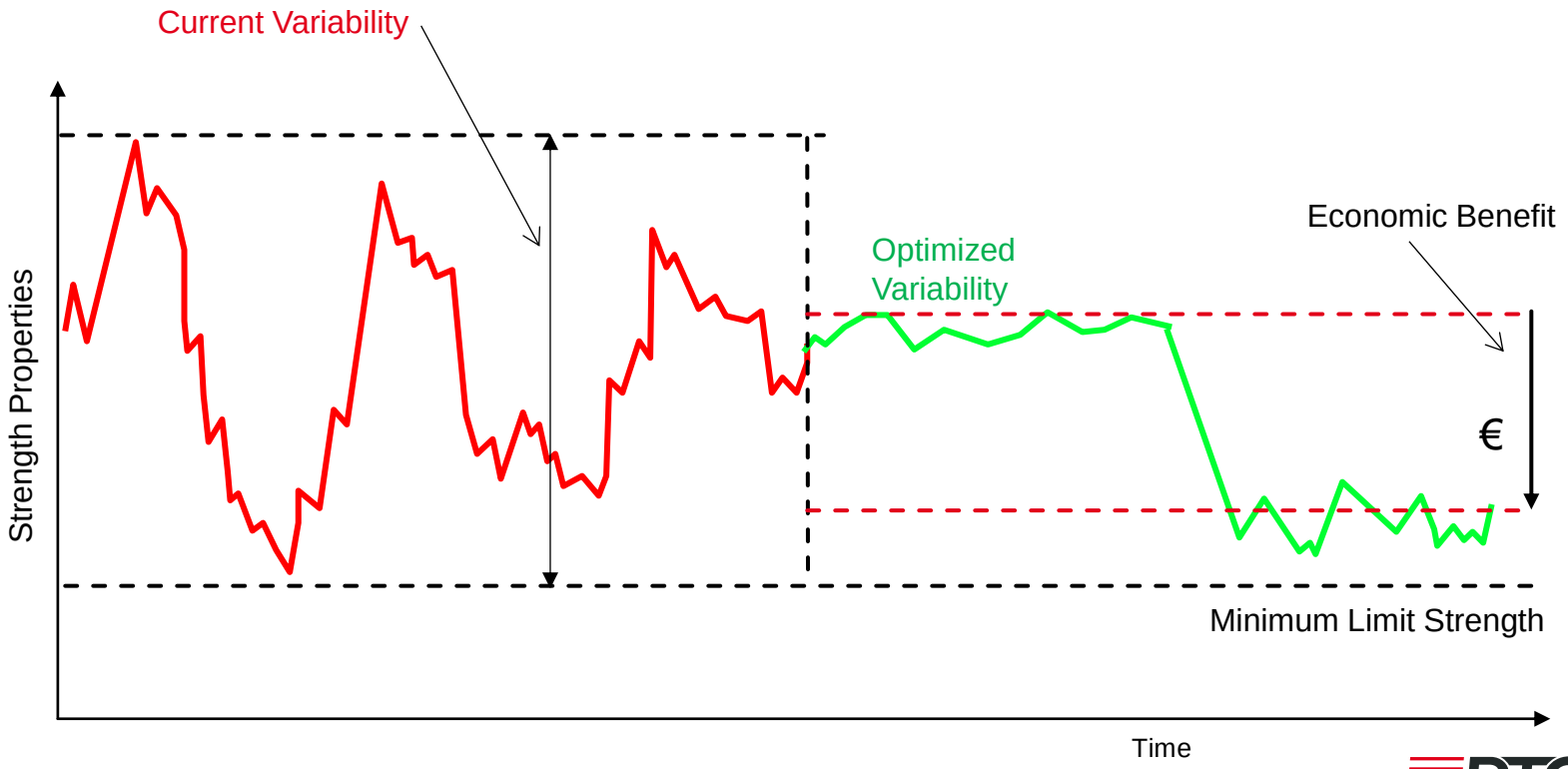
Benefits of MPC

Commonly used model to show the benefits of MPC

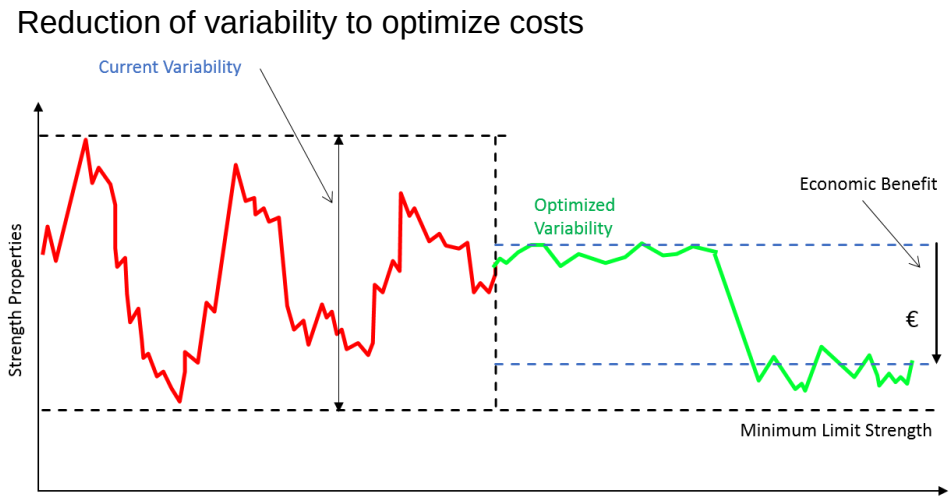
→ Reduction of variability to minimize cost



MPC Benefits depend on the process

There are many dependencies such as:

- Raw material
- Fiber treatment
- Additives
- Retention
- Fines and filler
- Web release
- M/D ratio
- Porosity
- Shrinkage
- Hold Out
- Stiffness
- Dusting, etc.



…and a lot are contrary to each other!

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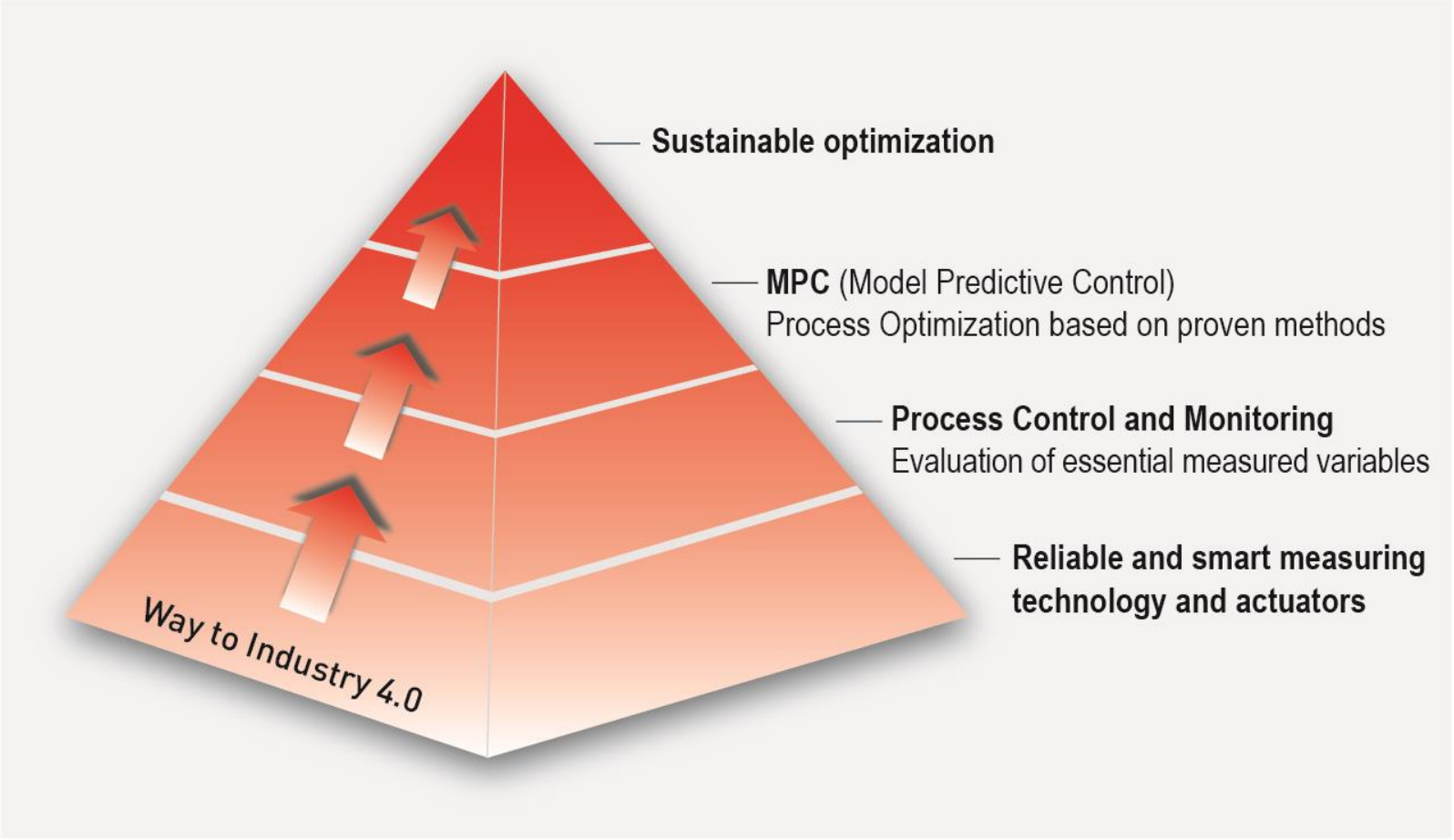
From single measurement to group wide information exchange



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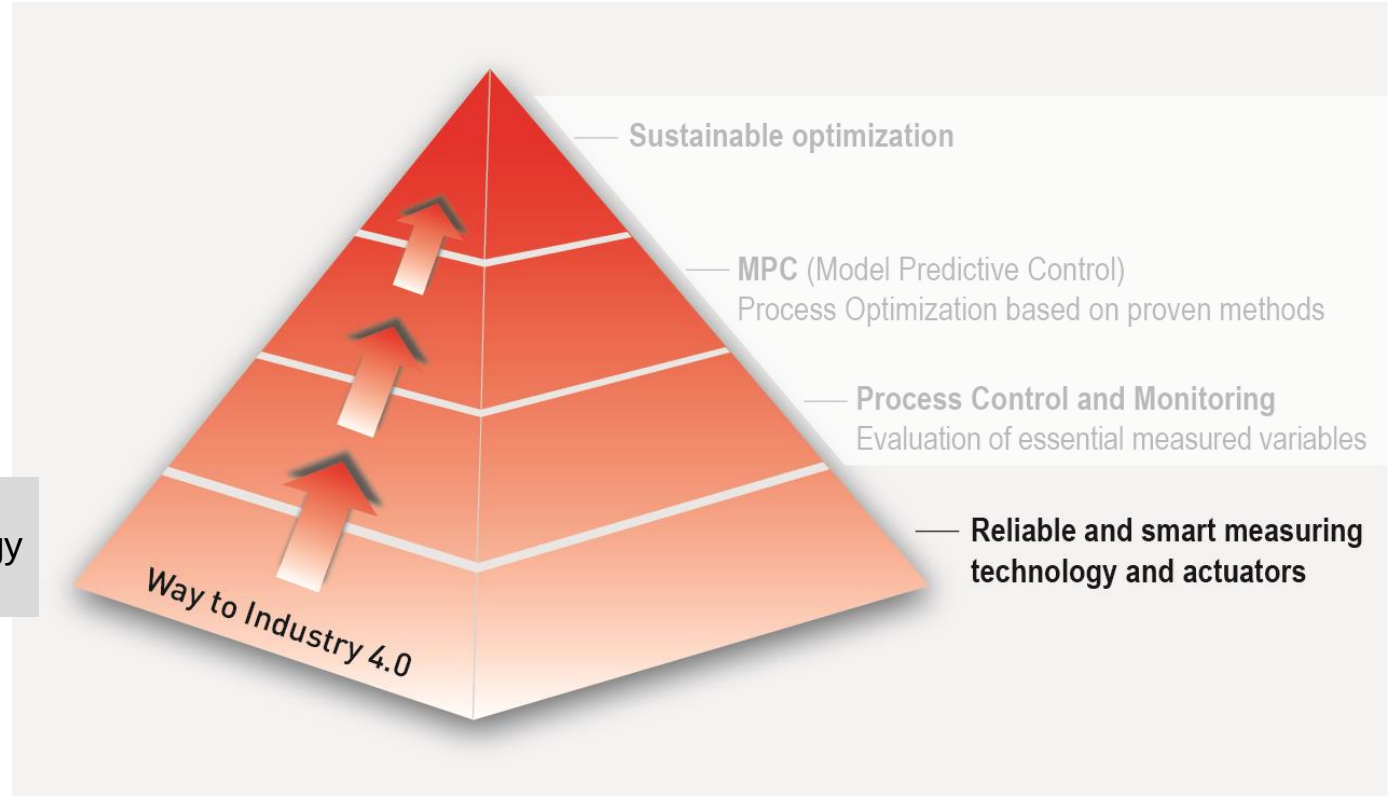
Without a solid foundation no permanent construction = Level 0

Basis
Smart sensors technology and actuators



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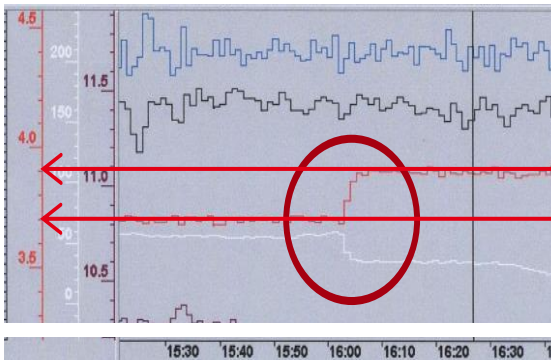
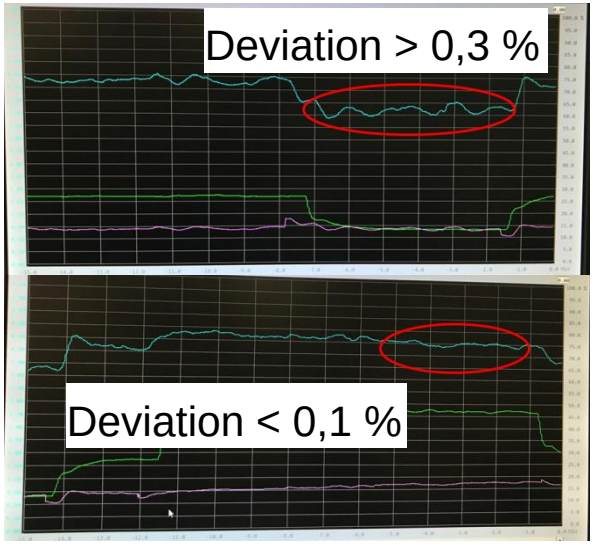
Level 0 example

Small inaccuracies often have a huge impact!



Poor reliability leads to frequent re-calibration

Incorrect dilution leads to instable conditions



Wrong shear force measurement causes high deviation

At a consistency of 3.7 % a 0.2% deviation results in approx. 5.5% change in mass flow!!!

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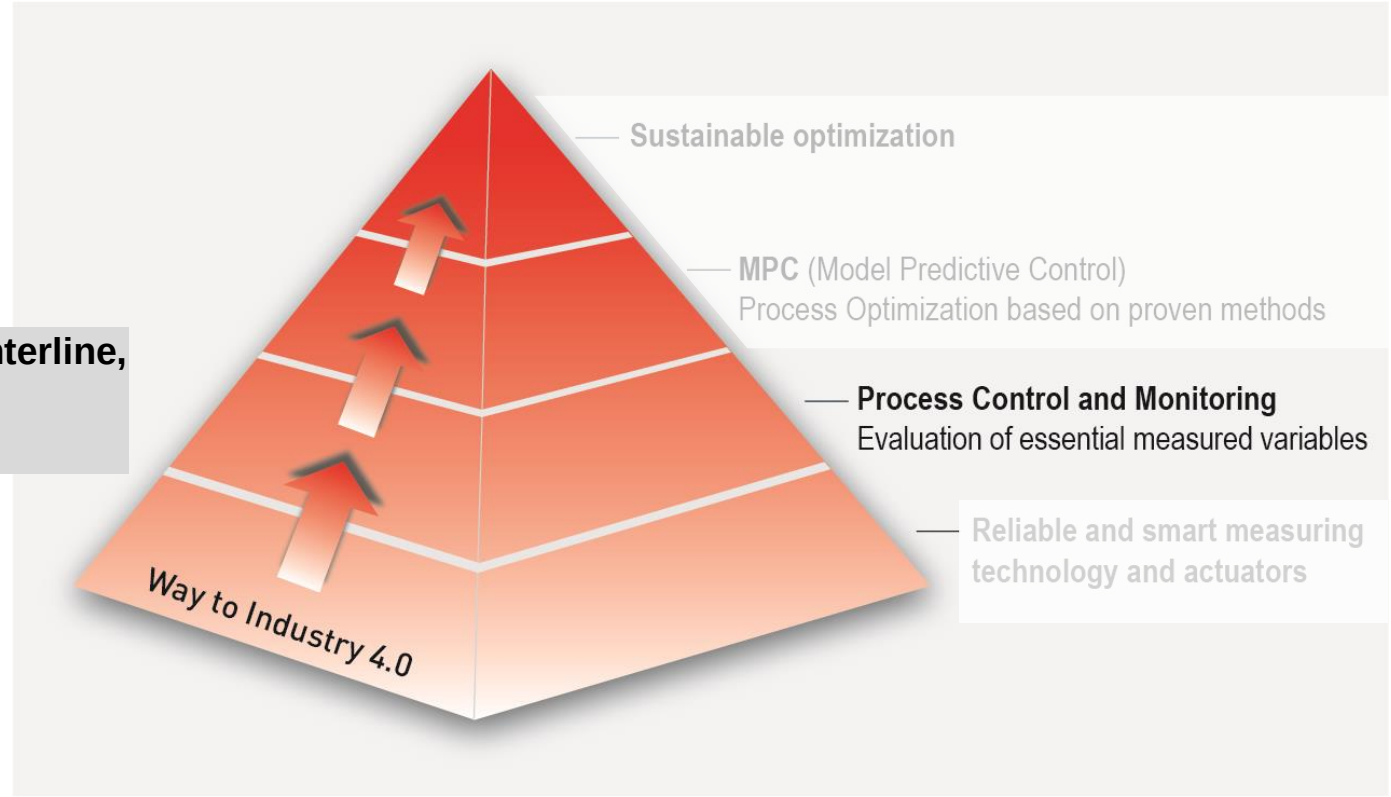
First optimize what needs to be optimized first = Level 1

Loop performance, centerline, down time analysis, dashboards, etc.



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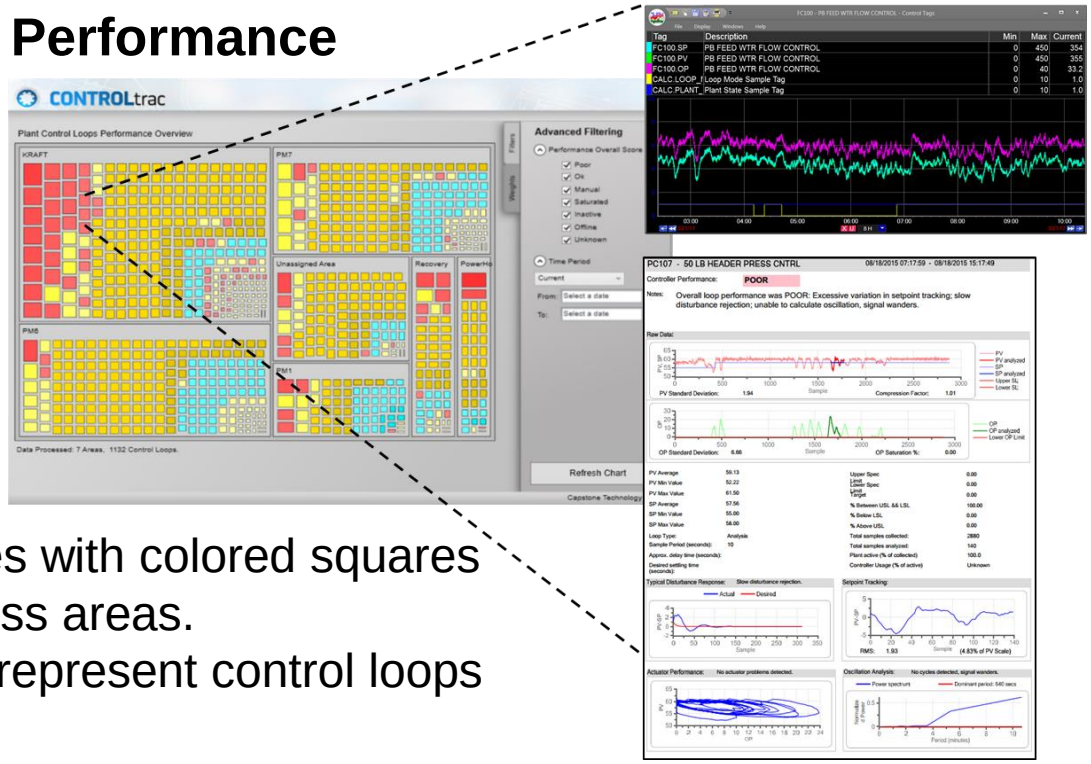
Level 1 example

Control Loop Performance



Individual frames with colored squares represent process areas.
Single squares represent control loops

Red and BIG squares signal problems in the individual control loops

Report: control loop quality and recommendations for action

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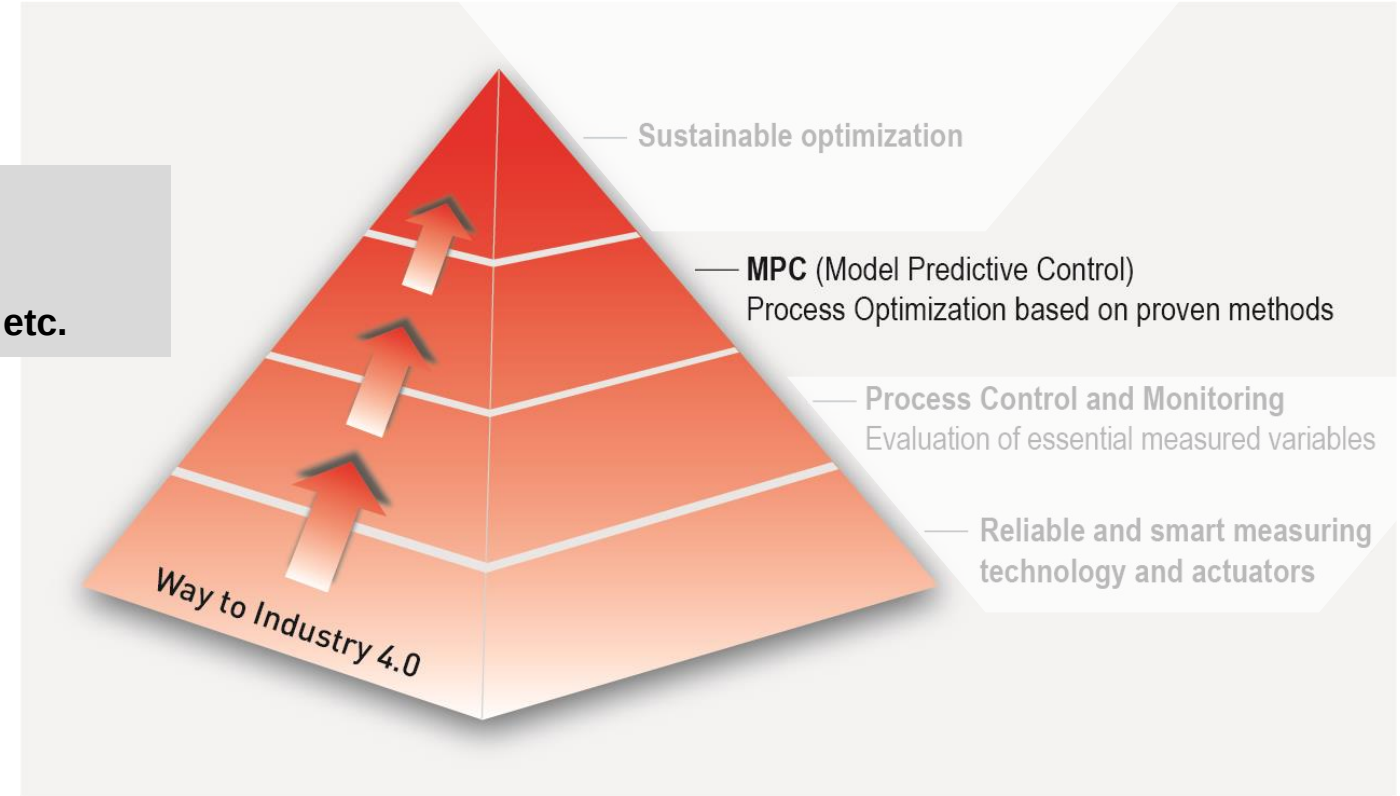
Advanced process control = Level 2

Soft sensors,
modeling,
stock tracking,
new control concepts, etc.



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Level 2 example

New control concepts with innovative measurements

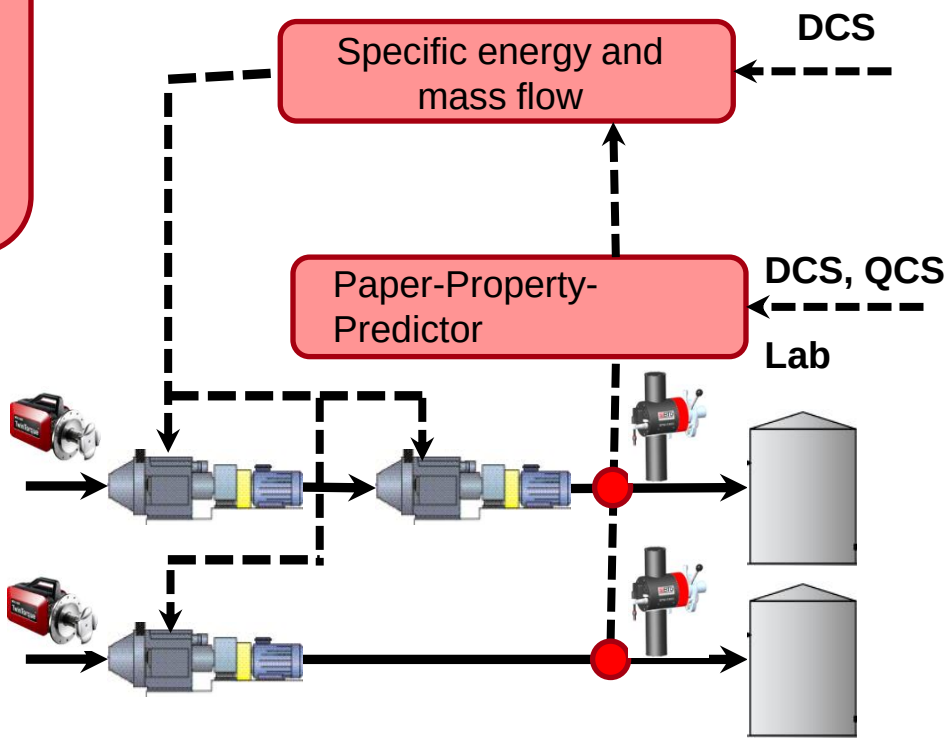
Objectives: optimize refiner operations to impact final paper properties and variability

Instruments

- Single Point Morphology
- Consistency
- Mass flow
- Freeness

APC

- Specific energy to paper properties
- Strength modeling



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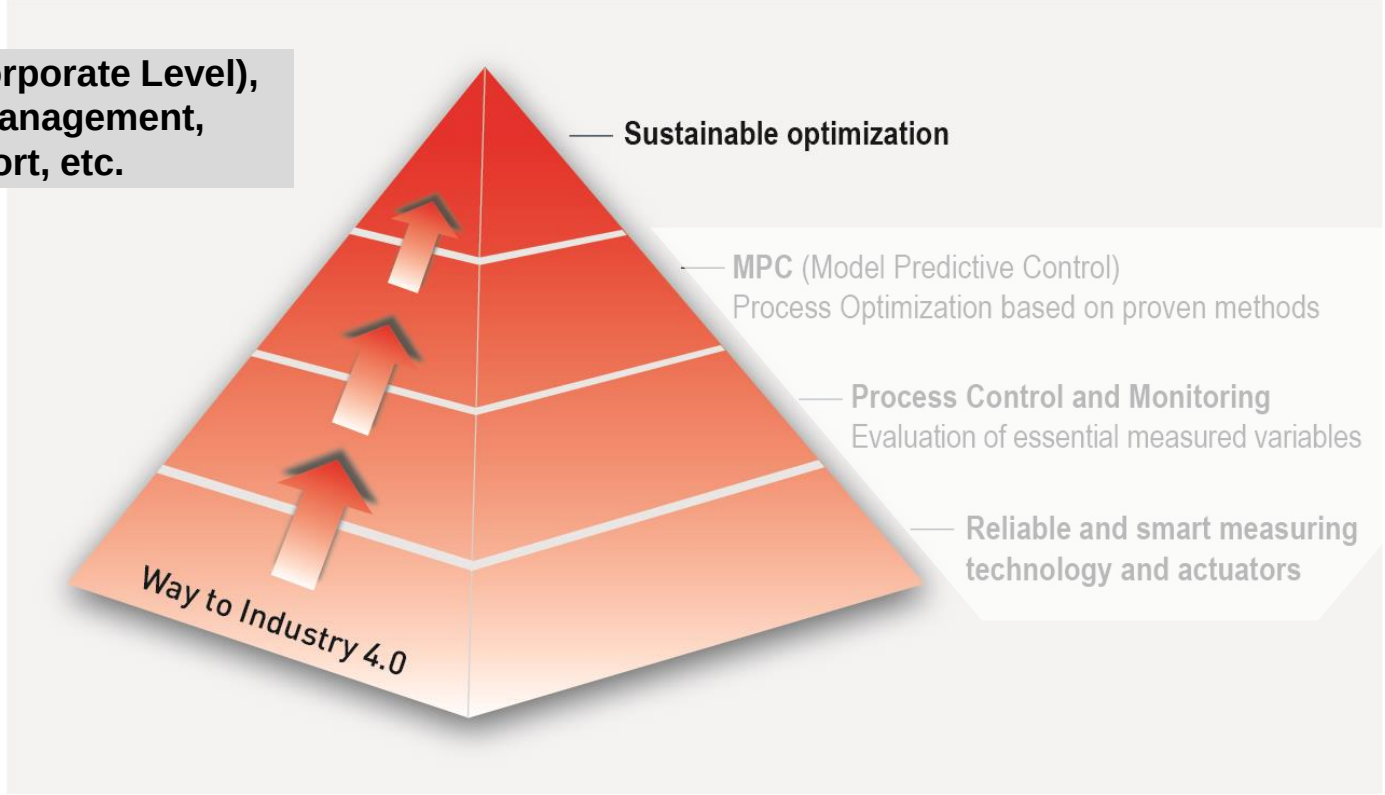
Data exchange, visualization and guidance = Level 3

Dashboard (Mill and Corporate Level), logistic/supply chain management, OEE and analytical report, etc.



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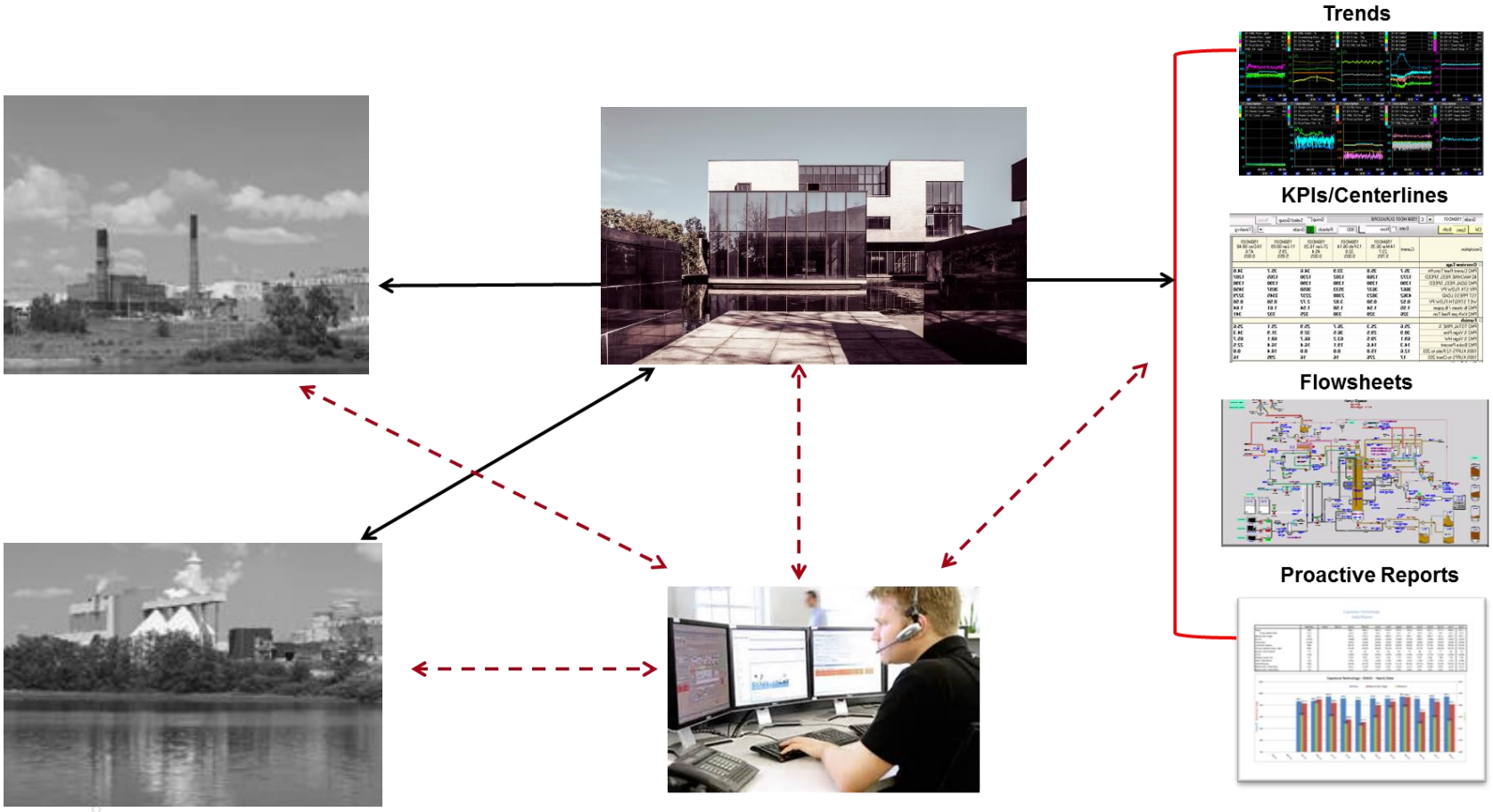
Level 3: BTG Digital - unit to group operations

Modular structure allows a step by step approach for stabilizing unit operations with site wide economic coordination.



Opportunities and Obstacles

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Opportunities Industry 4.0

Holistic goal management:

- just the right object(ive) *
- in the right quality
- at the right time
- in the right place
- At the lowest cost **

* Raw materials, personnel, assets, product, maintenance, etc.

** Manufacturing, distribution, environment, etc.

Industry 4.0 is supposed to fulfil these requirements

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Obstacles

Incompatible today and in the future

Sledge-hammer to crack the nut

Difficult to re-design

Unintentional data exchange

High demanding

Hard to disassemble

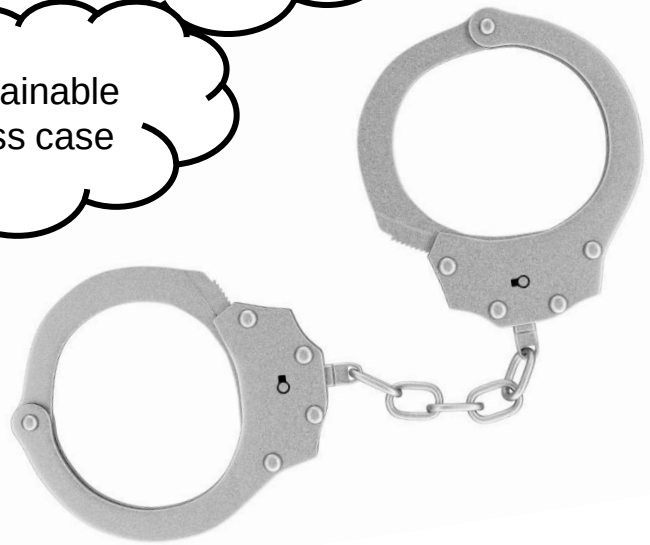
Low user acceptance

Black box

Embedded resources obligatory

No sustainable business case

Based on not optimized base



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BTG perspective

- Unique and individual approach to each opportunity
- Based on all existing systems and infrastructure
- Benefit focused modules

- Step by step approach according to customer requirements
- No interdependence with existing systems or infrastructure
- In-house care, improvement and extension
- Embedded BTG expertise possible but not obligatory
- Ongoing support (onsite, remote and automated reporting)
- Aims for a sustainable benefit

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Case
Bleach Plant Optimization

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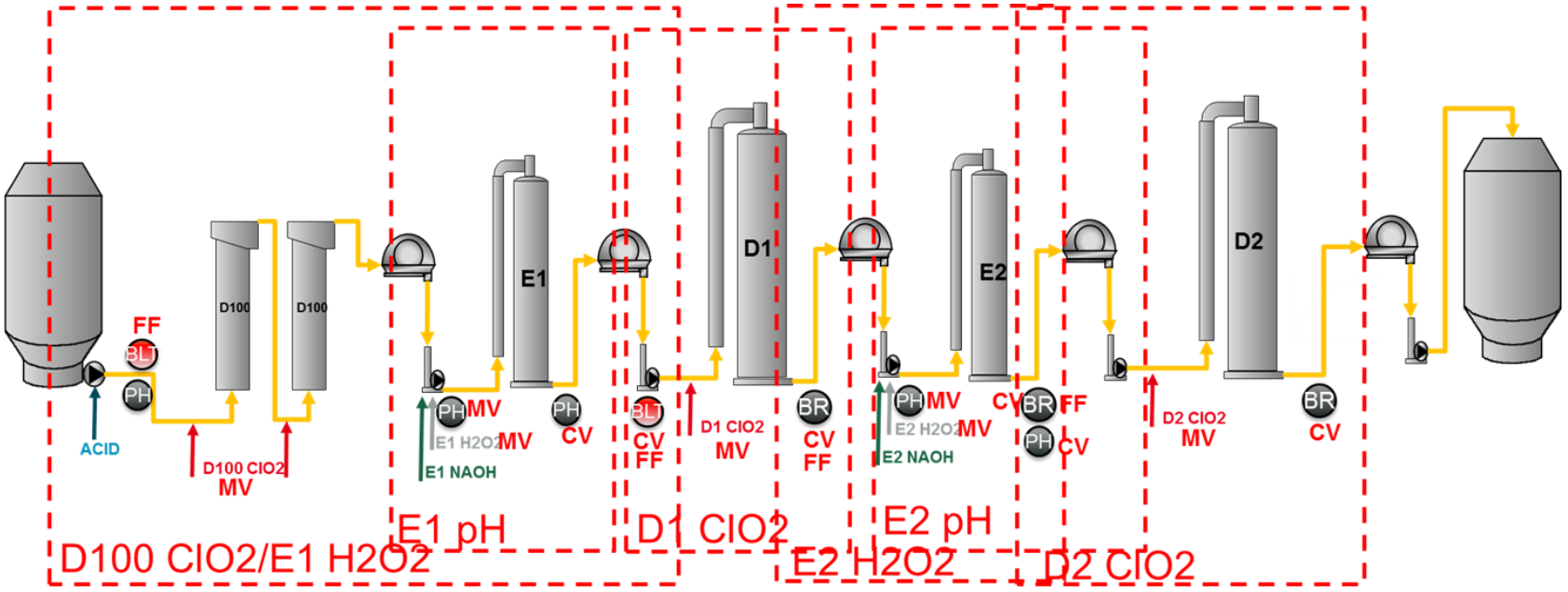
Instrumentation and MPC at Bleach Plant

Customer installed **MACSbleach** and continuous **B**leach **L**oad **T**ransmitter to replace discontinuous Fiber Kappa measurement



BLT 5500 BLT

Brightness sampler BR

pH Sensor PH

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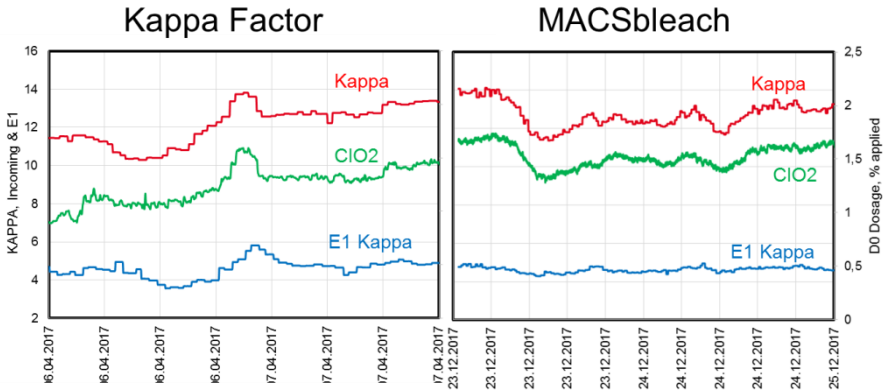
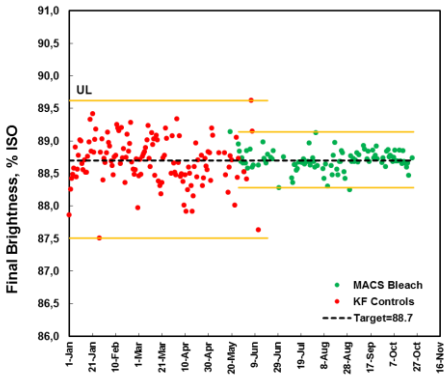
Results Bleach Plant Optimization





~35-45% reduction of pH variability

~50% reduction of brightness variability

~ 7.4% Chemical Savings

(without brightness target shift)

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Case
Paper and Tissue Machine

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Paper Machine – Advanced Process Control

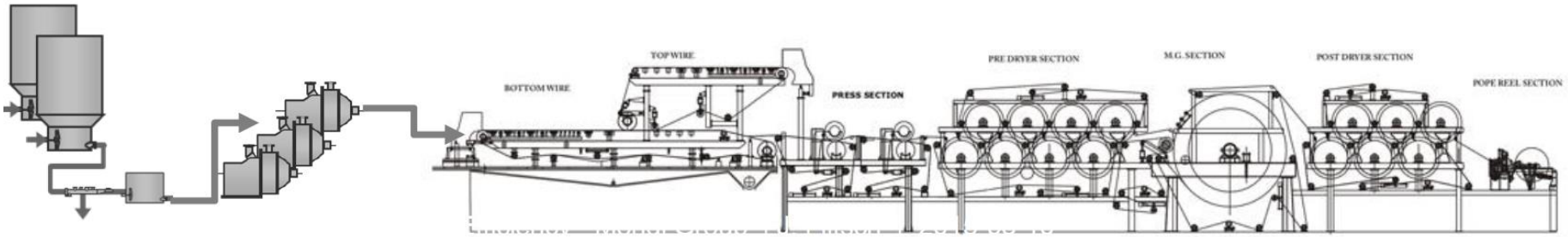
Real-Time Cost Control ⟵ **Real-Time Paper Properties Control**

			APC Process Modules (examples)			
Pulping	Blending	Retention		Strength	Print Perf.	Brightness
Bleaching	Refining	J/W Ratio	…other	Softness	Porosity	…other

Data Analytics – Center Lining

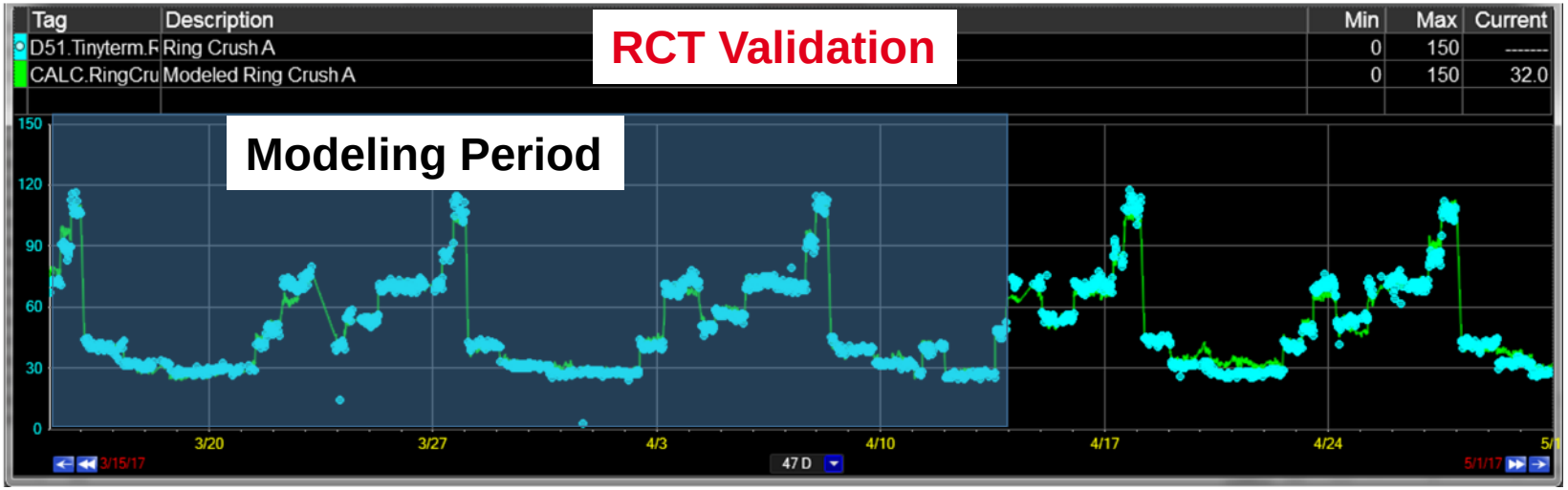
Property Predictor Modules – Software Sensors

Base Regulatory Monitoring / Innovative Single Point Sensors / Sensor Monitoring and Validation



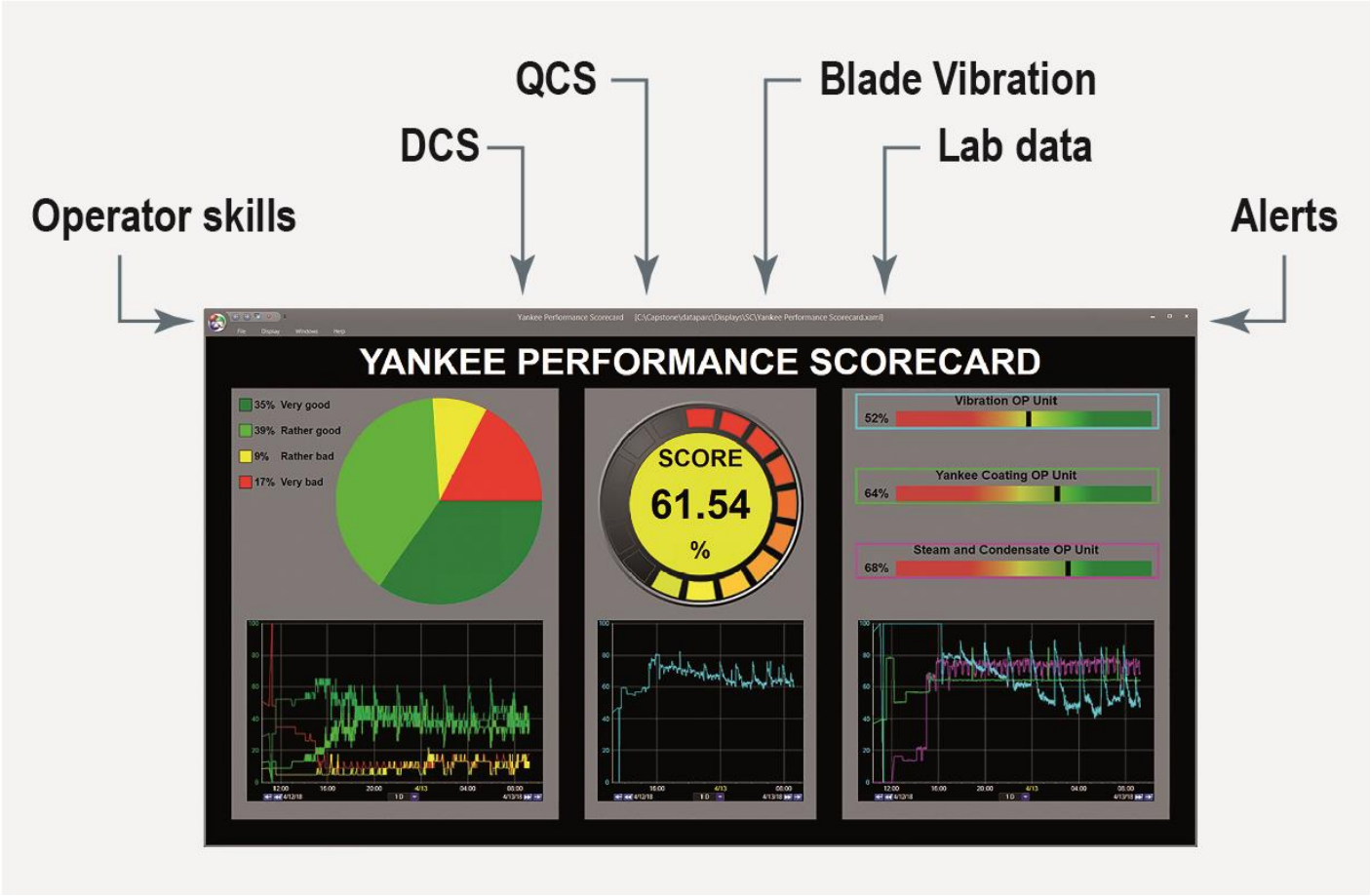
Initial Data Analysis – Strength

Model was built utilizing shaded section of dataset; unshaded section served as “validation” period



← Other models →

Vigilance™ 4.0
Manage Yankee Performance



Result Vigilance™ 4.0

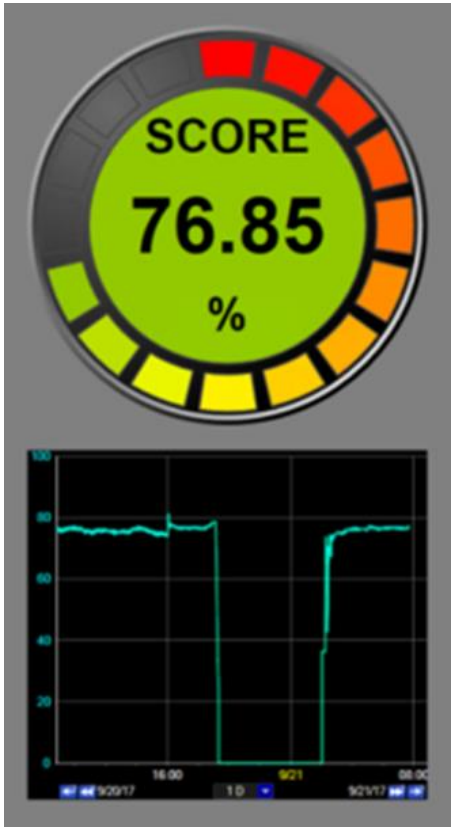
Leads to

- Lower creeping factor
- Less breaks
- Higher drying efficiency
- Less wearing of the creeping blade
- Better smoothness and thickness

and results into savings*

- Steam consumption: 52.000 €/a
- Creeping factor improvement 115.000 €/a
- Extend grinding intervals 50.000€/a

*Typical savings for a 3 meter tissue machine



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Thank you for attention.

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