Evolution of Process Control and Future Possibilities

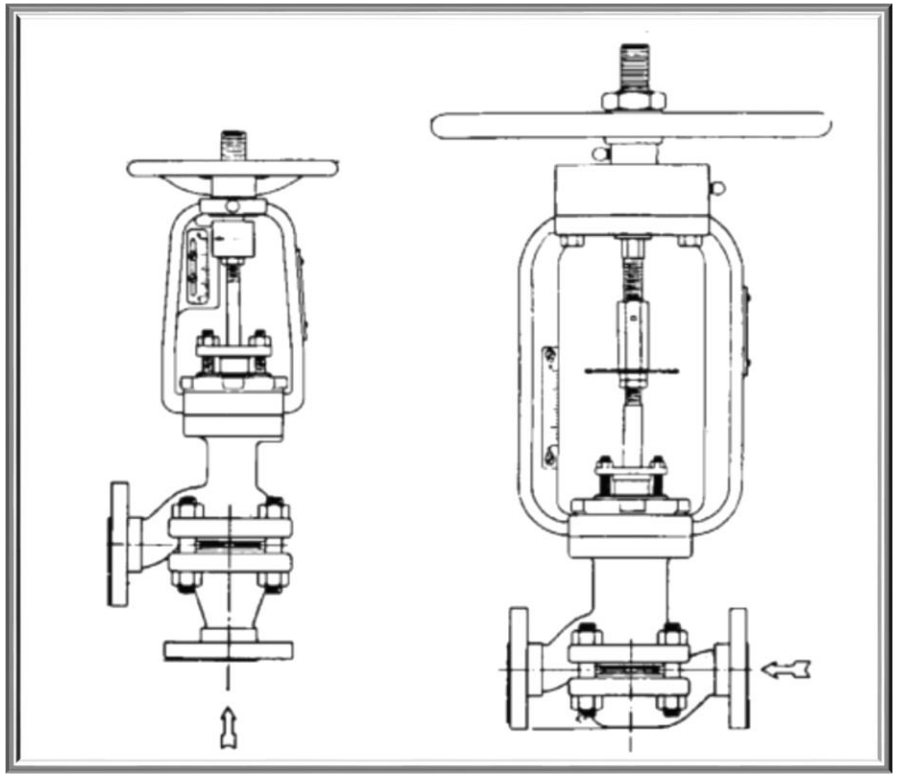
Mona Henderson

Valmet

Flow

From counting threads...

.... to % OP and magmeters



On rising stem valves (globe valves)

https://www.sciencedirect.com/topics/engineering/handwheel

Analyses

From manual samples and lab testing...

.... to on-line samples and analysis

Operation

From batch...

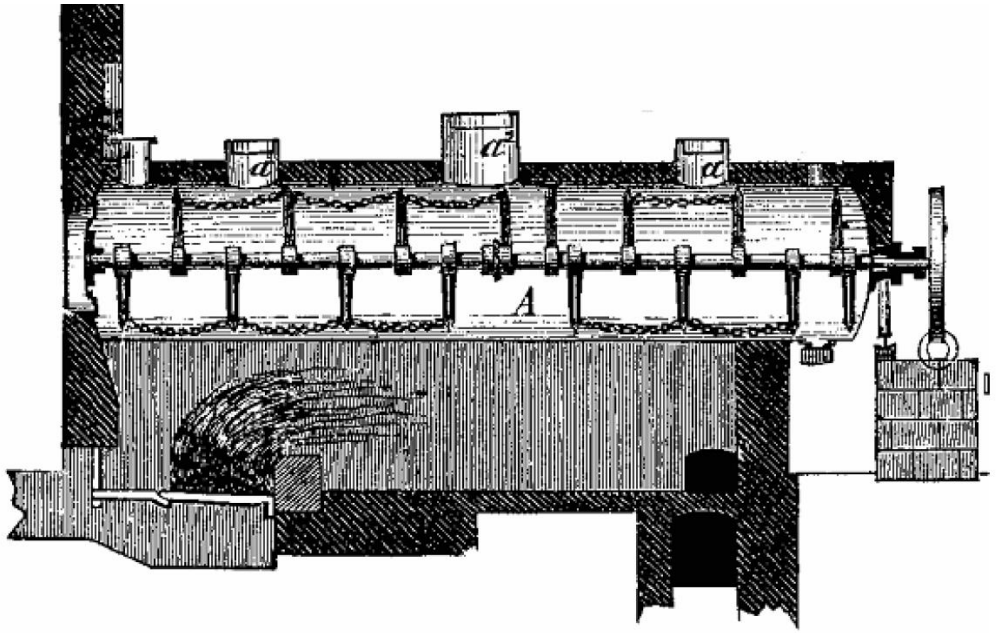


Figure 2 Direct heated horizontal digester for pulp production /1/.

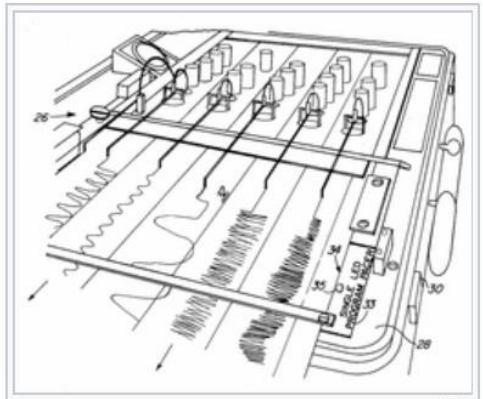
.... to continuous

Data Collection And Usage

From log sheets, circle- and strip-chart recorders....

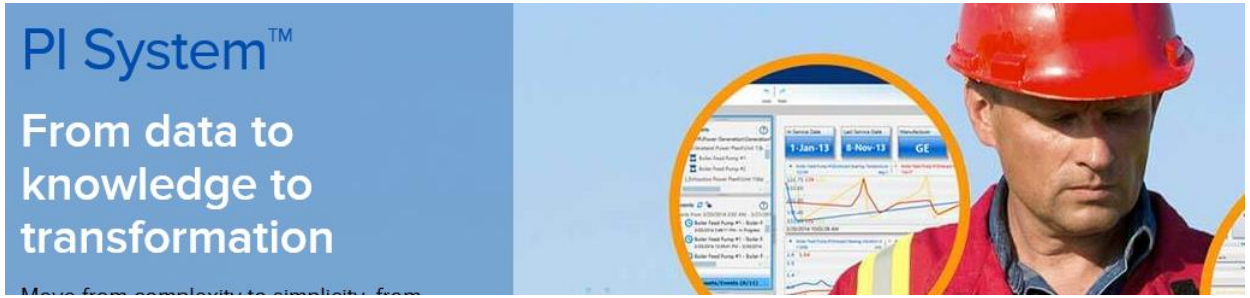
Circular Chart Recorder

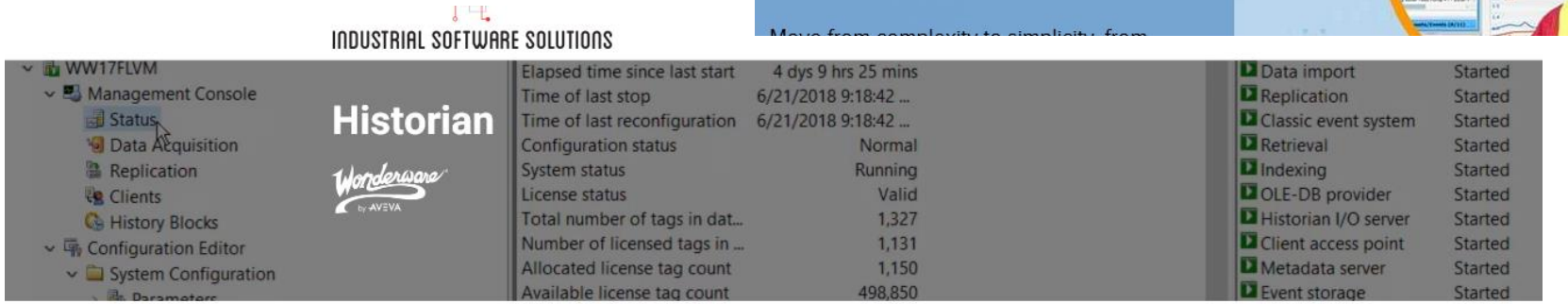
Strip Chart Recorder



A chart recorder which is part of a polygraph

... To DCS historians and APC systems





Optimization Solution

You cannot control what you do not measure!
Better measurements are key to better control!

Example for bleaching

- What are your after tower stage targets?
- How do you currently measure them?
- If you can improve the accuracy and frequency how much can you improve your process?
- How can you improve your process without doing this?
- Absolute after-tower measurements allow you to optimize your process to its most efficient state.

Can measurements be automated in order to improve the accuracy and frequency?

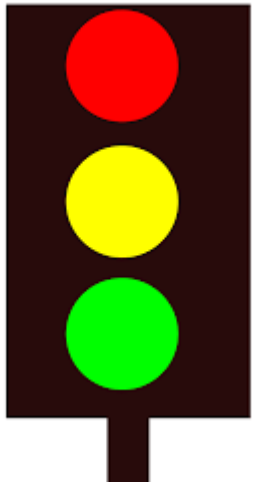
Process Control: Present And Future

Large and small scale optimization for manufacturing cost, product quality, and productivity / reliability

• Individual machines	e.g. Washer performance
• Systems	e.g. Oxygen Delignification
• Department	e.g. Bleach Plant
• Multiple areas	e.g. Fiberline washing & recovery
• ....entire mills	…coming soon to a mill near you
	…will operators be needed?

Individual Machines
Monitoring washing equipment

- Mechanical
  - Maintenance need
    - Roll
    - Hydraulic system
    - Wear parts
- Process
  - Formation
  - Outgoing pulp consistency
  - Wash liquor distribution
  - Unstable incoming production

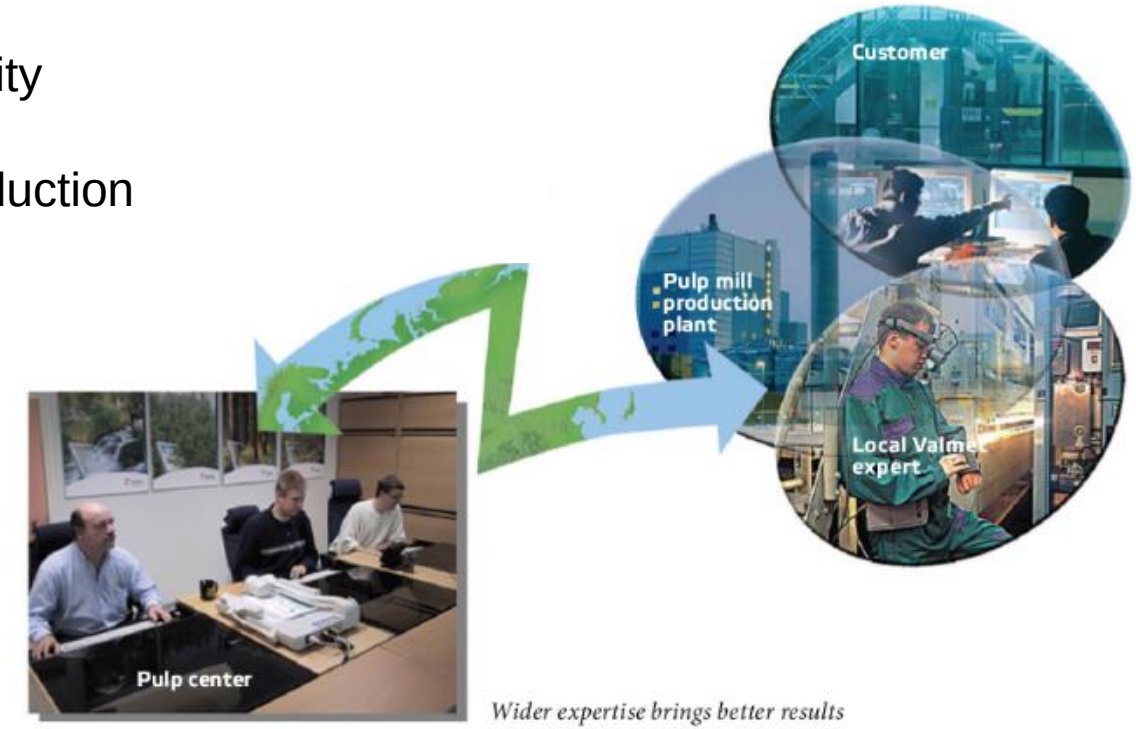


Systems
APC for Oxygen Delignification System

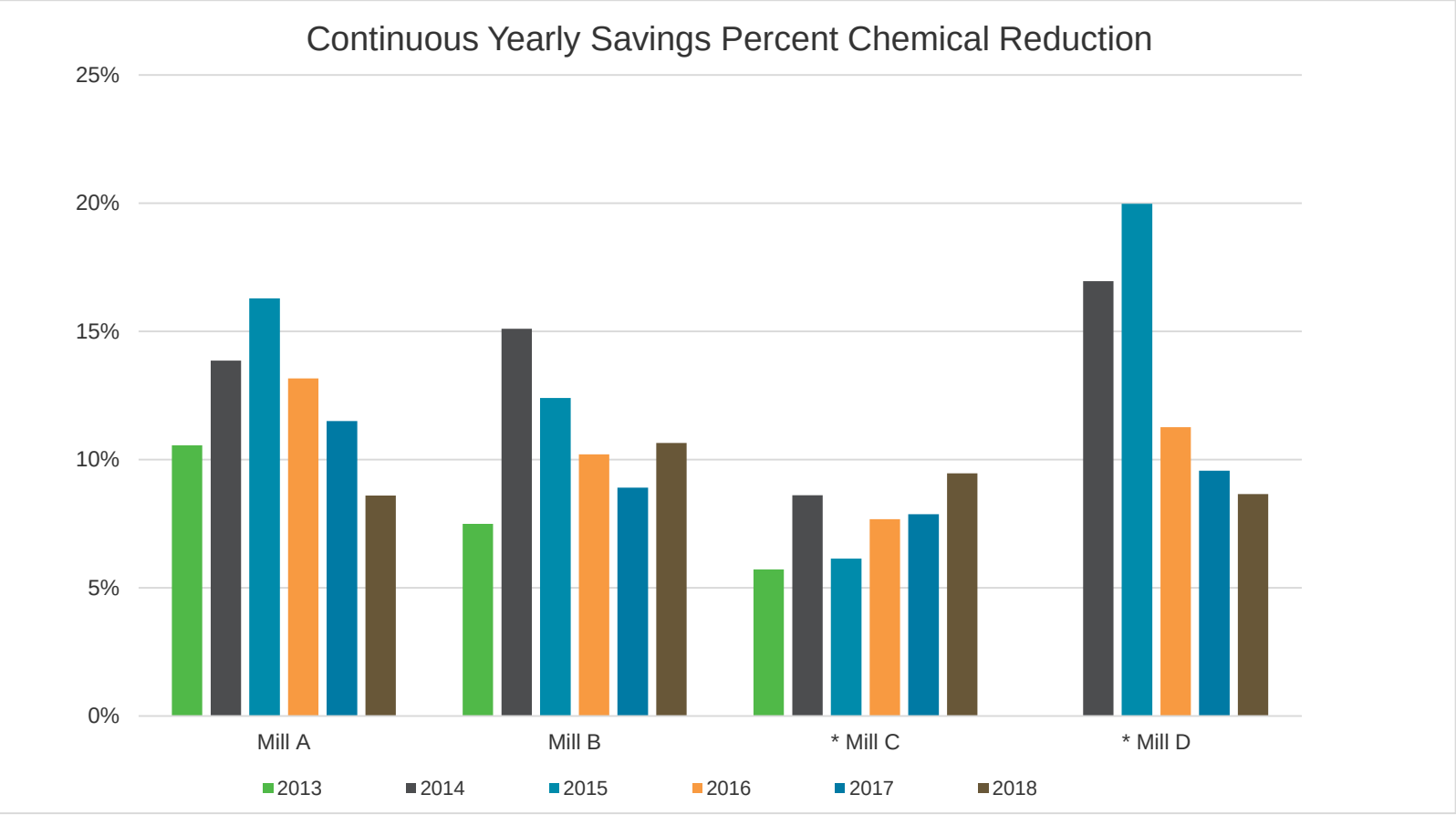
To reduce quality variability and operating costs.

From experience at other facilities, full implementation of an APC can result in several benefits:

- Optimal Pulp Brightness Level
- Reduced Pulp Brightness Variability
- Reduced Bleaching Chemicals
- More in Quality Specification Production
- Lower Effluent Load



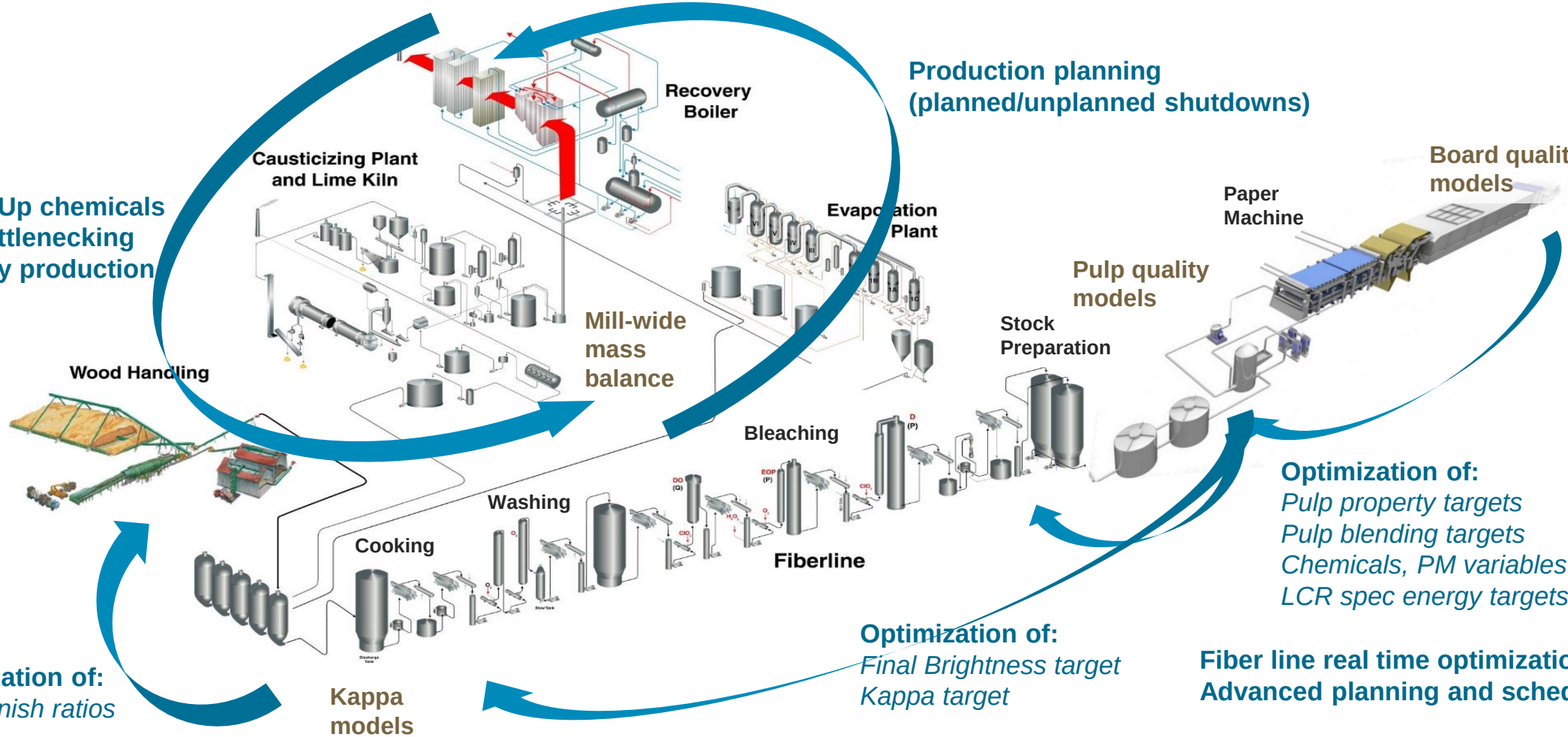
Long-Term Bleach Plant Performance Solutions Supported and Enhanced Advanced Controls



Note: * Mill C solution does not include caustic controls
Mill D solution implemented in 2014, mill switched fiber species between two lines in 2016

Mill Wide Optimization

High level process coordination and optimization



- Production planning system with inventory management
- Real time cost and yield accounting
- Recovery system balance & fiber line cost optimization

Optimization of integrated paper mill

Benefits of APC and analyzers cascade forward

Debarking Optimizer
Wood loss reduction **0.5-2%**

Cooking Optimizer
Kappa variation decrease **20-60%**
Wood yield increase **0.5-1%**

Washing Optimizer
Washing loss decrease **3-10%**
Dry solids content increase **0.3-1%**

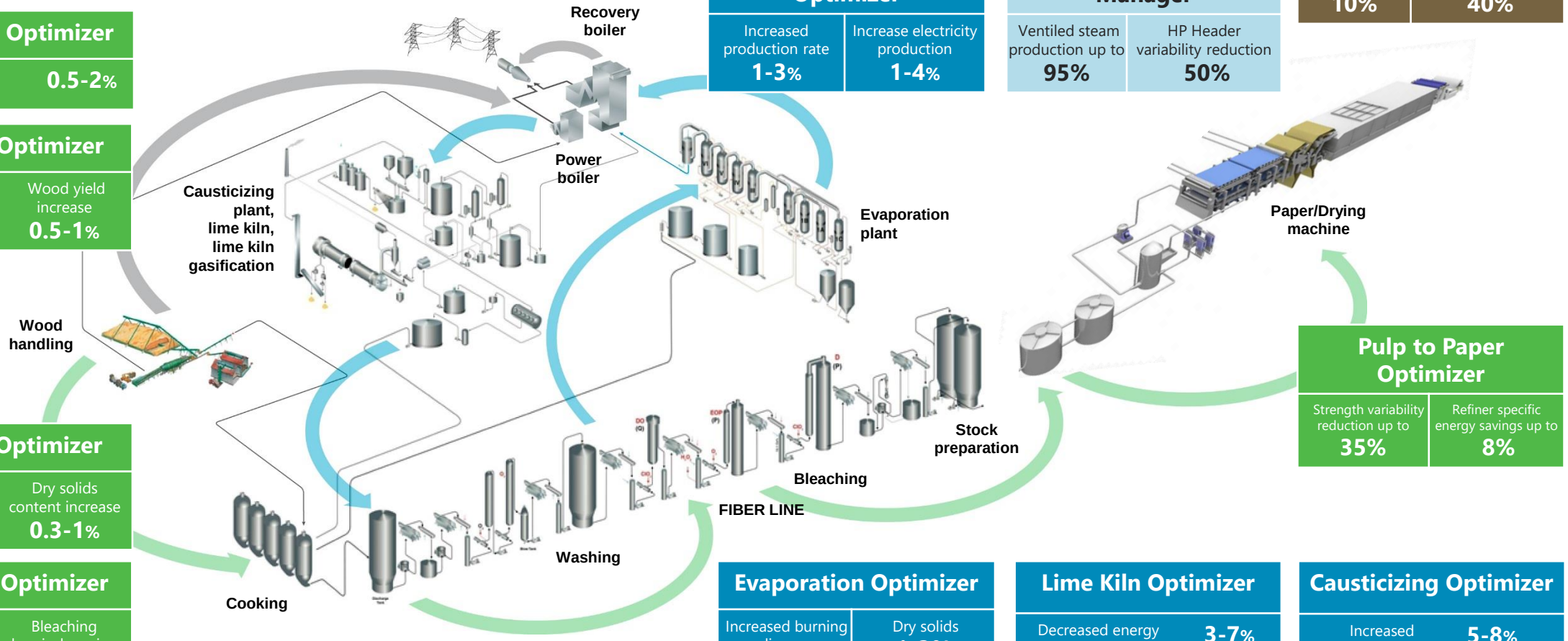
Bleaching Optimizer
Brightness variation decrease **10-50%**
Bleaching chemicals savings **5-15%**

Recovery Boiler Optimizer
Increased production rate **1-3%**
Increase electricity production **1-4%**

Combustion Manager
Fuel cost decrease **2-10%**
Boiler efficiency increase

Steam network Manager
Ventiled steam production up to **95%**
HP Header variability reduction **50%**

IQ Optimizer (QCS)
Production increase up to **10%**
Less rejects in grade change up to **40%**



Pulp to Paper Optimizer
Strength variability reduction up to **35%**
Refiner specific energy savings up to **8%**

Evaporation Optimizer
Increased burning liquor
Dry solids **1-3%**

Lime Kiln Optimizer
Decreased energy consumption **3-7%**

Causticizing Optimizer
Increased production rate **5-8%**

Flow Meters – Trivia to round things out

Mag Flow meters

1832 Michael Faraday - made a large scale open channel magmeter to measure flow of the river Thames

1915 MW Smith and Joseph Slepian filed a patent for a device to measure the speed of a boat using magneto-hydrodynamics

1930 EJ Williams used same concept for closed conduits

1952 First commercial magmeter by “Tobi-Meter”

1962 JA Shercliff published “Theory of electromagnetic flow-measurement”

Orifice (1912 – Weymouth),
Venturi (1797 – Venturi)
Rotameters (1908 – Kueppers)

Michael Faraday

References

Flow

https://www.sciencedirect.com/topics/engineering/handwheel

Flow meters

https://web-material3.yokogawa.com/LF01E00A00-05EN.us.pdf

https://www.emerson.com/documents/automation/white-paper-orifice-meters-development-of-orifice-meter-standards-technical-white-paper-daniel-en-43730.pdf

http://www.wermac.org/specials/venturiflowmeter.html

https://flowmetrics.com/the-history-of-variable-area-flow-meters/

Analyses

https://io9.gizmodo.com/incredible-historic-pictures-of-early-science-labs-485796493

Operation

https://core.ac.uk/download/pdf/80703546.pdf

https://www.valmet.com/pulp/cooking-and-fiberline/cooking/continuous-cooking/

Data collection and usage

https://en.wikipedia.org/wiki/Chart_recorder

https://www.phoenixthermalsupply.com/products/temperature_controller/chart-recorder/

https://www.osisoft.com/pi-system/

https://industrial-software.com/solutions/historian/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