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Produce targeted quality at lowest cost

OnEfficiency.Strength

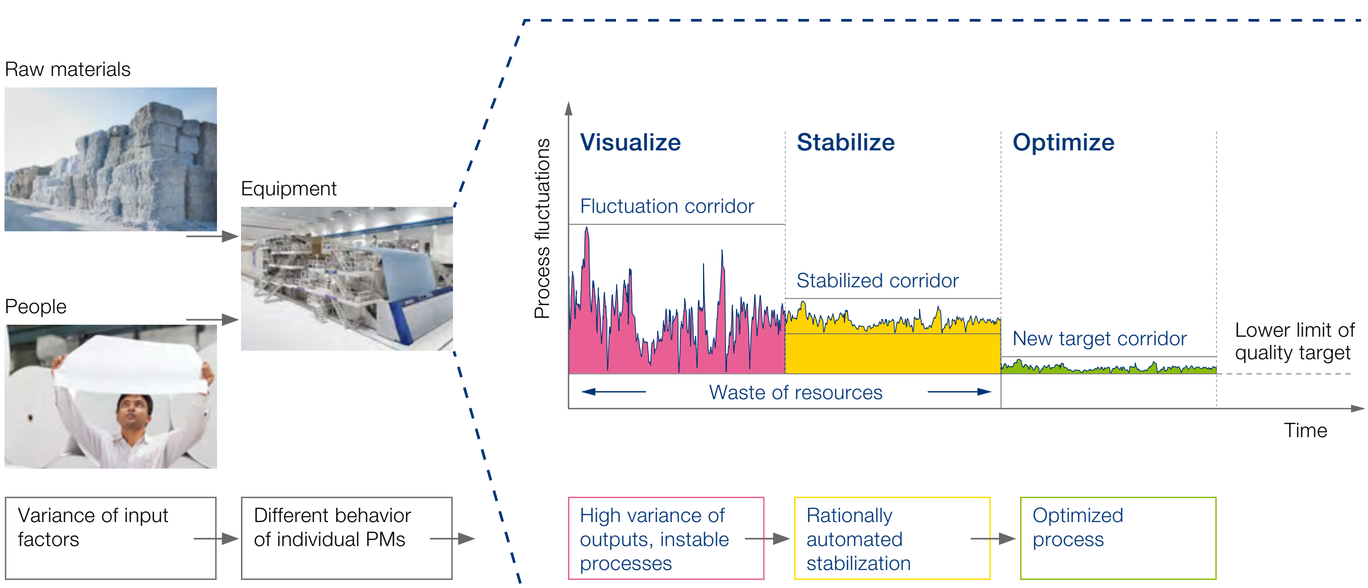
The OnEfficiency principle

OnEfficiency uses a simple three step approach to drive efficiency: Visualize – Stabilize – Optimize.

Variations in raw material, differing behavior of workers and complex equipment lead to variations in the process and the resulting quality parameters. To ensure a permanent achievement of the target quality, it is therefore necessary to maintain a safe margin from the lower limit of the quality target.

The greater the fluctuations, the greater the margin needs to be and the higher the potential for excessive resource consumption. Therefore, the first step in driving efficiency is to visualize the fluctuations so that in the second step the process can be stabilized and finally optimized to minimize waste while reliably meeting the quality targets.

The OnEfficiency principle: Visualize – Stabilize – Optimize



OnEfficiency.Strength

OnEfficiency.Strength combines three modules into a new generation of advanced process control (APC) concept:

- Virtual sensors (also called soft sensors)
- Model predictive control (MPC)
- A cost optimizer

The virtual sensors accurately predict quality values, which otherwise are only available at the end of each tambour as the result of destructive tests in the lab.

Knowing the paper properties in real-time allows the MPC to control the process to continuously reach these values, and the cost optimizer ensures this happens at lowest possible cost.

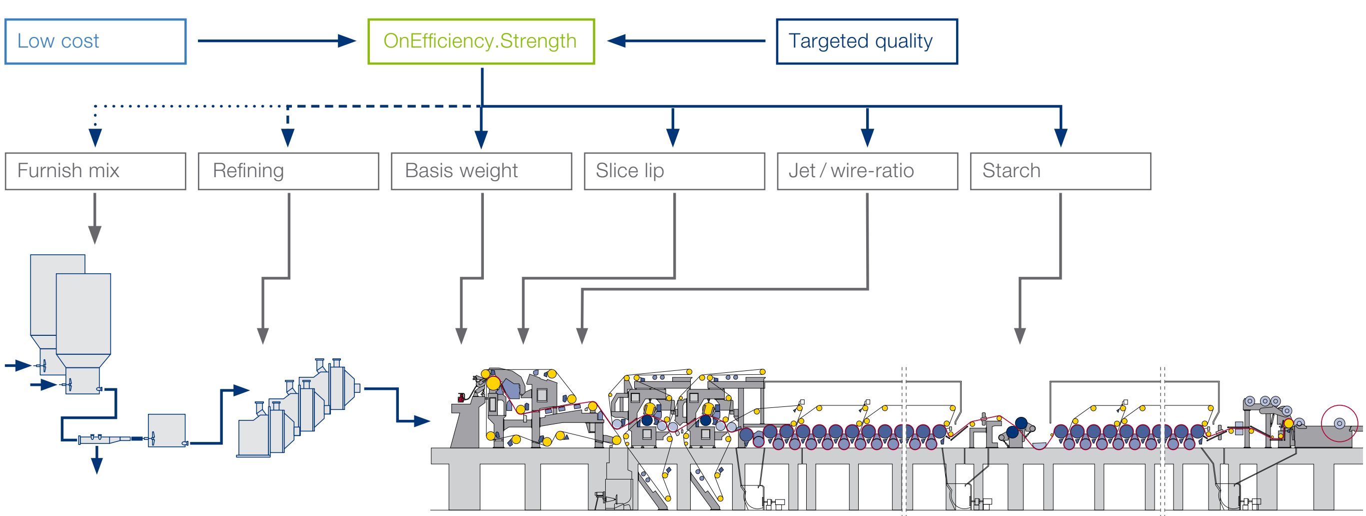
Without OnEfficiency.Strength

- Only destructive tests for strength properties
- Values only available at the end of each tambour
- Complex to control all process variables manually
- Cost aspect mostly unknown

With OnEfficiency.Strength

- Reduced off-spec production due to real-time availability of strength properties values
- Cost optimized fiber and strength agents utilization due to open or closed loop control of strength properties including cost optimization

Improve paper quality and lower cost



Example for Corrugated Medium, Fluting, Testliner

Virtual sensors

A virtual sensor is basically a physical and / or statistical model that allows the calculation of, for example, a strength value based on available data from the process, machine and QCS, which can then be visualized and used in operation and in open or closed loop control.

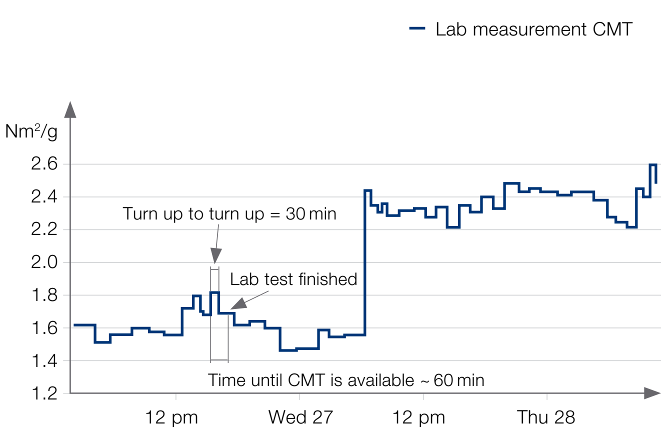
Situation without virtual sensor

- One strength value at the end of the tambour
- Time between turn ups 30 to 60 minutes
- Typical measuring time in lab 30 to 60 minutes
- Changes in strength properties can be noticed earliest 1 hour afterwards
- Process variations cannot be controlled

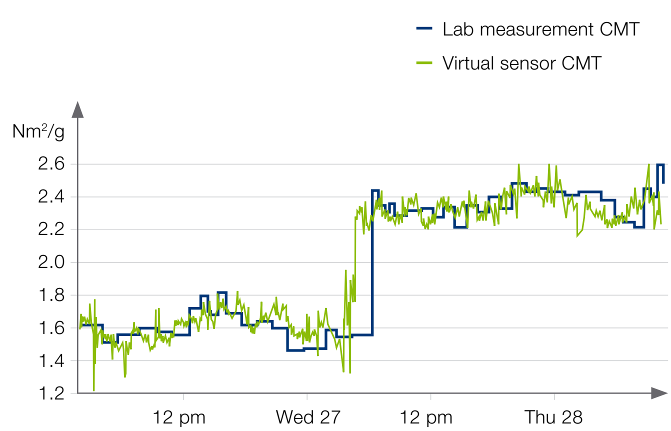
Situation with virtual sensor

- Real-time strength values
- No lab delay times
- No unnoticed process changes
- Immediate feedback on the effect of process changes on strength
- Straight to target grade changes

Situation without virtual sensor



Situation with virtual sensor



Three steps to create a virtual sensor

Step 1: Offline modeling

- Number of samples required: min. 600, best results above 3 000 samples
- Model with approx. 20 variables
- Virtual sensor model is valid over all grades
- Correlation for strength values typically > 90 %

Step 2: Learning phase

1. Getting started under observation
2. Auto-calibration + manual tuning
3. Time shift compensation
4. Remove outliers (e. g., breaks & shut downs)

Virtual sensor is ready for operation.

Step 3: Validation

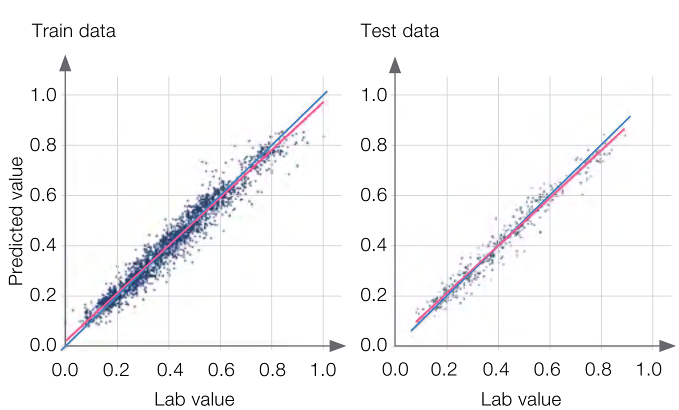
Verify correlation of lab and virtual sensor values:

- Grade change
- Changing influencing factors / actuator settings, e.g.
  - Jet / wire ratio
  - Slice lip opening
  - Starch concentration

Virtual sensor needs to “see” (predict) all typical impacts to strength!

If this is the case, then the virtual sensor can be used as basis for a control loop.

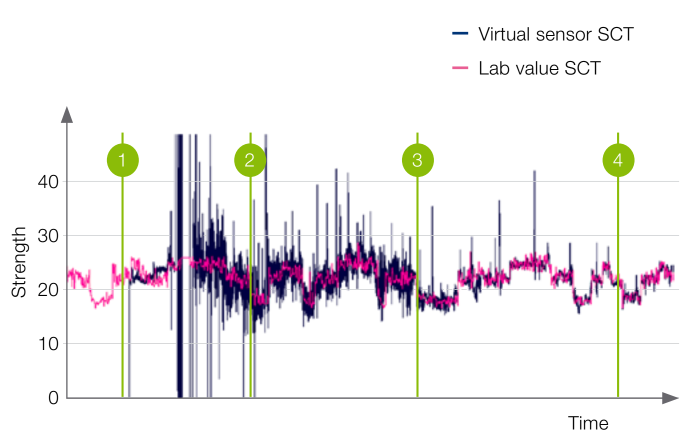
Offline modeling



Train correlation: 97 %

Test correlation: 97 %

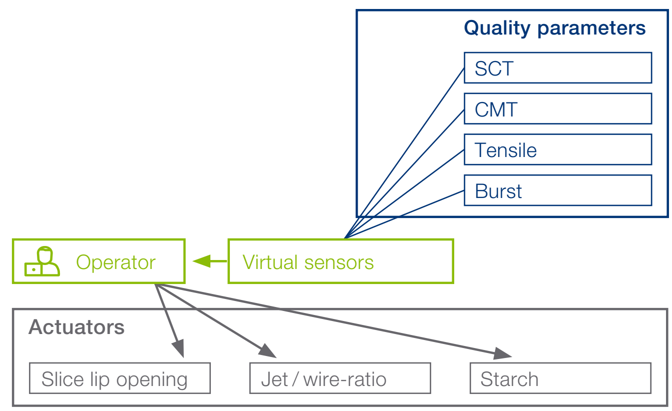
Learning phase



Three levels of control loops

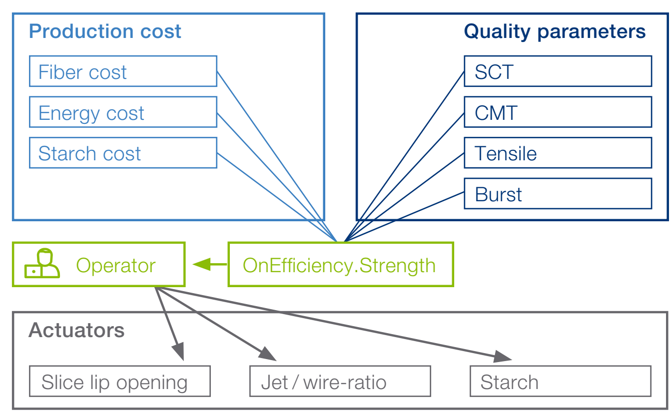
Virtual sensor

- Results of virtual sensor are displayed to the operator
- Operator decides based on experience
- Every shift may develop its own strategy
- Cost impact is mostly not taken into account



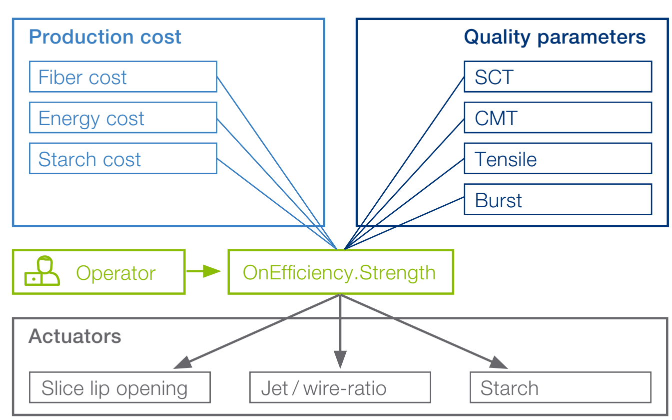
Open loop control

- OnEfficiency.Strength provides suggestions for optimum settings to reach target quality at lowest cost
- Operator decides if he follows the suggestion – experience of operators has final say



Closed loop control

- OnEfficiency.Strength reliably keeps all relevant quality parameters in spec
- OnEfficiency.Strength reduces cost, in this example by optimizing strength distribution between cross and machine direction and minimizing starch usage
- The operator supervises the correct function of the advanced process control and and, if necessary, adjusts the settings

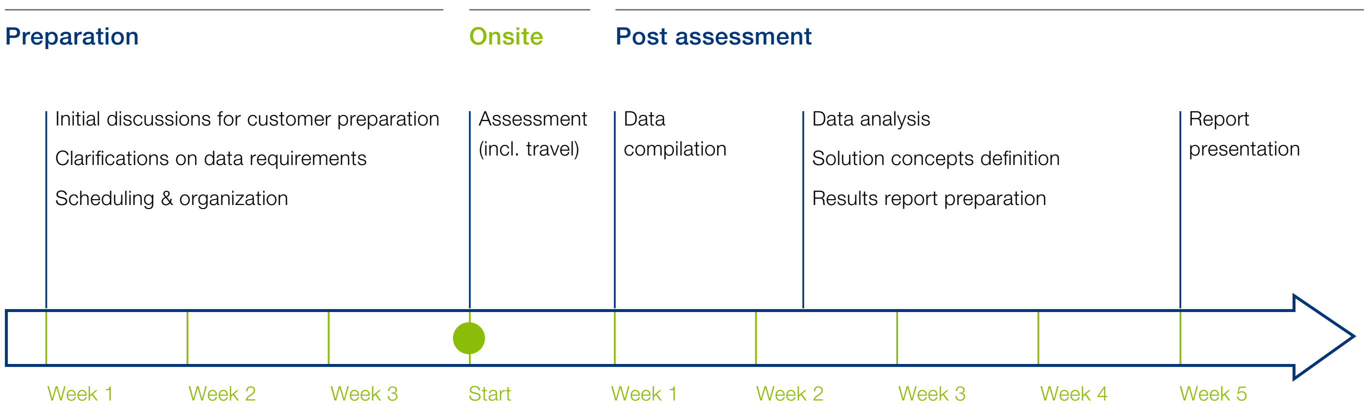


The pictures on this page show an example of OnEfficiency.Strength for Corrugated Medium, Fluting and Testliner.

Contact us to learn more about the solution for your specific paper machine!

The way to OnEfficiency.Strength

To define the right OnEfficiency.Strength solution for a specific paper machine and to calculate the individual savings potential, a value add assessment (VAA) is carried out. As part of the VAA the initial models for the virtual sensors are built to ensure maximum certainty when planning the project.



Saving examples

Example calculations of the savings potential for different grades

Metric	Testliner	Copy	Kraftliner
Production/year	350 000 t/a	350 000 t/a	420 000 t/a
Fiber cost	100 €/t	300 €/t	500 €/t
Starch cost	350 €/t	–	–
Filler cost	–	150 €/t	–
Average basis weight	100 g/m²	80 g/m²	180 g/m²
Savings are achieved by	Reduction of starch while optimizing fiber usage	Reduction of fiber usage & replacement by filler	Reduction of fiber usage
Optimization	↓ 0.50 g/m² starch	↓ 0.50 g/m² fibers ↑ 0.24 g/m² filler	↓ 3.50 g/m² fibers
Total fiber reduction	1 750 t/a (-0.5 %)	3 240 t/a (-0.9 %)	8 150 t/a (-1.9 %)
Total savings	**440 000 €/a (1.3 €/t)**	**814 000 €/a (2.3 €/t)**	**4 000 000 €/a (9.5 €/t)**

Contact us for more information and for an estimation of your individual savings potential!

Voith Group
St. Poeltener Str. 43
89522 Heidenheim, Germany

Contact:
Phone +49 7321 37-9429
Maria.Knauer@voith.com
www.voith.com/papermaking40

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