Towards autonomous mills
Driving efficiency with intelligent technologies

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## Opportunities of Digitalization in Pulp & Paper

### Example use cases in the paper and forest-products industry

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**Total opportunity** ~10% ~15% 5 p.p.
Mill of the future facilitated by Valmet Industrial Internet solutions

We want to empower our customers to move towards autonomous mills and plants through data driven solutions and by collaborating across the value chain

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### Digital workflow
- Changes the way you work

- **Connect people at work** or on the move to support more efficient operations and maintenance
- **Understand when and where your resources are needed through predictive applications**
- **Develop competencies** through training simulators, online learning and virtual reality solutions

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### Data-driven performance
- Utilize your data

- **Understand root causes** and **improvement potential** from historical data through data discovery
- **Identify upcoming problems** and improvement **opportunity** through advanced monitoring and predictive applications, and react accordingly
- **Optimize process areas** and **machines** through advanced process controls

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### Value-chain optimization
- Changing your business

- **Maximize mill profit** through optimizing production and quality across the process areas
- Integrate and visualize **information throughout the value chain**
- Open **ecosystem** and partnership
Case 1

Advanced analytics and optimization on PM
Actionable insight
Paper strength prediction combined with advanced process controls

**Challenge:** In the paper production process operators control paper strength and other quality variables based on laboratory measurements (time delay)

**Solution:**
- A decision support application for the operator to control paper strength level to minimize raw material cost
- VPC in key role to maintain the application

**Example results from magazine paper:**
- Real time information on paper strength to operators gave 1-2% savings in raw material consumption (~1M€ per year)

Kraft amount difference inside the target window (max and min): 3 – 4% → 3.1 – 4.1 MEUR / Year
Real time quality prediction for raw material savings

Sensor Data & model based strength prediction

Strength is predicted real time and visualized for operators in control room

User Interface for real time quality prediction

Control Actions

Results

Annual raw material savings

~1M€
Optimizing controls are reducing need for manual operation
Advanced process controls for optimizing paper strength

Automatic control runs paper strength closer to minimum accepted limit for minimizing overquality and raw material cost.

Results

- CD Tear variability reduced: 29%
- Kraft fiber savings (absolute %): 2.5%
- Additional annual raw material savings: >2M€
Case 2

Mill Wide Optimization – automated decision making
Mill of the future
Facilitated by Industrial Internet

- Assisted decision making
- Mill wide optimization
- Existing advanced process controls
- Advanced control optimization
- Local & VPC service
- Closed loop optimization of KPIs
- Operator advisory applications
- Local & VPC service
- Process optimization
- Local & VPC service
- Process recommendations, equipment and process modifications
- Mill wide optimization applications and services
- Mill wide optimization

Performance

Performance predictions

Local & VPC service

Local & VPC service

Actionable insight through advanced analytics

Monitor and report

Advise

Control

Optimize

Quality visualization

Savings

*VPC=Valmet Performance Center i.e. remote expert support
Optimization pulp mill
Benefits of APC and analyzers cascade forward

Annual pulp production:
- HW ~ 460 000 Adt
- SW ~ 270 000 Adt

Results
- Kappa variability reduction and optimized use of chemicals saves >5M€

Results where achieved through:
- Process analysis and consulting
- Continuous monitoring of performance
- Operator training
- Debottlenecking of controller constraints
- Maximizing controls utilization
- Proactive troubleshooting
- 24/7 phone and email support

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 + ESP Power Optimizer
- Increased production rate 1-3%
- Increase electricity production 1-4%

Steam network Manager
- Ventilated steam production up to 95%
- HP Header variability reduction 50%

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

Evaporation Optimizer
- Increased burning liquor 1-3%

Lime Kiln Optimizer
- Decreased energy consumption 3-7%

Causticizing Optimizer
- Increased production rate 5-8%

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

FIBER LINE
- Power boiler
- Annual pulp production:
  - HW ~ 460 000 Adt
  - SW ~ 270 000 Adt

Results
- Lowered cost of goods sold
- Improved product quality
- Increased production rate
- Decreased energy consumption
- Extended equipment life
- Reduced water usage
- Lowered fuel consumption
- Reduced chemical consumption
- Reduced emissions

Valmet Combustion Manager
- Increased production rate 1-3%
- Air flow optimization
- Combustion efficiency increase

Steam Network Manager
- Ventilated steam production up to 95%
- HP Header variability reduction 50%

Valmet IQ Optimizer (QCS)
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**Mill of the future**

Facilitated by Industrial Internet

- Performance predictions
- Local & VPC service
- Quality visualization
- Operator advisory applications
- Advanced control optimization
- Local & VPC service
- Closed loop optimization of KPIs
- Process recommendations, equipment and process modifications

*VPC=Valmet Performance Center i.e. remote expert support*
Valmet Mill Wide Optimization

Process Flowsheet Optimization

Process Flowsheet Simulation and Optimization

- Pulp and paper mill is modeled as a flowsheet
- Includes mass balances, time delays, and inventory constraints
- Pulp and liquor production, components, and properties are tracked through the process
- Flowsheet is treated as a set of equations that is solved simultaneously, calculating the optimum now and in the future
Mill Wide Optimization
High level process coordination and optimization

- Production maximization and/or stabilization
- On-spec final quality and production plan met at minimum costs
- Visibility of process stream quality, cost and worth across the mill

- Profit improvement potential evaluated at mill level

Mill Production Planner
Coordinate and balance pulp and liquor production

Mill Quality Planner
Set quality targets from feed to final product

Grade Scheduler
Achieve production plan at maximum profit

Quality Tracker
Track pulp and liquor quality through mill

Cost and Value Tracker
Track pulp and liquor cost and value through mill

Process Data Validator
Improve data reliability and detect errors

Wood Handling

Cooking
Kappa models

Bleaching

Fiberline

Stock Preparation

Evaporation Plant

Paper Machine

Paper quality models

Pulp quality models

Grade Scheduler

Grade Scheduler

Quality Tracker

Cost and Value Tracker

Process Data Validator

Mill-wide mass balance

Causticizing Plant and Lime Kiln

Recovery Boiler

Wood Handling

Cooking
Kappa models

Bleaching

Fiberline

Stock Preparation

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Paper Machine

Paper quality models

Pulp quality models

Grade Scheduler

Grade Scheduler

Quality Tracker

Cost and Value Tracker

Process Data Validator

Mill-wide mass balance
Control Room of the Future
Real-time centralized automated decision making

- Operating decisions are based on the total mill balance and forecast
- Process area decisions are coordinated to maximize profit subject to product quality and process stability

DCS Display of the Future
- high level view of mill performance