DATA-DRIVEN DECISION MAKING IN PAPER MACHINES USING VIRTUAL MEASUREMENTS

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Extended Solutions Services

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Virtual Measurements

Agenda

O1. Challenges facing paper mills

O2. Introducing Virtual Measurements

O3. Methodology

O4. Case study

Challenges facing papermakers

Lost profit due to variability quality/process parameters

Variability in paper properties can lead to rejects and off-spec tonnage.

No online measurement if QCS is unavailable

Long start up times excessive time to re-thread machine after sheet breaks due to quality changes

Slide 3

Where do we need Virtual Measurements?

Enhance efficiency and decision-making

- **Platform for Monitoring**

  - Real time information on *chemical*, *physical*, and *mechanical* operations

  - Ensure *efficiency, quality*, and *sustainability*

- **Traditional Measures Limitations**

  - Rely on physical sensors operations

  - High cost and maintenance issues

  - Difficulties in measuring certain variables in real-time.

Operators can optimize machine settings, material usage, and throughput

Slide 4

ABB's innovative Virtual Measurement technology

- **Enhances Quality Control**
  - Provides real-time data on paper properties
  - Allows for immediate adjustments
  - Reduces waste

- **Improves Cost Efficiency**
  - Enhances operational stability
  - Increases productivity
  - Promotes sustainability
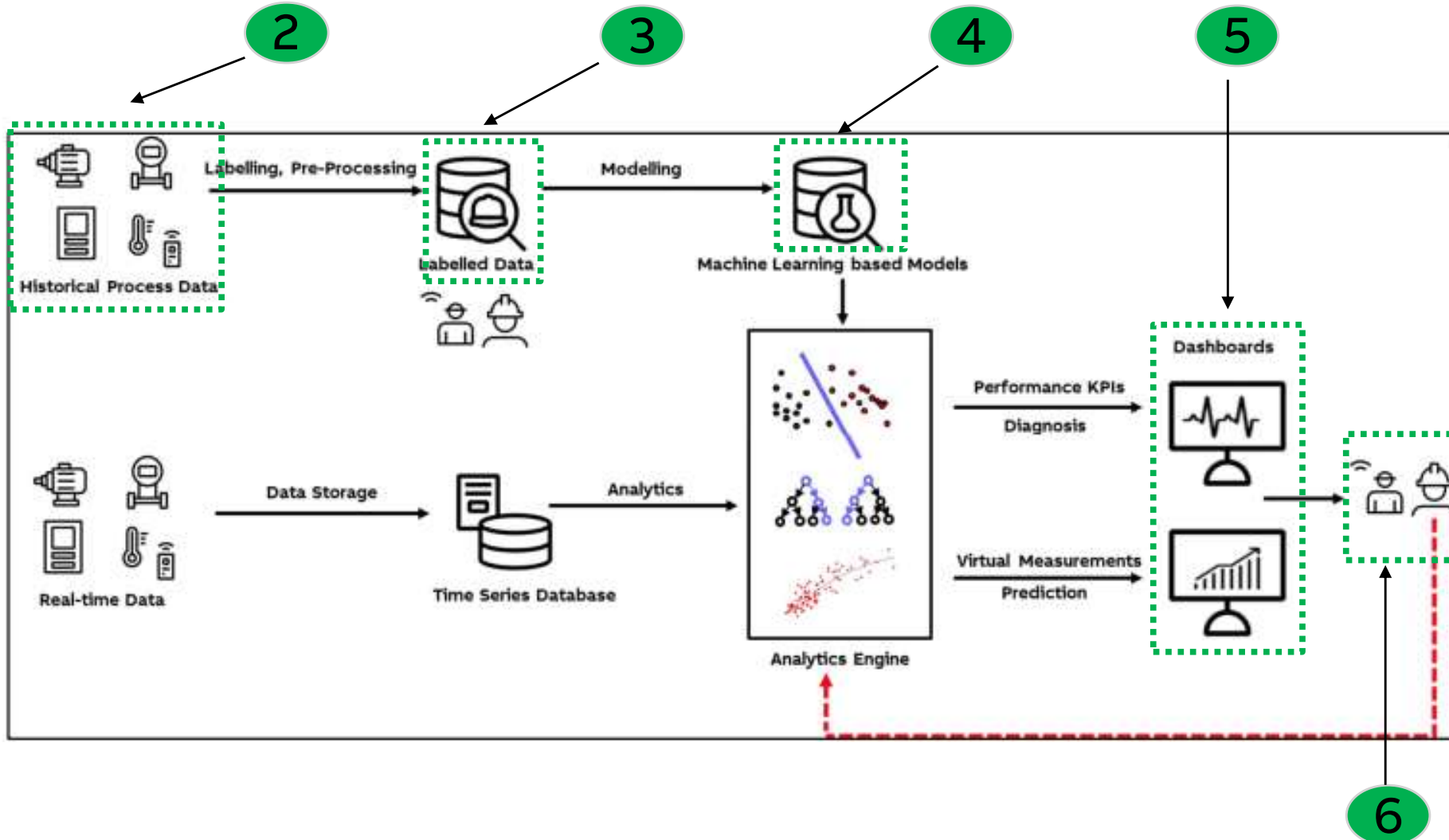 - Improves profitability

How are Virtual Measurements Developed?

Operator Guidance

Mathematical Models

Data-driven Algorithms

Virtual Measurements

Physical Sensors

Process Models

ML Techniques
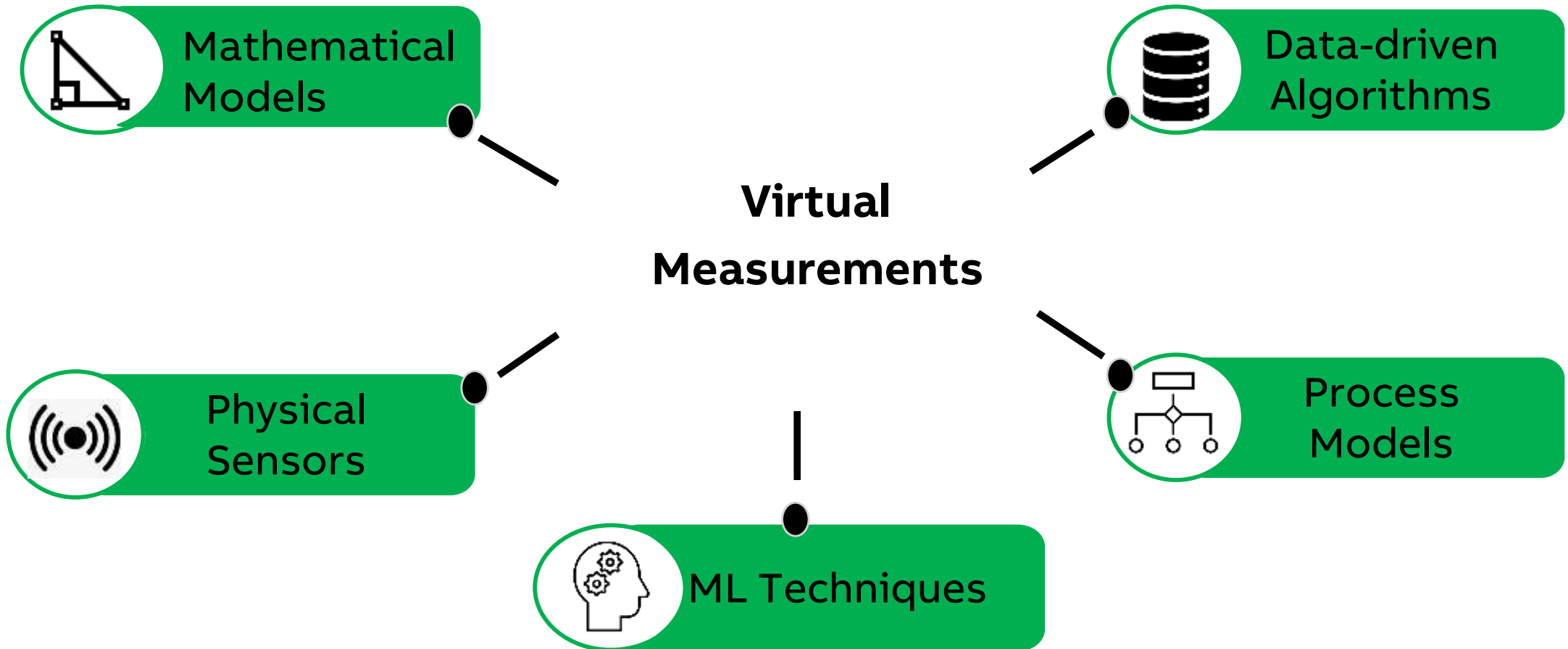
Methodology for Virtual Measurement Implementation

1. Define Objective
2. Data Collection
3. Data Preprocessing
4. Model Development
5. Integration & Testing
6. Deployment & Maintenance

Slide 7

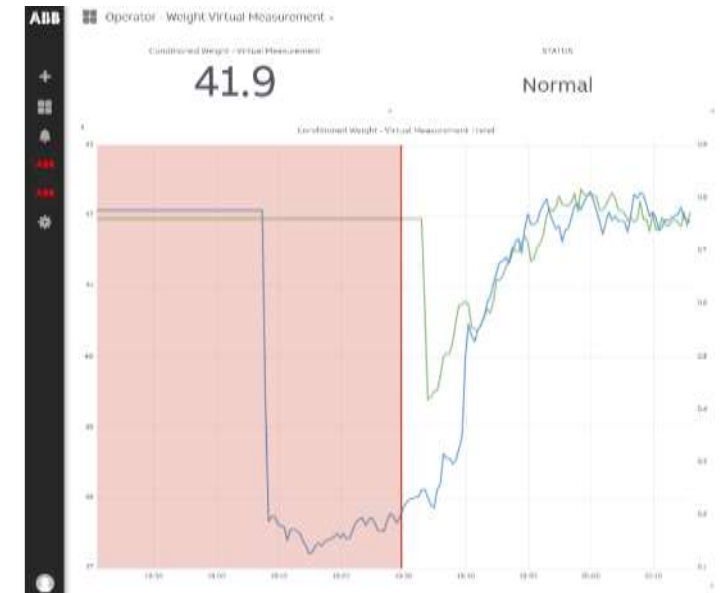# USE CASE

Weight Virtual Measurement (WVM)
Get on target faster with accurate, online virtual measurements

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ABB's Conditioned Weight Measurement

- Utilizes continuously optimized predictive calculations.

- Provides measurements when the QCS scanner is unavailable.

- Reduces off-specification paper

*No action taken from WVM*

WVM used to get on target faster

Legend:

─── QCS weight measurement ─── Weight Virtual Measurement ▮ Sheet break

Slide 9

Condition Weight Virtual Measurement

Benefits

- Reduces off-spec paper after sheet break and when experiencing long transport delays

- Decreases sheet break recovery time

- Improves runnability and start-up times

- Enables faster grade changes

- Increases mill profitability with more consistent quality

QCS Measurement

Weight Virtual Measurement
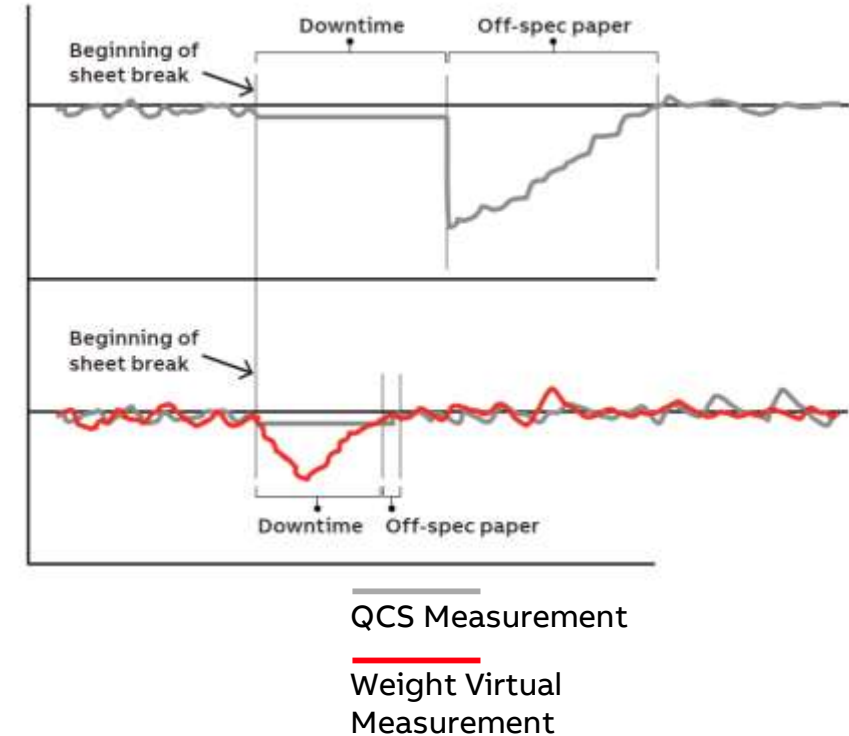
Operators can use the information to make stock flow adjustments to maintain weight

How is weight measured and impacted?
What we monitor, why, how it affects weight and anticipated outcomes of adjustments
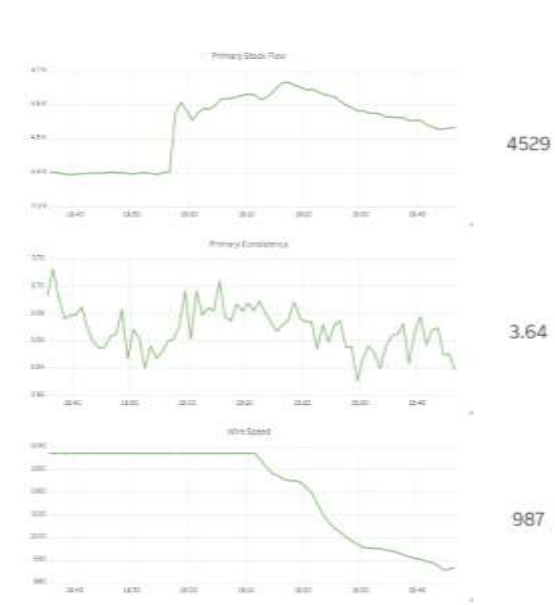
Inputs

Review machine-specific data to pull available inputs that affect weight

- Stock flow
- Consistency of the stock
- Wire speed
- Refining/freeness
- etc

Calculated weight display*

Curated inputs

Actions

Operators can make adjustments and see impact:

- Increase stock flow = increase weight
- Decrease machine speed = increase weight

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*Legend:
— QCS weight measurement   — Weight Virtual Measurement   ▮ Sheet break

Use case 1

Challenge

Lack of measurement during sheet breaks, start-up events and any scanner downtime/maintenance

35-minute sheet break recovery without reacting to virtual measurement

Solution

- Weight VM online KPIs
  - Virtual measurement available to operators during sheet breaks
  - Stock flow adjustments made during breaks to keep weight near target

Results

- Overall, 75% improved sheet break recovery

8-minute sheet break recovery when using Weight Virtual Measurement

Strength Virtual Measurement (SVM)
Challenge

Online measurement helps keep strength closer to off-spec limit to maximize profitability

- **Accurate Assessment Challenges:**
  - Reliance on periodic lab measurements.
  - Measurements conducted only after a reel is produced, leading to potential delays.
- **Impact on Process Optimization:**
  - Lack of frequent measurements.
  - Potentially affecting process optimization opportunities.
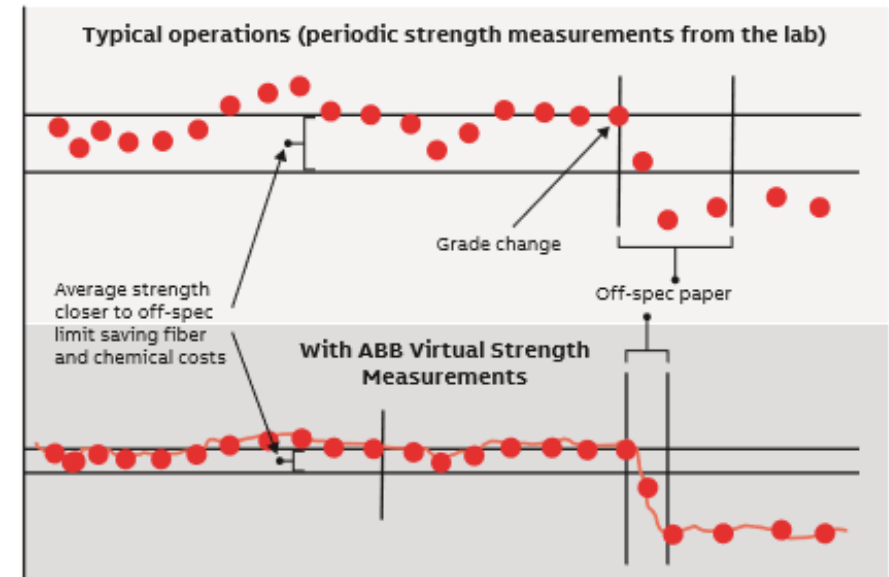 - Impacting profitability.

Operators can optimize machine settings, material usage, and throughput

Strength Virtual Measurement (SVM)
Benefits

Online measurement helps keep strength closer to off-spec limit to maximize profitability

- Enables more consistent quality
- Lowers fiber and/or chemical costs
- Increases throughput
- Enables faster grade changes
- Improves runnability
- Increases mill profitability

Typical operations (periodic strength measurements from the lab)

Grade change

Off-spec paper

Average strength closer to off-spec limit saving fiber and chemical costs

With ABB Virtual Strength Measurements

Operators can optimize machine settings, material usage, and throughput

Use case 2
Diagnose the root cause of sheet breaks

- In the Fig, Correlate the sheet break with abnormal behavior of the SVM

- By finding abnormal patterns, helps operators to investigate and pinpoint strength disturbance caused

- Preventive actions taken to prevent these situations from repeating in the future

Strength Virtual Measurement & Lab Reference Values
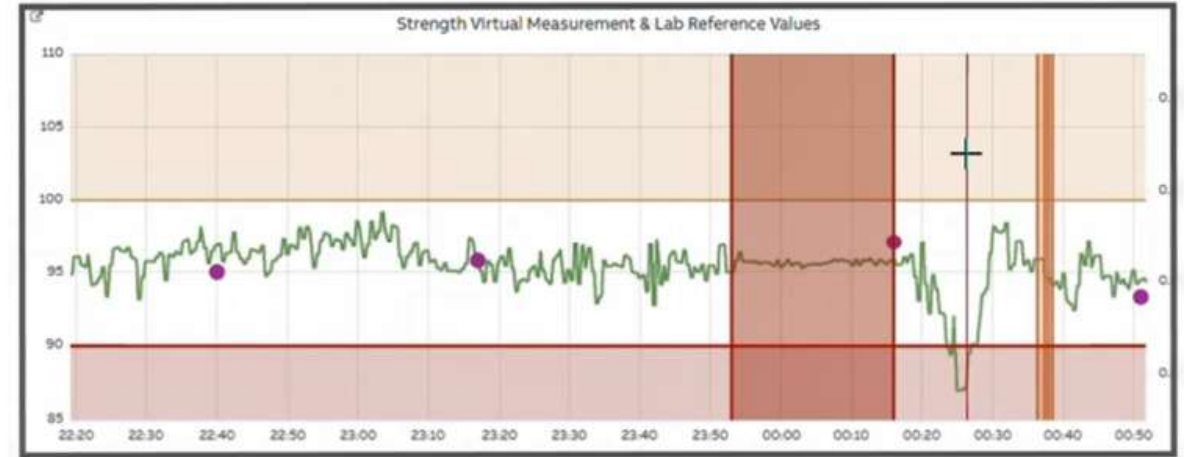
sheet breaks (red vertical shaded region in the Fig)

SVM used to identify out-of-spec production much before the reel was produced

Strength Virtual Measurement (SVM)

Results

- North American container board mill

   - Reduce reject by 3.5%

   - Increase machine speed by 6.5%

   - Decrease weight by 1.5%

Overall leading to significant financial savings.

Virtual Measurement features

Data, analytics, advanced modeling, user-friendly information and personalized expertise

ROBUST MODELING

Machine learning-generated calculation model built on expansive initial data set with inputs selected based on ABB expert analysis

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AUTO-CORRELATING

Auto-correlation algorithm leveraged for on-going accuracy with alerts for invalid events

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INTUITIVE DISPLAYS

Combines up-to-date data together with other KPIs to effectively calculate weight, show sheet breaks and inputs affecting weight

QUESTIONS?