Papermaker's experience with State-of-the-Art Automation

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May 1-4
PaperCon 2011
Northern Kentucky Convention Center

RETHINK PAPER:
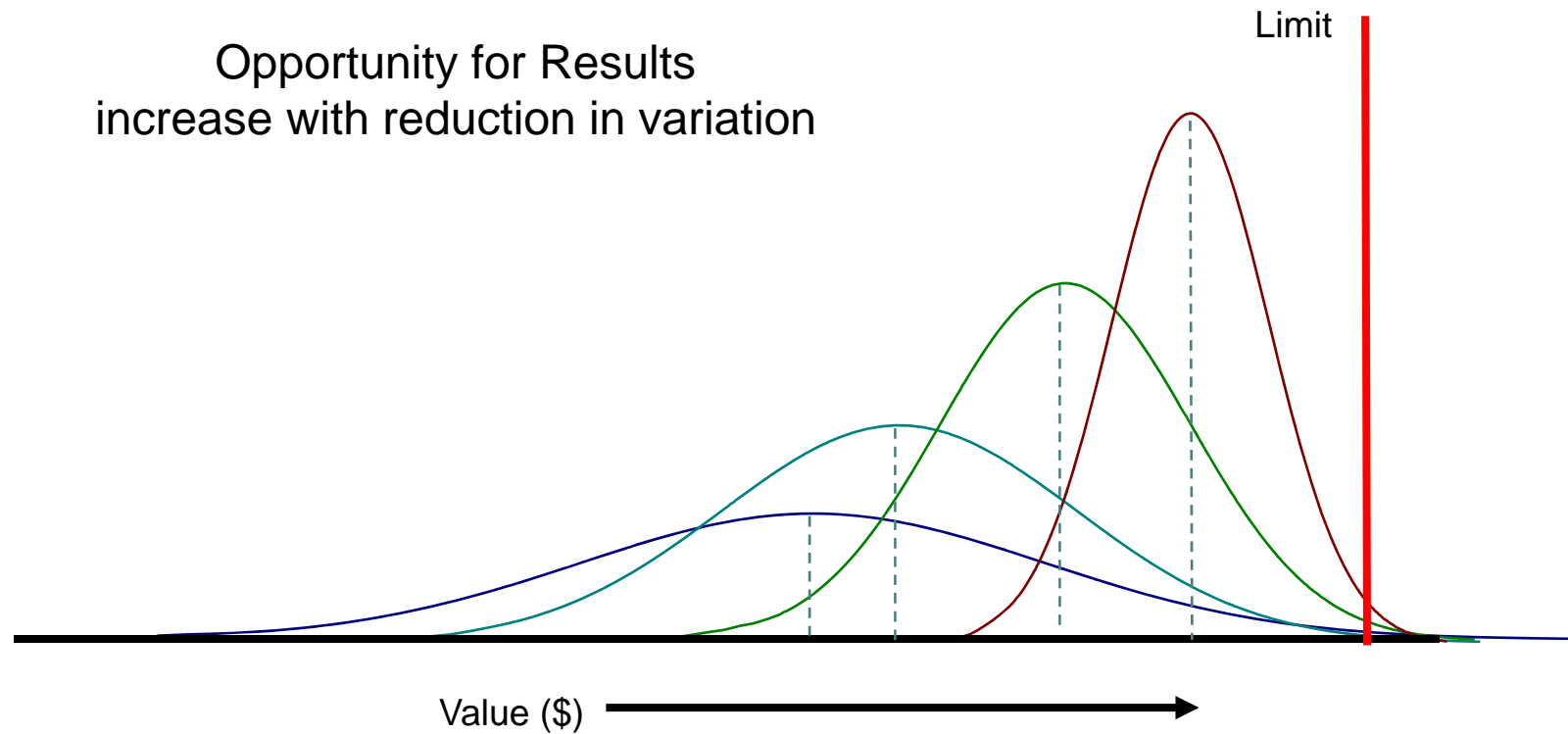Lean and Green

Presentation Topics

- Typical business case for Automation Investment
- Case History Experience
    - Best Practice Implementation
    - Asset Effectiveness
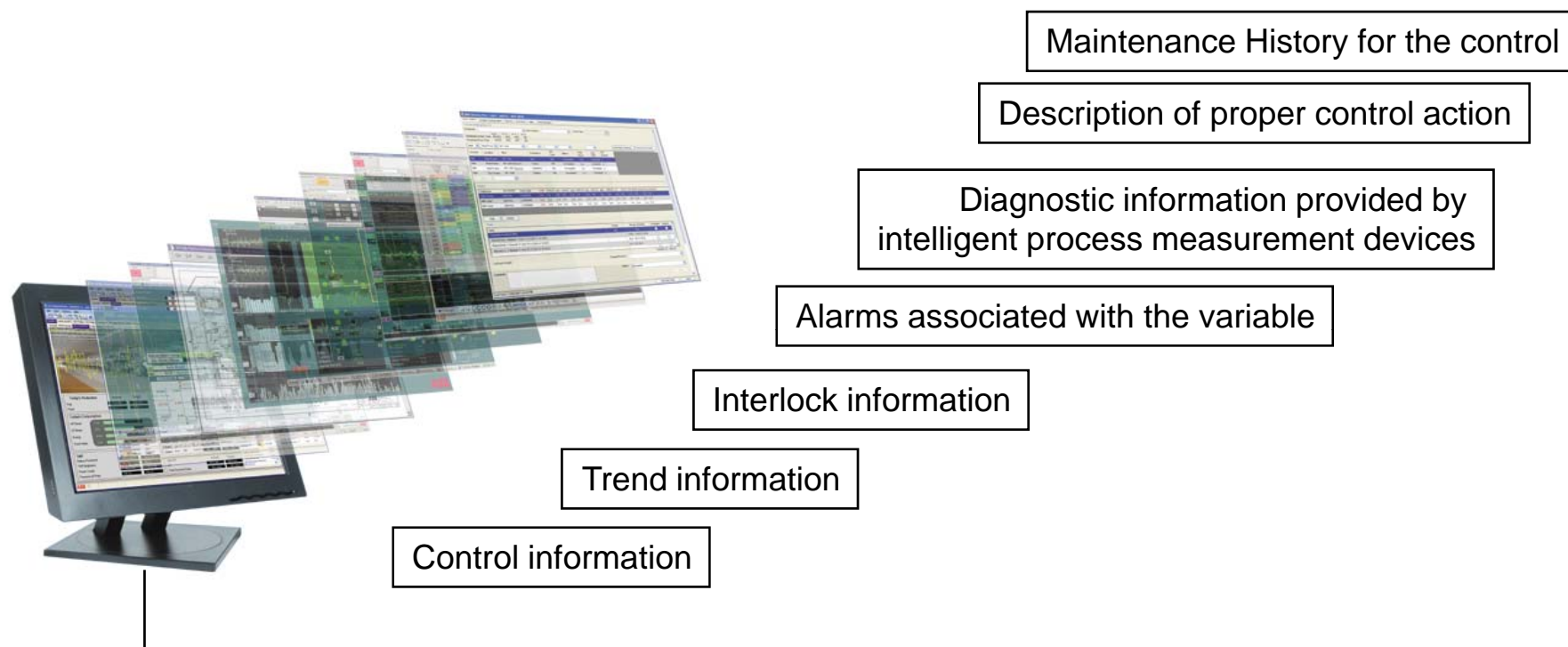   - Optimization
- Results Prediction
- Challenge

Business Case for Automation Investment

Opportunity for Results
increase with reduction in variation

Limit

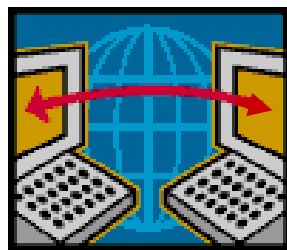Value ($)

State-of-the-Art Automation

Maintenance History for the control

Description of proper control action

Diagnostic information provided by intelligent process measurement devices

Alarms associated with the variable

Interlock information

Trend information

Control information
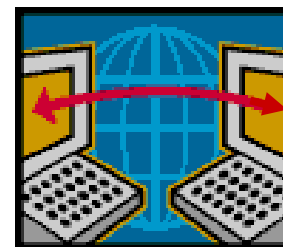
Mill Automation Computers

Mill Maintenance Computers

Mill Engineering Computers

Best Practice Implementation

How the user sees the information

Alarm

Mechanical

Standard Operating Procedure

Live Video

Asset Effectiveness

Product Documentation
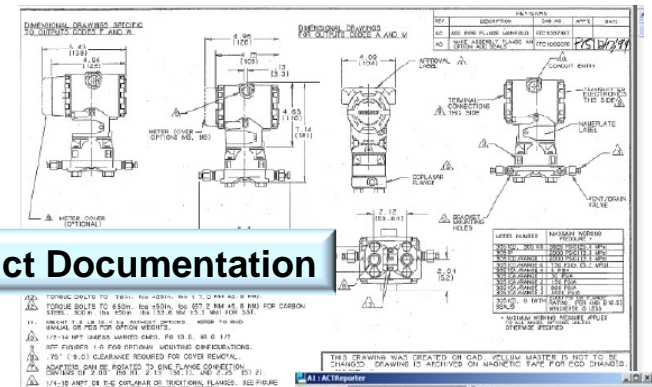
Diagnostic Information

Condition Information

Configuration

Operating Information
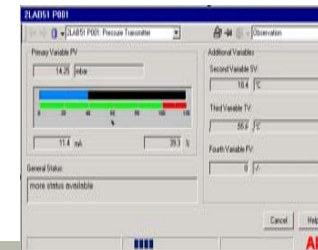
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Alarm Analysis

Top 20 Alarms
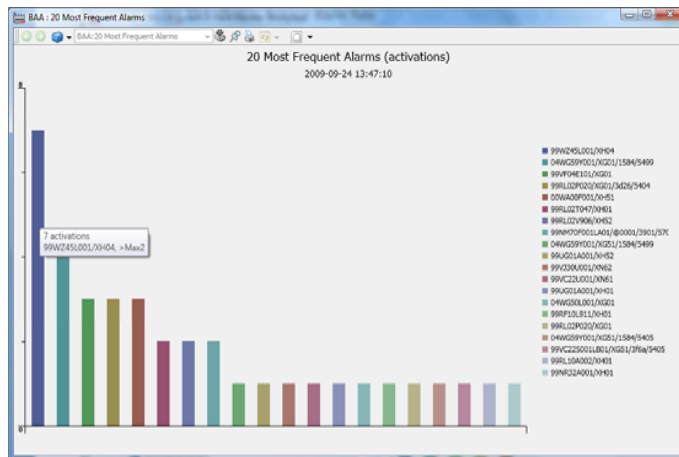
Active alarms, time in seconds
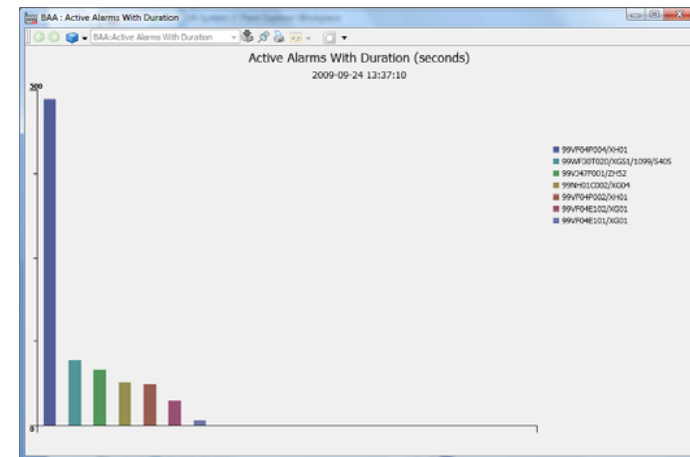
Top 20 longest in alarm state
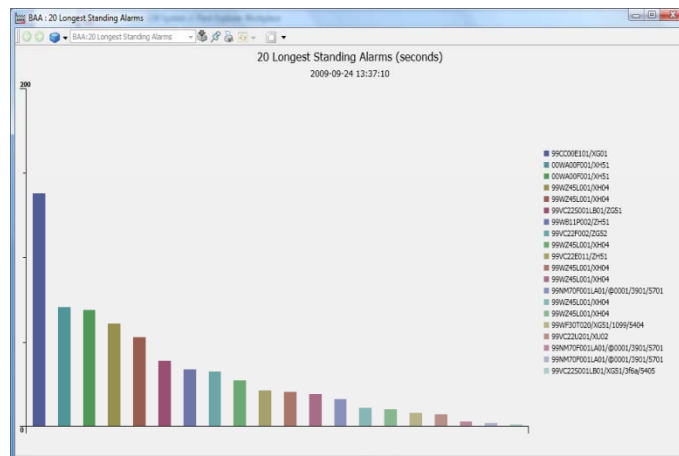
Distribution of alarm priority
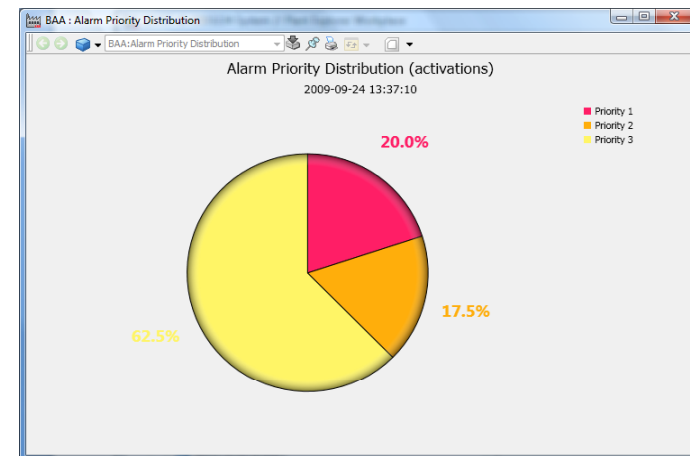
Optimization

Module Tasks

- Data Access
- Machine Testing
- Visualization
- Analysis
- KPI
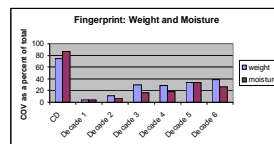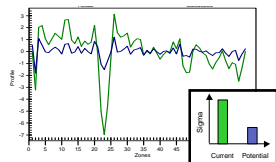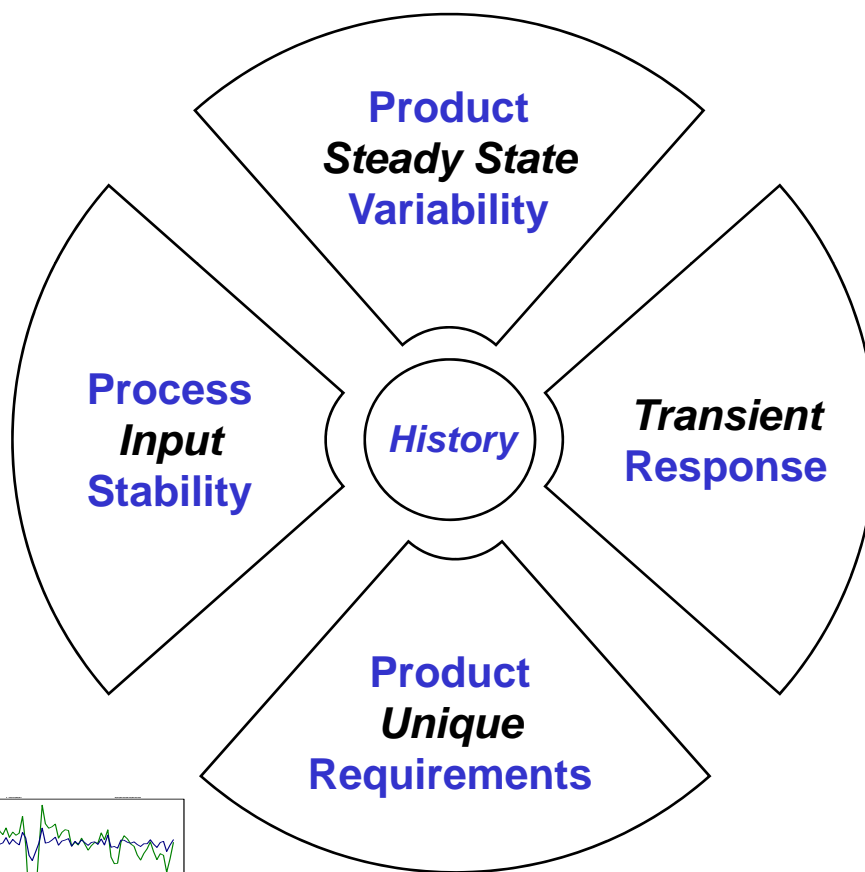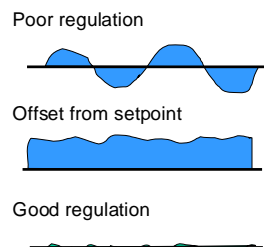
Module Reporting

- Return on Investment
- Performance Benchmark
- Summary of Findings
- Recommendations
- Implementation Plan
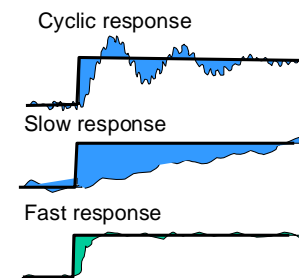
Diagnostics

- Complete
- Standard
- Efficient

Product *Steady State* **Variability**

Process *Input* **Stability**

History

Transient **Response**

Product *Unique* **Requirements**

Poor regulation

Offset from setpoint

Good regulation

Cyclic response

Slow response

Fast response

Fingerprint: Weight and Moisture

Optimization Areas

Grade Change

Speed Change / Speed Optimization

Sheet Break Recovery

Historical Data

| Mechanical Vibration Rotational | DCS Process and Control | MD Process and Control | CD Process and Control | Lab Testing |

Data Collection

Stock Delivery System
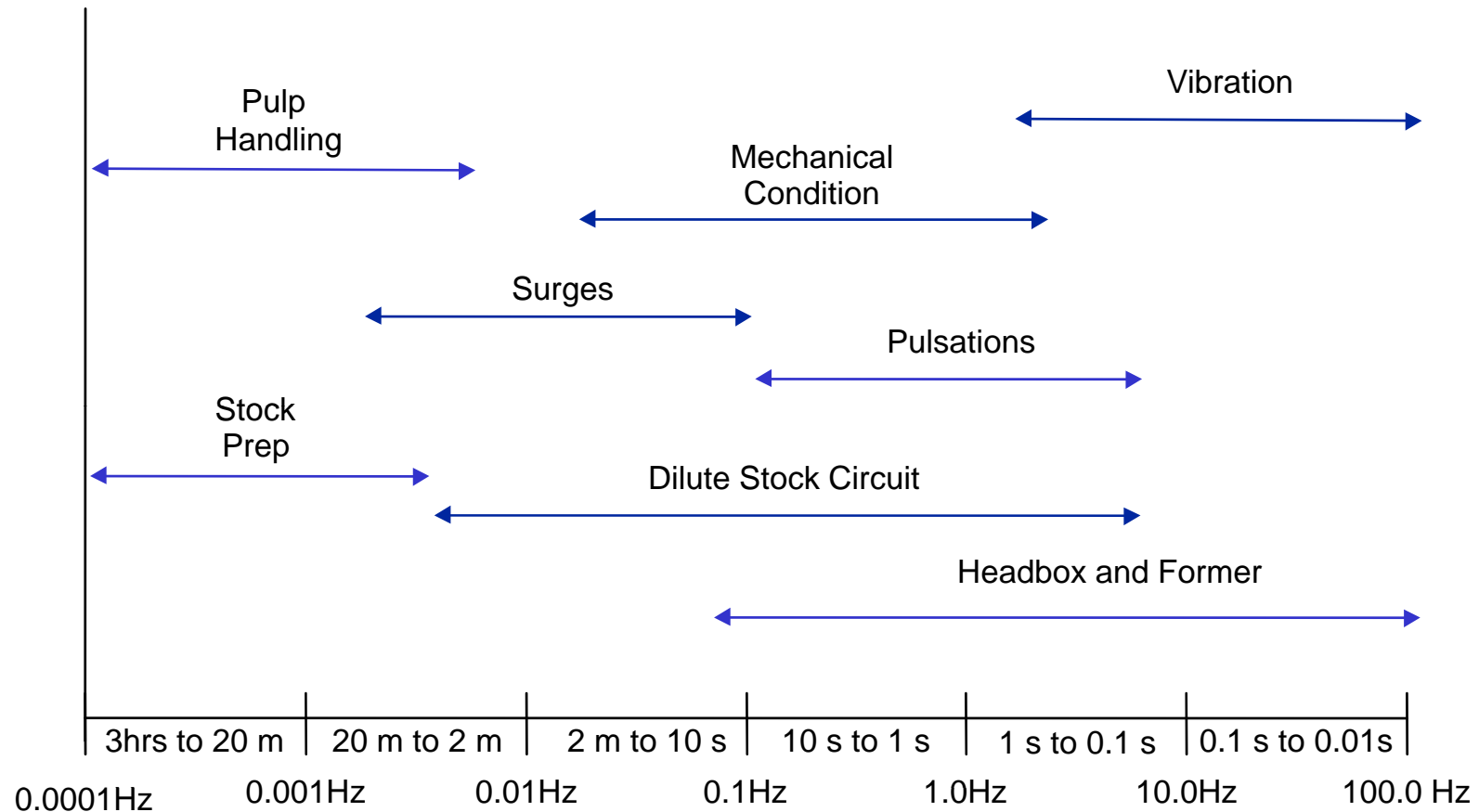
Diagnostic Capabilities

Provides information on:
- Controllable Energy
- Mechanical Pulsations of vibrations
- Benchmark of machine stability

Evaluates: Cyclic content of Weight and Moisture in: Cross Direction and Machine Direction from High Frequency up 500Hz down to Low Frequency of 5 hours.

Evaluates: On control Performance of: Total Head, Thick Stock Flow, Thick Stock Consistency, Machine Chest Level

Provides information on:
- Start up time
- Grade Change recovery
- Disturbance reduction
- Sheet break recovery
- Responsiveness

Product Variability

Fingerprint: Weight and Moisture

COV Weight = 5.17
COV Moisture = 36.45

Stock Approach Stability

Poor regulation

Offset from setpoint

Good regulation

History (VPA)

Machine Response

Cyclic response

Slow response

Fast response

Profiling Capability

Sigma

Current   Potential

Provides information on:
- Controllable Energy
- Stock Approach performance
- Tuning Quality
- Oscillation sources

Evaluates: Automatic and Manual mode operation of: Weight, Moisture, and Total Head.

Evaluates: On control Performance and model for: Weight, Moisture, and Caliper

Provides information on:
- Will CD control improve the profile?
- Is current CD control optimized?

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PM Module: Stock Stability Index

Indicates the stability of the Stock approach system. A high index suggests problems related to: process, control, mixing, etc.
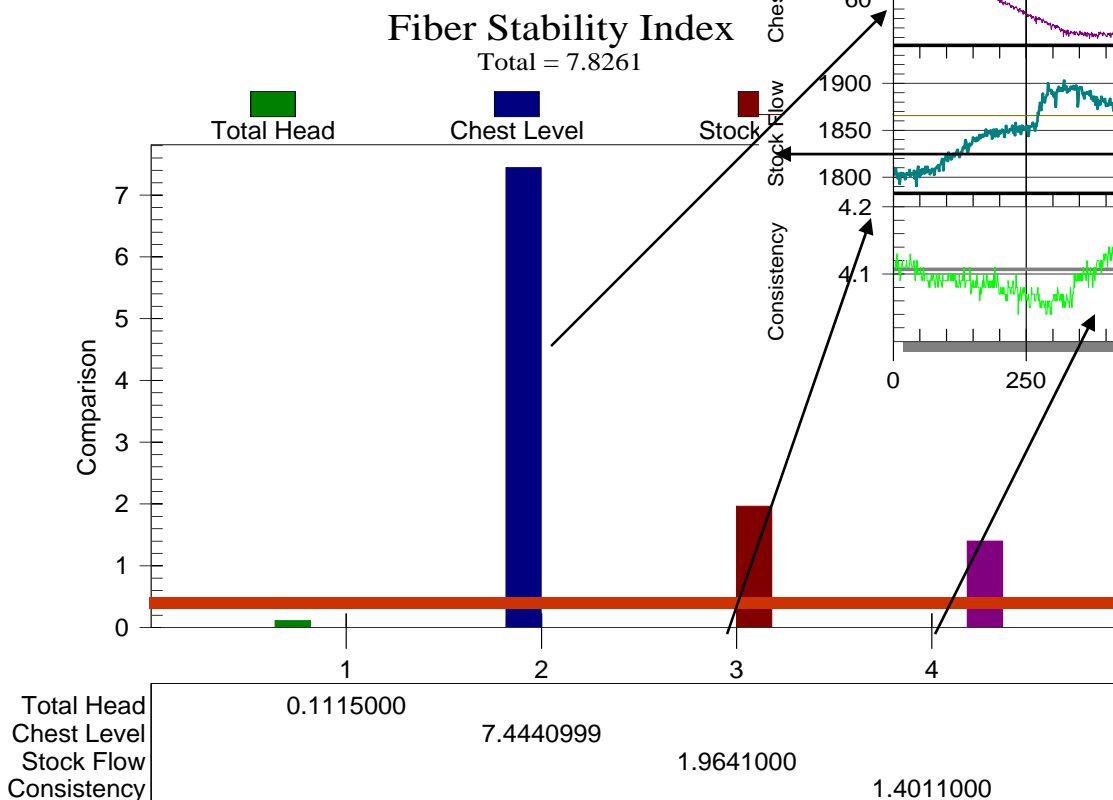
Fiber Stability Trends
Points = 1681

Fiber Stability Index
Total = 7.8261
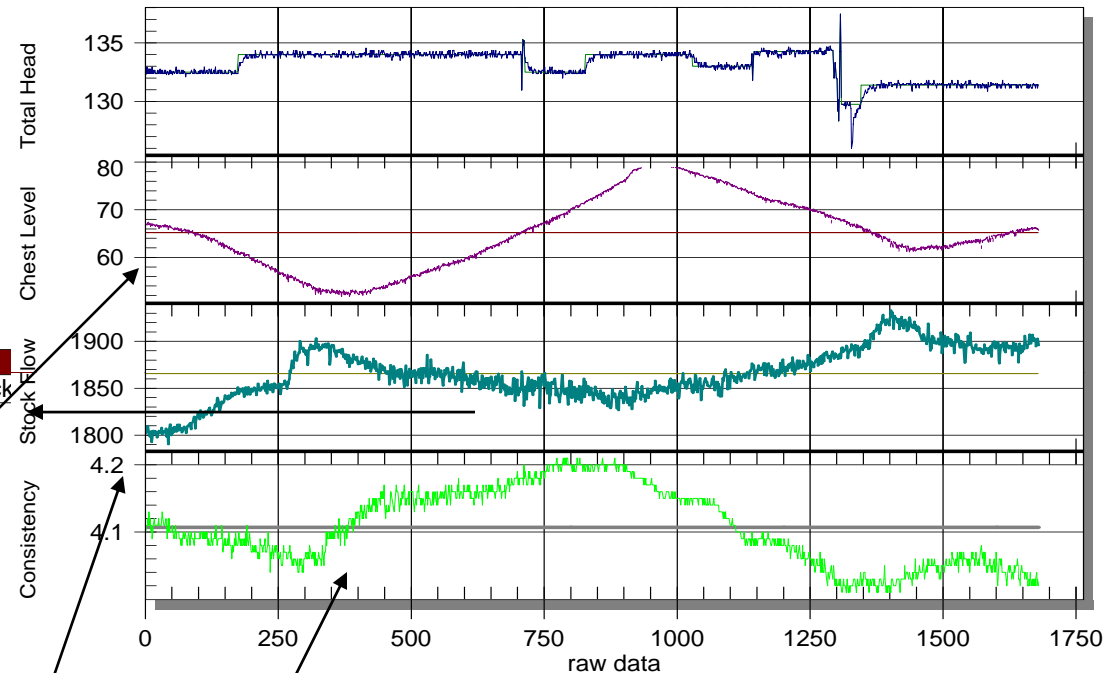
Raw Data Trend (~5 hours) shows that chest level impacts consistency and stock flow.

Index points to Machine chest level as the primary problem

	1	2	3	4
Total Head	0.1115000			
Chest Level		7.4440999		
Stock Flow			1.9641000	
Consistency				1.4011000

Transition Fingerprint: Paper Machine

Provides information on:
- Quality measurements during grade change
- limiting process measurements

Evaluates: Quantify grade change time for 30 to 60 grade changes

Evaluates: Control response during and after grade change

Transition Time

Control Response

Moisture Response

History

Provides information on:
- upstream and reel moisture response during grade change
- Upstream and reel moisture response to headbox changes

Setpoint Prediction

Evaluates: Moisture response during grade changes
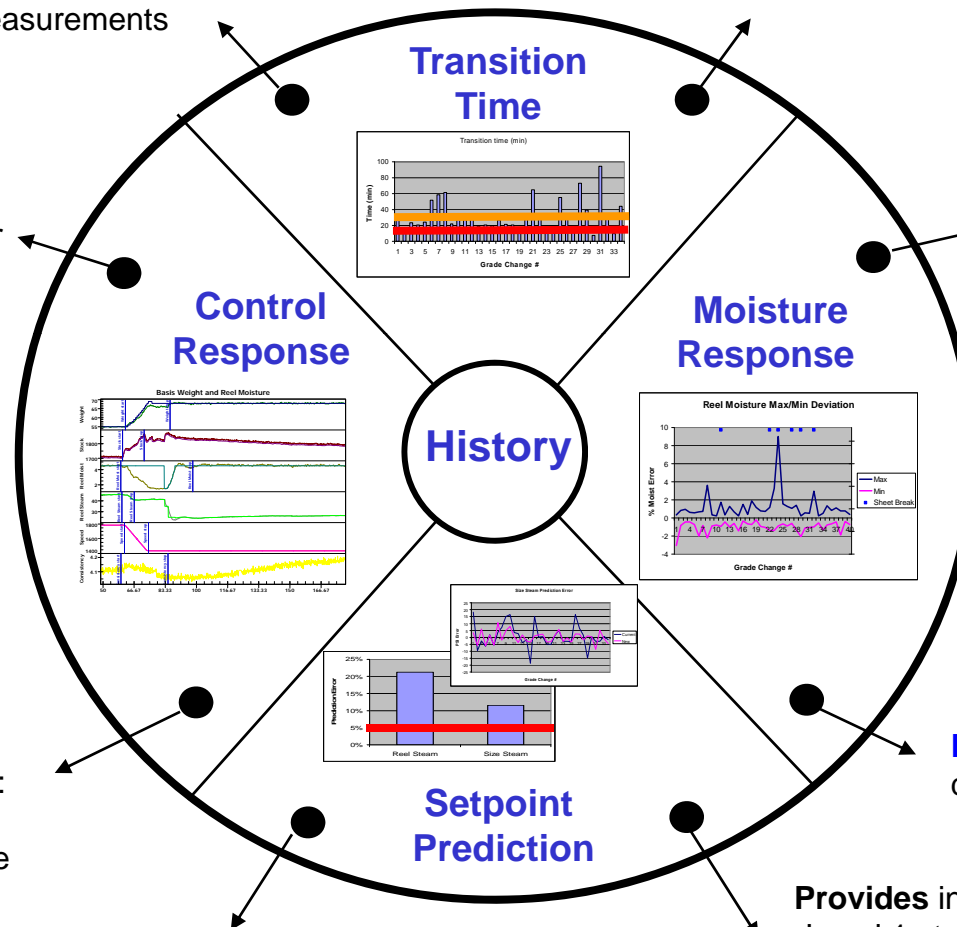
Provides information on:
- Level 1 PID response
- Level 2 control response

Evaluates: Grade change level 1 setpoint prediction

Provides information on:
- Level 1 steam pressure setpoint prediction
- Level 1 stock flow prediction

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Grade Change Time: KPI Tracking

Average grade change time: 42.5 min to 32.3 min! **24% improvement**

4 sheet breaks before corrective action. None observed after corrective action taken.

10 min per grade change production increase!

3 hour per month of extra production from reduced sheet breaks!

Results Prediction

1 to 3 % Efficiency improvements are realized by maximizing saleable production at planned production rates.

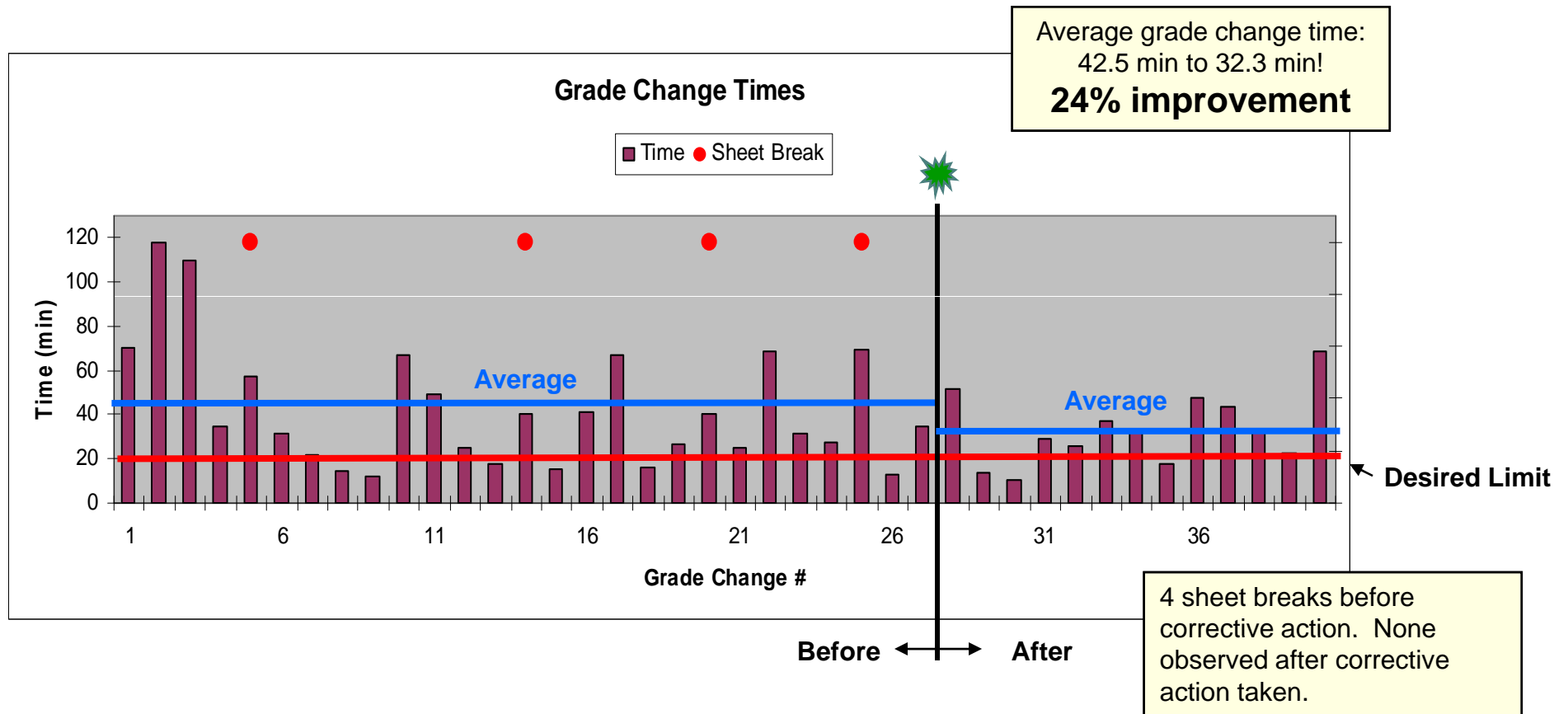| Theoretical Production Time |
|---|

| Planned Production Time | Planned Down Time | | Planning Factor (Pf) |

| Gross Operating Time | Unplanned down Time Losses | Process not running / *No stock on wire* | Availability Factor (A) |

| Net Operating Time | Speed Losses | Below target speed / *Breaks & Short Outages Stock on the wire* | Performance Factor (P) |

| Valuable Operating Time | Quality Losses | Does not meet spec / *Often referred to as: Broke, off grade, rejects* | Quality Factor (Q) |

Generalized model for evaluating efficiency

Paper Industry – Typical Values

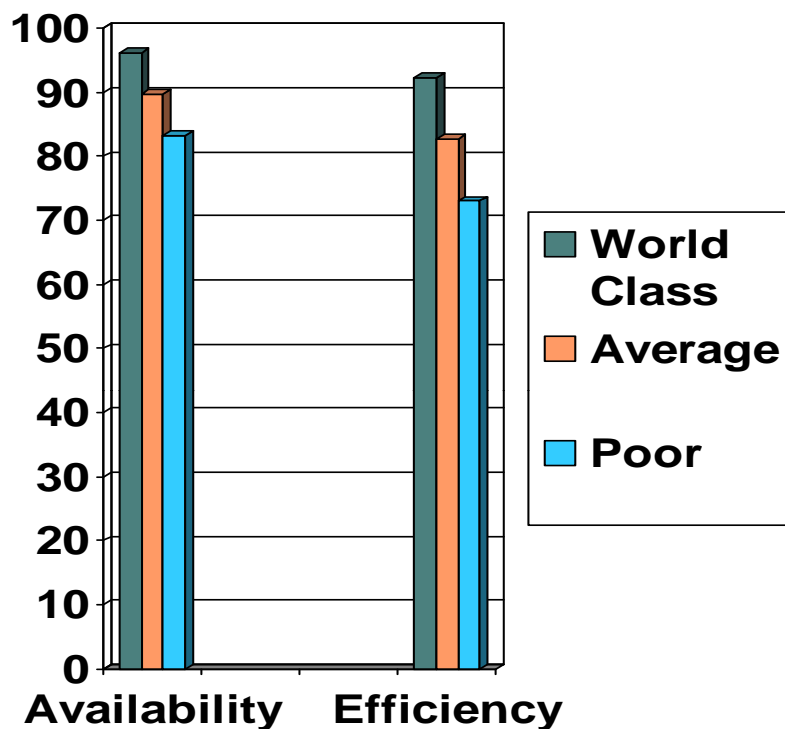| Typical values all grades	Parameter	Availability (Uptime)	Overall Machine Efficiency
		%	%
All Grades	Average	89.8	82.7
Survey Range - all grades	Low	83.3	73.0
	High	96.2	92.3
Recommended guideline for good operation	Parameter	Availability (Uptime)	Overall Machine Efficiency
		%	%
Bleach Board	Guidelines	93	84
Medium	Guidelines	94	91
Fine Paper	Guidelines	93	87
Fluff Pulp	Guidelines	95	92
Linerboard	Guidelines	94	91
Market Pulp	Guidelines	95	94

Source: Tappi

Typical Pulp and Paper Mill Performance

Gap Analysis Example

		7,2 %				
Speed losses	22,5 t/d	4,2 t/d	2,3 t/d	1,3 t/d	2,9 t/d	3,1 t/d
Speed losses due to grades	8,5 t/d					
Trim waste	0,6 t/d	240	130	77	167	176
Other waste	5 t/d					
Production Line Efficiency-% = Production efficiency % x (Gross Operation Time/Available time)% OR Efficiency-% = (100- A - P - Q)%	150 t/d	Web break	Downtime for other reasons	Unplanned maintenance downtime	Planned downtime	Non-mill factors

- 16,6 %
- 3 %
- 100 % production efficiency
- Gross Operating Efficiency
- Net Operating Efficiency

Net Operating time 7970 hours

Available Production time 8584 hours

Calendar Time 8760 hours

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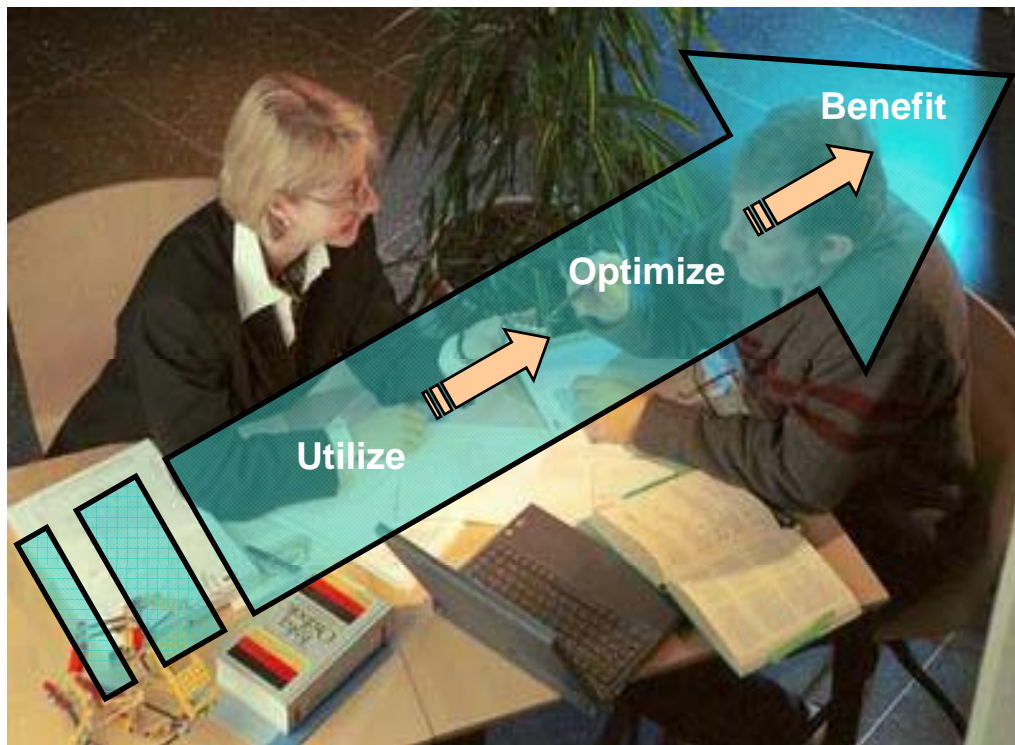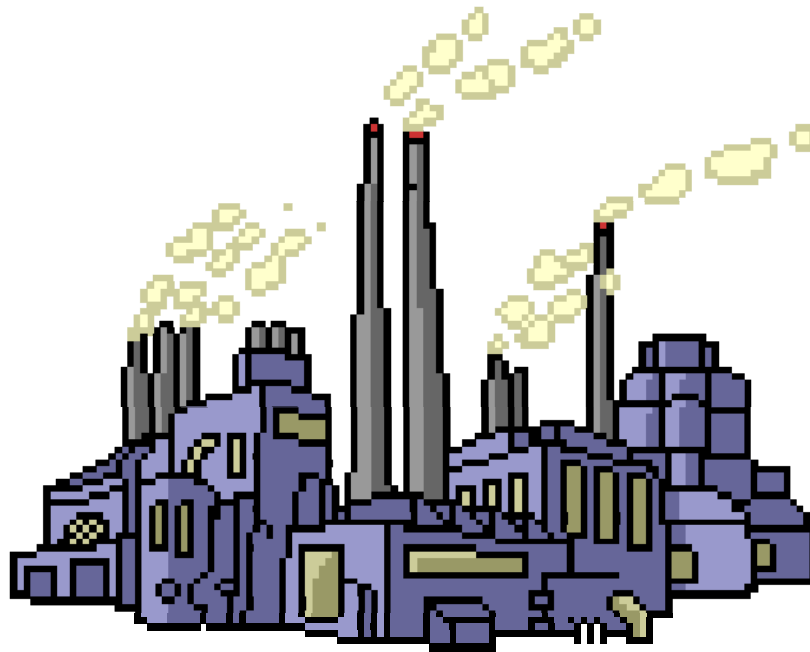# Visibility Tools help sustain performance
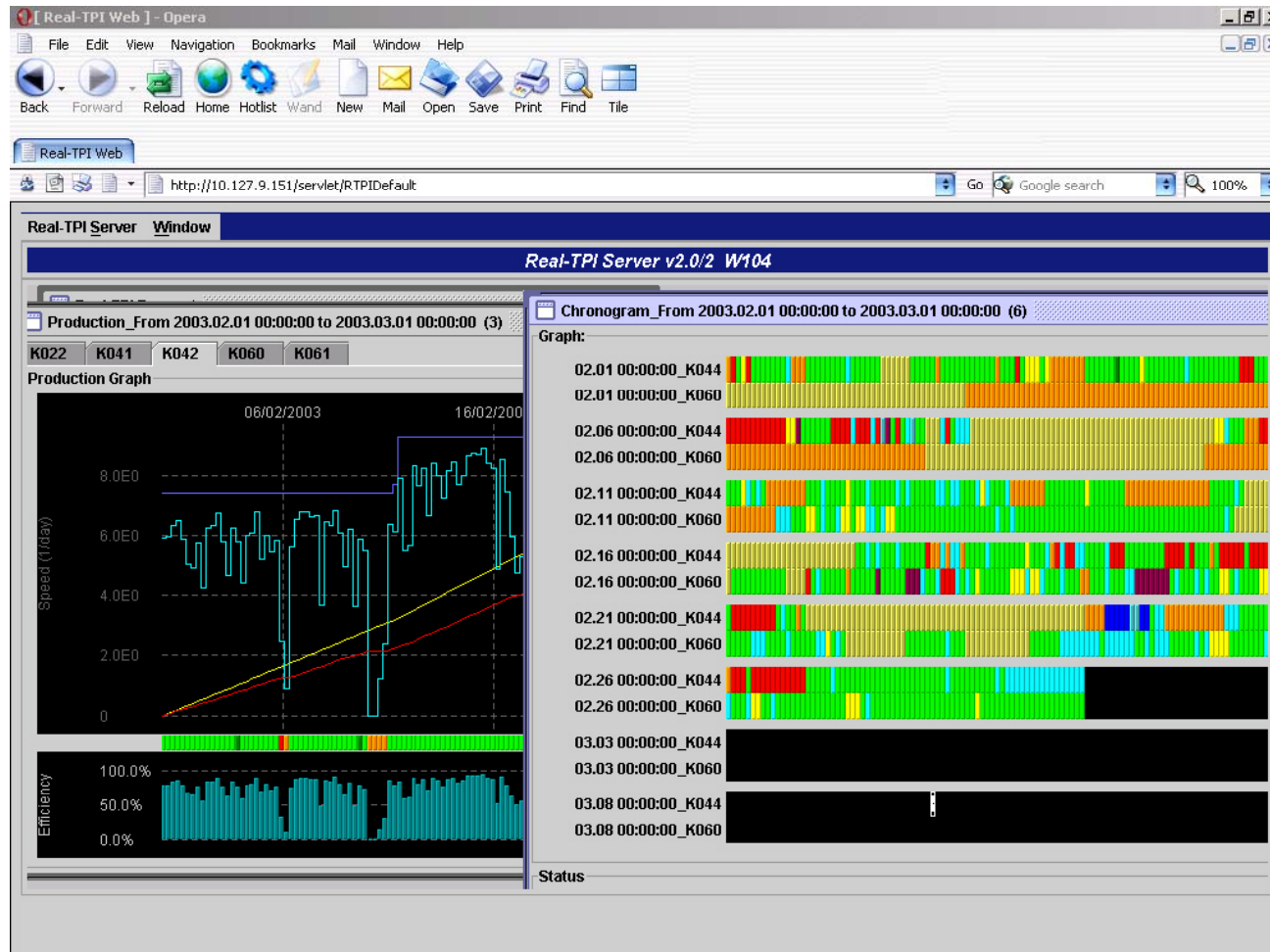
Case History Experience

Papermakers using these Capabilities today are Experiencing 1 to 3 % Efficiency Improvement

Challenge

As we consider the various types of information in the mill computer systems, our challenge is to consider how we can better leverage this information to improve mill operations.

Questions?