

A photograph showing a business meeting. Several people's hands are visible, pointing at various data visualization tools on a desk. There are printed documents with bar charts and line graphs, a tablet computer, and a calculator. The scene is brightly lit, suggesting an office environment.

Condition monitoring for process control

Overview of future Neles

Neles



Control valve solutions



On-off valve solutions



Intelligent safety valves



Valve Controllers, Actuators & Limit Switches



Valve services and spare parts



Leading position as flow control solution and services provider serving customers in oil & gas, petrochemicals, pulp, paper and bio industry and other process industries




Olli Isotalo
CEO

Vantaa, Finland
Headquarters

 **~2,900**
Employees

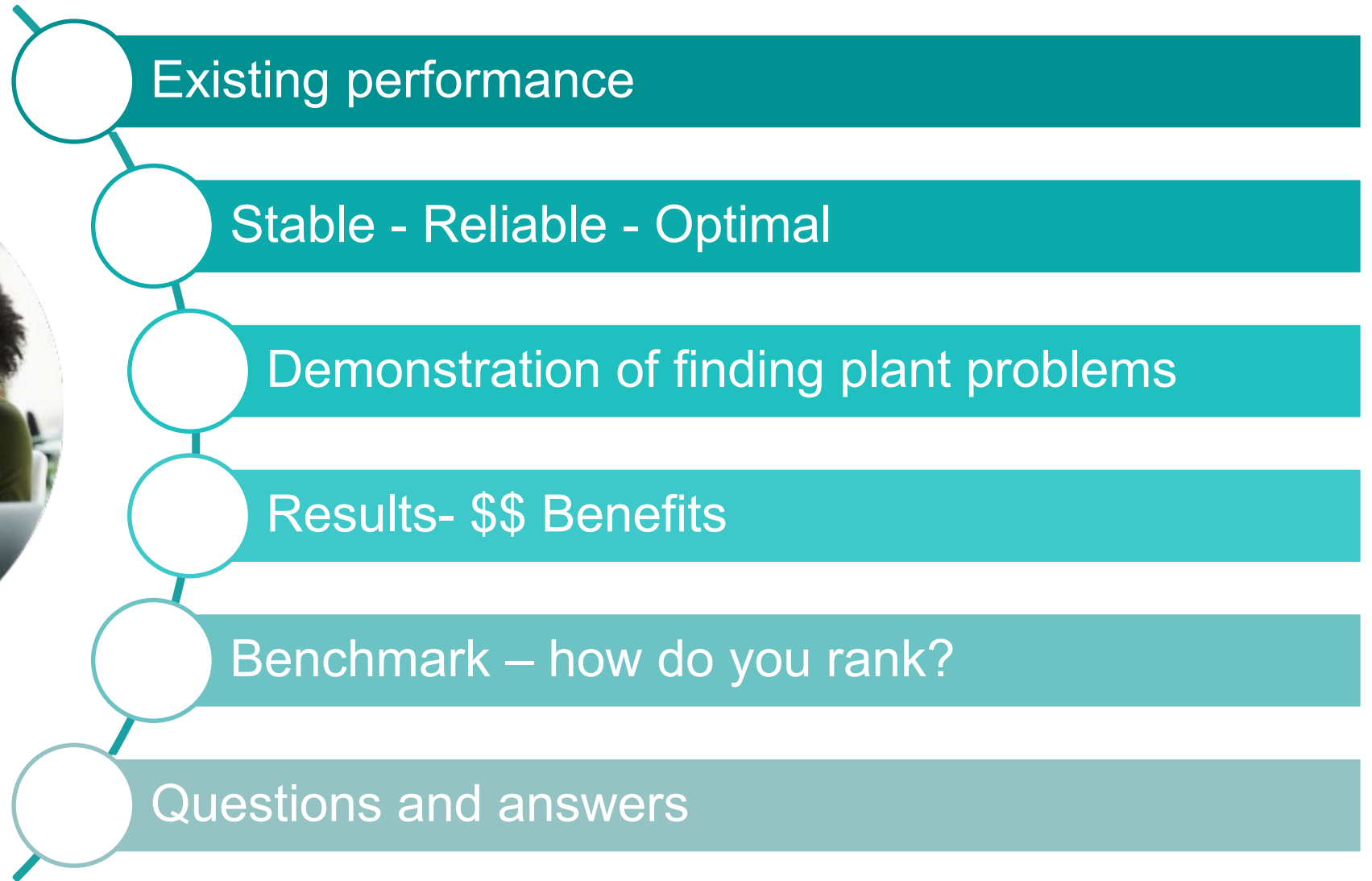
 **~40**
Countries present

 **~ 40**
Service Centers

The most modern valve plant footprint globally



40 service centers globally



Condition monitoring for optimal control performance



A worker wearing a hard hat and a safety vest is working on a complex industrial piping system. The worker is positioned in the center of the frame, looking upwards and to the right. The piping system consists of numerous parallel pipes running horizontally across the foreground and middle ground. The background is a bright, overexposed area, possibly a large window or an open industrial space.

10%-35% of control loops are in manual

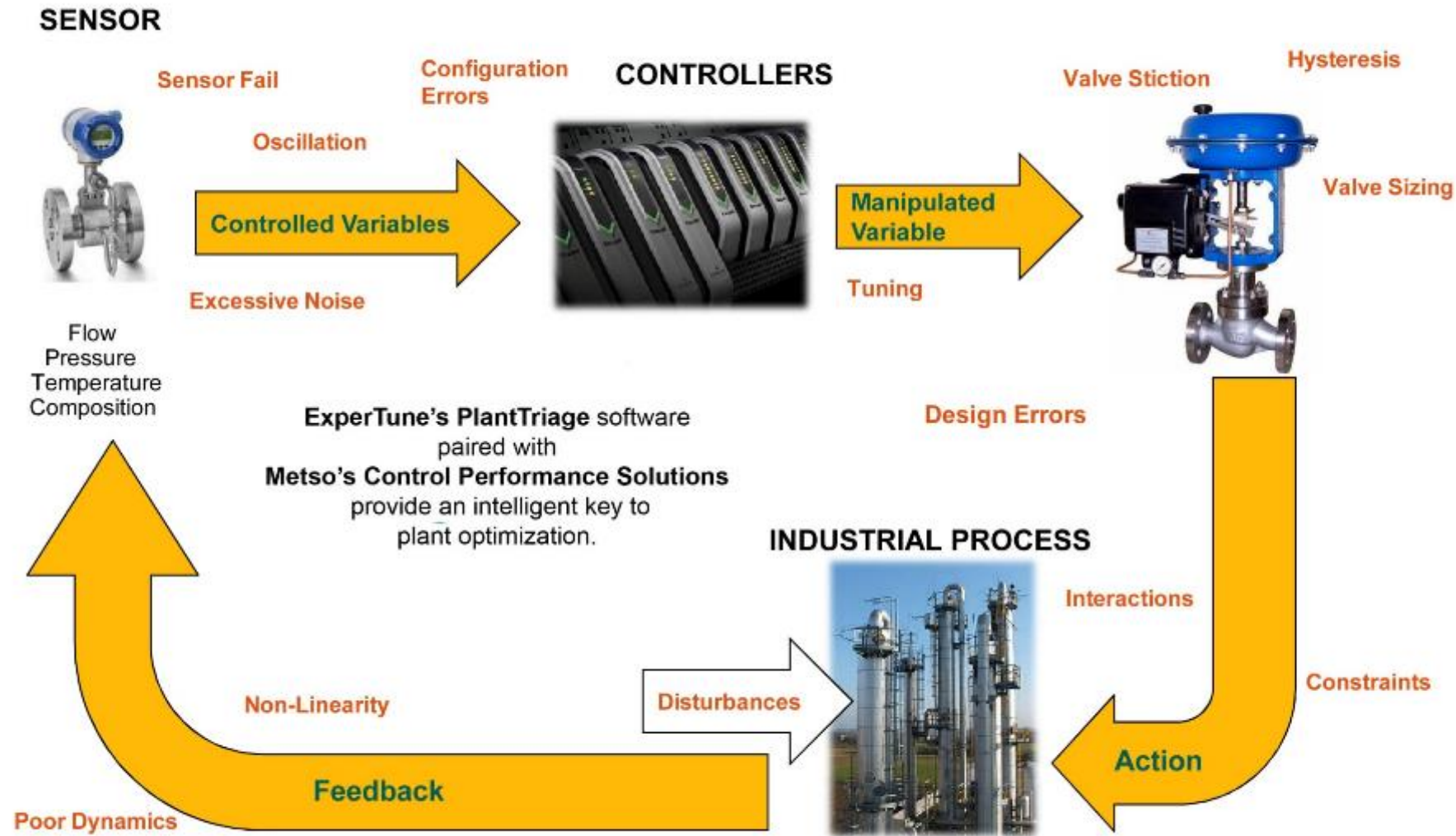
30% of control valves need maintenance

- Sites with no control performance program
 - 1.5M to 5.3M in under utilized assets by running in manual in a 1000 loop site
 - Are you repairing the correct valves?
 - 30% of control loops are tuned incorrectly, increasing variability in the process.
 - A tremendous amount of money can be saved by understanding the control loop interactions and implementing corrective action.

Detected issues

			Benchmarking	
	Plant 1 – 1100 valves	Plant 2 – 390 valves	Typical	World class
Excessive valve travel	4 %	9 %	5 – 15 %	< 5 %
Stiction	4 %	6 %	5 – 10 %	< 5 %
Oversized	20 %	12 %	5 – 15 %	< 5 %
Undersized	6 %	4 %	5 – 10 %	< 5 %
Loops in manual mode	21 %	12 %	10 – 25 %	< 10%

Existing Control performance





Improve

Reliability

Monitor the control infrastructure









Valves & Positioners

- Valve travel & reversals
- Stiction
- Oscillation





Sensor measurements

- Noise
- Flatline
- Off scale
- Spiking

Identify performance issues before they cause an incident

Loop	Description#	Sensor health %E	Sensor - Spiking %T	Noise band %T	Noise band (%)	PV Availability %T	PV at limit %T
							
TC007	Hold Tank	500*	38.68	46.06	2.257E-05	0	1000
VP_TIC101	Preheat Temperature	404.2*	51.11	404.2	8.084*	0	0
35TI002	Fermenter zone 1 temp	251.3*	-	-	-	1000	-
FC122	Caustic to WAC	223.3*	33.53	90.04	5.916E-07	0	446.6
18FC025	Master Fuel Rate	153.0*	153.8	4.935	0.2206	0	0
12NFC010	FD to Burners	117.3*	71.74	117.9	7.557E-08*	0	0
30LC303B	BLR B Steam Drum	100.2*	0	100.2	2.833E-07*	0	0
110PC051	Firebox Draft	85.95	66.66	26.25	3.694	0	0
.....	-	-

Maintenance approach

Maintenance approach	Cost impact
<p>Reactive maintenance or repair Race to failure and repair</p>	<p>High operating and maintenance costs </p>
<p>Preventive or time-based maintenance Service at a fixed cycle or time interval</p>	<p>High operating and maintenance cost and higher frequency of unplanned downtime </p>
<p>Condition-based monitoring with single variable Monitors process data, identifies bad trends and alerts before failure</p>	<p>Moderate operations and maintenance cost, high frequency of false positive diagnosis </p>
<p>Predictive and prescriptive maintenance analysis Analysis with multivariable time series data</p>	<p>Minimal operations and maintenance costs and downtime approach zero </p>

- Source: <http://www.valvemagazine.com/web-only/categories/trends-forecasts/7283-improving-control-valve-maintenance-with-the-industrial-internet-of-things.html>

Manage the improvement workflow

Select KPI's

Establish thresholds for performance

Not set at point of failure

Apply an economic weight factor per loop

Aids in prioritizing issues

Monitor

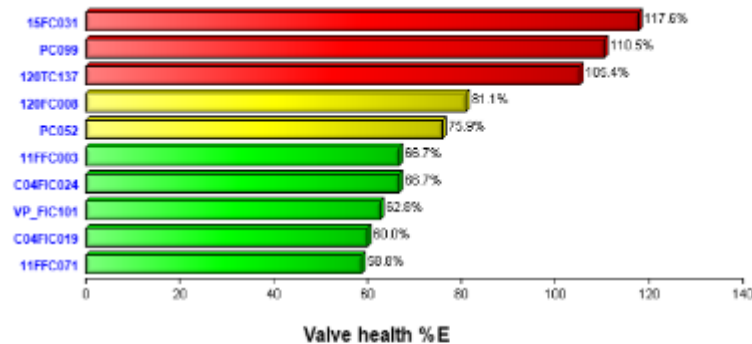
Review reports regularly (subscribe)

Set alerts to specific conditions

Evaluate condition trend direction and change rate

Act !

Create a system or process and engage regularly



Loop	Description#	Valve health %E	Osc - Valve %T	Suction %T	Output at limit %T
16FC031	C-7 Reflux	117.6%	117.6	86.47	0
PC099	Plant Water Supply	110.5%	23.33	221	0
128TC137	Cent. Blowdown Drum	105.4%	117.6	421.5	0

Focus on reliability

Pay attention to hardware KPIs

Is the Hardware performing?

Hardware

Sensor Health

Valve Health

Flat-Line

Noisy

Spiking

Sizing

Stiction

Hysteresis



Improve
Control

Can the controller do the job?

At a limit

- The control valve is 100% open/closed
- The variable-speed drive is at min/max speed
- The heater is on (or off) 100% of the time
- The control output is limited by a soft limit
- The process variable is at 0% or 100% of its span

Controller in manual *(open loop)*

- Control element only moves with operator intervention
- No response to disturbances

Stability is affected when you cannot respond

Loop	Description#	Output at limit (%)		
		Minimum	Average	Maximum
Sort	Sort	Sort ↓	Sort	Sort
11FFC016	Raffinate to WS	100	100*	100
C05TIC020	V-17 tank temp	43.25	98.77*	100
C04FIC039	Sweep gas flow	0	87.18*	100

What to do

Relieve the constraint

- Valve too small/large resize / alternate trim
- Change pumps
- Reduce throughput
- Repair / re-range measurement device

Find out why controller is manual

- Repair hardware
- Re-design the loop

Find the cycling loops, identify new robust tuning values

Controller tuning should benefit these 10 loops

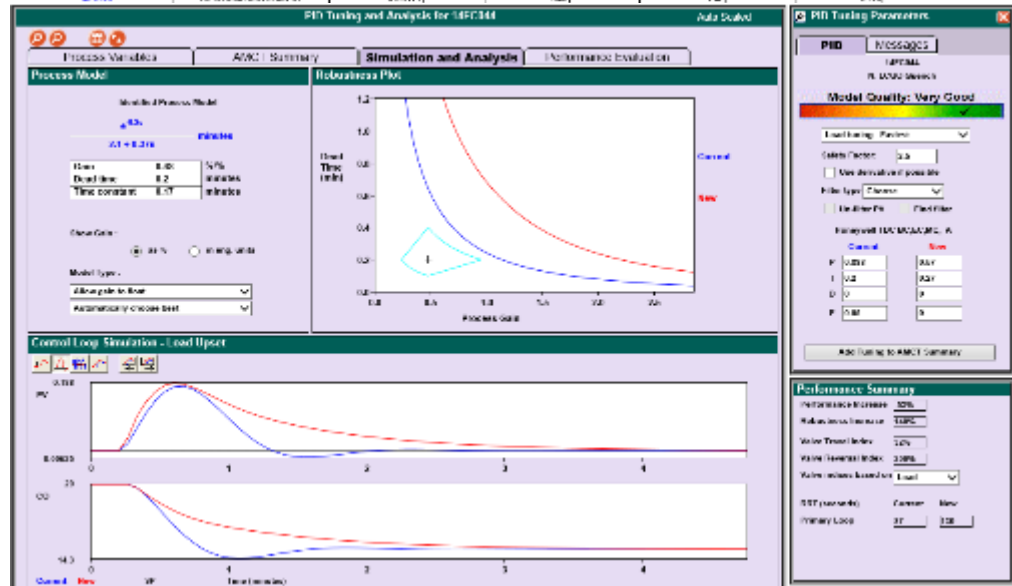


Control room operators should benefit from improved tuning. The report lists 10 loops that are currently manual and should be retuned. The report also lists 10 loops that are currently auto and should be retuned. The report also lists 10 loops that are currently manual and should be retuned.

For more information on this report, please contact your local Metso Automation representative.

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Loop	Description	Output Maximum	Control Mode (%)	Control Quality	Control Mode
1000001	1000001	1000001	1000001	1000001	1000001
1000002	1000002	1000002	1000002	1000002	1000002
1000003	1000003	1000003	1000003	1000003	1000003
1000004	1000004	1000004	1000004	1000004	1000004
1000005	1000005	1000005	1000005	1000005	1000005
1000006	1000006	1000006	1000006	1000006	1000006
1000007	1000007	1000007	1000007	1000007	1000007
1000008	1000008	1000008	1000008	1000008	1000008
1000009	1000009	1000009	1000009	1000009	1000009
1000010	1000010	1000010	1000010	1000010	1000010



Choose KPIs at higher levels

Drill down to other assessments to determine specific actions

Is the Controller controlling?

Service factor

At limit

Controlling

Valve at
Limits

PV at Limits

In Normal
Mode



Optimize Control

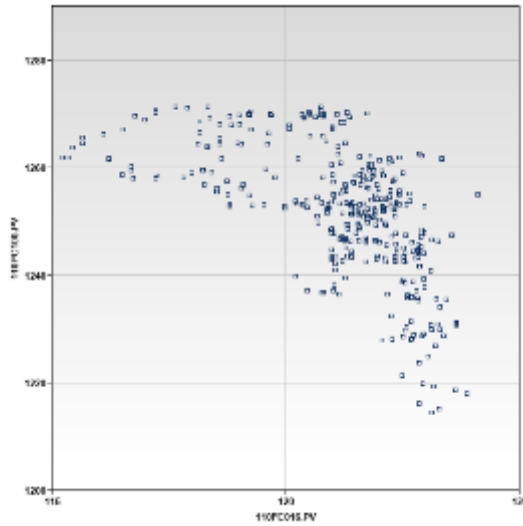
Analyze performance

Interacting Controls

- Closed control loops that disturb other loops
- Create cycles

Poor Controller Tuning

- Too aggressive, too slow
- Overshoot
- Cycling



Reduce
variability
through better
control



Values at 7:00 AM, 12/23/2017

Loop	Description#	Ex
		
C04LIC005	C15 btm level	
18FC026	Master Fuel Rate	
10FC029	Flash Drum Btms to mix tee	
33FC005	Fermenter air flow	
C05LC012	T211 level	
18FC028	A18 Recycle Flow 1	
C05PIC015	Fuel Gas Hdr	
11FFC071	Hot Solvent to extractor	

Manage performance

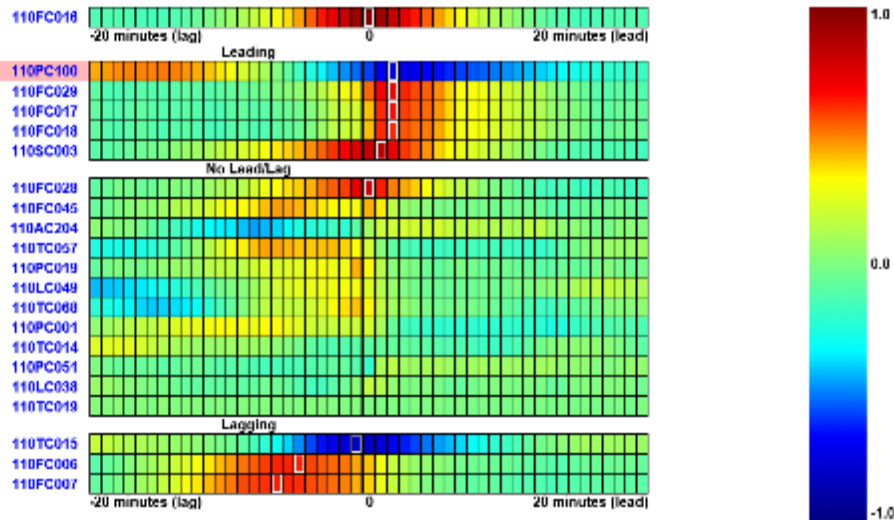
Find root causes

- Correlate oscilating loops
- Check interactions

Tune controllers to meet objectives

- Responsive and robust throughout the operating envelop.
- De-couple with appropriate parameters

Find the cycling loops, identify new robust tuning values



Controller tuning should benefit these 10 loops

Loops with a small quality of 1, 1 or 1 and an RST (or other) value above 0.9 are highly responsive and robust. The RST (or other) value above 0.9 means that the controller is highly responsive and robust. The RST (or other) value above 0.9 means that the controller is highly responsive and robust. The RST (or other) value above 0.9 means that the controller is highly responsive and robust.

For more information, see the RST (or other) value above 0.9. The RST (or other) value above 0.9 means that the controller is highly responsive and robust. The RST (or other) value above 0.9 means that the controller is highly responsive and robust. The RST (or other) value above 0.9 means that the controller is highly responsive and robust.

Loop	Controller	Controller Quality	Controller RST (%)	Controller RST (%)	Controller RST (%)	Controller RST (%)	Controller RST (%)	Controller RST (%)	Controller RST (%)
110FC018	110FC018	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110PC100	110PC100	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110FC029	110FC029	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110FC017	110FC017	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110FC018	110FC018	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110SC003	110SC003	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110FC028	110FC028	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110FC046	110FC046	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110AC204	110AC204	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110TC057	110TC057	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110PC019	110PC019	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110LC049	110LC049	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110TC080	110TC080	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110PC001	110PC001	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110TC014	110TC014	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110PC051	110PC051	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110LC038	110LC038	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110TC019	110TC019	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110TC015	110TC015	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110FC006	110FC006	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%
110FC007	110FC007	0.98	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%	95.11%

PID Tuning and Analysis for 110FC144

Auto-tuned PID parameters for process 110FC144. The interface shows a Robustness Plot (RST) and a Control Loop Simulation (Load Offset) graph. The RST plot shows the relationship between RST and Process Gain. The Control Loop Simulation graph shows the response of the process to a load offset.

PID Tuning Parameters:

Parameter	Value
P	0.000
I	0.000
D	0.000
F	0.000

Performance Summary:

Metric	Value
Performance Index	0.95
Robustness Index	0.95
Value Trend Index	0.95
Value Trend Index	0.95
Value Trend Index	0.95
Value Trend Index	0.95

Drive variability reductions

Is the Control effective?

Control Measures

Variability

Control

Oscillations

Statistics

Error

Harris Index

Significance

Period

Optimize

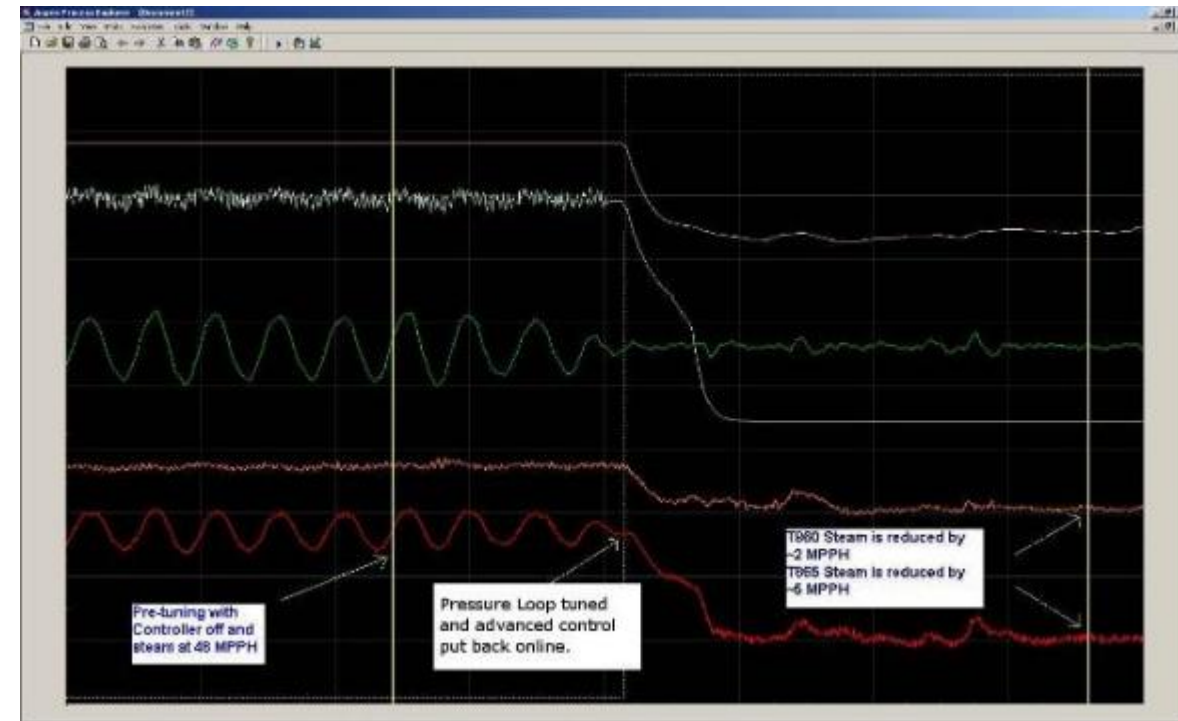
Determine best operating point(s)

Operate closer to targets

Once stable, move the average

Keep key variables on their targets

Capture the value that was hidden by problems



What to do

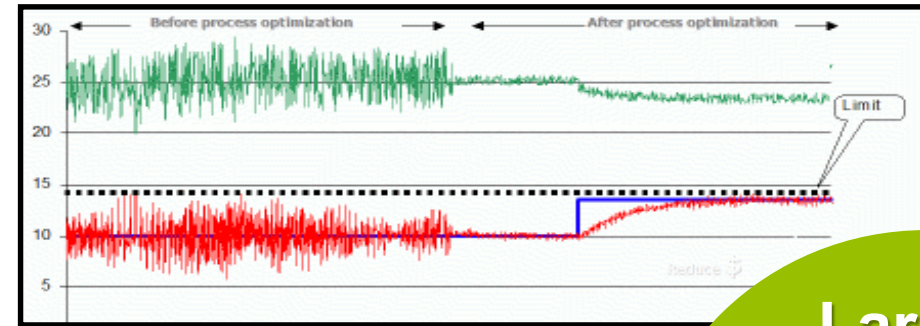
Once stable move setpoints closer to targets

Use 6-sigma to identify opportunity gaps

Compute and report savings associated with closing the gap


Monitor

Review reports regularly (subscribe)
Set alerts on Time of Spec, opportunity gap



Largest benefits are obtained by moving the operating points

Changing setpoints on 9 loops may generate some economic



With some loops, the closer you can control the PV to the spec limit, without going over it, the more product you will be. The Opportunity Gap gives a measure of the opportunity of moving the setpoint closer to the specification limit. Also, if configured, the Real Time Savings Advisor provides a monetary value for the process improvement.

This report shows those loops that are most likely to generate additional value through a setpoint adjustment.

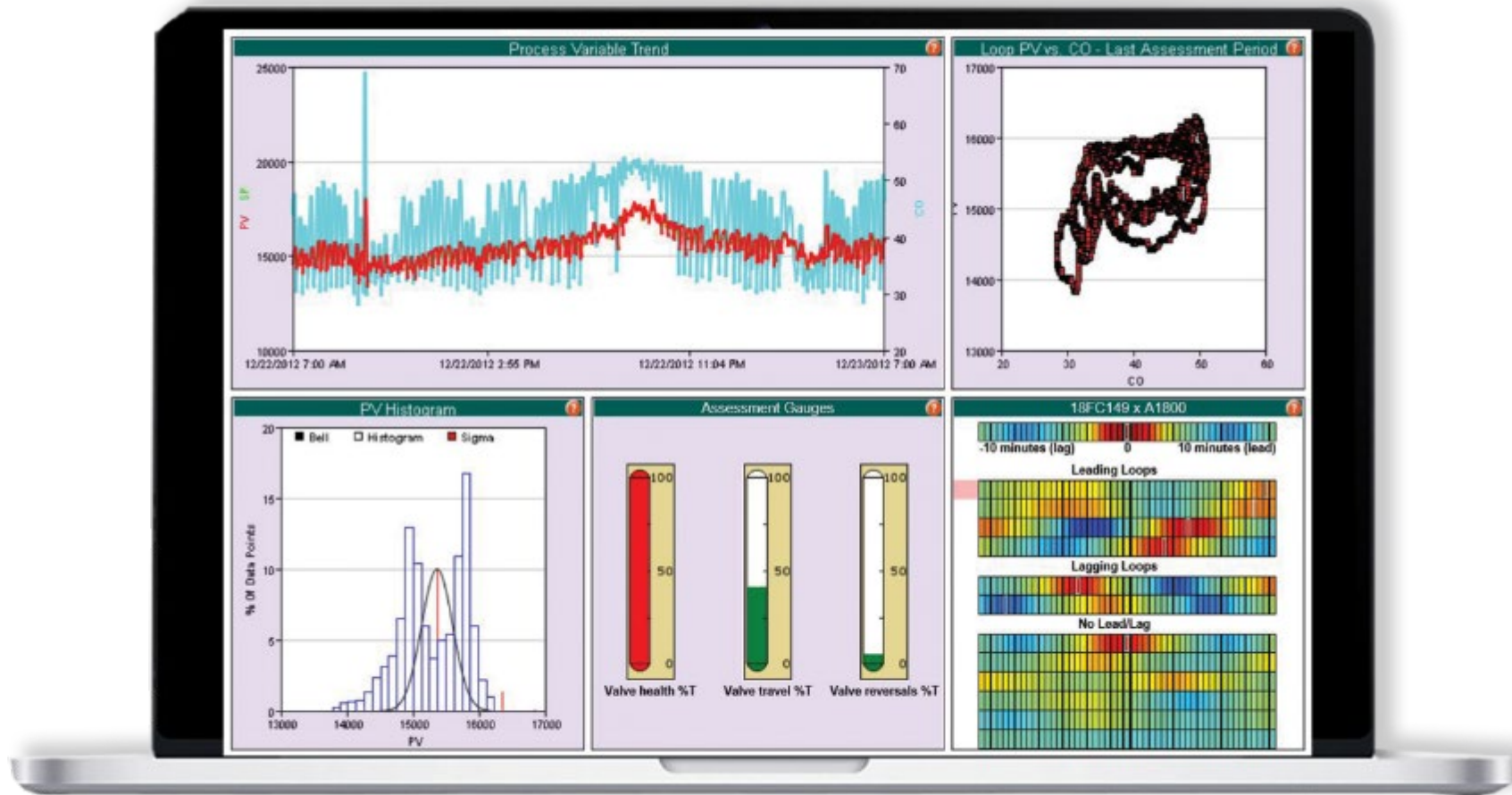
To find more opportunity gap improvements, set specification limits in the PlantFridge engineering interface. This focus on variability reductions, such as loop tuning, sensor and valve repairs.

Average values between 7:00 AM, 12/16/2017 and 7:00 AM, 12/22/2017

Loop	Description#	Opportunity gap	Opportunity gap %T	Time off spec (%)	Real-time Savings Advisor (\$)
27AC108Z	Distorta light component	0.8724	42.51	0.4314	836.57
1E1C90Q	A10 Train 2 Outlet Temp	0.725	33.32	0.1375	5460

Expertune PlantTriage

Demonstration



European Pulp mill

Valve analysis

Problem

Valve oscillation detected by PlantTriage

Device demonstrated big deviation and pressure jumps

Leakage revealed in the actuator diaphragm

Solution

Automatic detection

Actuator and valve were replaced in the next planned shutdown

The quick flow changes disappeared



Unplanned shutdown avoidance

Valve monitoring

Problem

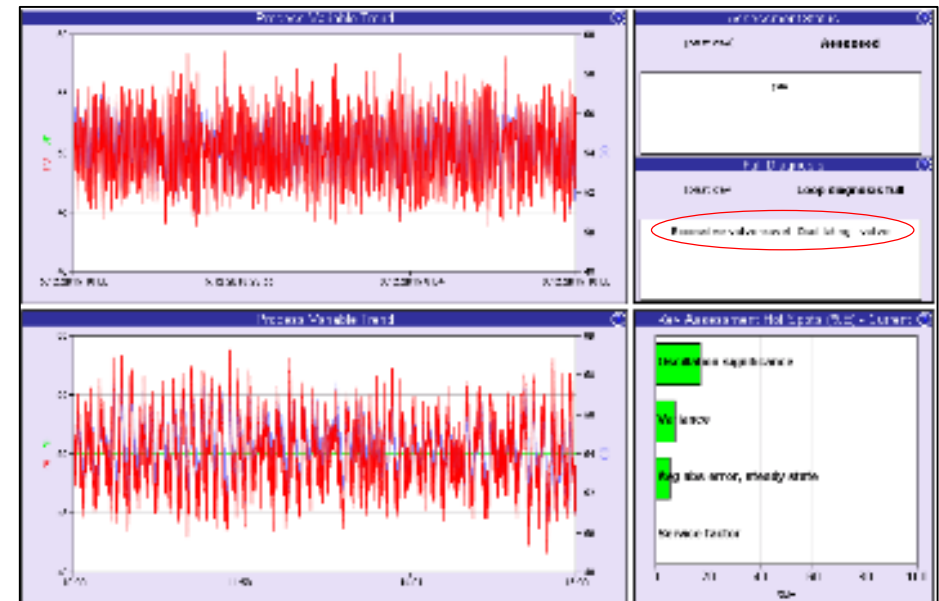
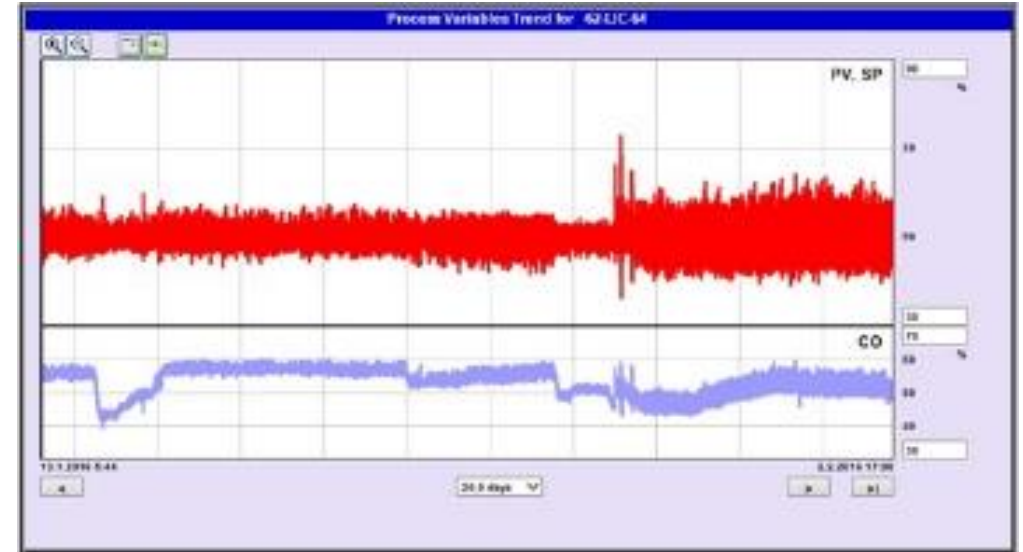
Excessive oscillation due to valve

Field inspection revealed the actuator was barely bolted in.

Solution

Automated detection

Replace and ensure all four bolts secure with an addition of an adhesive



European Oil refinery

Control loop analysis

Problem

Valve has known to have previous issues

Valve demonstrating a lot of movement

Valve monitored and found to operate well

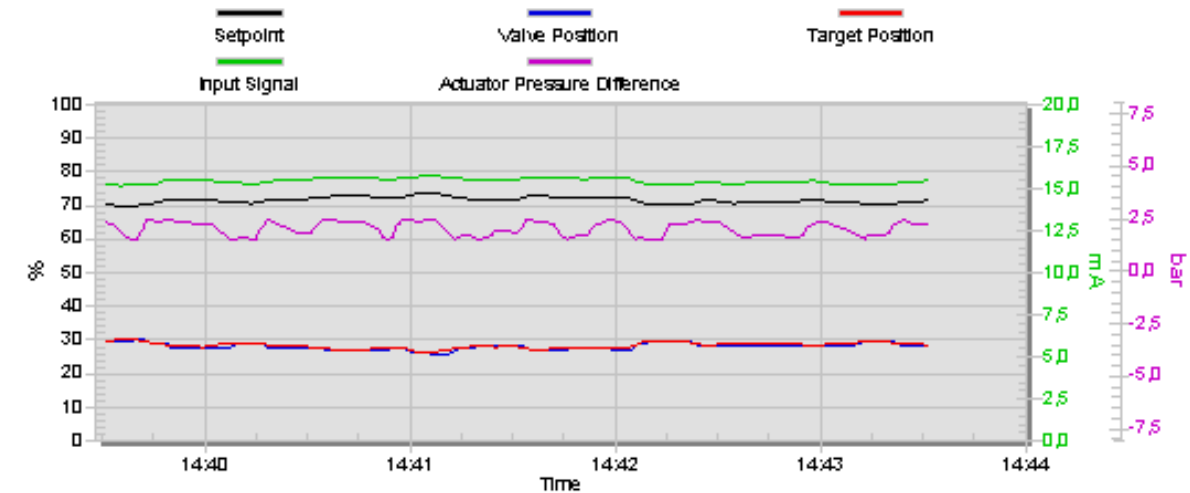
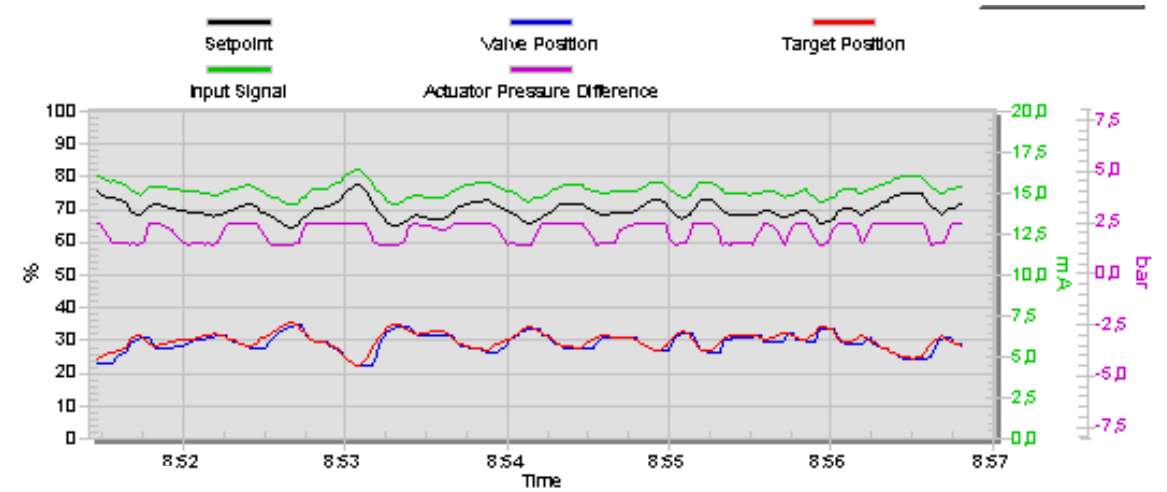
Solution

Adjustment to the positioner performance level

Control loop was retuned

No additional repair to the valve package

Valve lifetime extended



Case studies



**Bleaching plant
in Russia**

**Saves 400
KEUR a year**



BP's refineries

**Estimate \$1-5
million per
refinery, per year.**



European refinery

**Saves 7 MEUR
per year**



Vale Brazil

**A 100% Return on
Investment in 4
months**



SABIC

**Saves \$1 million
per year**



Ras Gas

**Saves \$1 million
per year**

Summary

Utilize condition monitoring:



- 01 Implement **predictive maintenance**
- 02 **Activate** existing controllers
- 03 **Optimize** performance

Resources and examples

Visit Metso.com, search for Expertune to discover more

Learn more



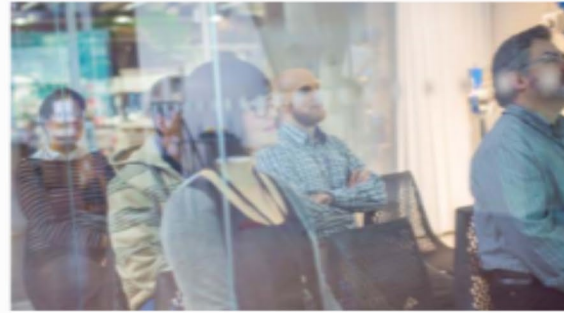
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Join us for a live presentation



Private demonstration

Would you like a private software demonstration?



Expert training classes

Would you be interested additional software instruction.



Podcasts & webinar recordings

Listen to podcasts available from four gateways. Also listen to previously recorded webinars.





Questions



For further information



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