VALUE NOW: Using PI Data to Improve and Optimize Process Control

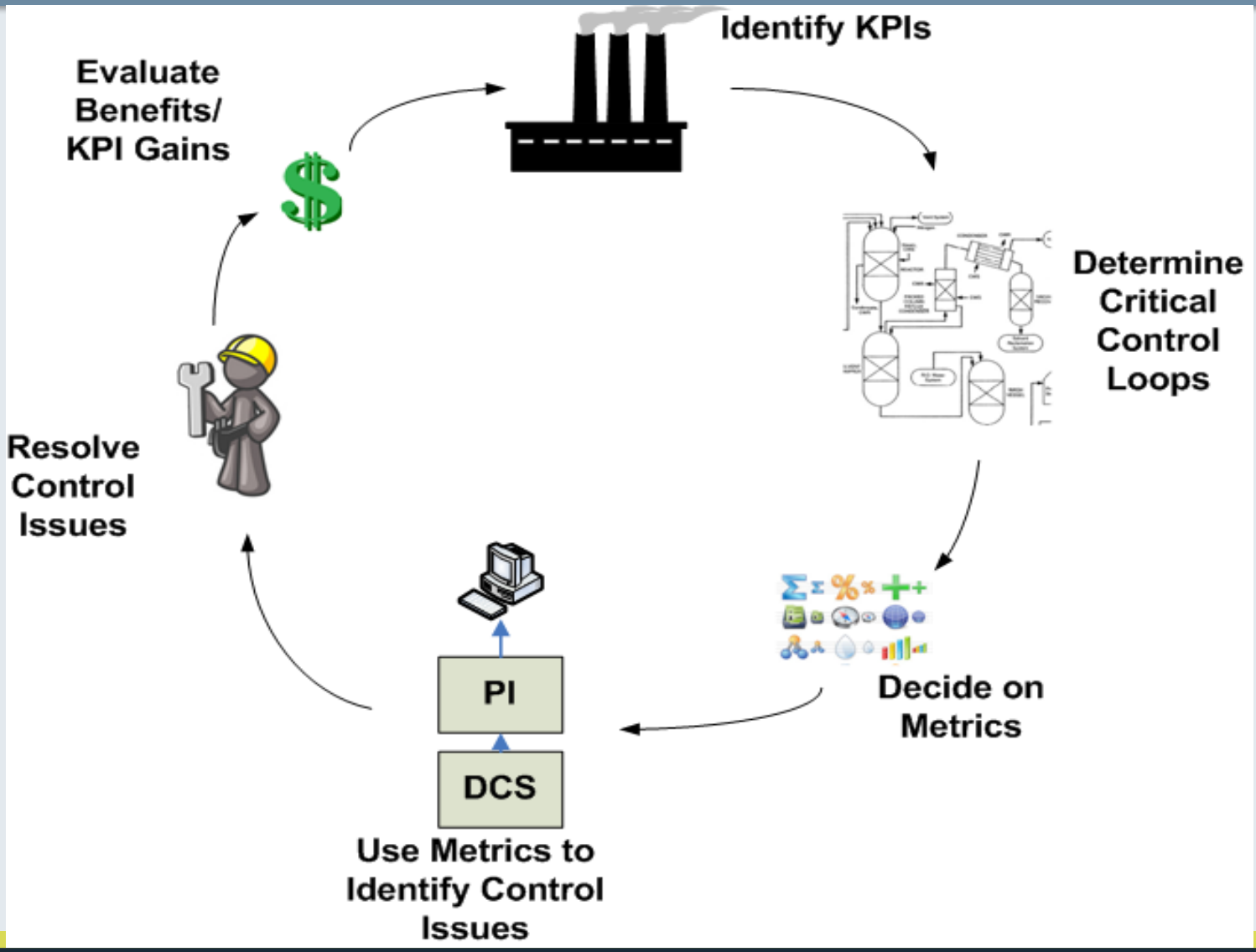
John Cunningham
The RoviSys Company

Empowering Business in Real Time
PI Infrastructure for the Enterprise

Who is RoviSys?

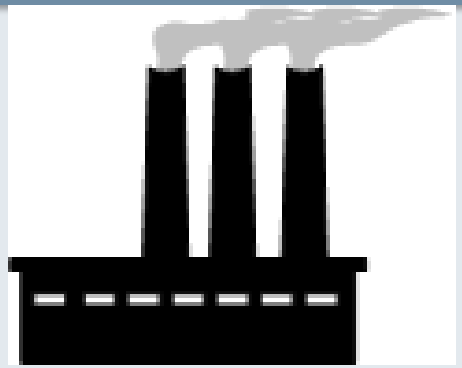
- Founded in 1989 in Aurora, Ohio
- Primary business is control system integration and information system integration
- 200 engineers in Ohio, North Carolina, and Singapore
- OSISoft partner for many years
  - System Integrator; ISV; Consulting Partner
  - rCAAM – Control Assessment and Monitor software

Presentation Overview



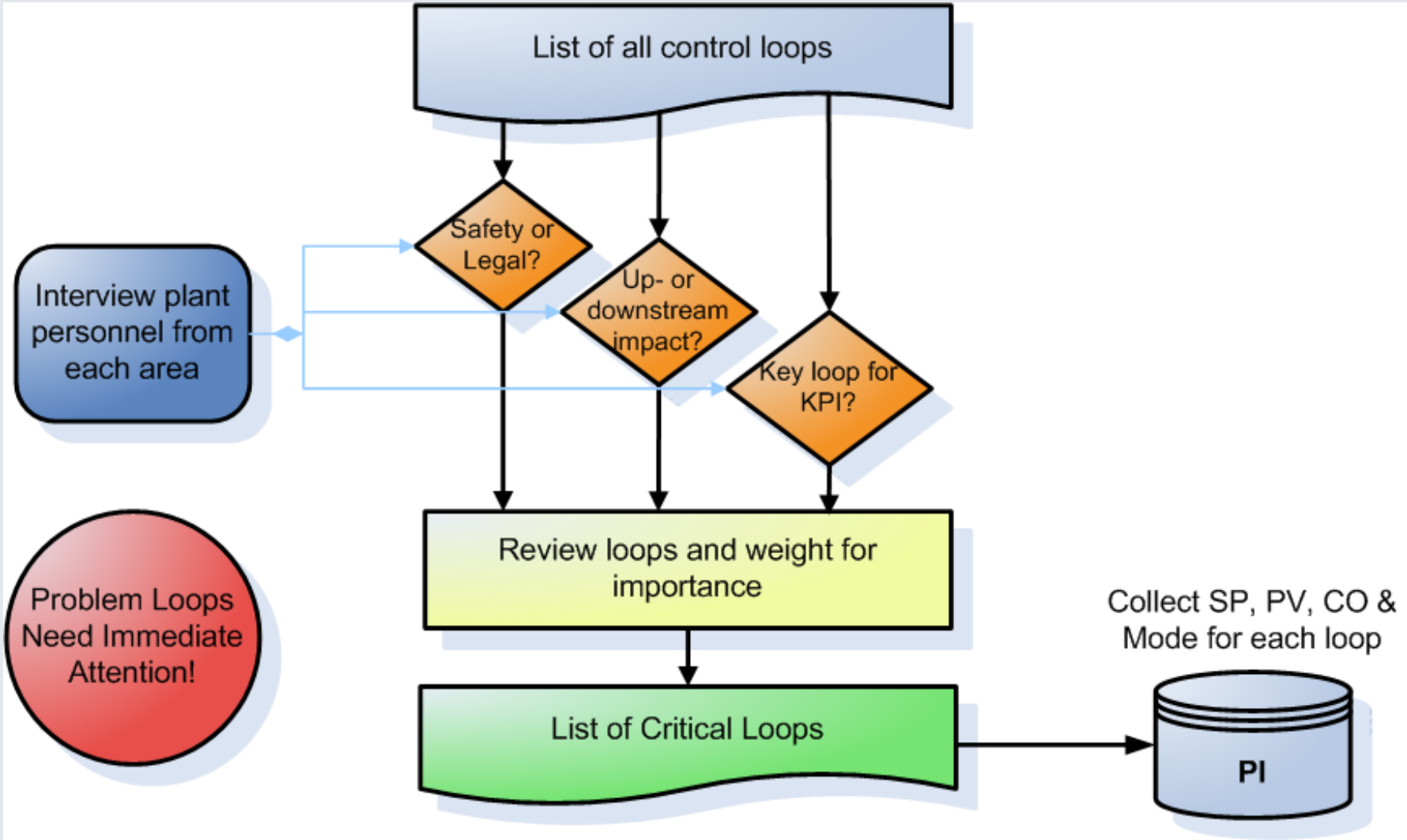
Identifying Business Drivers

- Making any performance improvements should be based on business drivers – KPIs



Business Situation	KPIs
We can sell all that we can make	Throughput
	Cycle time
	Uptime
	Reduce waste
Limited by market conditions	Reduce costs
	Reduce energy usage
High waste rate or dissatisfied customers	Consistent quality
	Reduce product variability

Which Control Loops are Critical?



What Analysis Do You Do?

- Analysis tools should be easily understood
  - By process engineer and by technicians
  - Ideally would not require extensive process knowledge to implement, understand, and act on
- Analysis tools should be able to work with control loop data – PV, SP, CO, Mode
- It should be relatively easy to act on the analysis
- Should tie back to the KPIs
  - Actions taken should result in KPI improvements

Before Investing in Loop Monitoring

- Is software easy to setup and configure?
- Initial investment must be considered
  - ROI - payback period
  - Initial investment – software & engineering
  - Time investment for setup, ongoing support
- Who is responsible for keeping it going?
  - How much time required?
  - Adapting to changing process conditions
  - Is responsibility for action distributable?

Performance Metrics

- Key questions the metrics should address:
  - Can the controller do what we want it to do?
  - Are we using the controller to do what we want it to do?
  - Is the controller doing what we want it to do?
  - Are we looking at the controller performance at the right times?

Key Performance Metrics

Metric	Indications	Possible Problems
Time that the controller output is outside limits	Indicates that the controller is limited by valve	• Wrong valve size • Problem with the valve • Process may have changed
Time controller is in desired mode	Indicates if controller is left in manual mode and unable to perform its job	• Controller not responding to process disturbances • Wrong size valve • Operator not comfortable with controller • Other process issues
Controller Stability	Indicates if controller is oscillating and the magnitude of the oscillations	• Poor tuning • Valve stiction • Coupling between loops

Processing Performance Data

- Select a time period for review
  - A shift, a crew, a batch, a day, etc.
- With PI, you already have the data
  - Extract data from PI for any previous time period
  - Calculate performance metrics and report
- Distribute the metrics
  - Graphical displays – ProcessBook, rtWebParts
  - Reports, email
  - Alarms via PI Notifications

Have a Plan to Address Issues

- No value if you don't act on the issues reported
- Do plant personnel have the time to tackle these problems?
  - If not, alarms and reports back up
  - People get used to them and ignore them
- Consider generating work orders for problems
- Hire outside services to address specific issues

Deciding if it is Worthwhile

- Establish a baseline before any actions
  - Costs, production rates, KPIs
  - Variability measures
  - This is easy to do using your historic PI data
- Take corrective actions based on analysis tool
- Establish new standard with changes made
- Estimate benefits by comparison with baseline
  - Cost savings, production improvements
  - Reduced variability

Ongoing Improvements

- Put calculated statistics back into PI for tracking improvements over time
  - This month vs. last month
  - Shift improvements
  - Batch comparisons
- Continue tightening constraints on metrics
- Tackle additional loops
- Make sure the team stays engaged

Thank you for your time and attention!

For more information on RoviSys or rCAAM..

John Cunningham

jc@rovisys.com

330-995-8124

www.rovisys.com

How To Leverage Your Data?

Presented by

Michel Ruel, Top Control Inc.

Empowering Business in Real Time

PI Infrastructure for the Enterprise

Top Control : history

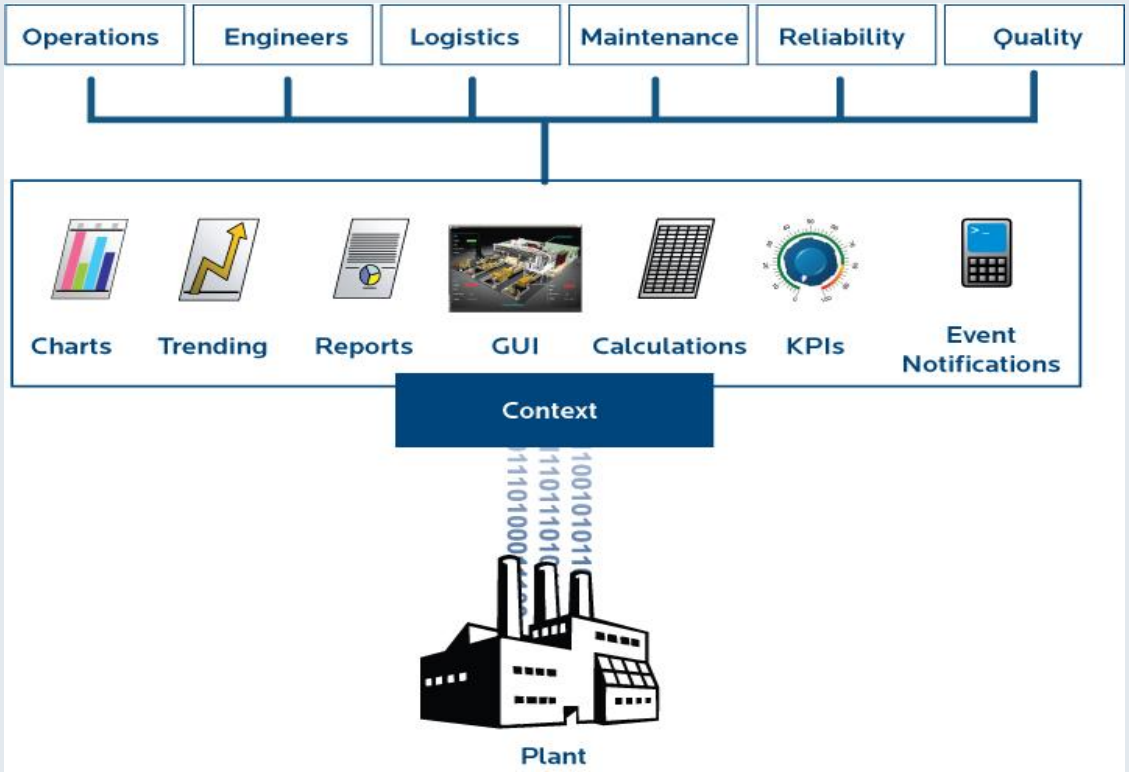
- 1994-2009
  - Training, consulting, optimization
    - Offices in USA, Canada
    - Strategic partner of Matrikon
    - Customers in 31 countries

Tools for Operational Excellence



Value added solutions:

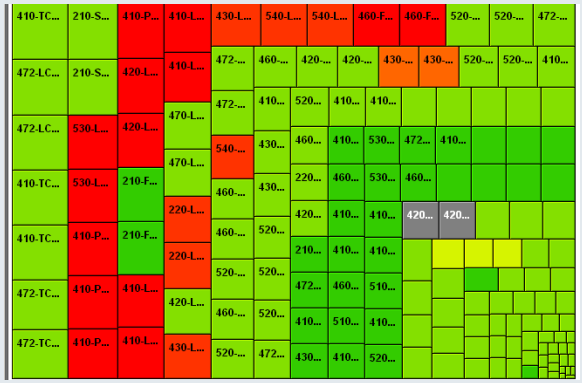
- Alarm management
- Control performance monitoring
- Equipment condition monitoring
- Process performance monitoring



- Data connectivity
- Data management
- Data and process visualization
- Engineering analysis

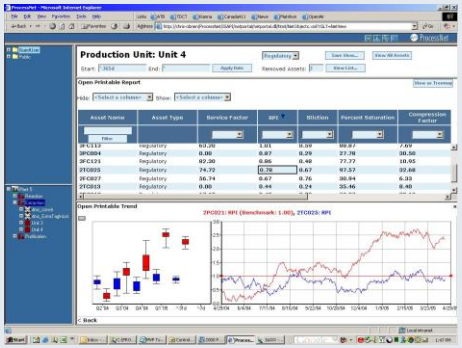
Data→Knowledge → Diagnostics

Diagnostics



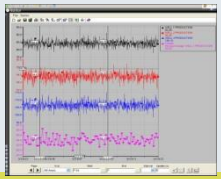
Result$

Analysis



Performance

Process systems

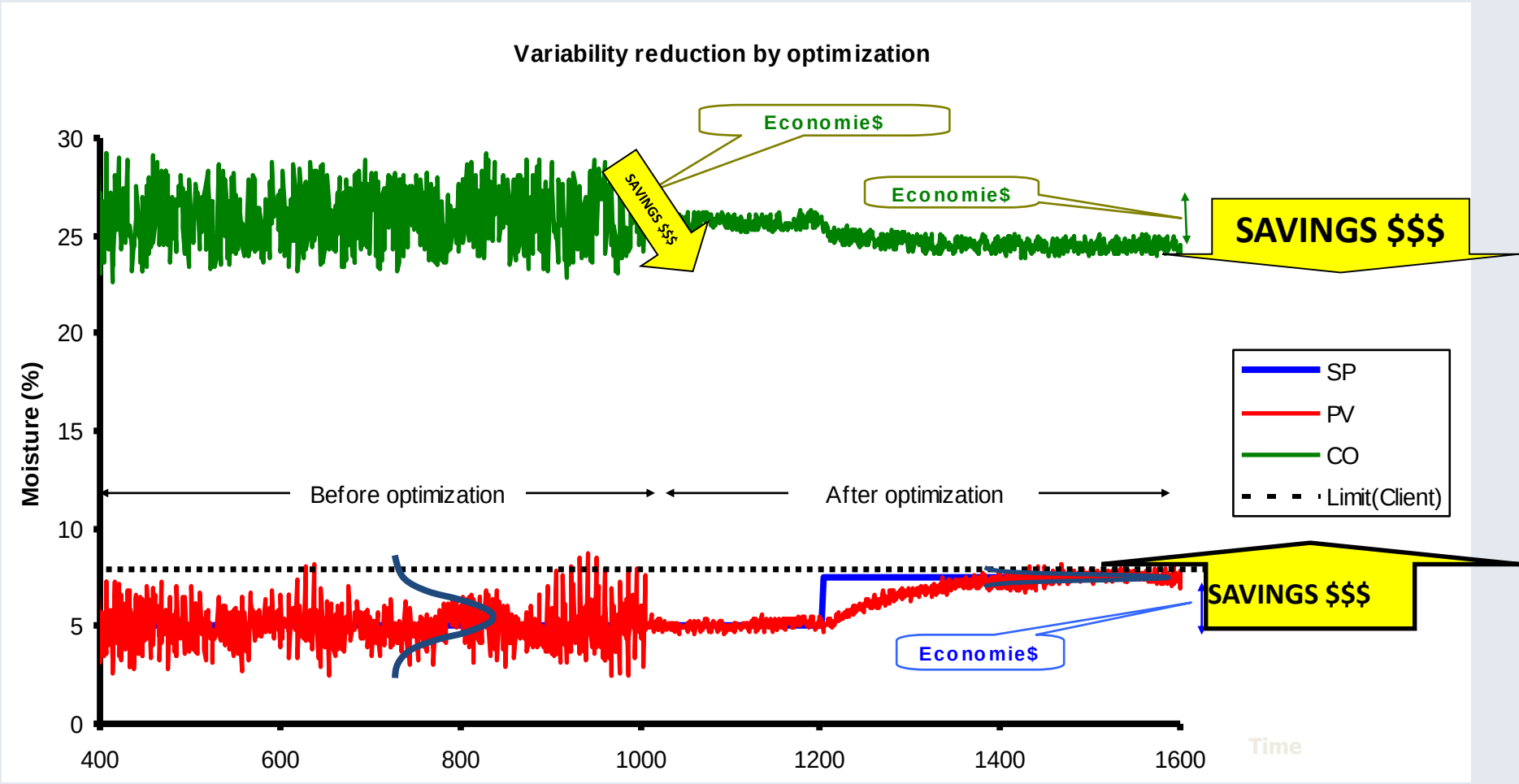


Data

Control


Complexity
Follow-up effort
Qualifications
RTO
Multivariable
Models
Control strategies
Tuning, modeling
PID
Configuration, tuning
Valves, transmitters, sensors
Calibration, maintenance
Process equipments, pumps, reservoirs…
Maintenance
1, 2,…%
1, 2…%
1, 2…%
1, 2…%
Automated

Impacts

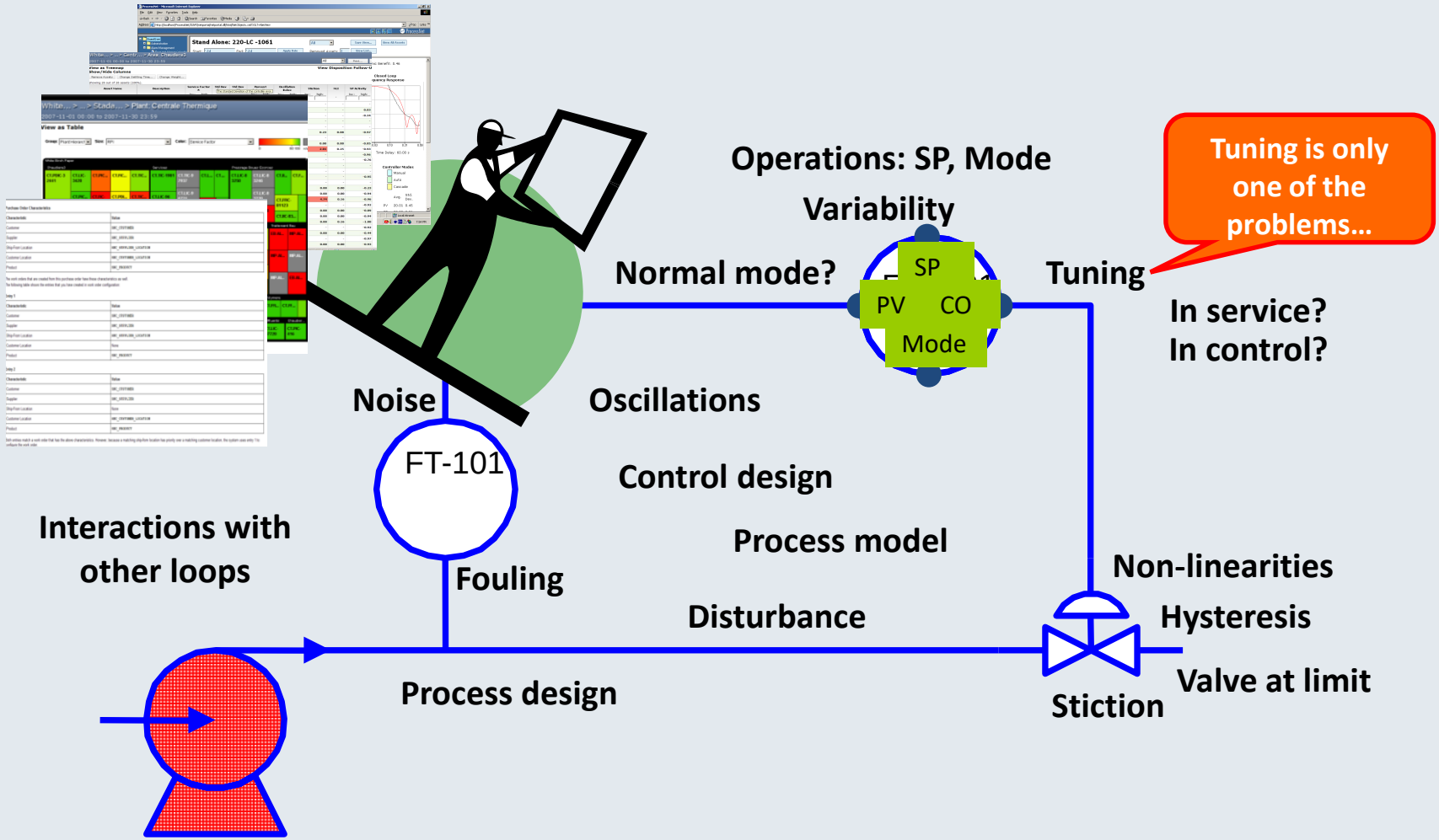

Variability reduction by optimization
Economie$
Economie$
SAVINGS $$$
SAVINGS $$$
Economie$
SP
PV
CO
Limit(Client)
Before optimization
After optimization
Moisture (%)
Time
30
25
20
15
10
5
0
400
600
800
1000
1200
1400
1600

The reality

Numbers from audits, articles and our field experience

- ***20 % Control loops, improper design***
- ***30 % Control valve related problems***
- ***15 % Not installed properly***
- ***30 % Nonsensical tuning parameters***
- ***85 % Improper tuning parameters***
- ***only 25 % give a better performance in automatic control !!***

Problems: What Could Go Wrong



ProcessNet - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites Media

Address http://localhost/ProcessNet/ISAPI/netportal/netportal.dll/html/NetObjects.xml?XSLT=NetView

ProcessNet

GuestUser
- Administration
- Alarm Management
  - Frequent Alarmers Weekly
- Control Asset Management
  - Poor Performers Weekly R
  - WebReport - 1012
  - WebReport - 1013
  - WebReport - 1015
  - Mike's Unit - PID

Matrikon
- Chemicals
  - Additives
    - 420-LC -1260
    - 430-FC -1086
    - 430-LC -1180
    - 460-FC -1901
    - 460-FIC -0306A
    - 460-LC -1609
    - 470-LC -1005
    - 510-PC -0019
    - 530-LC -1043
    - 540-LC -2000
  - Poly
- Mining & Materials
- Oil & Gas
  - Crude Unit
  - FCC
- Power & Utilities
- Pulp and Paper

Stand Alone: 220-LC -1061

All | Save View... | View All Assets

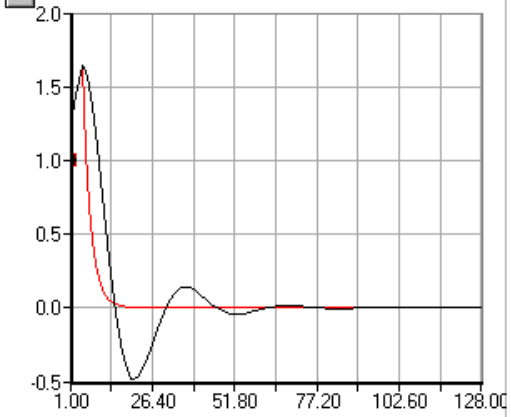
Start: *-3d End: *-2d Apply Date | Removed Assets: 3 View List...

RPI: 0.54
Stiction: 1.19

Osc. Index: 0.53
Osc. Period (min): 32.00

Economic Benefit: 0.46

Closed Loop Impulse Response



Settling Time: 44.00 min (Actual)

Analysis Reliability

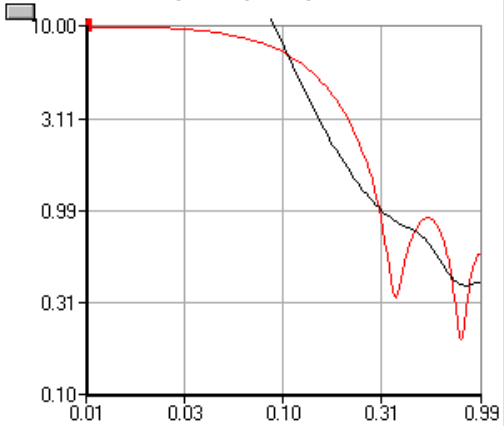
Samples Requested:	1441
Samples Analysed:	1394
Sample Period (s):	59.999306
Saturation (%):	0.00
Service Factor (%):	100.00
Compression Factor:	1.02

Time in Mode (%)

Auto	100

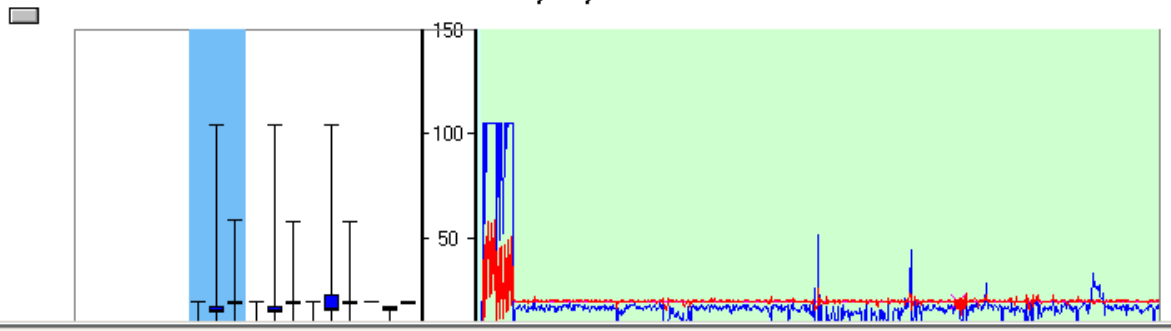
Rise Time: 15.00 min

Closed Loop Frequency Response



Time Delay: 60.00 s

PV, OP, and SP



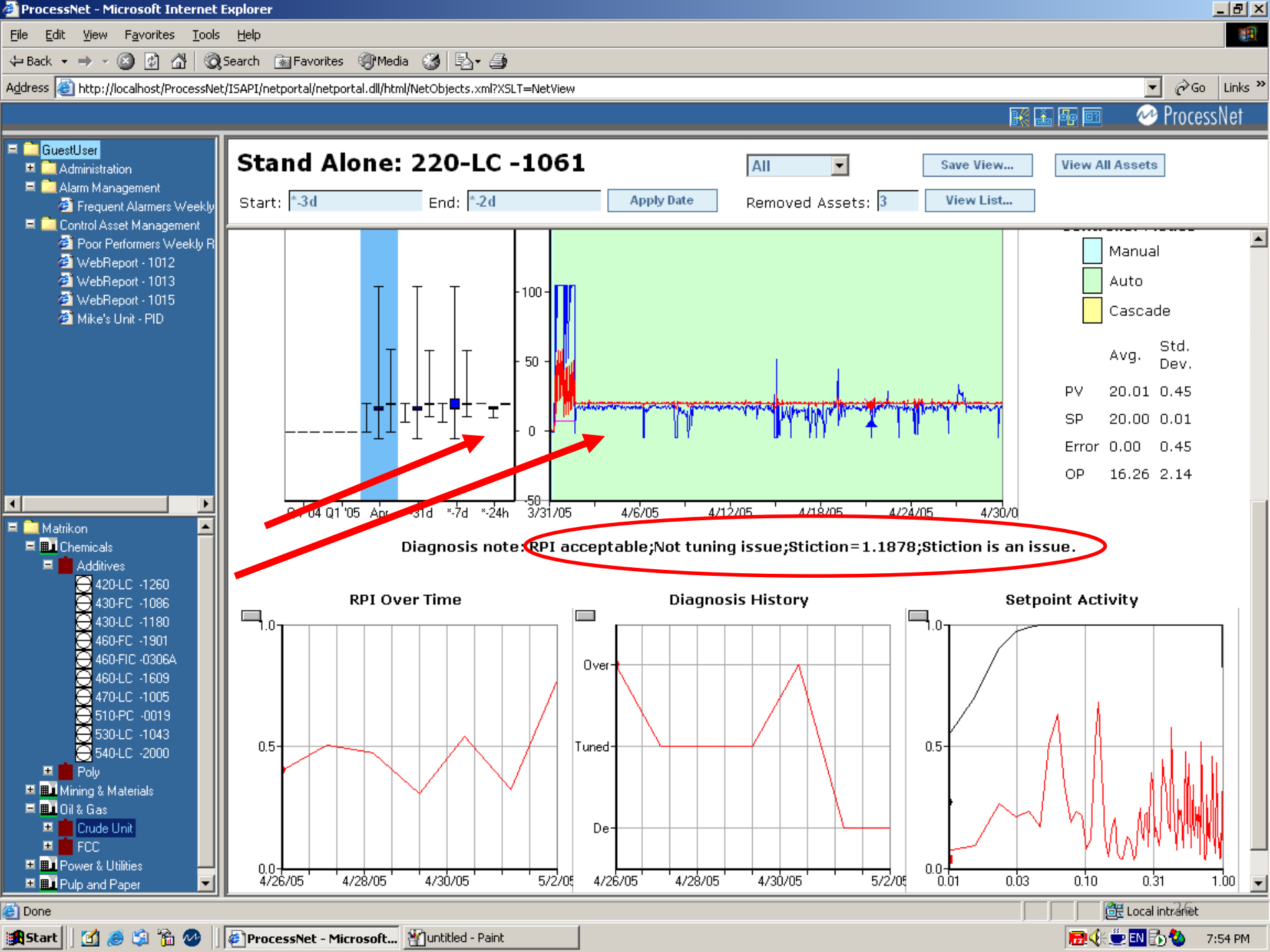
Controller Modes

- Manual
- Auto
- Cascade

	Avg.	Std. Dev.
PV	20.01	0.45

Done | Local intranet

Start | ProcessNet - Microsoft... | untitled - Paint | 7:54 PM


ProcessNet - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://localhost/ProcessNet/ISAPI/netportal/netportal.dll/html/NetObjects.xml?XSLT=NetView
Go Links
ProcessNet
GuestUser
Administration
Alarm Management
Frequent Alarmers Weekly
Control Asset Management
Poor Performers Weekly R
WebReport - 1012
WebReport - 1013
WebReport - 1015
Mike's Unit - PID
Matrikon
Chemicals
Additives
420-LC -1260
430-FC -1086
430-LC -1180
460-FC -1901
460-FIC -0306A
460-LC -1609
470-LC -1005
510-PC -0019
530-LC -1043
540-LC -2000
Poly
Mining & Materials
Oil & Gas
Crude Unit
FCC
Power & Utilities
Pulp and Paper
Stand Alone: 220-LC -1061
All
Save View...
View All Assets
Start: *-3d
End: *-2d
Apply Date
Removed Assets: 3
View List...
100
50
0
-50
Q4 '04 Q1 '05 Apr -31d *-7d *-24h 3/31/05 4/6/05 4/12/05 4/18/05 4/24/05 4/30/0
Manual
Auto
Cascade
Avg. Std. Dev.
PV 20.01 0.45
SP 20.00 0.01
Error 0.00 0.45
OP 16.26 2.14
Diagnosis note: RPI acceptable;Not tuning issue;Stiction=1.1878;Stiction is an issue.
RPI Over Time
1.0
0.5
0.0
4/26/05 4/28/05 4/30/05 5/2/05
Diagnosis History
Over
Tuned
De
4/26/05 4/28/05 4/30/05 5/2/05
Setpoint Activity
1.0
0.5
0.0
0.01 0.03 0.10 0.31 1.00
Done
Local intranet
Start
ProcessNet - Microsoft...
untitled - Paint
7:54 PM

Expected Results

- Service factor↗
- Tuning
- Repair
- Review control strategies
- Optimize

- Variability: ÷ 2
- Cycling: removed
- Valve travel: ÷5 (valve wear ÷ 2)
- Robustness: X 2
- Performance: X 2

Expected Benefits of Optimization

- Increase process performance
- Use resources (human & material) wisely

Reduced energy costs
Reduced waste
Reduced variability
Reduced valve maintenance
Reduced pollution
Cycling removed

Increased up-time
Improved product quality
Improved efficiency
Better operation
Improved safety
Smoother start-up

Conclusions

- **1-Usage 2-Stability 3-Performance**
- **Resources** are used where they are really **needed**
- Process control systems are used to their **full potential**
- Operation and production are **optimal**
- Maintenance and engineering are **efficiently** used.

Boiler 3, November 2007 vs April 2008

November 2007	April 2008
2 sticky valves	None

[redacted] > Area: Chaudiere3

2007-11-01 00:00 to 2007-11-30 23:59

View as Treemap
Show/Hide Columns
View Disposition Follow-U

Remove Assets | Change Settling Time... | Change Weight...

Showing 26 out of 26 assets (100%).

Asset Name	Description	Service Factor	Std Dev	Std Dev	Percent	Oscillation Index	Stiction	NLI	SP Activity
		low : high:	-	-	low : high:	low : high:	low : high:	-	low : high:
CT.FICAIRSF	MAITRE AIR SOUS LA GRILLE CH3	0.00	-	-	30.67	-	-	-	-
CT.FIC-3235	DEBIT_GAZ -CANAL PRINCIPAL...	2.27	3.93	5.77	94.63	0.09	-	-	0.03
CT.FIC-3252	CONTROLEUR DEBIT_MAZOUT-...	2.30	10.01	11.29	14.31	0.12	-	-	-0.34
CT.TIC-94540	TEMPERATURE-AIR D'APPOINT	11.42	4.14	15.15	99.92	0.00	-	-	-
CT.FICAIRDF	AIR AU DESSUS DE GRILLE CH3	18.05	-	25.85	30.63	0.00	-	-	-
CT.PIC-3267	CONTROLEUR PRESS VAPEUR C...	31.20	7.25	2.15	68.89	0.22	0.23	0.08	-0.97
CT.FIC-32446	DEBIT DE PURGE-LAVEUR DES ...	38.22	-	-	98.19	-	-	-	-
CT.PIC-3405	PRESS AIR-SORTIE RECHAUF. ...	73.70	0.03	3.25	27.39	0.10	0.00	0.00	-0.85
CT.TIC-3403	TEMP AIR -SORTIE RECHF VAP...	74.22	0.97	10.88	79.35	0.39	2.01	0.25	-0.93
CT.PDIC-3360	PRESSION_REGIST-BRULEUR 2 ...	74.72	0.06	27.03	96.95	0.23	-	-	-0.96
CT.PDIC-3350	PRESSION_REGIST-BRULEUR 3 ...	74.72	0.07	27.28	90.41	0.16	-	-	-0.76
CT.PDIC-3359	PRESSION_REGIST-BRULEUR 4 ...	74.72	0.09	18.59	99.31	0.31	-	-	-
CT.PDIC-3369	PRESSION_REGIST-BRULEUR 1 ...	74.72	0.11	21.65	99.31	0.20	-	-	-
CT.FIC-36327	CONV.6 COND. CENDRES-DEBI...	74.75	14.89	6.91	94.82	0.22	-	-	-0.95
CT.PIC-3451	PRESSION DE VAPEUR CH3	79.20	173.05	27.90	99.89	0.18	-	-	-
CT.FICAIRMG	DEBIT AIR BRUL. AUXILIAIRES ...	81.39	7.13	3.71	48.25	0.08	0.00	0.00	-0.23
CT.PIC-3422	PRESSION DE LA FOURNAISE -...	82.30	0.01	9.75	10.97	0.07	0.00	0.00	-0.94
CT.LIC-32448	NIVEAU-LAVEUR DES GAZ	85.15	3.04	11.78	22.81	0.29	4.74	0.16	-0.96
CT.PDIC-32441	PRESSION DIFF. LAVEUR DES ...	90.53	0.06	11.30	70.45	0.08	-	-	-0.92
CT.TIC-32463	TEMPERATURE ELECTROFILTRE...	91.69	3.63	12.39	75.09	0.12	0.00	0.00	-0.89
CT.PIC-32252	PRESSION VERS SECHOIR	95.38	0.14	12.73	30.45	0.14	0.00	0.00	-0.94
CT.LIC-3420	NIVEAU EAU ALIMENTATION-CH3	95.65	1.46	7.07	6.93	0.19	0.00	0.16	-1.00
CT.LIC-32273	NIVEAU-SILO DE BIOMASSE	98.49	12.66	14.97	1.51	0.11	-	-	-0.92
CT.TIC-94222	TEMPERATURE ECHANGEUR DE ...	99.74	0.27	1.46	0.00	0.23	0.00	0.00	-0.44
CT.PIC-3241	CONTROLEUR PRESSION GAZ C...	100.00	8.38	8.99	95.49	0.09	-	-	-0.97
CT.PIC-3249	CONTROLEUR PRESSION MAZO...	100.00	109.40	7.03	0.00	0.09	0.00	0.00	-0.93

[redacted] ... > Area: Chaudiere3

2008-04-01 00:00 to 2008-04-30 23:59

View as Treemap
Show/Hide Columns
View Disposition Follow-U

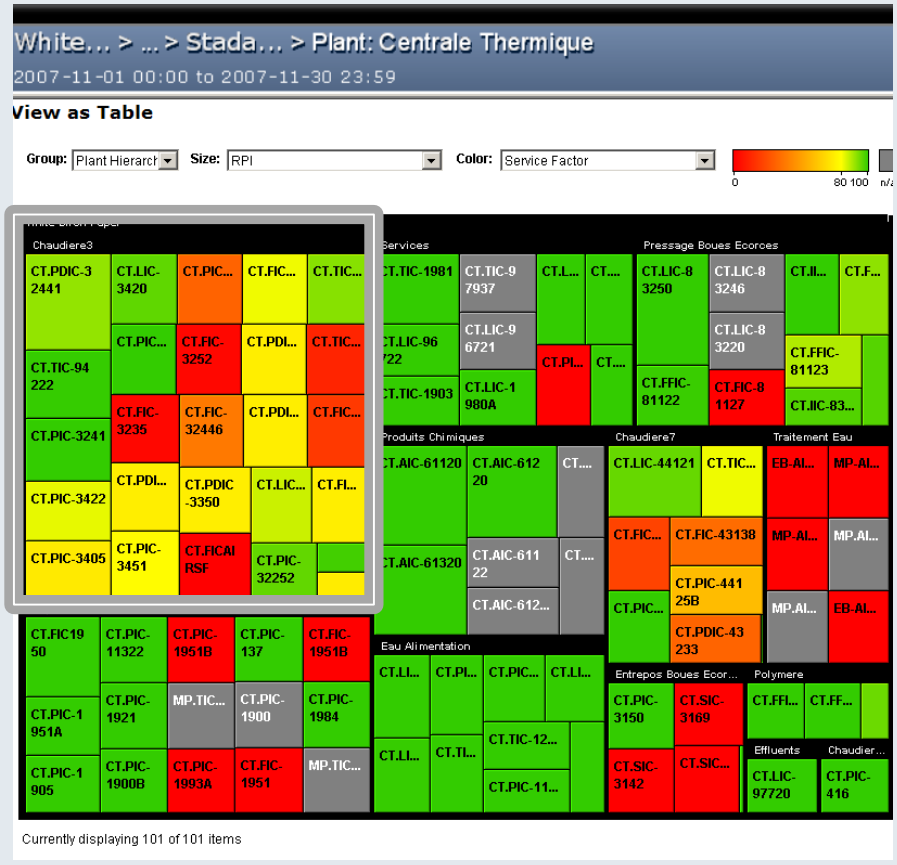
Remove Assets | Change Settling Time... | Change Weight...

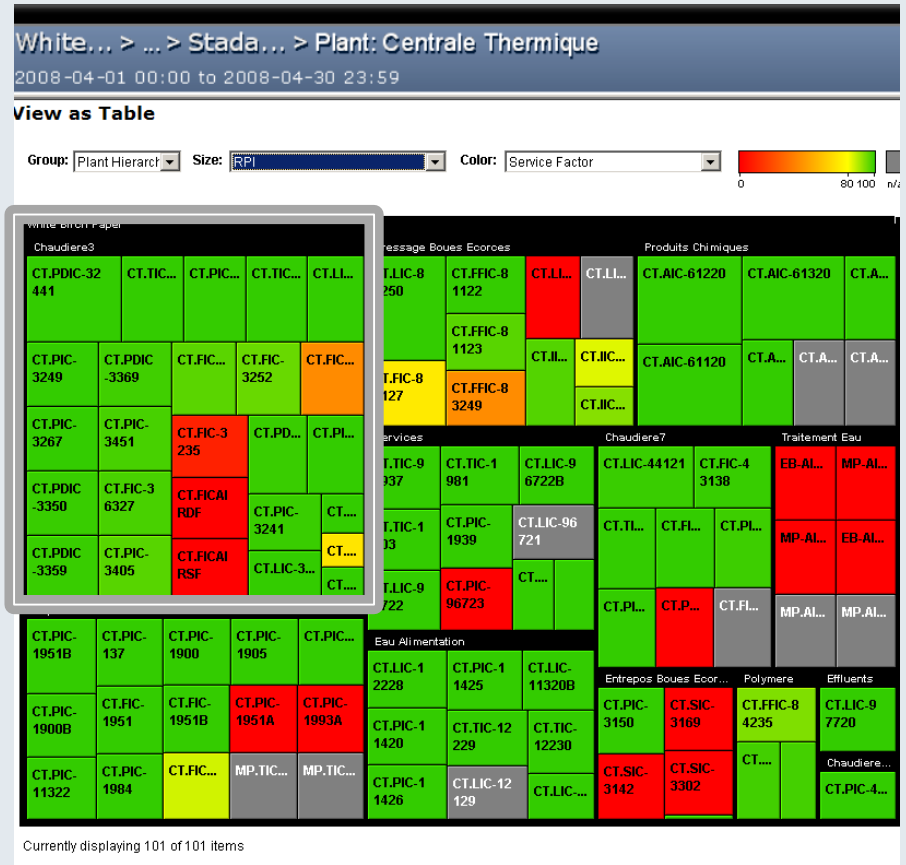
Showing 26 out of 26 assets (100%).

Asset Name	Description	Service Factor	Std Dev Error	Std Dev OP	Percent Saturation	Oscillation Index	Stiction	NLI	SP Activity
		low : high:	-	-	low : high:	low : high:	low : high:	-	low : high:
CT.FICAIRDF	AIR AU DESSUS DE GRILLE CH3	0.04	5.14	11.84	7.77	0.34	-	-	-
CT.FICAIRSF	MAITRE AIR SOUS LA GRILLE CH3	0.04	3.18	3.84	6.81	0.32	-	-	-
CT.FIC-3235	DEBIT_GAZ -CANAL PRINCIPAL...	10.60	3.47	12.42	79.36	0.10	-	-	-0.50
CT.FIC-32446	DEBIT DE PURGE-LAVEUR DES ...	43.74	1.78	2.60	65.18	0.09	0.00	0.00	-0.86
CT.TIC-32463	TEMPERATURE ELECTROFILTRE...	71.85	3.55	9.41	65.74	0.20	0.00	0.00	-0.96
CT.FIC-3252	CONTROLEUR DEBIT_MAZOUT-...	94.79	0.95	1.12	0.00	0.12	-	-	-0.73
CT.FICAIRMG	DEBIT AIR BRUL. AUXILIAIRES ...	96.12	10.75	10.27	85.79	0.22	-	-	-0.19
CT.PIC-3405	PRESS AIR-SORTIE RECHAUF. ...	96.46	0.03	3.36	1.79	0.07	0.00	0.00	-0.39
CT.FIC-36327	CONV.6 COND. CENDRES-DEBI...	97.90	22.84	8.49	97.35	0.33	-	-	-
CT.PIC-3451	PRESSION DE VAPEUR CH3	98.00	156.69	18.72	97.72	0.07	-	-	-
CT.PDIC-3369	PRESSION_REGIST-BRULEUR 1 ...	98.69	0.09	23.76	99.25	0.11	-	-	-
CT.PDIC-3360	PRESSION_REGIST-BRULEUR 2 ...	99.37	0.04	23.78	77.72	0.19	-	-	-0.89
CT.PIC-3241	CONTROLEUR PRESSION GAZ C...	99.40	9.76	9.53	95.84	0.19	-	-	-0.68
CT.PDIC-3359	PRESSION_REGIST-BRULEUR 4 ...	99.49	0.05	20.79	99.38	0.18	-	-	-
CT.PDIC-3350	PRESSION_REGIST-BRULEUR 3 ...	99.51	0.05	28.04	90.87	0.12	-	-	-0.86
CT.PIC-3422	PRESSION DE LA FOURNAISE -...	99.89	0.01	7.54	0.04	0.07	-	-	-0.96
CT.PIC-32252	PRESSION VERS SECHOIR	99.91	0.14	6.42	0.25	0.12	0.00	0.00	-0.99
CT.LIC-32273	NIVEAU-SILO DE BIOMASSE	99.91	13.44	11.07	0.00	0.12	-	-	-0.90
CT.LIC-32448	NIVEAU-LAVEUR DES GAZ	99.93	2.11	8.94	26.41	0.27	1.75	0.11	-0.98
CT.LIC-3420	NIVEAU EAU ALIMENTATION-CH3	100.00	1.30	7.68	3.32	0.15	0.00	0.07	-0.89
CT.PDIC-32441	PRESSION DIFF. LAVEUR DES ...	100.00	0.05	15.63	51.09	0.14	0.00	0.00	-0.97
CT.PIC-3249	CONTROLEUR PRESSION MAZO...	100.00	6.33	0.00	0.00	0.12	0.00	0.00	-0.92
CT.PIC-3267	CONTROLEUR PRESS VAPEUR C...	100.00	1.78	0.58	0.92	0.20	0.09	0.04	-0.96
CT.TIC-3403	TEMP AIR -SORTIE RECHF VAP...	100.00	0.73	9.94	34.59	0.65	1.79	0.28	-0.96
CT.TIC-94222	TEMPERATURE ECHANGEUR DE ...	100.00	0.15	1.35	0.00	0.17	0.06	0.02	-0.95
CT.TIC-94540	TEMPERATURE-AIR D'APPOINT	100.00	0.21	9.98	87.94	0.18	-	-	-0.96

November 2007 vs April 2008

November2007	Mapril 2008





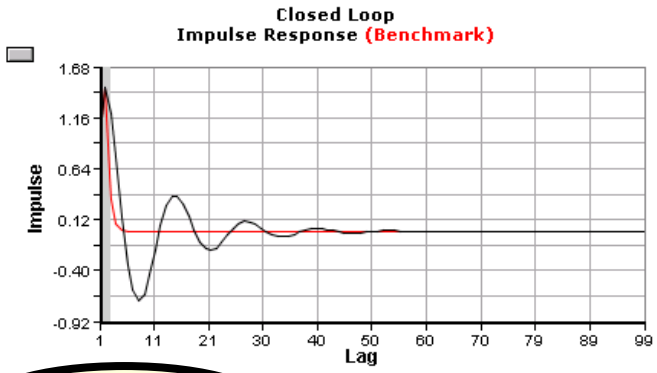
An example at White Birch: PIC 1900

(tuning parameters adapted to load)

February 8 2008

RPI:
Economic Benefit: 2.00
Weight: 0.50

Osc. Index: 0.50
Osc. Period (min): 12.00



Settling Time: 35.00 min

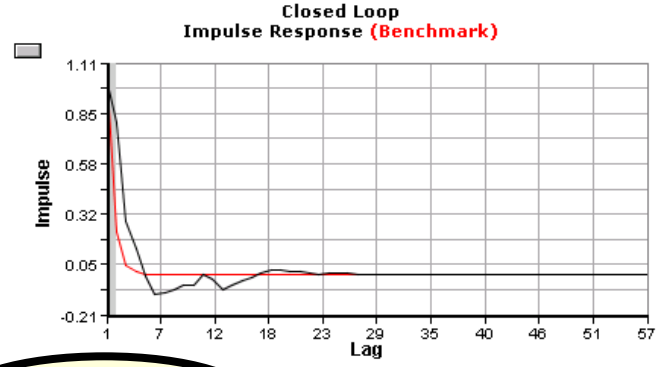
Diagnosis note: Poor control; Overtuned Integral.

	Avg.	Std. Dev.
PV	2648.13	60.16
SP	2650.00	0.00
Error	-1.87	60.16
OP	15.54	5.87

June 30 2008

RPI:
Economic Benefit: 1.00
Weight: 0.50

Osc. Index: 0.15
Osc. Period (min):



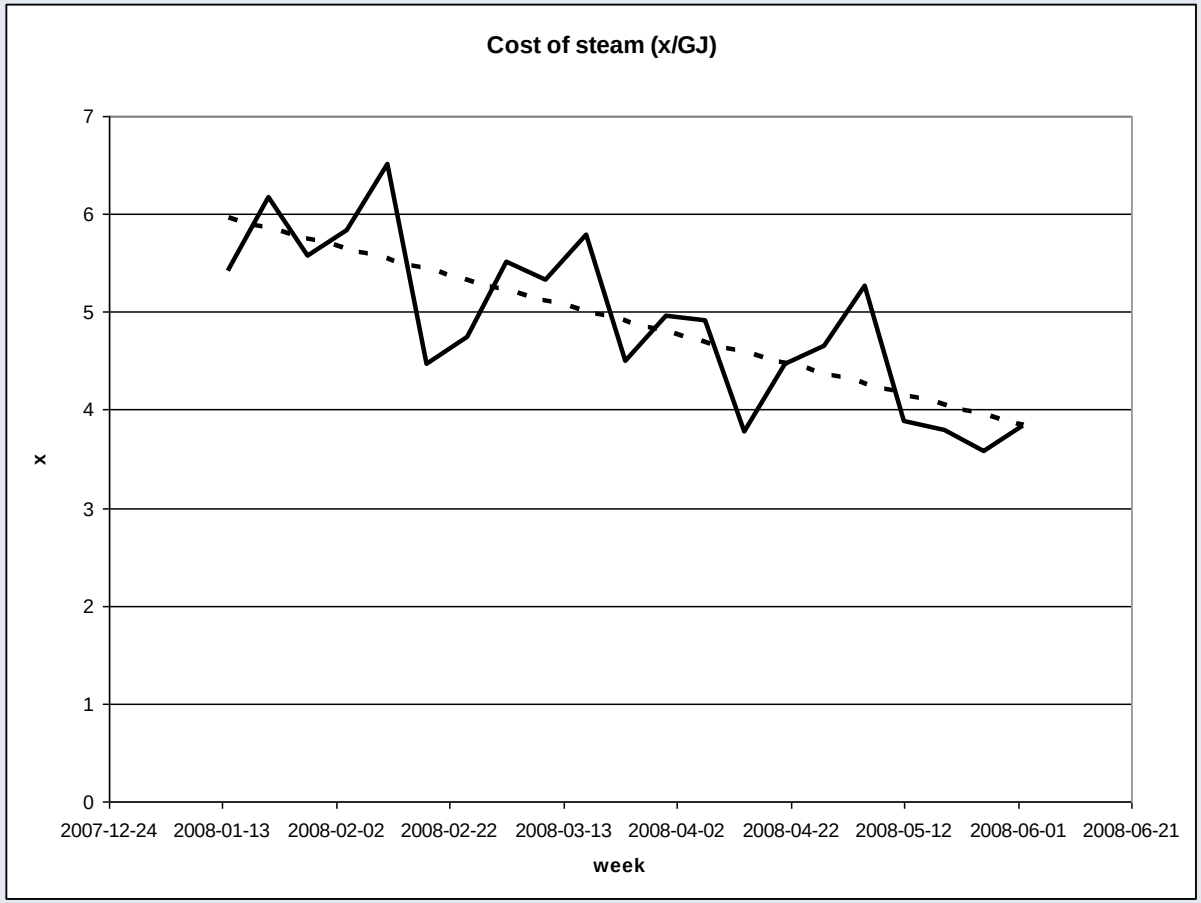
Settling Time: 15.00 min

Diagnosis note: Good control; External oscillatory disturbances or nonlinearity may exist.

	Avg.	Std. Dev.
PV	2649.73	20.42
SP	2650.00	0.00
Error	-0.27	20.42
OP	10.78	1.70

3 times better

Steam cost over 6 months



Small Gestures That Count!

- Actions
  - Daily
  - Weekly
  - Monthly
  - Yearly
- Workflow, procedures
- What can be automated?
- How can the process be sustained?
- How can optimization be optimized?

Thank You

Michel Ruel

President

Top Control Inc

mruel@topcontrol.com

(877)867-6473

www.topcontrol.com