

# ANDRITZ Capital Market Day 2017

## OPP (Optimization of Process Performance)

Daniel Schuck, 12<sup>th</sup> September 2017, Graz

# OPP - Optimization of Process Performance

- Increase process stability
- Reduce energy or chemical cost
- Debottleneck production, increasing total production
- Increase mill availability
- Fast response to move from area to area, or production to cost
- Keep existing savings in the long term
- Support to operation: in diagnostics, start-up, mill-balance



**Mill-wide**

**OPP Goals**

# OPP - Optimization of Process Performance

OPP - references

OPP is a **Service/Solution** offered by **ANDRITZ**



**Regional Specialist  
Remote Support**



**Local Support**



**Existing DCS / ERP**

**Collaborative Network:**

- Control Experience
- Automation Experience
- Maintenance Experience
- Best practices Database
- Continuous R&D






































**Metris Platform**

- ANDRITZ Platform & Methodology

# OPP - Optimization of Process Performance

## OPP - references

	Customer	1000 ton/year	Start-up		Customer	1000 ton/year	Start-up
	Customer A	2,330	2007		Customer S	1,950	2016
	Customer B	1,758	2010		Customer T	400	2016
	Customer C	485	2010		Customer U	700	2016
	Customer D	1,100	2011		Customer V	-----	2016
	Customer E	1,300	2011		Customer W	1,700	2016
	Customer F	1,125	2011		ANDRITZ P&P (Capital)	-----	2016
	Customer G	1,490	2011		ANDRITZ P&P (Services)	-----	2016
	Customer H	455	2012		ANDRITZ HYDRO	-----	2016
	Customer I	780	2013		ANDRITZ METALS	-----	2016
	Customer J	1,100	2013		ANDRITZ SEPARATION	-----	2016
	Customer K	420	2013		Customer X	730	2017
	Customer L	460	2014		Customer Y	950	2017
	Customer M	610	2014		Customer Z		2017
	Customer N	450	2014		Customer AA		2017
	Customer O	1,500	2014		Customer AB		2017
	Customer P	500	2015		Customer AC		2017
	Customer Q	450	2015		Customer AD		2017
	Customer R	4,700	2015				

+5 by end of 2017  
+116 by end of 2020

Pulp

Paper

Pulp/Paper

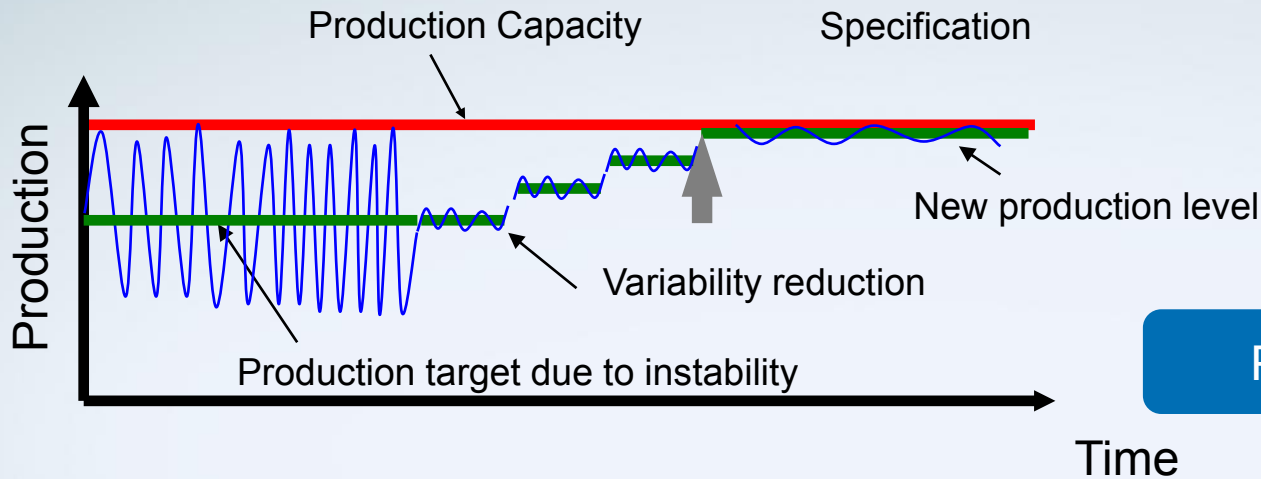
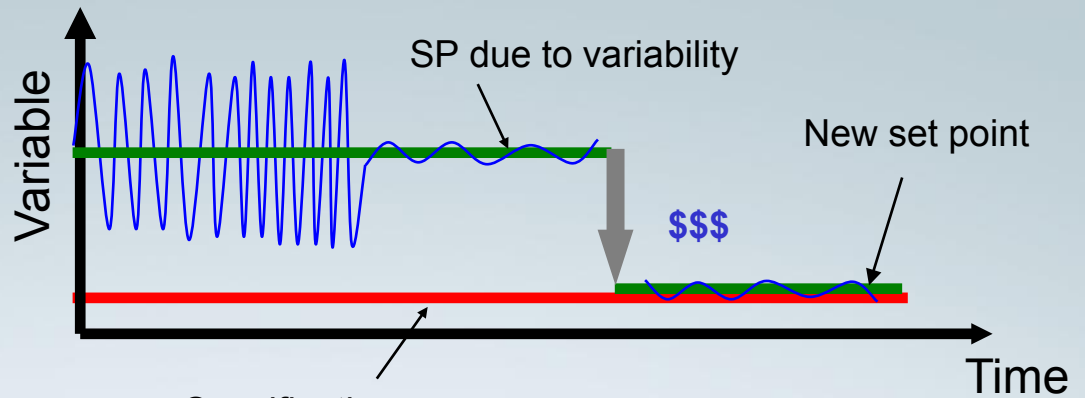
Steel



More than 150 million euros savings without capital investments

Typical Savings

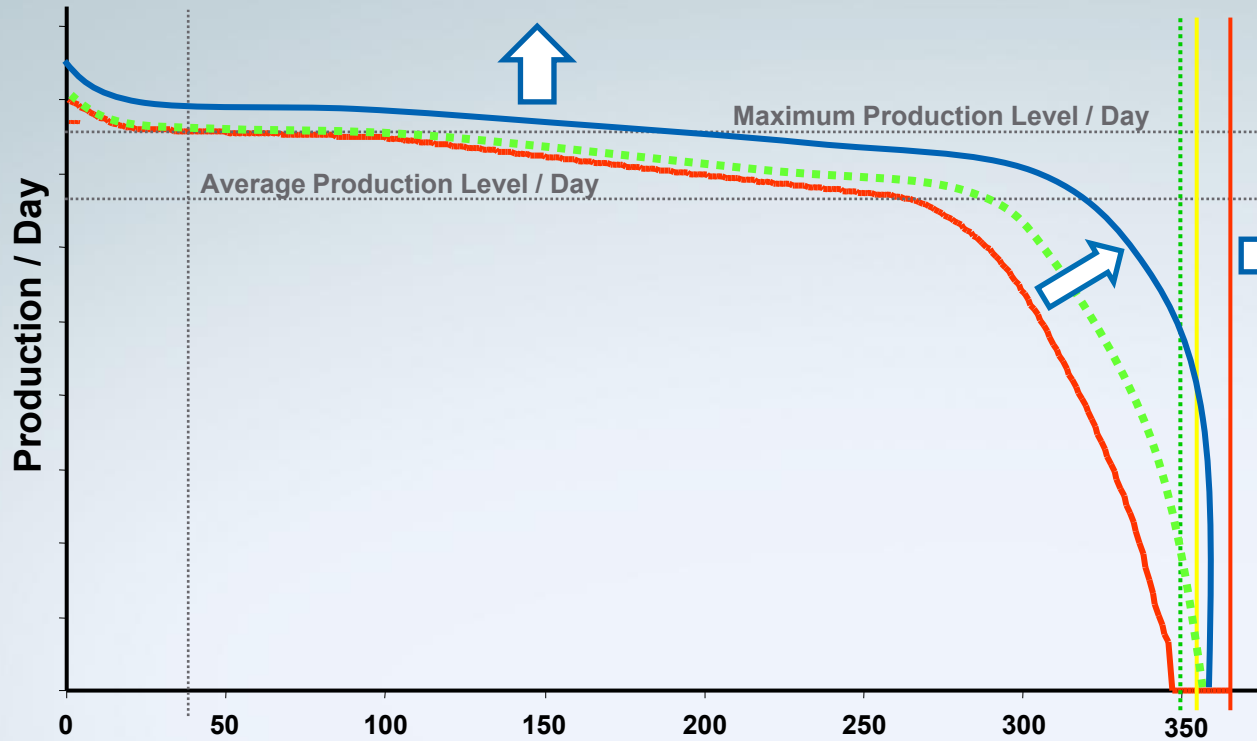
Chemical or energy savings



Production increase

How OPP reaches process performance

- Reduce process variability
- Fast start-up
- Debottlenecking
- Mill balance



- Avoid shutdown using automatic slowdown system
- Mill balance
- Production stability
- Equipment failure prediction

<90% (opportunity to improved)

90-91% (acceptable)

91-92% (target)

>92% (excellent)

# How OPP reaches process performance

# Strategy & Organization

## Metris Platform

<b>BUSINESS INTELLIGENCE</b>	Management and technical KPIs, dashboards, balanced scorecard, project management tool, etc	<b>LEVEL 4: MANAGERS</b>
<b>DATA ANALYTICS</b>	Data mining, statistics, power spectral density, KPIs	
<b>NOTIFIER</b>	OPP, SMS, e-mail, follow-up	<b>LEVEL 3: ENGINEERS (OPERATIONS AND MAINTENANCE)</b>
<b>PIMS</b>	Data historian, process displays	
<b>DAILY MANAGEMENT</b>	Tools for Log book, meetings, risk assessment, work permit	
<b>OPERATOR ASSISTANCE</b>	Start-up sequences, diagnostic systems, root cause analysis, process specification check	<b>LEVEL 2: OPERATORS AND SHIFT SUPERVISOR / CORDINATOR</b>
<b>SMART CONTROLS</b>	Advanced Process Controls, Decision support, adaptative setpoints, mill balance	
<b>SOFT SENSORS</b>	Measurement validation, process diagnostics	
<b>REGULATORY CONTROL</b>	Control loop tuning and assessment, dead time compensators, feedforward, etc.	
<b>AUGMENTED REALITY</b>	Real time data, diagnostic, procedures, remote support	
<b>ASSET MANAGEMENT</b>	Risk-based maintenance, predictive maintenance, condition Monitoring, Valves, motors, analyzers, interlock bypass, etc.	<b>LEVEL 1: FIELD OPERATORS AND MAINTENANCE TECHNICIAN</b>



# Strategy & Organization

## Metris Platform

### CUSTOMERS STRATEGIC DRIVERS

PRODUCTION	RAW MATERIAL COST	ENERGY COST	MAINT COST	QUALITY	SAFETY	ENVIRONMEN.	PRODUCTIVITY
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<b>BUSINESS INTELLIGENCE</b>	Management and technical KPIs, dashboards, balanced scorecard, project management tool, etc	●	●	●	●	●	●	●
<b>DATA ANALYTICS</b>	Data mining, statistics, power spectral density, KPIs	●	●	●	●	●	●	●
<b>NOTIFIER</b>	OPP, SMS, e-mail, follow-up	●	●	●	●	●	●	●
<b>PIMS</b>	Data historian, process displays	●	●	●	●	●	●	●
<b>DAILY MANAGEMENT</b>	Tools for Log book, meetings, risk assessment, work permit	●	●	●	●	●	●	●
<b>OPERATOR ASSISTANCE</b>	Start-up sequences, diagnostic systems, root cause analysis, process specification check	●	●	●	●	●	●	●
<b>SMART CONTROLS</b>	Advanced Process Controls, Decision support, adaptative setpoints, mill balance	●	●	●	●	●	●	●
<b>SOFT SENSORS</b>	Measurement validation, process diagnostics	●	●	●	●	●	●	●
<b>REGULATORY CONTROL</b>	Control loop tuning and assessment, dead time compensators, feedforward, etc.	●	●	●	●	●	●	●
<b>AUGMENTED REALITY</b>	Real time data, diagnostic, procedures, remote support	●	●	●	●	●	●	●
<b>ASSET MANAGEMENT</b>	Risk Based Maintenance, predictive maintenance, condition Monitoring, Valves, motors, analyzers, interlock bypass, etc.	●	●	●	●	●	●	●

# Strategy & Organization

## Metris OPP Platform

### AUTONOMOUS OPERATIONS

#### MANAGEMENT OPTIMIZATION

- 1 Business Intelligence
- 2 Quality Management
- 3 Augmented Reality
- 4 Knowledge Management
- 5 Data Analytics

#### PROCESS OPTIMIZATION

- 1 Process & Control Engineering
- 2 Production Management
- 3 Mill Balance
- 4 Smart Controls

#### ASSET OPTIMIZATION

- 1 Systems
- 2 Devices

# Autonomous Operations

## Decision levels

MARKET STRATEGY	<b>Maximize company results</b> Market x Budget analysis and definition of production strategy	MONTHLY
PRODUCTION STRATEGY	<b>Budget control</b> Speed, Economy, Balanced (It defines how mill balance should work)	DAILY
PRODUCTION & COST MANAGEMENT	<b>Mill balance control</b> Start-up/Stop, Speed-up/Slow-down, Recipes (35 controls)	MINUTES TO HOURS
SMART CONTROLS	<b>Control of complex variables</b> Kappa, Brightness, Moisture, Dry-solids, etc. (75-100 controls)	3 -300 SECONDS
REGULATORY CONTROLS & SAFETY	<b>Control of simple variables and avoid interlocks</b> Flow, Temperature, etc. (1000 controls + 2000+ interlocks)	0.1 -1 SECONDS
RELIABILITY	<b>Equipment (some assets have their own controls)</b> Big assets, instruments, valves, motors, etc. (15,000+ devices)	MILISECONDS

# Autonomous Operations

## How to achieve it

### Customer need

Equipment must be reliable

### How to improve it?

Prediction of failure and automatic notification based on on-line data

Prediction of failure and automatic notification based on inspections. AR (Augmented Reality) can help.

Risk-based Maintenance (RBM) algorithm

Instruments

Control Valves

On-off Valves

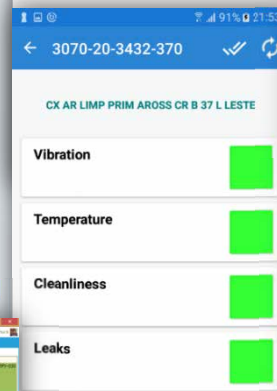
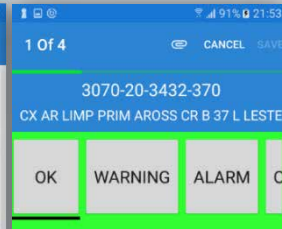
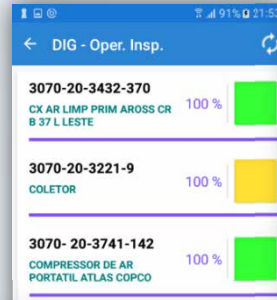
Motors

Variable Frequency Drives

Pumps

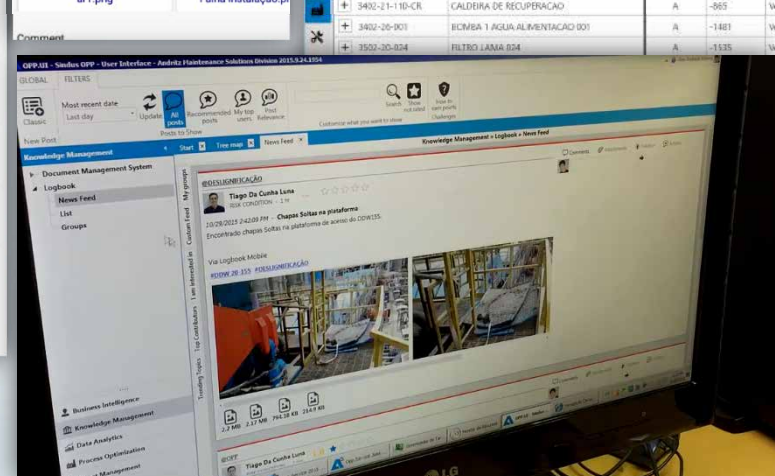
Smart Sensors

Soft Sensors



Asset Performance - Risk - Summary of Assets

Installation Local	Description	Criticality	Days left	Risk (Max)	Risk Distribution	Very High	High	M		
3502-20-019	CD FILTER 019	A	-1410	Very High		29	29			
Risk	Days left	Notification	Type	Description	Priority	Status	User Status	Created Timestamp	Days	Work Ore
Very High	-1122	000010048191 Z1		SANAR VAZAMENTO VISOR CD	Critico	ORDA MSEN		5/29/2014 12:00:00 AM	1125	
Very High	-845	000010058489 Z1		TROCAR TODAS TELAS DO CD FILTER	Critico	ORDA MSEN		3/2/2015 12:00:00 AM	848	
Very High	-845	000010058486 Z1		RETRABAR CHUVEIRO CD FILTER	Critico	ORDA MSEN		3/2/2015 12:00:00 AM	848	
Very High	-845	000010058499 Z1		ABRIR AS LINHAS DOS AGITADORES CD FILTER	Critico	ORDA MSEN		3/2/2015 12:00:00 AM	848	
Very High	-845	000010058509 Z1		ABRIR VISORES E VALVULAS DE DRENDO	Critico	ORDA MSEN		3/2/2015 12:00:00 AM	848	
Very High	-845	000010058511 Z1		ABRIR BOCAS DE VISTAS DO CD FILTER	Critico	ORDA MSEN		3/2/2015 12:00:00 AM	848	
Very High	-845	000010058512 Z1		HIDROUATEAR CD FILTER E PERIFERICOS	Critico	ORDA MSEN		3/2/2015 12:00:00 AM	848	
Very High	-845	000010058521 Z1		HIDROUATEAR TANQUES SEPARADORES CD	Critico	ORDA MSEN		3/2/2015 12:00:00 AM	848	
Very High	-845	000010058704 Z1		TROCAR VISORES DAS TELAS DO CD-FILTER	Critico	ORDA MSEN		3/2/2015 12:00:00 AM	848	
	3402-26-002	BOMBA 2 AGUA ALIMENTACAO 002		A	-1461	Very High		13	21	
	3402-21-10-CR	CALDEIRA DE RECUPERACAO		A	-865	Very High		13	11	
	3402-26-001	BOMBA 1 AGUA ALIMENTACAO 001		A	-1481	Very High		12	27	
	3502-20-024	FILTRO LAMA 024		A	-1535	Very High		12	27	
						Very High		9	25	



# Autonomous Operations

## How to achieve it

### Customer need

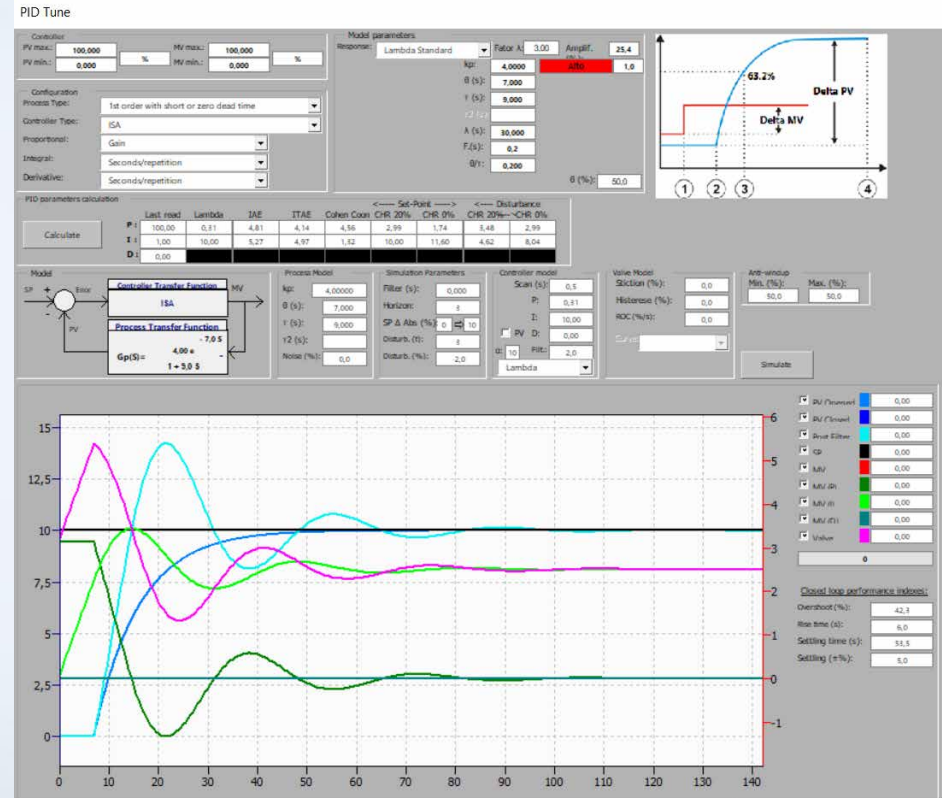
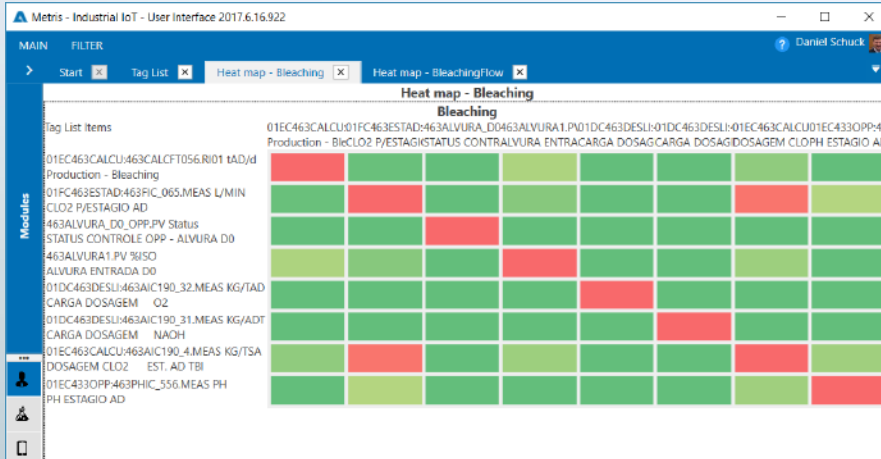
Basic loops must work at least 95% in auto mode, with minimum IAE (Integral of Absolute Error)

Automatic diagnostics of instruments and valves

### How to improve it?

Automatic diagnostics of control loop performance

Control loop monitoring and tuning



# Autonomous Operations

## How to achieve it

### Customer need

Interlocks must be avoided

### How to improve it?

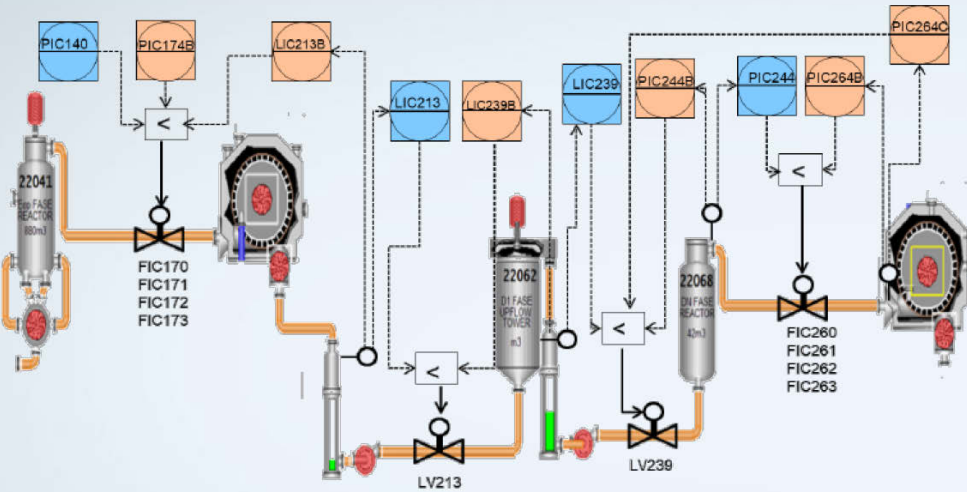
Automatic slow-down system

“Hacking” operator actions and make it automatically

Eliminate not needed interlocks

Review interlock limits

Delay interlocks when possible



Metris - Industrial IoT - User Interface 2017.6.16.922

MAIN ACTIONS

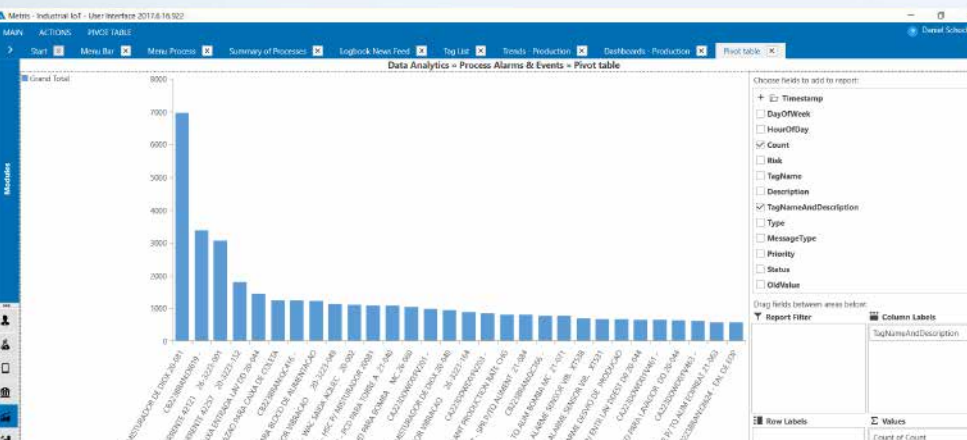
Start Tag List Heat map - Bleaching Historical

Data Analytics » Process Alarms & Events » Historical

Full Text Search

Drag a column header and drop it here to group by that column

Message Type	Timestamp	Risk	Tag Name	Description	Type
Alarm	10/20/2016 6:53:00 AM	80 %	CB223BRAN:LT467	TANQUE DE FILTRADOD2 21-082	LLABS
Alarm	10/20/2016 6:53:00 AM	0 %	CB223DDW:153:P039	UNIDADE HIDRAULICA20154	ENABLE
Alarm	10/20/2016 6:53:00 AM	0 %	LB223BRAN:M2084COR_HH	RASPADOR TOPO TORRE D2	STATE
Alarm	10/20/2016 6:53:00 AM	80 %	LB223BRAN:42084COR_HH	RASPADOR TOPO TORRE D2	STATE
Alarm	10/20/2016 6:54:00 AM	0 %	CB223BRAN:LI457	TQ ALIMENT LAVADORDD 21-085	HIABS
Alarm	10/20/2016 6:54:00 AM	80 %	LB223BRAN:42084COR_HH	RASPADOR TOPO TORRE D2	STATE
Event	10/20/2016 6:54:00 AM	100 %	CB223DDW:153:FV021	PCD P/ LAV DD EST D2 20-153	OUT
Event	10/20/2016 6:54:00 AM	100 %	CB223DDW:153:FV021	PCD P/ LAV DD EST D2 20-153	OUT
Event	10/20/2016 6:54:00 AM	100 %	CB223DDW:153:FV021	PCD P/ LAV DD EST D2 20-153	OUT
Event	10/20/2016 6:54:00 AM	100 %	CB223DDW:153:FV021	PCD P/ LAV DD EST D2 20-153	OUT
Event	10/20/2016 6:54:00 AM	100 %	CB223DDW:153:FV021	PCD P/ LAV DD EST D2 20-153	OUT
Event	10/20/2016 6:54:00 AM	100 %	CB223DDW:153:FV021	PCD P/ LAV DD EST D2 20-153	OUT
Event	10/20/2016 6:54:00 AM	100 %	CB223DDW:153:FV021	PCD P/ LAV DD EST D2 20-153	MA
Event	10/20/2016 6:54:00 AM	100 %	LB223BRAN:42081LOG	LOGICA 42081 26-3223-080	BI15
Alarm	10/20/2016 6:54:00 AM	0 %	CB223DDW:153:FC027	WCL LAV. DD EST D220153 FACE 1	LOABS
Alarm	10/20/2016 6:54:00 AM	70 %	GA223BRAN:34:42084COR	CORRENTE 42084 20-3223-085	HIABS
Alarm	10/20/2016 6:54:00 AM	100 %	GA223BRAN:34:42084COR	CORRENTE 42084 20-3223-085	HHABS



# Autonomous Operations

## How to achieve it

### Customer need

Key process variables must be controlled inside specifications

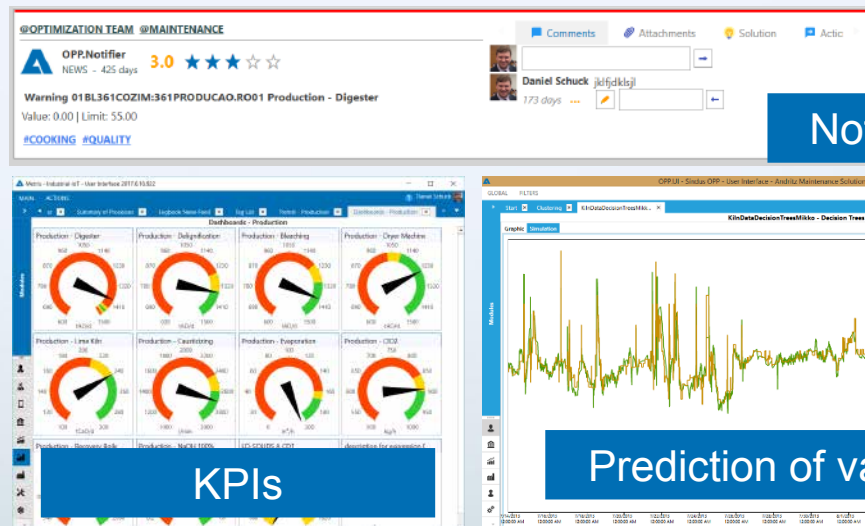
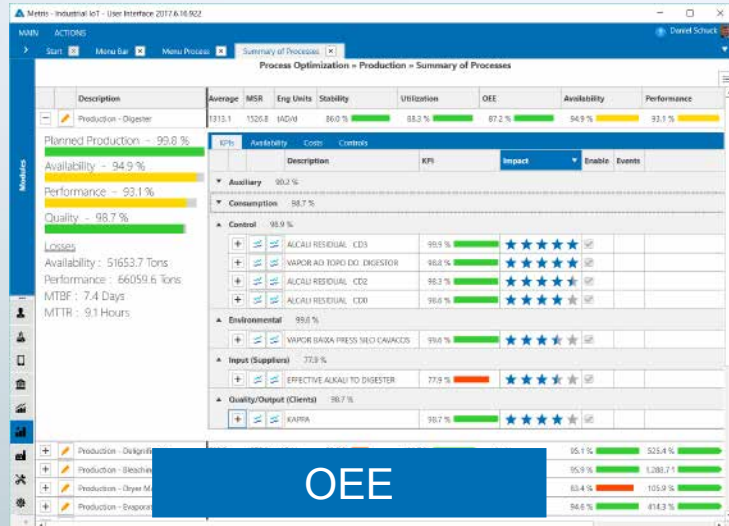
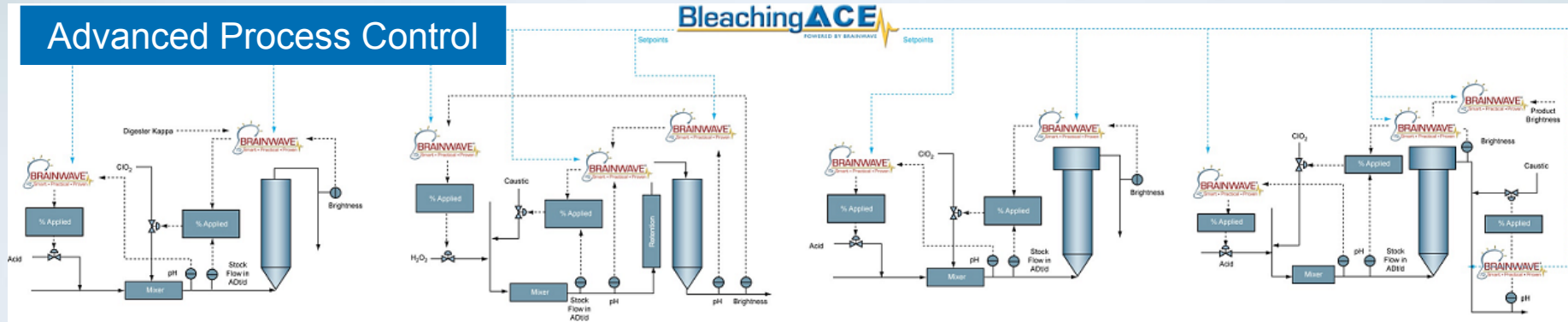
### How to improve it?

Sophisticated control algorithms must be developed and updated continuously

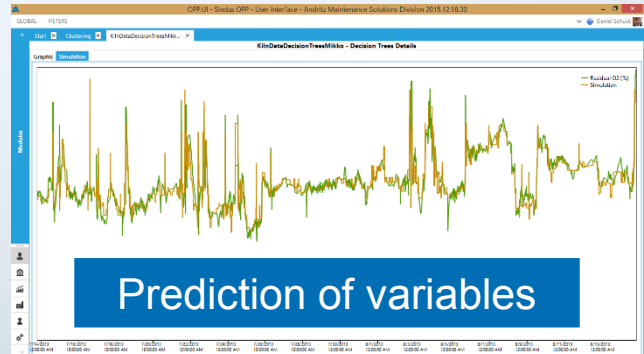
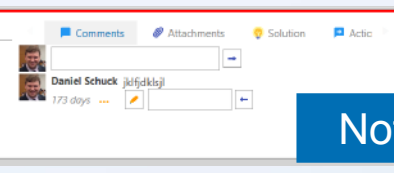
Specifications limits must be reviewed based on best operations days

Prediction of process problems and automatic notification

### Advanced Process Control



### Notifications



# Autonomous Operations

## How to achieve it

### Customer need

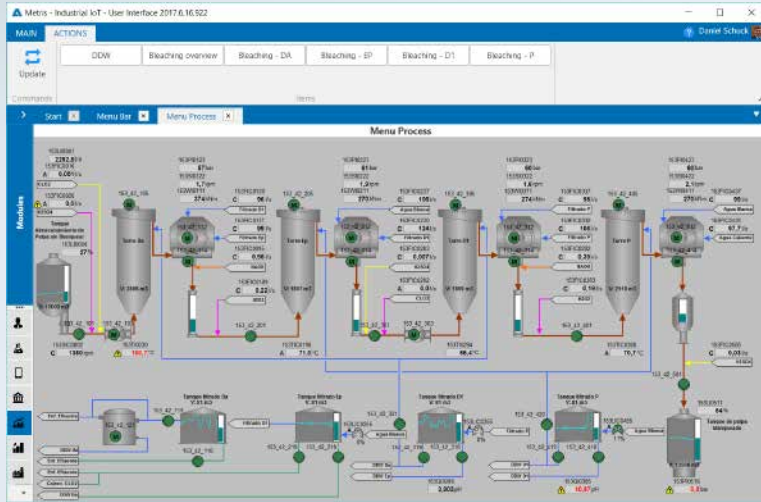
Production rate and chemical/energy consumption must be always optimized

Sophisticated control algorithms must be developed and updated continuously

### How to improve it?

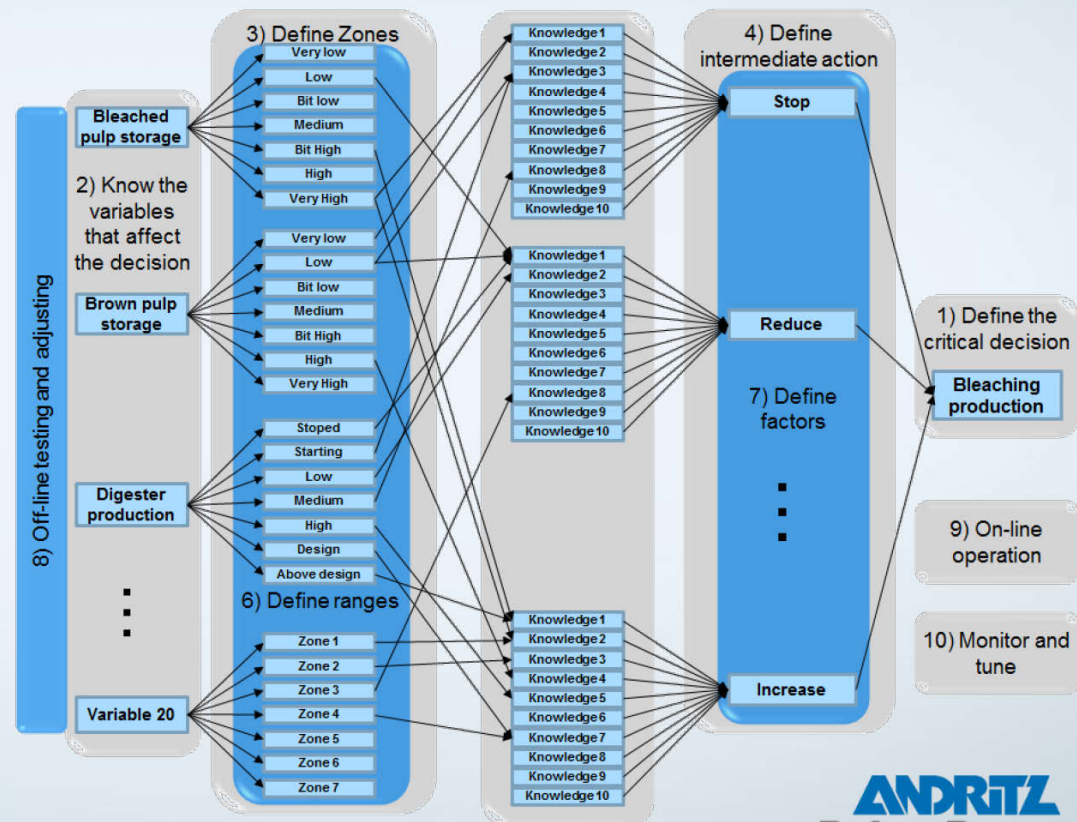
Create a footprint of key equipment

Benchmark with best productions days and suggest possible changes in the model automatically



Reduce TDS	Increase TDS	Reduce O2 weight%	Increase O2 weight%
0	0,150097	0	0
0,000001	0,000001	0,000001	0,000001
0,000002	0,000002	0,000002	0,000002
0,000003	0,000003	0,000003	0,000003
0,000004	0,000004	0,000004	0,000004
0,000005	0,000005	0,000005	0,000005
0,000006	0,000006	0,000006	0,000006
0,000007	0,000007	0,000007	0,000007
0,000008	0,000008	0,000008	0,000008
0,000009	0,000009	0,000009	0,000009
0,000010	0,000010	0,000010	0,000010
0,000011	0,000011	0,000011	0,000011
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0,000046	0,000046	0,000046	0,000046
0,000047	0,000047	0,000047	0,000047
0,000048	0,000048	0,000048	0,000048
0,000049	0,000049	0,000049	0,000049
0,000050	0,000050	0,000050	0,000050

Input	Description	Enable	Zone	Name	X1	X2	X3	X4	Out	RULES
1	Dust emission-moving average (last 20 minutes)	True	1	Normal	0	0	0	0	0,000001	0,000001
2	Dust emission-average (current day)	True	2	Normal	0	0	0	0	0,000001	0,000001
3	Dust emission-moving average (last 10 minutes)	True	3	Normal	0	0	0	0	0,000001	0,000001
4	O2-moving average	True	4	Can increase	0	0	0	0	0,000001	0,000001
5	Total air loss	True	5	Can reduce	0	0	0	0	0,000001	0,000001





# Autonomous Operations

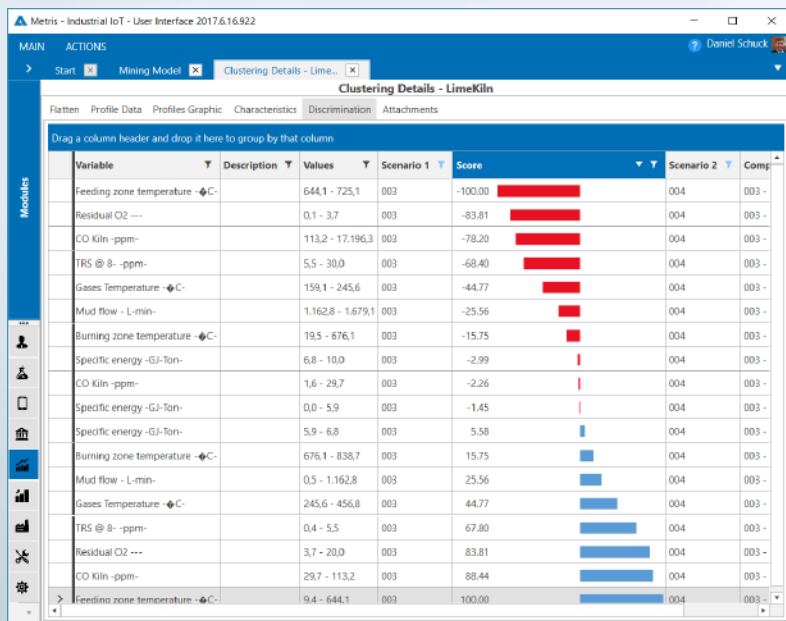
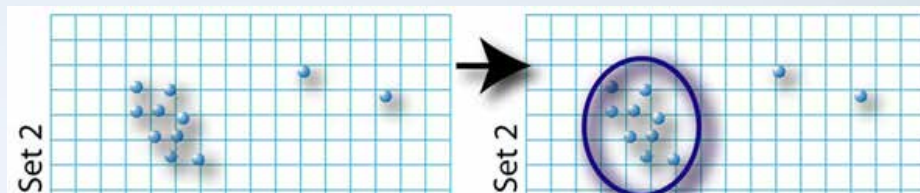
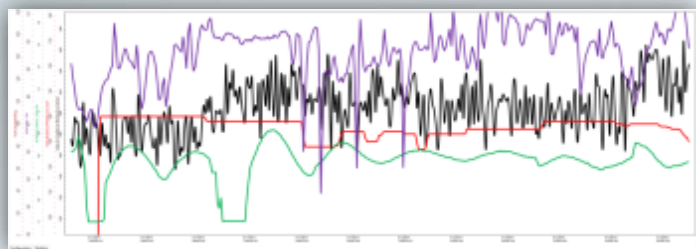
## How to achieve it

### Customer need

How to deal with changes in raw material

### How to improve it?

Process model and recipes must be created for every scenario to make the process at its optimal level



# Autonomous Operations

## How to achieve it

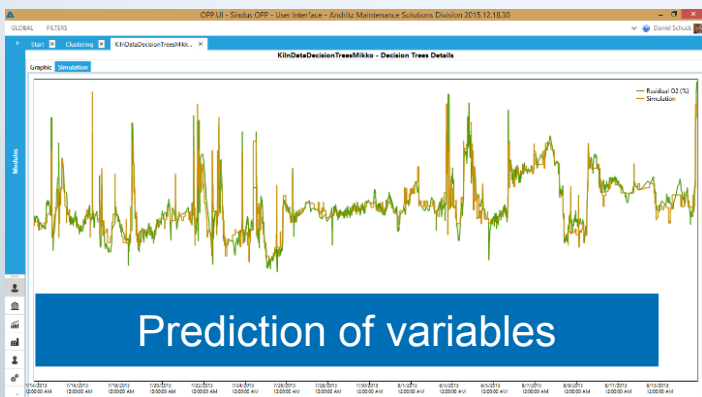
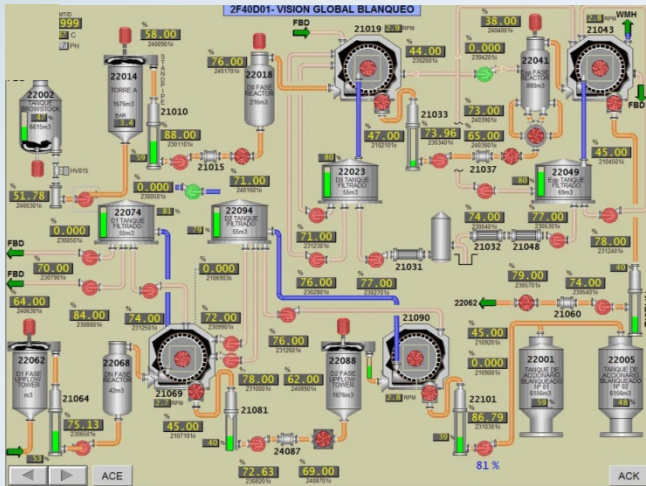
### Customer need

How to deal when something goes wrong, like an instrument failure

### How to improve it?

Switch off part of the algorithm and give instructions in how to proceed

Start-up sequence to start the process quickly and in a standardized way



Prediction of variables

### 2F40D26 - PARTIDA AUTOMATICA DE BLANQUEO

CARGA PARAMETROS

1) BBA 2310401 = AUTO  
2) START BBA 2310301  
3) LIC400 AUTO SP= 25.0 %  
4) SIC403 REMOTO  
5) PIC407 AUTO SP= 6.00 BAR  
6) PIC404 MAN= 50.0 %  
7) HV368 = AUTO  
8) HV401 = AUTO  
9) START REPULPER 2109201  
10) ESPERA PIC379= 2.50 BAR  
11) START BBA 2309801  
12) ESPERA HV371= 80.0 %  
13) HV371 MAN= 80.0 %  
14) ESPERA FI369= 13.8 L/S  
15) BBA 2309601 = AUTO  
16) START DDW 2309101  
17) PIC373 AUTO= 50.0 L/S  
18) PIC375 AUTO= 50.0 L/S  
19) SIC959 REMOTO  
20) PIC364 AUTO SP= 0.39 BAR  
21) ABRE HV392-HV393-HV394 HV395  
22) REMOTO FIC360-FIC361 FIC362-FIC363  
23) LIC348A AUTO SP= 55.0 %  
24) LIC381 AUTO SP= 80.0 %  
25) HV349 MAN= 50.0 %  
26) HV347 MAN= 50.0 %  
27) START BBA 2310001  
28) HV359 MAN= 20.0 %  
29) ESPERA LIC348A= 70 %  
30) ESPERA LIC348B= 70 %  
31) START RASTRILLO 2408901  
32) INICIA SEQ FASE D2 NO  
33) ESPERA BBA 2308201 EN SERVICIO

SEQ 1 - "DDW D2" START SEQ 1

SEQ 2 - "FASE\_D2" START SEQ 2

1) ABRE HV321  
2) START MEZCLADOR 2408701  
3) BBA 2308401 = AUTO  
4) PIC317 AUTO SP= 8.50 BAR  
5) HV268 = AUTO

SEQ 3 - "DDW D1" START SEQ 3

1) START REPULPER 2107101  
2) ESPERA PI270= 2.50 BAR  
3) START BBA 2307801  
4) ESPERA HV272= 80.0 %  
5) HV272 MAN= 80.0 %  
6) ESPERA FI269= 13.8 L/S  
7) BBA 2307601 = AUTO  
8) START DDW 2307001  
9) FIC274 AUTO SP= 50.0 L/S  
10) FIC276 AUTO SP= 50.0 L/S  
11) START 2309901  
12) SIC859 REMOTO  
13) PIC264 AUTO SP= 0.39 BAR  
14) REMOTO FIC260-FIC261 FIC262-FIC263  
15) PIC244 MAN= 40.0 %  
16) LIC281 AUTO SP= 80.0 %  
17) START BBA 2308001  
18) HV245 MAN= 20.0 %  
19) BBA 2306601 = AUTO  
20) ESPERA FI260= 40.0 L/S  
21) START 2306501  
22) LIC239 AUTO SP= 50.0 %  
23) PIC241 MAN= 50.0 %  
24) INICIA SEQ FASE D1 NO

SEQ 4 - "FASE\_D1" START SEQ 4

1) START RASTRILLO 2406301  
2) ABRE HV221  
3) START MEZCLADOR 2406101  
4) BBA 23058010 = AUTO  
5) PIC217 AUTO SP= 8.35 BAR  
6) HV189 = AUTO  
7) START BBA 2305701  
8) LIC213 AUTO SP= 35.0 %  
9) PIC214 MAN= 50.0 %

SEQ 5 - "DDW EOP" START SEQ 5

1) START REPULPER 2104501  
2) ESPERA PI102= 2.50 BAR  
3) START BBA 2302901  
4) ESPERA HV101= 80.0 %  
5) HV101 MAN= 80.0 %  
6) ESPERA FI098= 13.8 L/S  
7) BBA 2305101 = AUTO  
8) START DDW 2304401  
9) FIC185 AUTO SP= 50.0 L/S  
10) FIC187 AUTO SP= 50.0 L/S  
11) SIC759 REMOTO  
12) PIC174 AUTO SP= 0.33 BAR  
13) REMOTO FIC170-FIC171 FIC172-FIC173  
14) HV151 MAN= 100 %  
15) START RASTRILLO 2404001  
16) PIC140 MAN= 30.0 %  
17) PIC148 MAN= 38.0 %  
18) START BBA 2305401  
19) START BBA 2304201  
20) HV136 MAN= 20.0 %  
21) HV146 MAN= 20.0 %  
22) HV175 MAN= 20.0 %  
23) ESPERA FI170= 10 L/S  
24) ESPERA FI171= 10 L/S  
25) ESPERA FI172= 10 L/S  
26) ESPERA FI173= 10 L/S  
27) INICIA SEQ FASE EOP NO

SEQ 6 - "FASE\_EOP" START SEQ 6

1) ABRE KV138A-KV138B KV138C-KV138D  
2) START DISTRIBUIDOR 2403901  
3) START MEZCLADOR 2403801  
4) BBA 2303501 = AUTO  
5) START BBA 2303401  
6) LIC120 AUTO SP= 35.0 %  
7) PIC121 MAN= 50.0 %  
8) INICIA SEQ DDW D0 NO  
9) PIC124 AUTO SP= 10.85 BAR

SEQ 7 - "DDW D0" START SEQ 7

1) START REPULPER 2102101  
2) ESPERA FI098= 13.8 L/S  
3) BBA 2302501 = AUTO  
4) START DDW 2302001  
5) FIC083 AUTO SP= 50.0 L/S  
6) FIC085 AUTO SP= 50.0 L/S  
7) SIC659 REMOTO  
8) PIC074 AUTO SP= 0.33 BAR  
9) REMOTO FIC070-FIC071 FIC072-FIC073  
10) START RASTRILLO 2401701  
11) START BBA FILTRADO 2307901  
12) PIC055 MAN= 30.0 %  
13) FIC057 MAN= 20.0 %  
14) START MEZCLADOR 2401601  
15) INICIA SEQ TORRE NO  
16) ESPERA BBA 2301101 EN SERVICIO  
17) FIC070A REMOTO  
18) RAMPA PRODUCCION  
19) ABRE HV051  
20) FIC050 REMOTO

SEQ 8 - "TORRE A" START SEQ 8

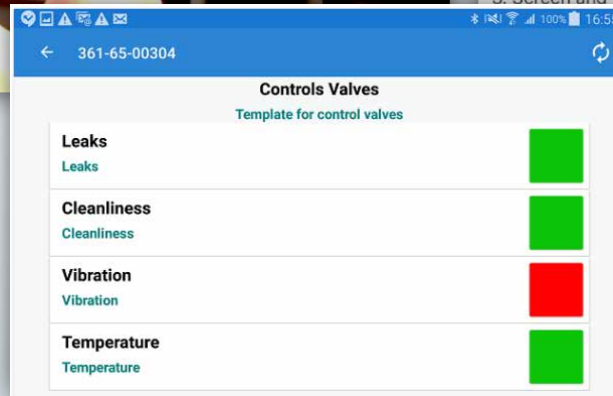
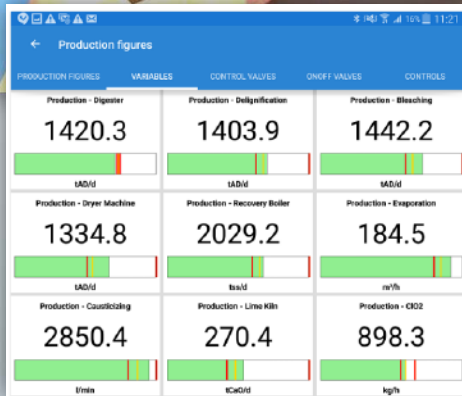
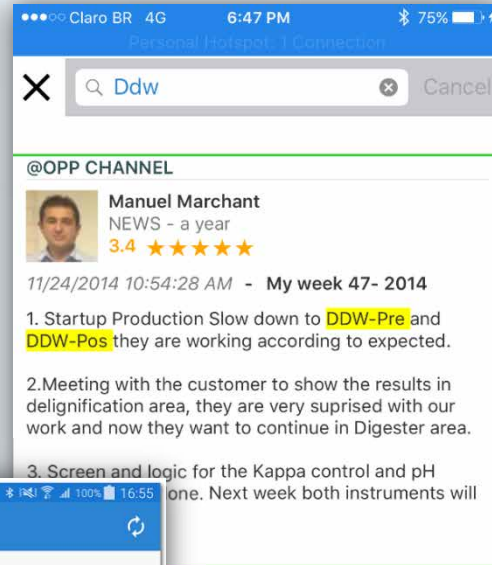
1) START UNID LUBR 2300301  
2) START RASTRILLO TAC 2400301  
3) START RASTRILLO 2400901  
4) START BBA 2301101  
5) BBA 2300701 = AUTO  
6) START BBA 2300601  
7) PIC018 MAN= 25.0 %  
8) LIC037 AUTO SP= 55.0 %  
9) PIC041 MAN= 20.0 %  
10) ABRE HV025  
11) FIC024 REMOTO

10) INICIA SEQ DDW EOP NO  
11) ABRE HV219  
12) FIC218 REMOTO  
13) FIC212 AUTO SP= 0.09 L/S  
14) ABRE HV319  
11) FIC318 REMOTO  
12) FIC312 AUTO SP= 0.02 %

# Autonomous Operations

## How to achieve it

Customer need	How to improve it?		
How to reduce the time to repair	Show contextual information	Have a knowledge database	Team of experts to support the mill



o Queiroz  
9 months  
★★★★★  
1 AM - Thermography for UI!  
nd I was messing around in Amazon  
w a section only with start-up  
st fits to us is a thermal camera, that  
Android or iOS phones.

# Autonomous Operations Results

Installation and tuning: Sep-Dec/16

KPI	Baseline	Goal	Jan/17	Feb/17	Mar/17	Apr/17	May/17	Jun/17
Operational Stability (average/ MSR) <b>hour base</b>	91%	94%	90.3%	94.1%	93.7%	90.5%	93.3%	95.5
Variable Costs (Consumption + Energy)	0%	-10%	-6,2%	-10,9%	-10.5%	-6.5%	-9.7%	-11%
OPP controls ON (% of Time of)	0%	90%	65,1%	90%	95%	85%	96%	97%

Production Records	Before	Q1/2017	Q2/2017	Q3/2017
Daily	5420	-	5508 (+1.6 %)	
Monthly average	4988	-	5045 (+1.1 %)	5105 (+2.3 %)
Quarter average	4694	4814 (+2.5%)	4872 (+3.8 %)	

# ANDRITZ Capital Market Day 2017

OPP

**Thanks!**

Any questions?

**Daniel Schuck**

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