



Growing on Smart Data

SIEMENS Gamesa
RENEWABLE ENERGY

Siemens Gamesa Renewable Energy Today



87 GW

Installed Global
Capacity



25k

Employees



11 €B

Annual Revenue ²



11.5 GW

Order Entry



23.2 €B

Order Book



True global, modern
and scalable footprint



Advanced digital
capabilities



Portfolio covering
all requirements

- ¹ End of June 2018 (Q3 FY18)
- ² End of FY'17

Siemens Gamesa Renewable Energy Today

Three business units with strong market position

Onshore



- **74 GW** installed in 75 countries.
- **9,7 GW** promoted in 14 countries.
- The technology partner of choice for onshore wind power projects.

Offshore



- **11,4 GW** installed all over the world since 1991.
- The most experienced offshore wind company with the most reliable product portfolio in the market.

Service



- **55,4 GW** under service and maintenance.
- Helping customers achieve their business objectives by ensuring that turbines work at peak efficiency throughout their life cycle.

fGamesa WindOne® Project - 2011

Company Challenges

Reduce **costs**

Increase **benefits**

Keep **customers in focus**

Unique **repository** for all the company

Extracting **more value** from existing assets

Knowledge tools for managing underperformance

Project Challenges

Huge amount of **information**

Change the way **maintenance** was done

Thousands of assets in remote locations

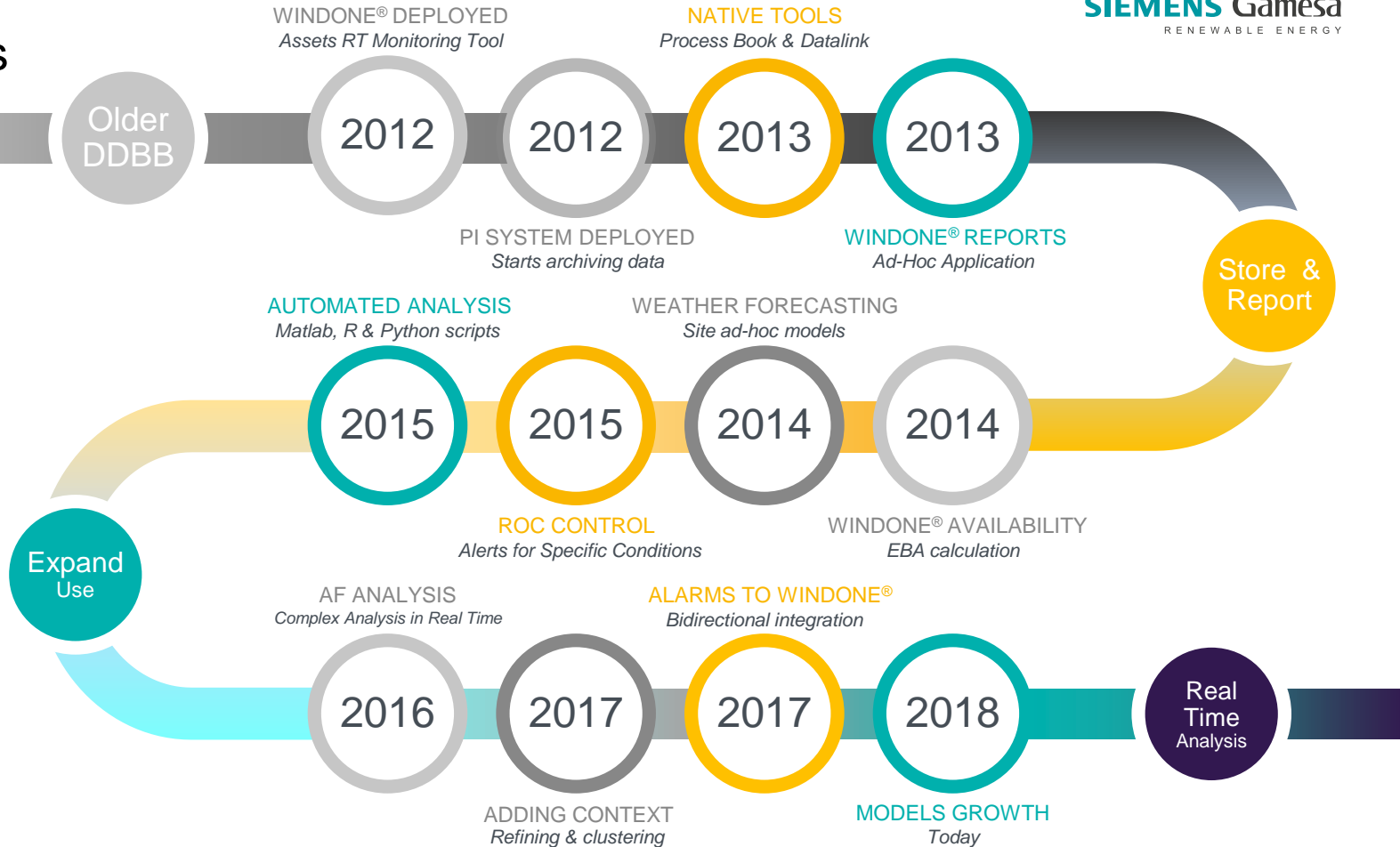
Personnel in many different **countries & cultures**

fGamesa WindOne® Project

- Thousands of Wind Turbines in remote locations
- Billions of data generated



Milestones



Facts about our PI System



>900

Wind Farms connected to
WindOne®



>19k

Wind Turbines
Integrated



3.2 MM

Active Tags with Real Time
Acquisition



90k

Running Analysis



400

Direct Users



>2000

Indirect Users



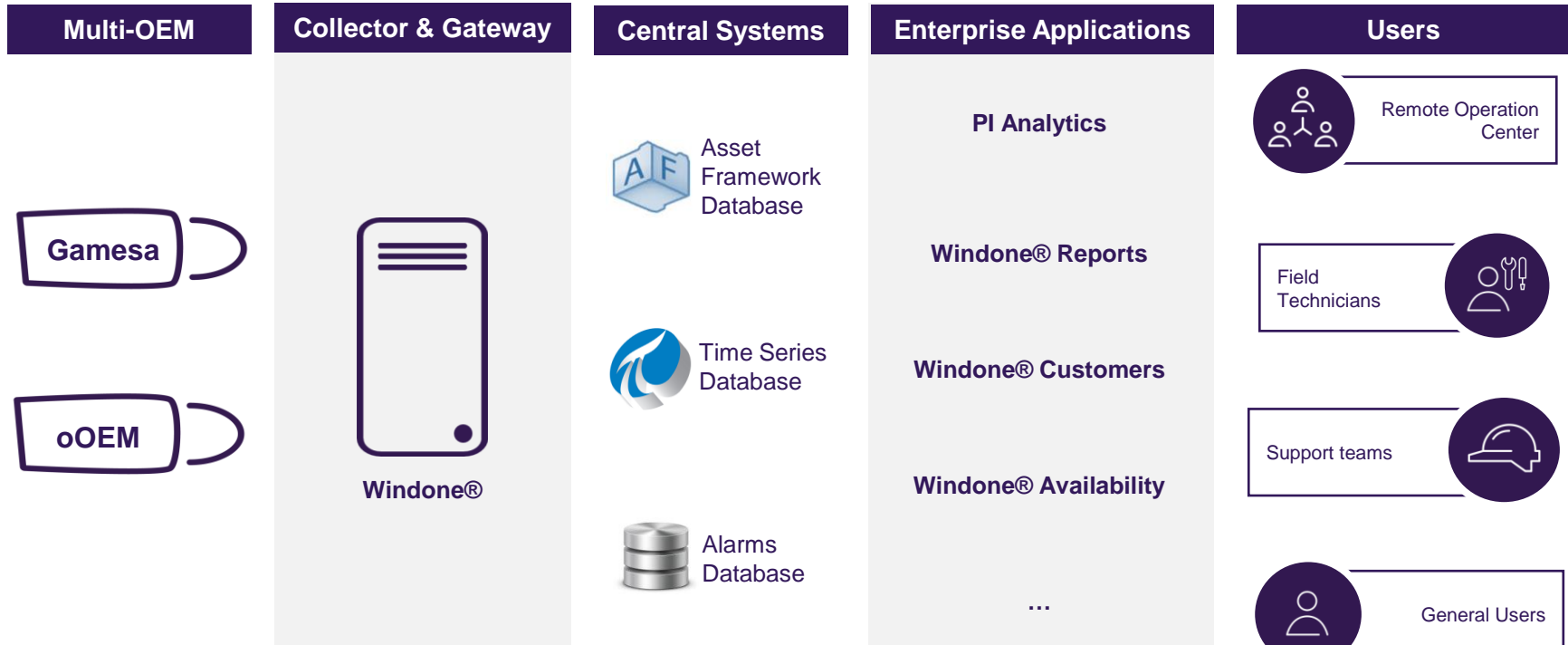
Data from wind turbines,
wind farms, SCADAs,
regulators, met masts &
substations



6 Different
applications using PI
Data

** Figures as of September 2018.*

General Architecture

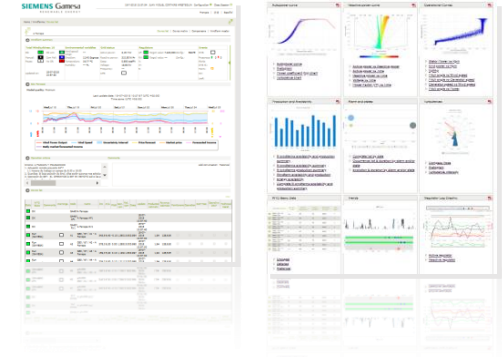
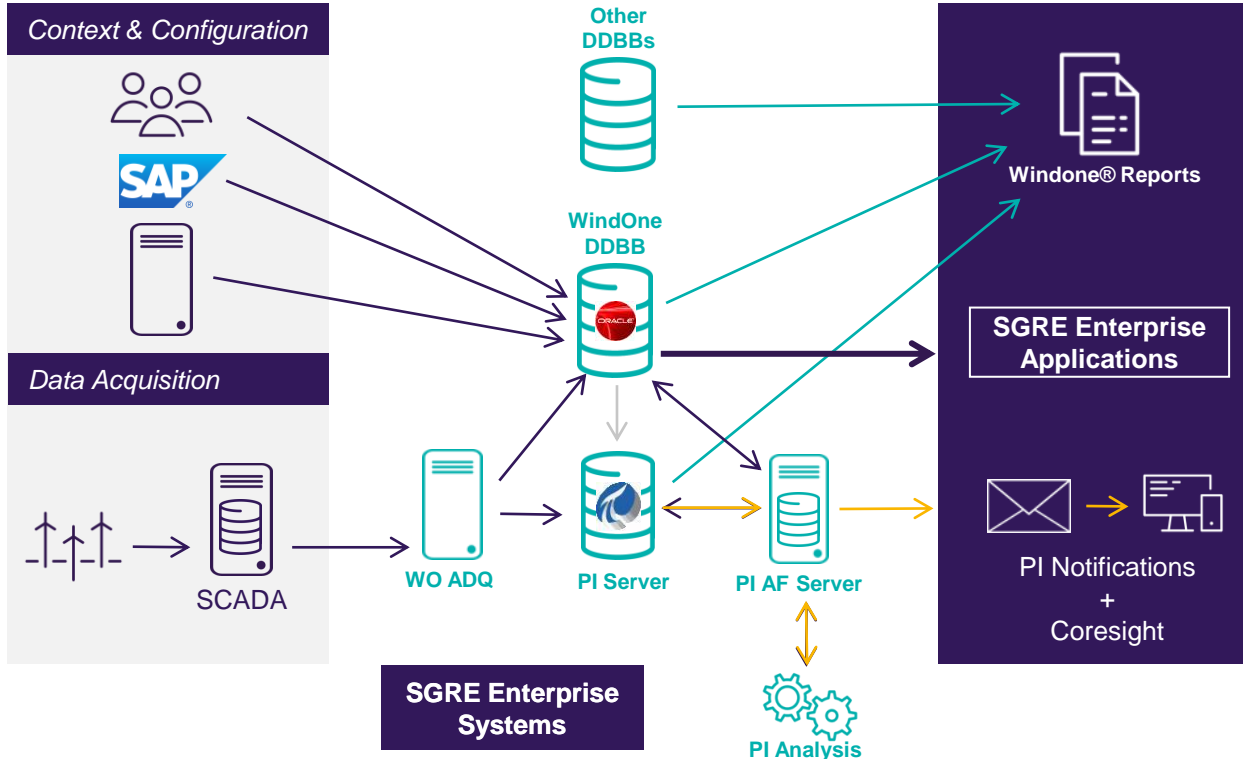


Use Cases

Success Stories

Particular use cases

Several examples on how the PI System has helped the company



Same system, different solutions for different use cases:

- WindOne® Reports
- Remote operation center solutions
- Advanced analytics

WindOne® Reports Example

Challenge



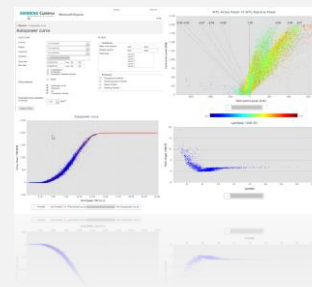
- Predefined, easy-to-get and quick reports for all stake-holders within the company.
- Integrated with other company tools.

Solution



- Combine PI System data with other data sources to provide standard reports executed under the same assumptions.
- PI SDK, PI AF SDK.

Details



- > 30 reports and subreports.
- Assets health, behaviour and configuration, fleet analysis, wind farm reports.

Outputs



- Used by Support Teams, Field Technicians and many others.
- O&M personnel able to execute reports at "design engineers" level.

WindOne® Reports Example

Challenge



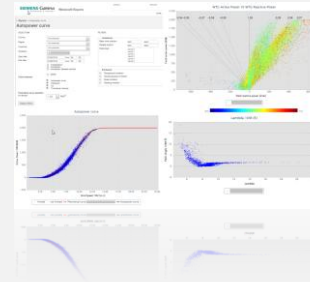
- Predefined, easy-to-get and quick reports for all stake-holders within the company.
- Integrated with other company tools.

Solution



- Combine PI System data with other data sources to provide standard reports executed under the same assumptions.
- PI SDK, PI AF SDK.

Details



- > 30 reports and subreports.
- Assets health, behaviour and configuration, fleet analysis, wind farm reports.

Outputs



- Used by Support Teams, Field Technicians and many others.
- O&M personnel able to execute reports at "design engineers" level.

WindOne® Reports Example

Challenge



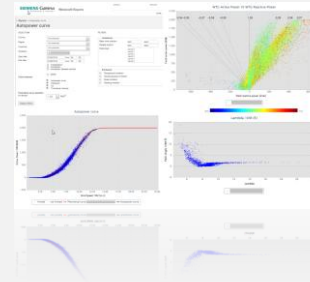
- Predefined, easy-to-get and quick reports for all stake-holders within the company.
- Integrated with other company tools.

Solution



- Combine PI System data with other data sources to provide standard reports executed under the same assumptions.
- PI SDK, PI AF SDK.

Details



- > 30 reports and subreports.
- Assets health, behaviour and configuration, fleet analysis, wind farm reports.

Outputs



- Used by Support Teams, Field Technicians and many others.
- O&M personnel able to execute reports at "design engineers" level.

WindOne® Reports

SIEMENS Gamesa Windone® Reports

Settings Viewcase [Log Out]

HOME REPORTS

> Reports > Autopower curve

Autopower curve

SELECTION

Country: Not selected
 Region: Not selected
 Customer: Not selected
 Windfarm: Not selected
 Start date: 01/06/2018 hour: 00 : 00
 End date: 21/06/2018 hour: 00 : 00

Chart selection

☐ Histogram
☒ Autopower curve
☒ Cp
☒ Turbulence intensity

Theoretical curve selection
 Air density: 1.225 kg/m³
 Select WTGs

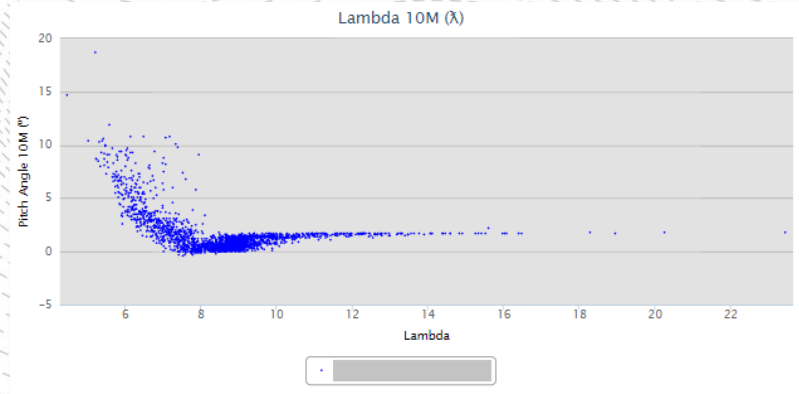
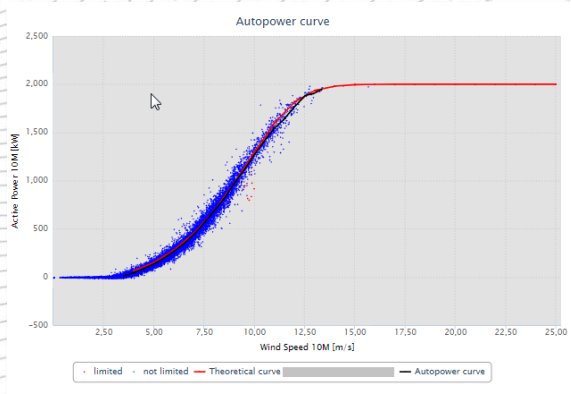
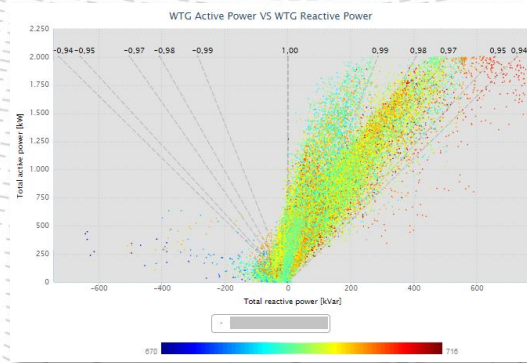
FILTERS

Inclusives

Mean wind direction: MIN: MAX:
 Nacelle position: MIN: MAX:
 Noise level: Level 0, Level 1, Level 2, Level 3, Level 4, Level 5

Exclusive

☐ Temperature limitation
☐ Active-frequency limitation
☐ Noise limitation
☐ Derating limitation



WindOne® Reports Example

Challenge



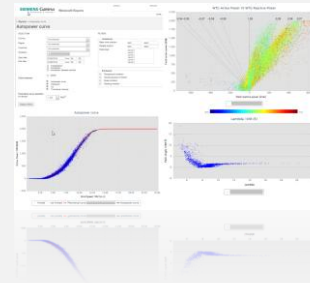
- Predefined, easy-to-get and quick reports for all stake-holders within the company.
- Integrated with other company tools.

Solution



- Combine PI System data with other data sources to provide standard reports executed under the same assumptions.
- PI SDK, PI AF SDK.

Details



- > 30 reports and subreports.
- Assets health, behaviour and configuration, fleet analysis, wind farm reports.

Outputs



- Used by Support Teams, Field Technicians and many others.
- O&M personnel able to execute reports at "design engineers" level.

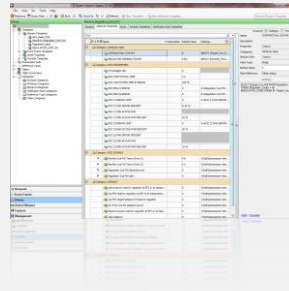
Remote Operation Center Example

Challenge



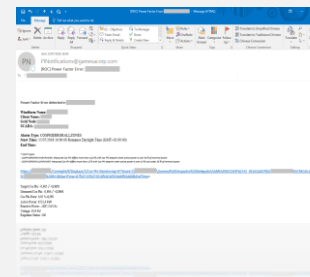
- Grid Operator requirements.
- Operate & maintain Wind Farms, apply setpoints.
- Internal requirements.

Solution



- Wind Farms, Wind Turbines, Scadas & Regulators modelled in PI AF.
- Expression analysis & Event Frames used.

Details



- ROC operators get a notification either if there is near gets out of range (+security margin) or the quality indicator gets too low.

Outputs



- ROC operators check the situation at the Wind farm and then decide the best course of action.

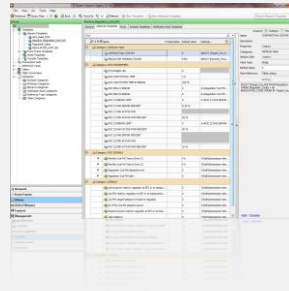
Remote Operation Center Example

Challenge



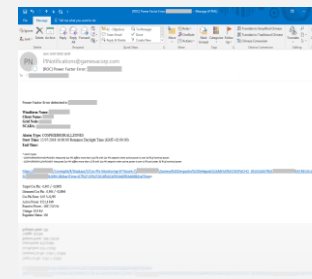
- Grid Operator requirements.
- Operate & maintain Wind Farms, apply setpoints.
- Internal requirements.

Solution



- Wind Farms, Wind Turbines, Scadas & Regulators modelled in PI AF.
- Expression analysis & Event Frames used.

Details



- ROC operators get a notification either if there is near gets out of range (+security margin) or the quality indicator gets too low.

Outputs



- ROC operators check the situation at the Wind farm and then decide the best course of action.

Regulator Power Factor Control

WPIAServerV01Remote Operation Center - PI System Explorer Legacy 32-bit

File View Go Tools Help

Database Query Date Back Refresh New Template New Attribute Template Search Element Templates

Library

- Remote Operation Center
 - Templates
 - Element Templates
 - aero_base_ROC
 - Reactive_Regulation_Unit_WO**
 - Regulation_base
 - REGULATION_UNIT_DO
 - Event Frame Templates
 - Model Templates
 - Transfer Templates
 - Enumeration Sets
 - Reference Types
 - Tables
 - Table Connections
 - Categories
 - Analysis Categories
 - Attribute Categories
 - Element Categories
 - Notification Rule Categories
 - Reference Type Categories
 - Table Categories

Reactive_Regulation_Unit_WO

General Attribute Templates Ports Analysis Templates Notification Rule Templates

Filter

Name	Description	Default Value	Settings...
Category: Attribute Value			
CONTRACTUAL COS PH		0	SELECT [Target_Cos_P...
REGULATOR NOMINAL POWER		0 kW	SELECT [Nominal_Powe...
Category: ROC PARAMETERS			
PI Coresight URL		0	https://CoresightServ...
ROC COS PH EVAL TIME		1 h	
ROC COS PH MIN TIME IN ERROR		100 %	
ROC REG Z1 ERROR		0	A=Regulation Cos Ph...
ROC REG Z2 ERROR		0	A=Regulation Cos Ph...
ROC Z1 ERROR LIMIT		0	A=ROC Z1 MAX ERROR...
ROC Z1 MAX ERROR PERCENT		X %	
ROC Z1 MIN ACTIVE PWR		w kW	A=REGULATOR NOMIN...
ROC Z1 MIN ACTIVE PWR PERCENT		k %	
ROC Z2 ERROR LIMIT		0	A=ROC Z2 MAX ERROR...
ROC Z2 MAX ACTIVE PWR PERCENT		r %	
ROC Z2 MAX ERROR PERCENT		Y %	
ROC Z2 MIN ACTIVE PWR		z kW	A=REGULATOR NOMIN...
ROC Z2 MIN ACTIVE PWR PERCENT		s %	
Category: ROC SIGNALS			
Monthly Cos Ph Time in Error Z1		0 h	\\%@(Gamesa servidor...
Monthly Cos Ph Time in Error Z2		0 h	\\%@(Gamesa servidor...
Regulation Cos Ph absolute error		0	\\%@(Gamesa servidor...
Regulation Cos Ph alert		0	\\%@(Gamesa servidor...
Category: SIGNALS			
Active power read by regulator at SET or at measur...		0	\\%@(Gamesa servidor...
Cos Ph read by regulator at SET or at measureme...		0	\\%@(Gamesa servidor...
Cos Ph target setpoint of reactive regulator		0	\\%@(Gamesa servidor...
ID of the Cos Ph setpoint source		0	\\%@(Gamesa servidor...
Reactive power read by regulator at SET or at mea...		0	\\%@(Gamesa servidor...
Valor objetivo		0	\\%@(Gamesa servidor...

Group by: ☒ Category ☐ Template

Name: CONTRACTUAL COS PH

Description:

Properties: <None>

Categories: Attribute Value

Default UOM: <None>

Value Type: Single

Default Value: 0

Data Reference: Table Lookup

Settings...

SELECT [Target_Cos_Ph] FROM Regulators
WHERE [Regulator_Code] = @
[REGULATOR_CODE] ORDER BY Target_Cos_Ph

Units Forecasts

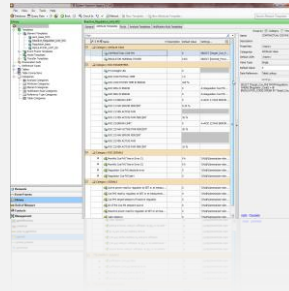
Remote Operation Center Example

Challenge



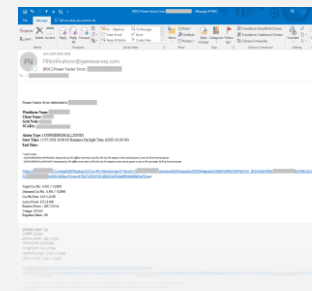
- Grid Operator requirements.
- Operate & maintain Wind Farms, apply setpoints.
- Internal requirements.

Solution



- Wind Farms, Wind Turbines, Scadas & Regulators modelled in PI AF.
- Expression analysis & Event Frames used.

Details



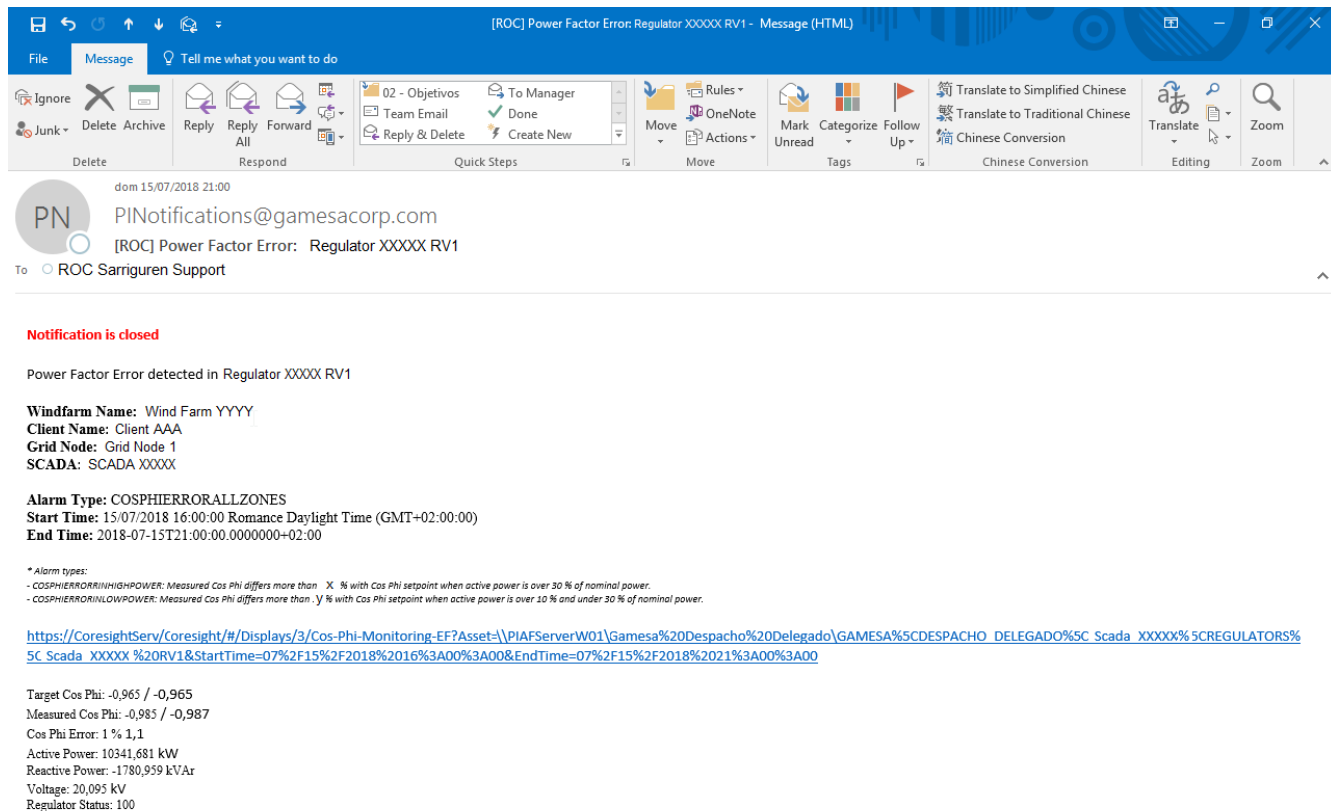
- ROC operators get a notification either if there is near gets out of range (+security margin) or the quality indicator gets too low.

Outputs



- ROC operators check the situation at the Wind farm and then decide the best course of action.

Regulator Power Factor Control



The screenshot shows an email client window with a blue header bar. The title bar reads "[ROC] Power Factor Error: Regulator XXXXX RV1 - Message (HTML)". The ribbon includes "File", "Message", and a search bar. The "Message" tab is active, showing icons for Ignore, Delete, Archive, Reply, Reply All, Forward, and a "Tell me what you want to do" search bar. Below the ribbon, the email header shows the sender "PINotifications@gamesacorp.com" and the subject "[ROC] Power Factor Error: Regulator XXXXX RV1". The email body contains the following text:

Notification is closed

Power Factor Error detected in Regulator XXXXX RV1

Windfarm Name: Wind Farm YYYY
Client Name: Client AAA
Grid Node: Grid Node 1
SCADA: SCADA XXXXX

Alarm Type: COSPHIERRORALLZONES
Start Time: 15/07/2018 16:00:00 Romance Daylight Time (GMT+02:00:00)
End Time: 2018-07-15T21:00:00.0000000+02:00

* Alarm types:
- COSPHIERRORHIGHPOWER: Measured Cos Phi differs more than .X % with Cos Phi setpoint when active power is over 30 % of nominal power.
- COSPHIERRORLOWPOWER: Measured Cos Phi differs more than .Y % with Cos Phi setpoint when active power is over 10 % and under 30 % of nominal power.

https://CoresightServ/coresight/#/Displays/3/Cos-Phi-Monitoring-EF?Asset=\\PIAFServerW01\\Gamesa%20Despacho%20Delegado\\GAMESA%SCDESPACHO_DELEGADO%5C_Scada_XXXXX%5CREGULATORS%5C_Scada_XXXXX%20RV1&StartTime=07%2F15%2F2018%2016%3A00%3A00&EndTime=07%2F15%2F2018%2021%3A00%3A00

Target Cos Phi: -0,965 / -0,965
Measured Cos Phi: -0,985 / -0,987
Cos Phi Error: 1 % 1,1
Active Power: 10341,681 kW
Reactive Power: -1780,959 kVAr
Voltage: 20,095 kV
Regulator Status: 100

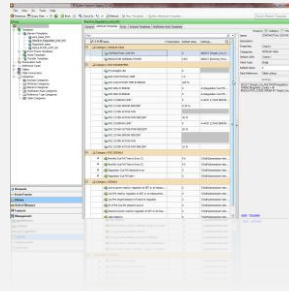
Remote Operation Center Example

Challenge



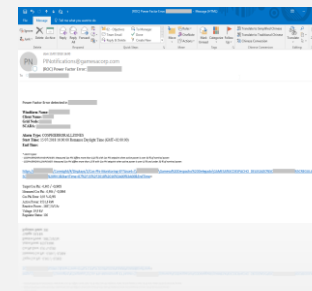
- Grid Operator requirements.
- Operate & maintain Wind Farms, apply setpoints.
- Internal requirements.

Solution



- Wind Farms, Wind Turbines, Scadas & Regulators modelled in PI AF.
- Expression analysis & Event Frames used.

Details



- ROC operators get a notification either if there is near gets out of range (+security margin) or the quality indicator gets too low.

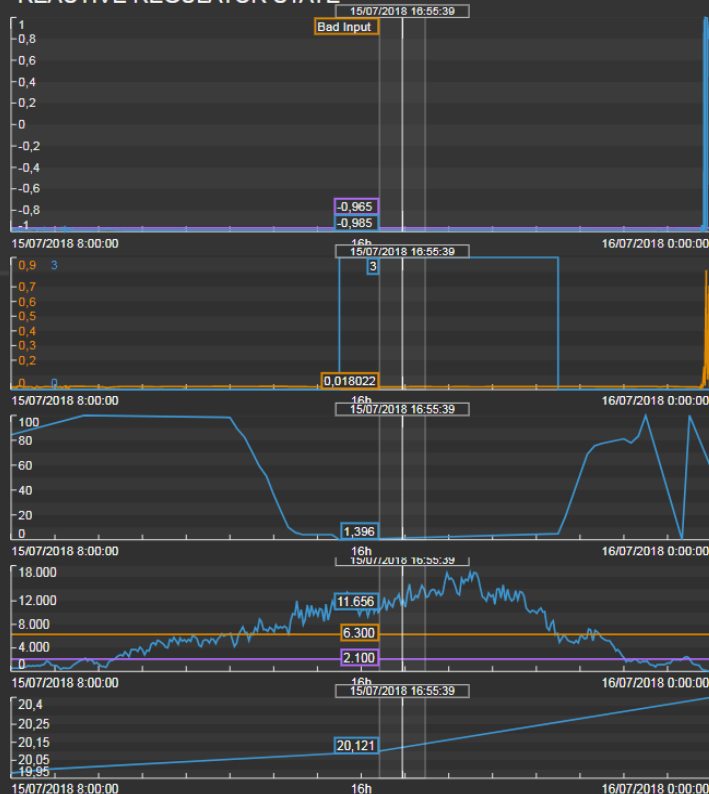
Outputs



- ROC operators check the situation at the Wind farm and then decide the best course of action.

Regulator Power Factor Control

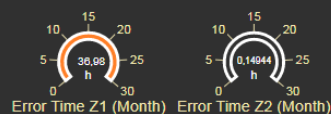
REACTIVE REGULATOR STATE



Cos PHI read by regulator at SET or at n
-0.405 TBD
Cos PHI target setpoint of reactive regul.
Bad Input TBD
Valor objetivo
-0.965 TBD

Value
CLIENT AAA
REGULATOR XXXXX RV1
SCADA XXXXX
GRID NODE
WIND FARM YYYY

Regulator Status
100,000



Zone 1 (High Power)



Zone 2 (Low Power)



ROC Z1 MIN ACTIVE PWR
6.300 kW

ROC Z2 MIN ACTIVE PWR
2.100 kW

Active power read by regulator at SET
74.967 TBD

Voltage read by regulator at SET or at r
20.4 TBD

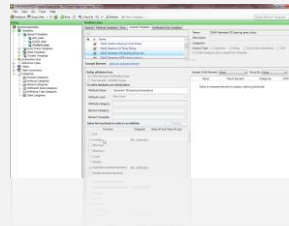
Advanced Analytics Example

Challenge



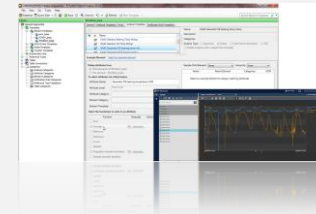
- Assets health & performance monitoring.
- Detect / Predict hidden faults.
- Improve maintenance.
- Avoid major incidents.

Solution



- Expression analysis & event frames analyzing RT WTG signals.
- Raising alarms if conditions trigger model thresholds.

Details



- Definition & Parametrization.
- Check asset condition vs model.
- Alarm included in Alarms DDBB

Outputs



- O&M People & site supervisors to carry out tasks depending on alarm code.

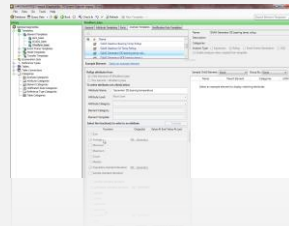
Advanced Analytics Example

Challenge



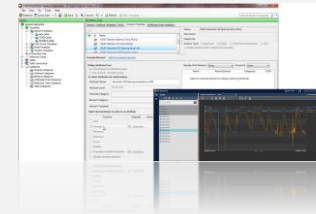
- Assets health & performance monitoring.
- Detect / Predict hidden faults.
- Improve maintenance.
- Avoid major incidents.

Solution



- Expression analysis & event frames analyzing RT WTG signals.
- Raising alarms if conditions trigger model thresholds.

Details



- Definition & Parametrization.
- Check asset condition vs model.
- Alarm included in Alarms DDBB

Outputs



- O&M People & site supervisors to carry out tasks depending on alarm code.

Wind Farm's 3 σ quality check

The screenshot displays the OSIsoft PI World software interface, specifically the 'aero_base' template configuration window. The interface is divided into several sections:

- Library:** A tree view on the left showing the hierarchy of templates, including 'Genset Analytics', 'Templates', 'Element Templates', 'aero_base', 'SCADA_base', 'Windfarm_base', 'Event Frame Templates', 'Model Templates', 'Transfer Templates', 'Enumeration Sets', 'Reference Types', 'Tables', 'Table Connections', and 'Categories'.
- General:** The main configuration area for the 'Test_TempDashboard_GearboxOil' template. It includes fields for Name, Description, Categories, and Analysis Type (Expression, Rollup, Event Frame Generation, SQC). The 'Enable analyses when created from template' checkbox is checked.
- Example Element:** A table showing the configuration for the 'Test_TempDashboard_GearboxOil' element. The table has columns for Name, Expr, Value at Evaluation, Value at Last Trigg, and Output Attribute. The 'Result' row is highlighted, showing the expression 'Test_TempDashboard_GearboxOil.Result'.
- Functions:** A list of functions available for use in the expression, including Abs, Acos, And, Ascii, Asin, Atn, Atn2, Avg, BadVal, Bod, Bom, Bonm, Ceiling, Char, Compare, Concat, Contains, Convert, Cos, Cosh, Cot, Coth, Crc, Csch, Curve, and D. The 'Abs' function is selected, and its description is shown: 'Abs(number x) Return the absolute value of an integer or real number. Example: Abs(1)'.

The bottom of the window shows the 'Scheduling' section with options for 'Event-Triggered' and 'Periodic' (selected). The 'Run every day at 1:00' checkbox is checked, and the 'Configure' button is visible.

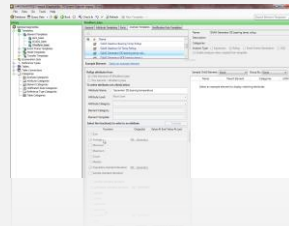
Advanced Analytics Example

Challenge



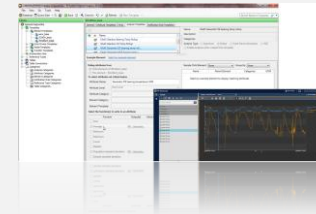
- Assets health & performance monitoring.
- Detect / Predict hidden faults.
- Improve maintenance.
- Avoid major incidents.

Solution



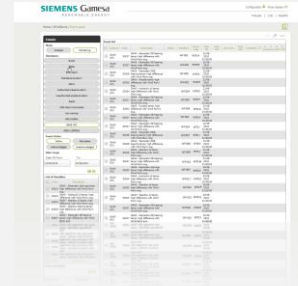
- Expression analysis & event frames analyzing RT WTG signals.
- Raising alarms if conditions trigger model thresholds.

Details



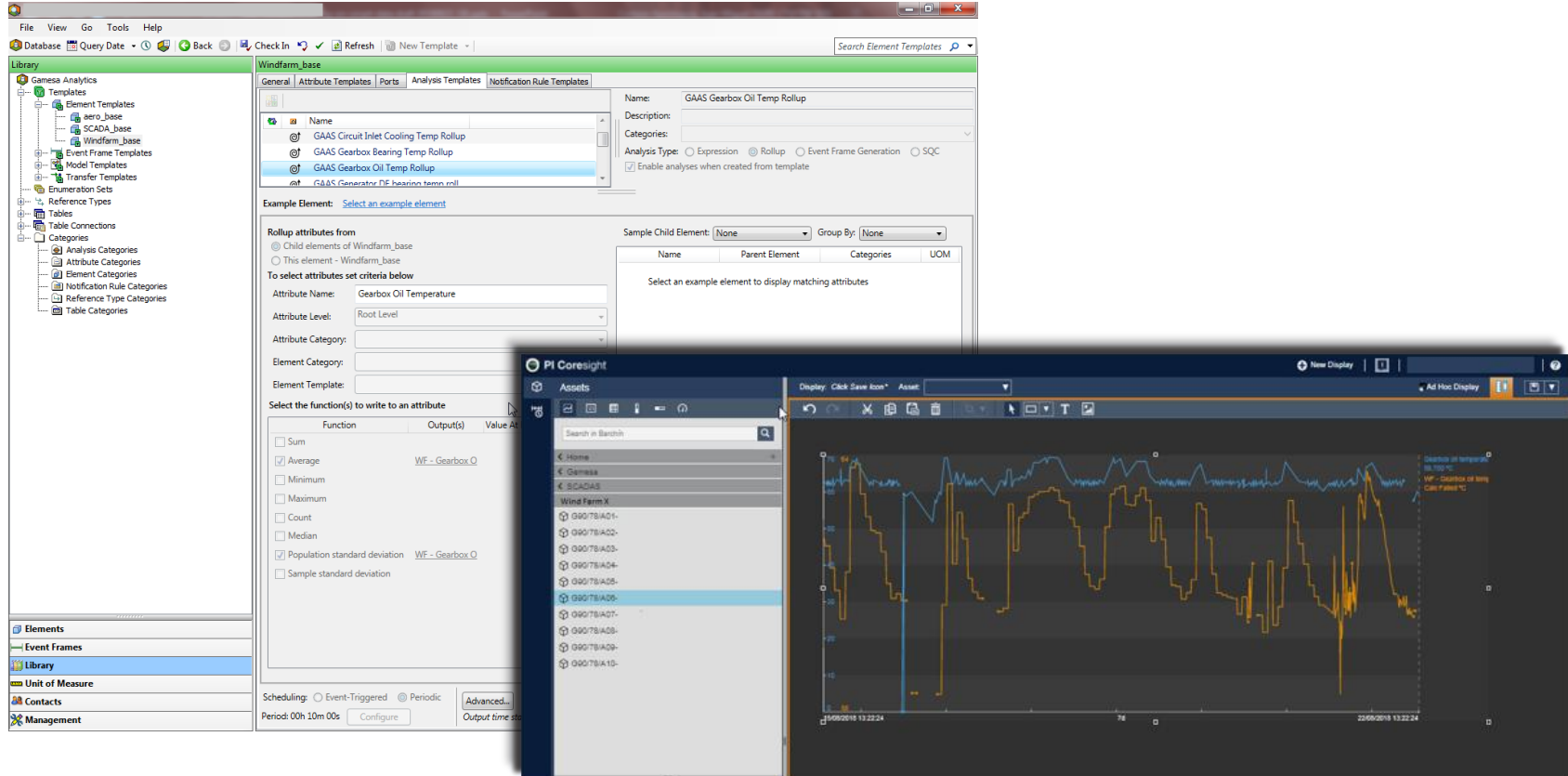
- Definition & Parametrization.
- Check asset condition vs model.
- Alarm included in Alarms DDBB

Outputs



- O&M People & site supervisors to carry out tasks depending on alarm code.

Wind Farm's 3 σ quality check



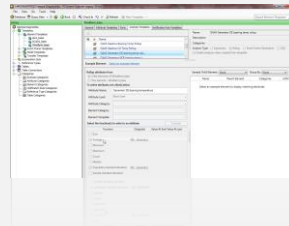
Advanced Analytics Example

Challenge



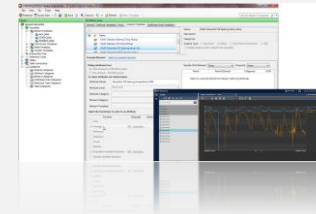
- Assets health & performance monitoring.
- Detect / Predict hidden faults.
- Improve maintenance.
- Avoid major incidents.

Solution



- Expression analysis & event frames analyzing RT WTG signals.
- Raising alarms if conditions trigger model thresholds.

Details



- Definition & Parametrization.
- Check asset condition vs model.
- Alarm included in Alarms DDBB

Outputs



- O&M People & site supervisors to carry out tasks depending on alarm code.

Wind Farm's 3 σ quality check

Events

Mode: Analysis Monitoring

Datatypes:

- Event
- State
- PMS Alarm
- Maintenance alarm
- Alarm
- Authorized presence alarm
- Unauthorized presence alarm
- Alerts
- CMS Alarm Comments
- Ice warning
- APS (AURA)
- GAAS (PI)
- ARDA (SMPDA)

Event status: Active Not active

Acknowledged Unacknowledged

Date range:

Date ON From: 15/08/2018 To: 22/08/2018

List of Variables:

Code	Description
<input type="checkbox"/> 83033	GAAS - Generator sliprings temp: high difference with Wind Farm avg.
<input type="checkbox"/> 83034	GAAS - Hydraulic oil temp: high difference with Wind Farm avg.

Event list								
<input type="checkbox"/>	Subtype	Code	Description	Status	Windfarm	Device code	Date ON	Date OFF
<input type="checkbox"/>	GAAS (PI)	83037	GAAS - Generator DE bearing temp: high difference with Wind Farm avg.		WF 001	WTG A	22-08-2018 01:00:00	
<input type="checkbox"/>	GAAS (PI)	83037	GAAS - Generator DE bearing temp: high difference with Wind Farm avg.		WF 002	WTG B	22-08-2018 01:00:00	
<input type="checkbox"/>	GAAS (PI)	83038	GAAS - Generator NDE bearing temp: high difference with Wind Farm avg.		WF 003	WTG C	22-08-2018 01:00:00	
<input type="checkbox"/>	GAAS (PI)	83035	GAAS - Gearbox oil temp: high difference with Wind Farm avg.		WF 012	WTG P	20-08-2018 01:00:00	
<input type="checkbox"/>	GAAS (PI)	83035	GAAS - Gearbox oil temp: high difference with Wind Farm avg.		WF 012	WTG P	20-08-2018 01:00:00	
<input type="checkbox"/>	GAAS (PI)	83037	GAAS - Generator DE bearing temp: high difference with Wind Farm avg.		WF 005	WTG F	22-08-2018 01:00:00	
<input type="checkbox"/>	GAAS (PI)	83042	GAAS - Coolant temp: high difference with Wind Farm's avg.		WF 006	WTG G	22-08-2018 01:00:00	
<input type="checkbox"/>	GAAS (PI)	83037	GAAS - Generator DE bearing temp: high difference with Wind Farm avg.		WF 001	WTG H	22-08-2018 01:00:00	
<input type="checkbox"/>	GAAS (PI)	83037	GAAS - Generator DE bearing temp: high difference with Wind Farm avg.		WF 004	WTG I	22-08-2018 01:00:00	
<input type="checkbox"/>	GAAS (PI)	83038	GAAS - Generator NDE bearing temp: high difference with Wind Farm avg.		WF 007	WTG J	21-08-2018 01:00:00	
<input type="checkbox"/>	GAAS (PI)	83038	GAAS - Generator NDE bearing temp: high difference with Wind Farm avg.		WF 008	WTG K	21-08-2018 01:00:00	
<input type="checkbox"/>	GAAS (PI)	83035	GAAS - Gearbox oil temp: high difference with Wind Farm avg.		WF 009	WTG L	21-08-2018 01:00:00	
<input type="checkbox"/>	GAAS (PI)	83037	GAAS - Generator DE bearing temp: high difference with Wind Farm avg.		WF 010	WTG M	21-08-2018 01:00:00	
<input type="checkbox"/>	GAAS (PI)	83033	GAAS - Generator sliprings temp: high difference with Wind Farm avg.		WF 004	WTG N	20-08-2018 01:00:00	
<input type="checkbox"/>	GAAS (PI)	83034	GAAS - Hydraulic oil temp: high difference with Wind Farm avg.		WF 011	WTG O	20-08-2018 01:00:00	
<input type="checkbox"/>	GAAS (PI)	83035	GAAS - Gearbox oil temp: high difference with Wind Farm avg.		WF 012	WTG P	20-08-2018 01:00:00	
<input type="checkbox"/>	GAAS (PI)	83035	GAAS - Gearbox oil temp: high difference with Wind Farm avg.		WF 013	WTG Q	20-08-2018 01:00:00	

Particular use cases

Several examples on how the PI System has helped the company

Challenge

Improve O&M services

Solution

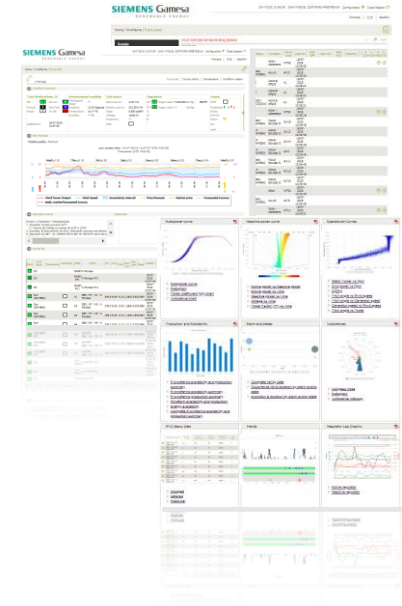
Use PI System capabilities jointly with other enterprise systems.

- WindOne Reports: web application.
- PI EF + Notifications + Coresight for Remote Operation Center
- PI Analysis + Alarm generation + Enterprise Systems

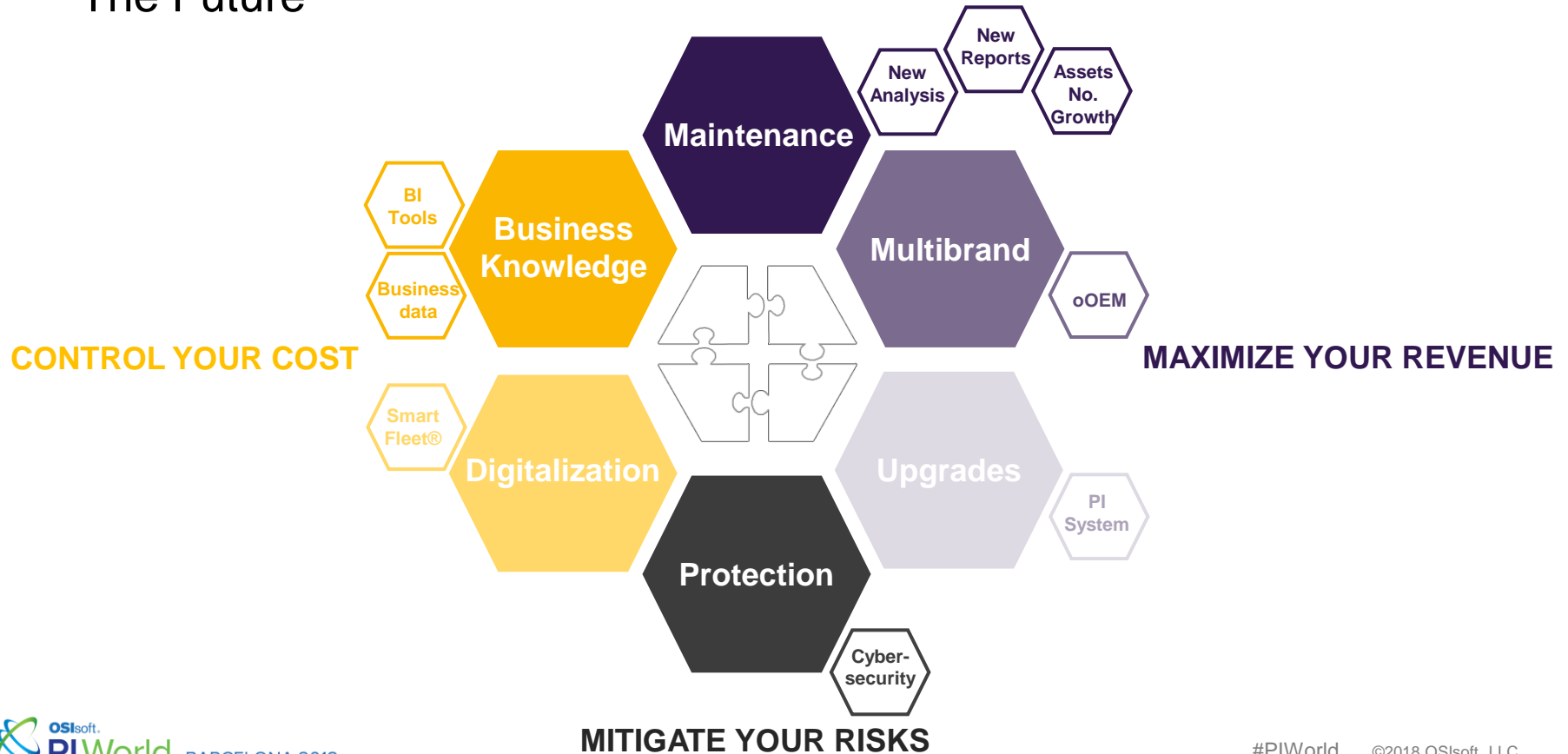
Results

What benefits were achieved/measured?

- Anticipation to problems.
- Standard reporting.
- Effective operation & maintenance of a huge fleet of WTGs.
- Reduce cost of O&M.
- Increased performance of support teams, better time-to-solution ratio.



The Future



We are



Cortaire, Juan Miguel

Chief Engineer

Siemens Gamesa Renewable Energy

Juan.Cortaire@siemensgamesa.com



Suescun, Edurne

Service Product Manager

Siemens Gamesa Renewable Energy

Maria.Suescun@siemensgamesa.com

Questions?

Please wait for
the **microphone**

State your
name & company



Please rate this session in the mobile app!



謝謝 KEA LEBONA
TARADH LEIBH 고맙습니다
DZIĘKUJĘ CI NGIYABONGA TEŞEKKÜR EDERİM GRACIES OBRIGADO شكرا SALAMAT
DANKON TANK TAPADH LEAT
DANKIE TERIMA KASIH
KÖSZÖNÖM
СПАСИБО
PAKMET CIZGE
GO RAIBH MAITH AGAT
БЛАГОДАРЯ GRACIAS
ТИ БЛАГОДАРАМ
TAK DANKE MAHADSANID
RAHMAT MERCI
HATUR NUHUN
CẢM ƠN BẠN
WAZVIITA
FALEMINDERIT
DANK JE ΕΥΧΑΡΙΣΤΩ GRATIAS TIBI
AČIŲ SALAMAT MAHALO IĀ 'OE TAKK SKALDU HA
GRAZZI PAKKA PĒR PAXMAT CAĞA
SIPAS JI WERE TERIMA KASIH
UA TSAUG RAU KOJ
ТИ БЛАГОДАРАМ
СИПОС
MULTUMESC
FAAFETAI
ESKERRIK ASKO
HVALA ХВАЛА ВАМ
TEŞEKKÜR EDERIM
HVALA
DZЯКУЙ
DI OU MÈSI
ĐAKUJEM
MATUR NUWUN
GRAZIE



OSIsoft.

PIWorld

THANK YOU



OSIsoft.

PIWorld

BARCELONA 2018

#PIWorld

©2018 OSIsoft, LLC

34