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Enhance process reliability of Water Treatment System via multiple Machine Learning Based Analytics

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AVEVA



Eni

Our Digital Transformation

- Eni is an integrated energy company with more than 30.000 employees in 68 countries around the world. In 2021, the company launched a new strategy that will enable it to provide a variety of fully decarbonized products, combining environmental and financial sustainability.
- The growth of digital makes achieving our production and sustainability goals possible.
- The digitalization of Eni has led to the creation of the **digital plant**, a control panel that groups and displays information relating to the most relevant processes and also allows access to predictive models.

Digital Plant | Water treatment system



Challenge

- Increase the availability of the Water Treatment System in a complex FPSO with minimal effort by leveraging on information available from the sensor grid.



Solution

- Develop predictive and anomaly detection capabilities via machine learning solutions on top of data available on PI System
- Allow Data, prediction and reporting to be available in our Integrated Operation Center



Benefits

- Have a real-time view of the main KPIs of the asset aggregated in a centralized manner.
- Access key information and always be in line, including with preventive alerts, on the status of the main phenomena relating to the asset.
- Access all key information from a single dashboard, with the ability to query even legacy systems.

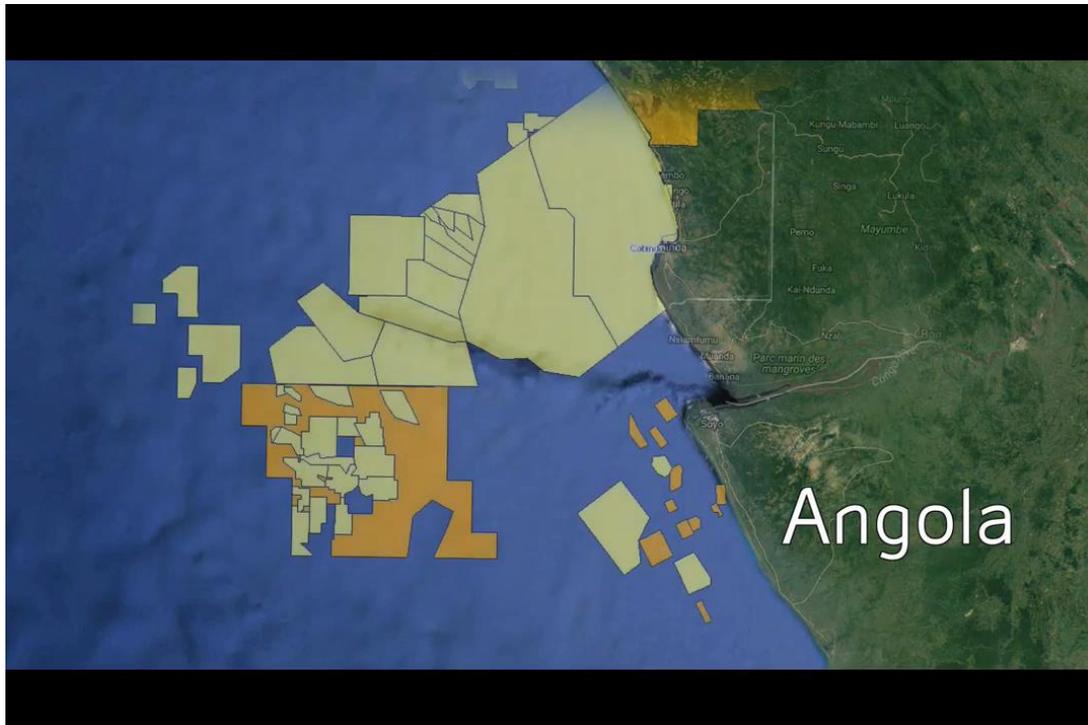
THE CHALLENGE

Water Treatment Reliability

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The Plant

A Floating Production Storage and Off loading Latest Generation



• Oil extraction & Water Treatment

- 11 Wells, which 6 of extraction oil and 5 for water reinjection.
- NO Process Flaring
- NO Water To Overboard

The digitization of the plant has led to the creation of the Digital Plant, a control panel that groups and displays information relating to the most relevant processes including the 4 algorithm for water treatment system.

Focus on Water Treatment Reliability

Algorithms developed and trained on data stored on PI Data Archive

| | Model | Objective | Benefits |
|---------------------------------------|-------------------|---|--|
| Oil in Water | Anomaly Detection | The goal is to detect sensor anomalies | Monitoring the sensor life-cycle |
| Oil in Water | Early Warning | Provide an alarm flag | Warning in advance dangerous sensor off-spec |
| Produced Water Cooler | Forecasting | Forecast of number of days remaining until a critical situation | Allows a better planning of preventive maintenance activities |
| Ultrafiltration Sulphate Reduction | Prediction | Predict the number of days remaining until a critical situation | Optimization of the maintenance operations and the scheduling of the cleaning to ensure the continuity of water injection. |

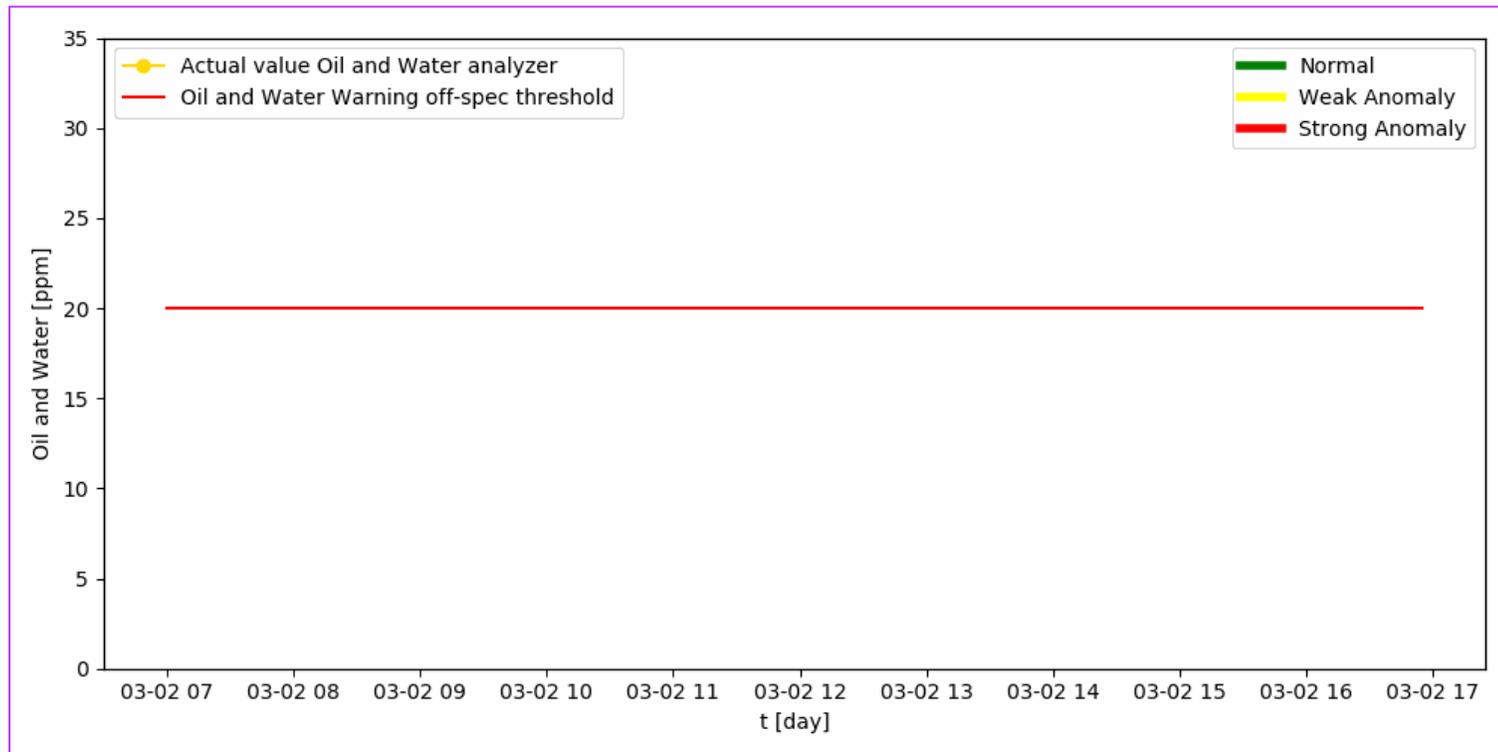
THE SOLUTION

Machine Learning Details

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Machine Learning Details

Oil in Water

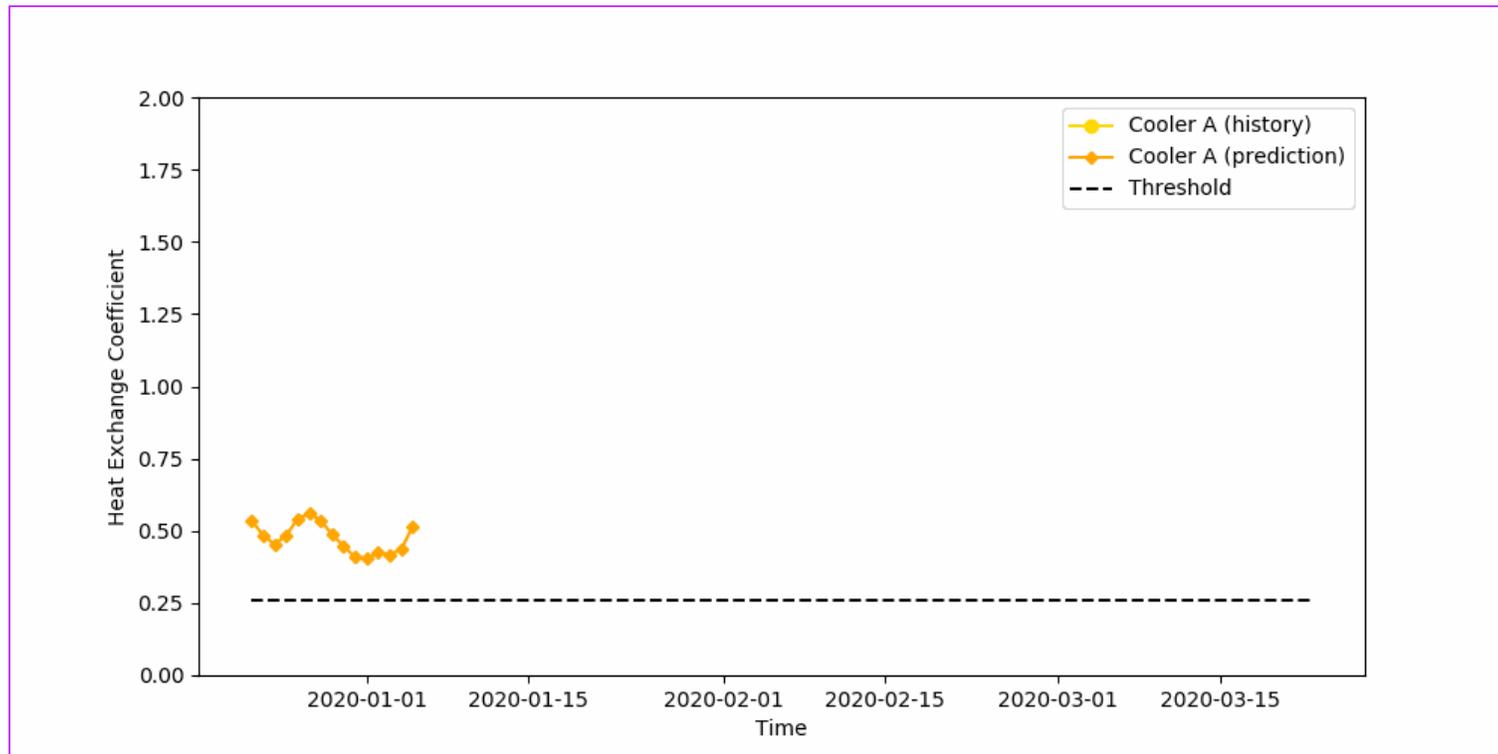


REGARDING THE OIL IN WATER SENSOR ANALYZER, THE GOAL IS TO **DETECT SENSOR ANOMALIES**

PROVIDE AN ALARM FLAG WHEN THE SENSOR IS **APPROACHING A PREDEFINED WARNING THRESHOLD.**

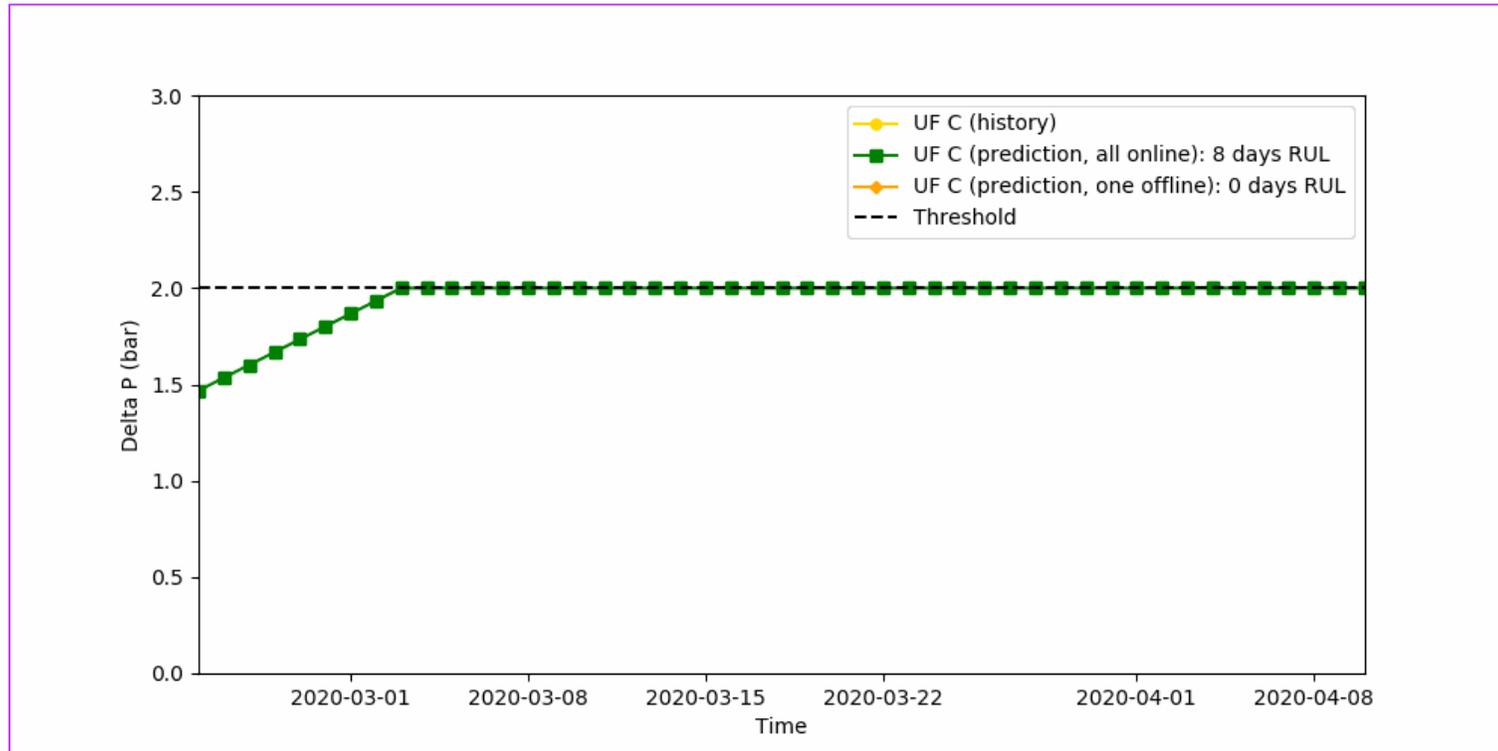
Machine Learning Details

Produced Water Coolers



Machine Learning Details

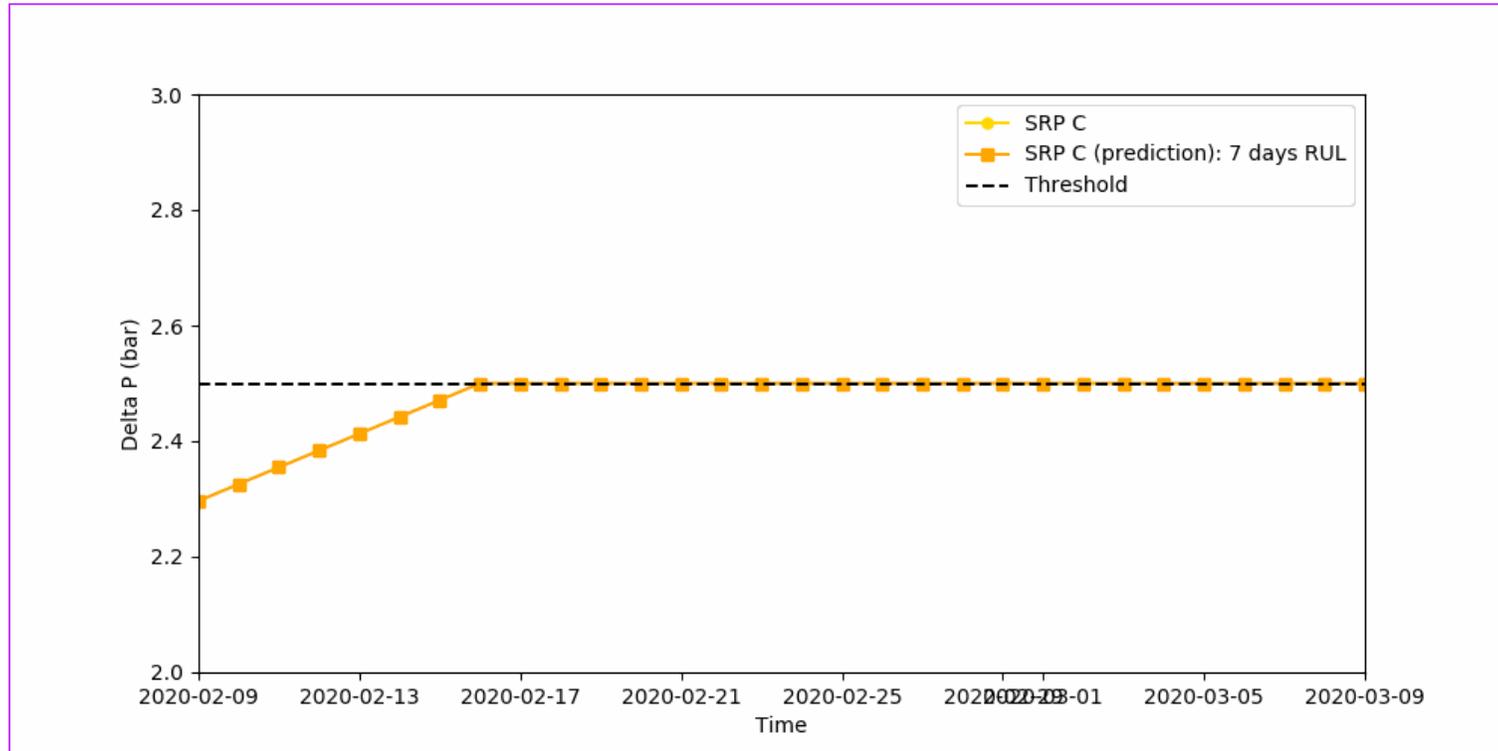
Ultrafiltration Train cleaning in place



PREDICT THE NUMBER OF DAYS REMAINING UNTIL A CRITICAL SITUATION (CLEANING IN PLACE) IS REACHED FOR EACH UF TRAIN IN 2 WORKING CONDITIONS

Machine Learning Details

Sulphate reduction package cleaning in place



PREDICT THE NUMBER OF DAYS REMAINING UNTIL A CRITICAL SITUATION (CLEANING IN PLACE) IS REACHED FOR EACH SRP TRAIN.

IMPLEMENTATION DETAILS

Architecture

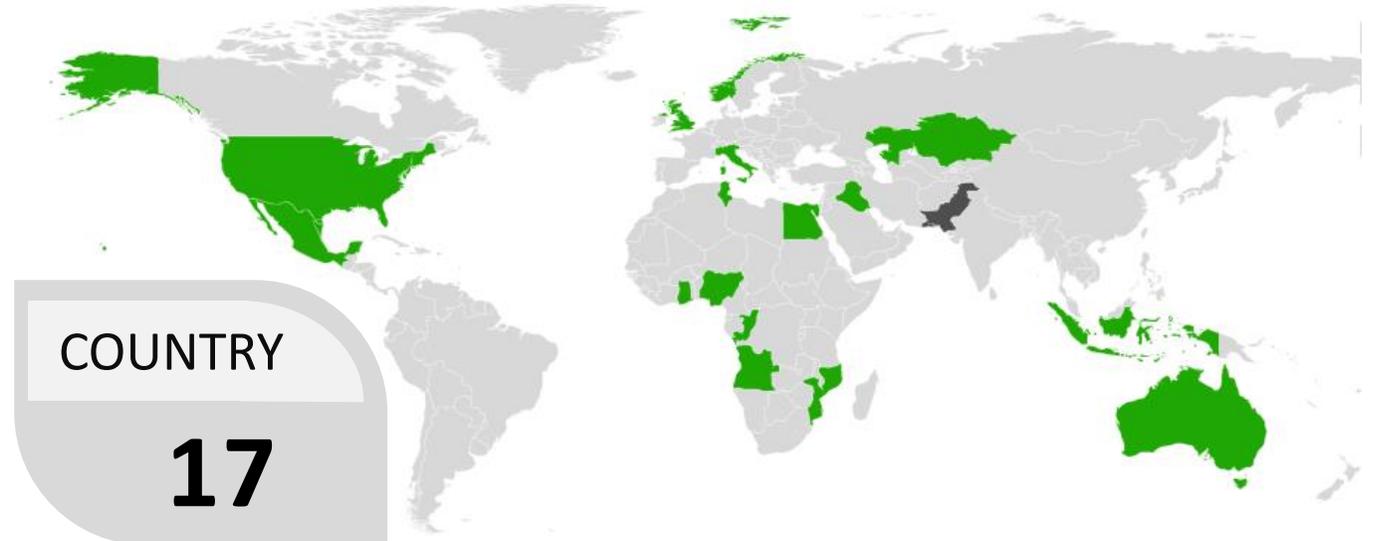
And Integration with other Systems

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AVEVA PI System as our Single Source of Data

EDOF: Eni Implementation of PI System

- *The digital transformation plays a key role in the data analysis for a continuous and efficient management of the subsurface and of the process plants*
- *The eDOF (Eni **D**igital **O**il **F**ield) system, allows the collection of signals coming from all the deployed sensors, in order to have a complete monitoring of the overall Asset, from wells and reservoir to point of sale of products.*



- **High and Low frequency data** are fundamental for the comprehension of the behavior of subsurface and topside processes.
- eDOF is developed leveraging on a **strong synergy** between business and ICT depts.
- eDOF is the **main enabler** of the digital transformation in Eni

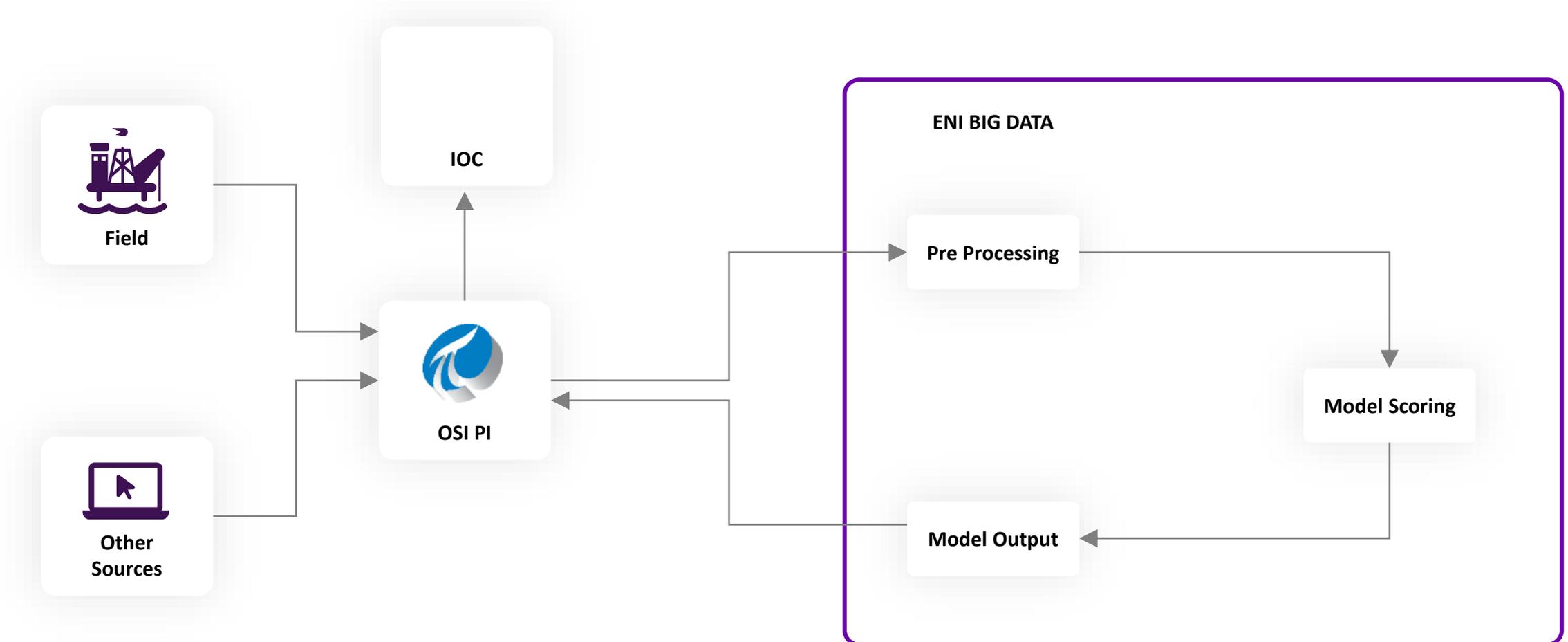
AVEVA PI System as our Single Source of Data

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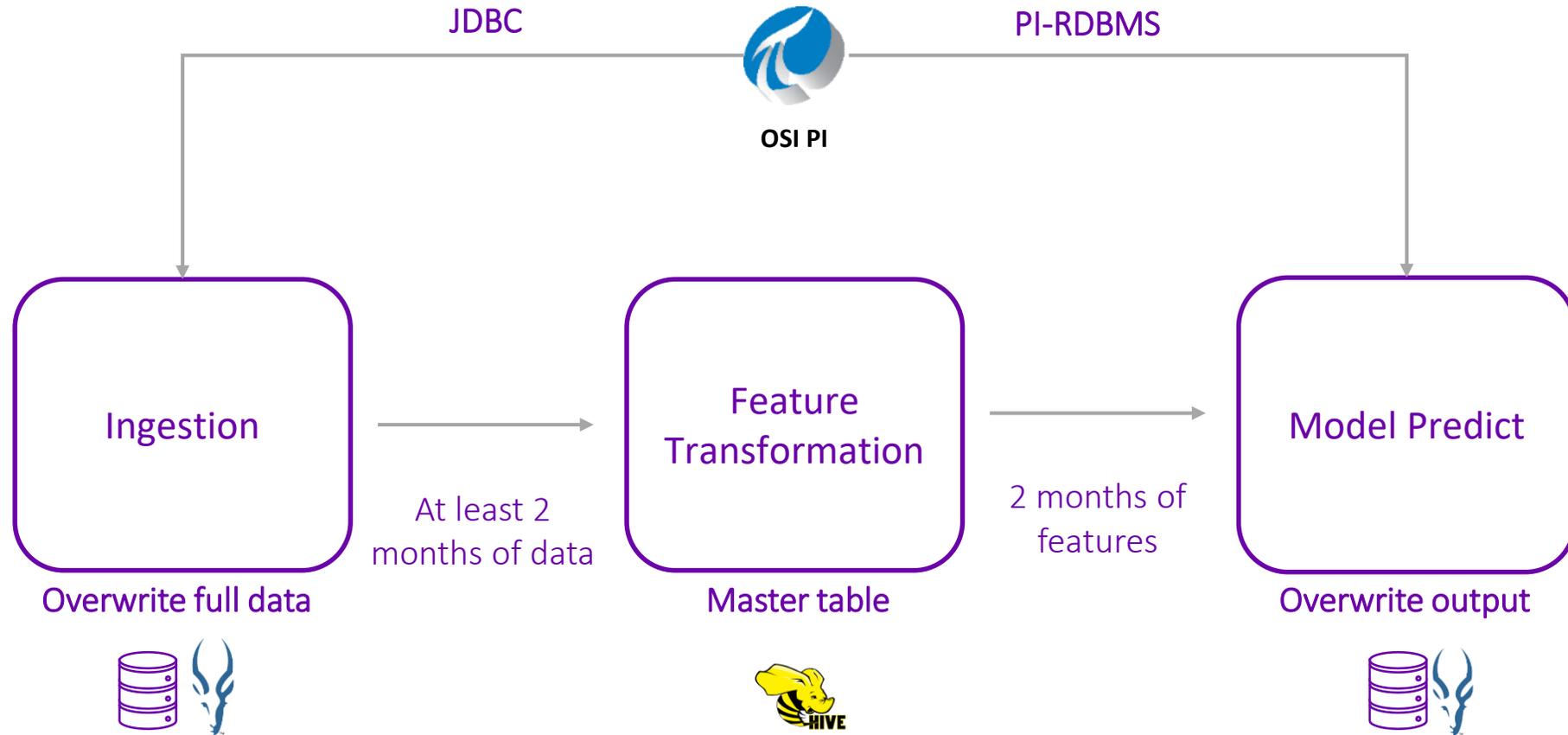
Integrating with new system

Keeping PI System at the core of our architecture



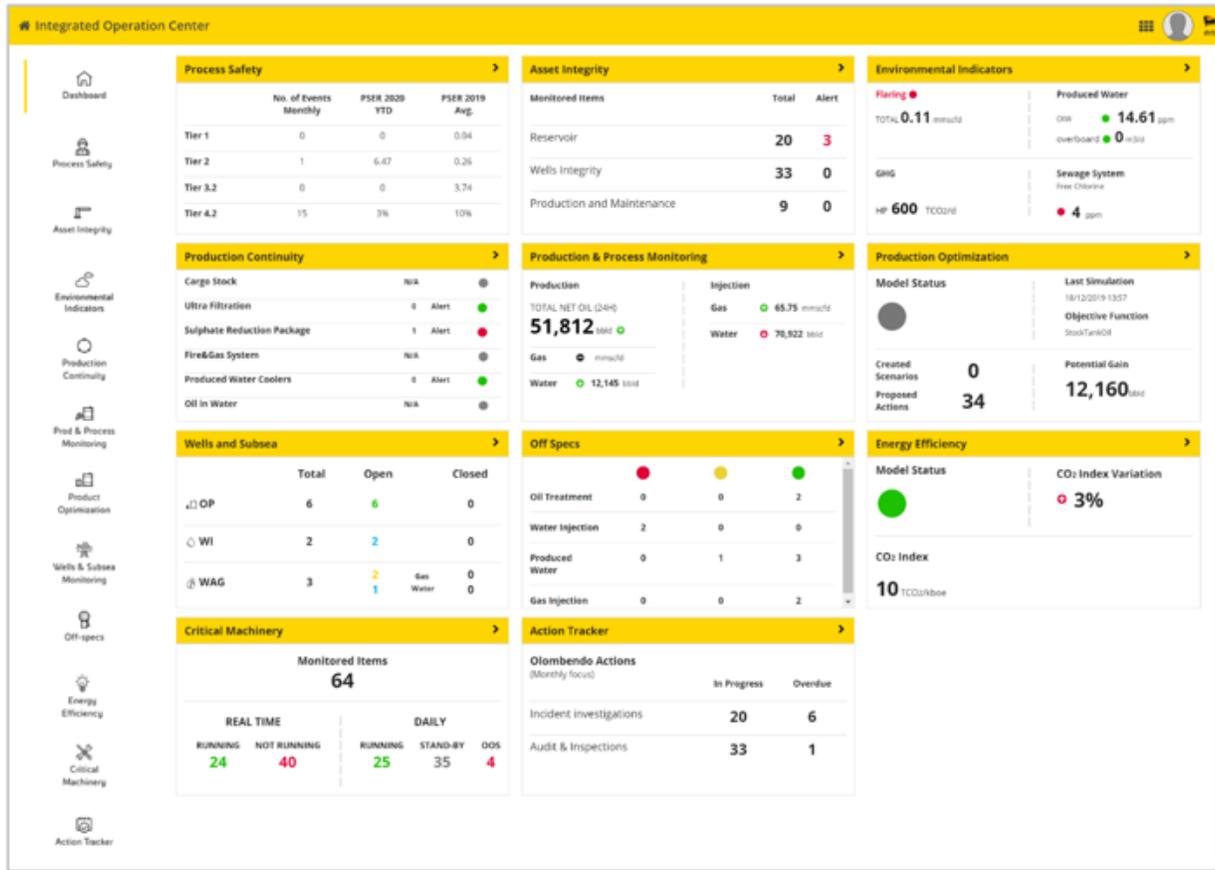
Inferencing Cycle Example:

FOULING FILTERS MODEL SCORING IN PRODUCTION



Displaying Data on IOC

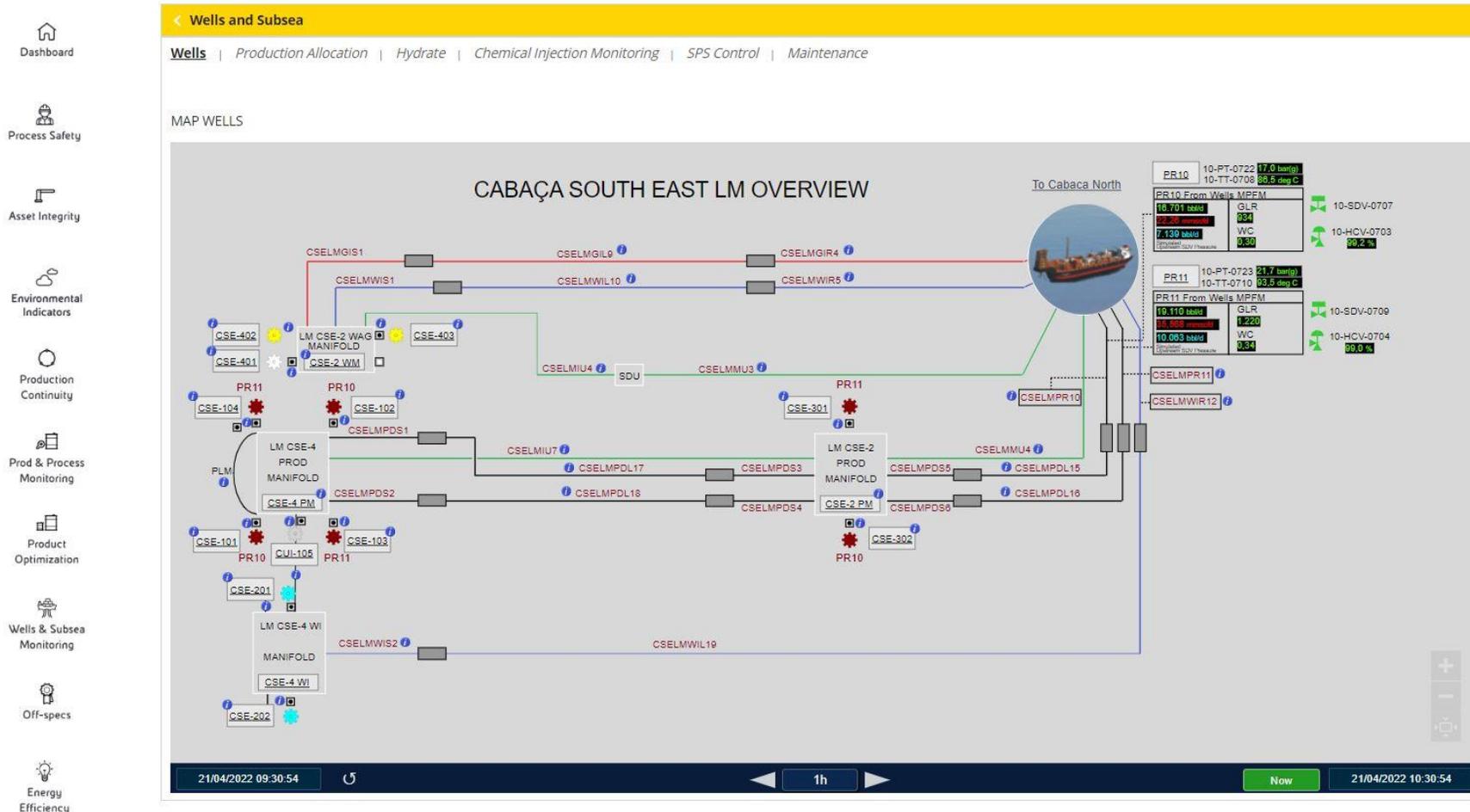
Integration with Appian BPM



- To visualize our results the complete integration of the results written in PI System with Appian has been carried out.
- Integration made by leveraging on PI Web API.
- Many of the visualizations were made entirely in PI System and embedded directly in Appian.

Displaying Data on IOC

Integration with Appian BPM



Final Remarks



Impacts and Savings

Equipment involved

- **Ultrafiltration train**
- **Sulphate reduction package**
- **Produced water coolers**
- **Oil in water analyzer**

Benefits in Process and Maintenance

- **Accurate monitoring** of current and future status of each equipment involved.
- **High availability of the wash water system** guarantees a good quality of the oil to be offloaded, in terms of salt content.
- More **support to the production wells** in the long term
- **Avoiding frequent water injection shutdowns** will guarantee the support to the production wells in the long term.



Dave Cook

Operations Director Eni Angola

The Angola East Hub is the first plant in Africa to be fully digitalised and now it represents a model of excellence for all other Eni plants on the continent. Digitalisation will bring benefits in efficiency, safety, asset integrity, supporting our activities, providing a robust tool to speed up data collection and data analysis. The optimised process will help maximise production resulting in a new way to “see” and monitor data. Thanks to the integrated vision in the IOC we will be able to have new ideas as never before. The IOC is really an ambitious tool for new perspectives.



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