



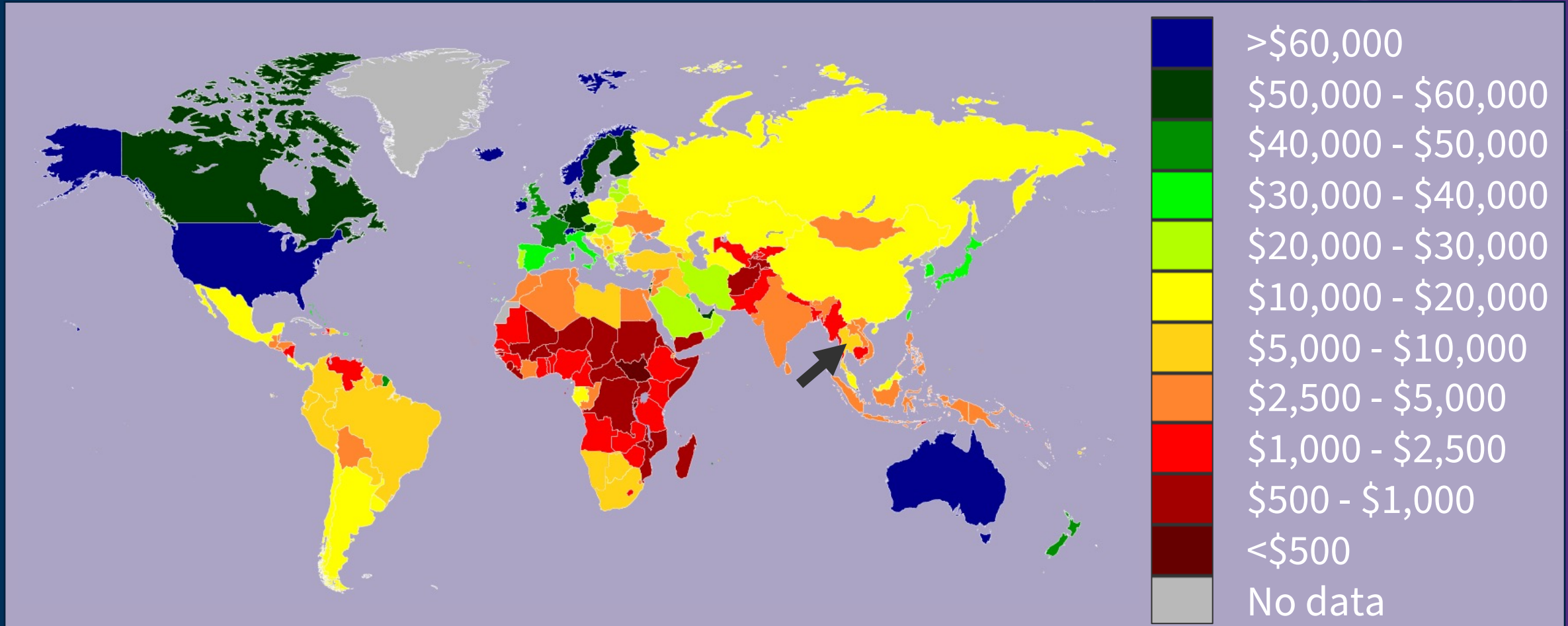
Upstream Condensate Production Optimization in the Gulf of Thailand

Suradech Kongkiatpaiboon

PROCESS ENGINEER

CHEVRON THAILAND E&P

Our lives can be improved through technology



World map of countries by GDP per capita (nominal) for 2022

<https://commons.wikimedia.org/>

Recent Thailand assets transition

Pre-April 2022

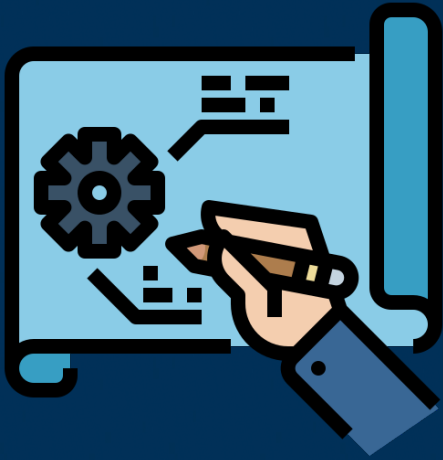


Post-April 2022



Both production and organization size have been reduced

Process to implement new tool in Chevron Thailand



**Local
Prototype**

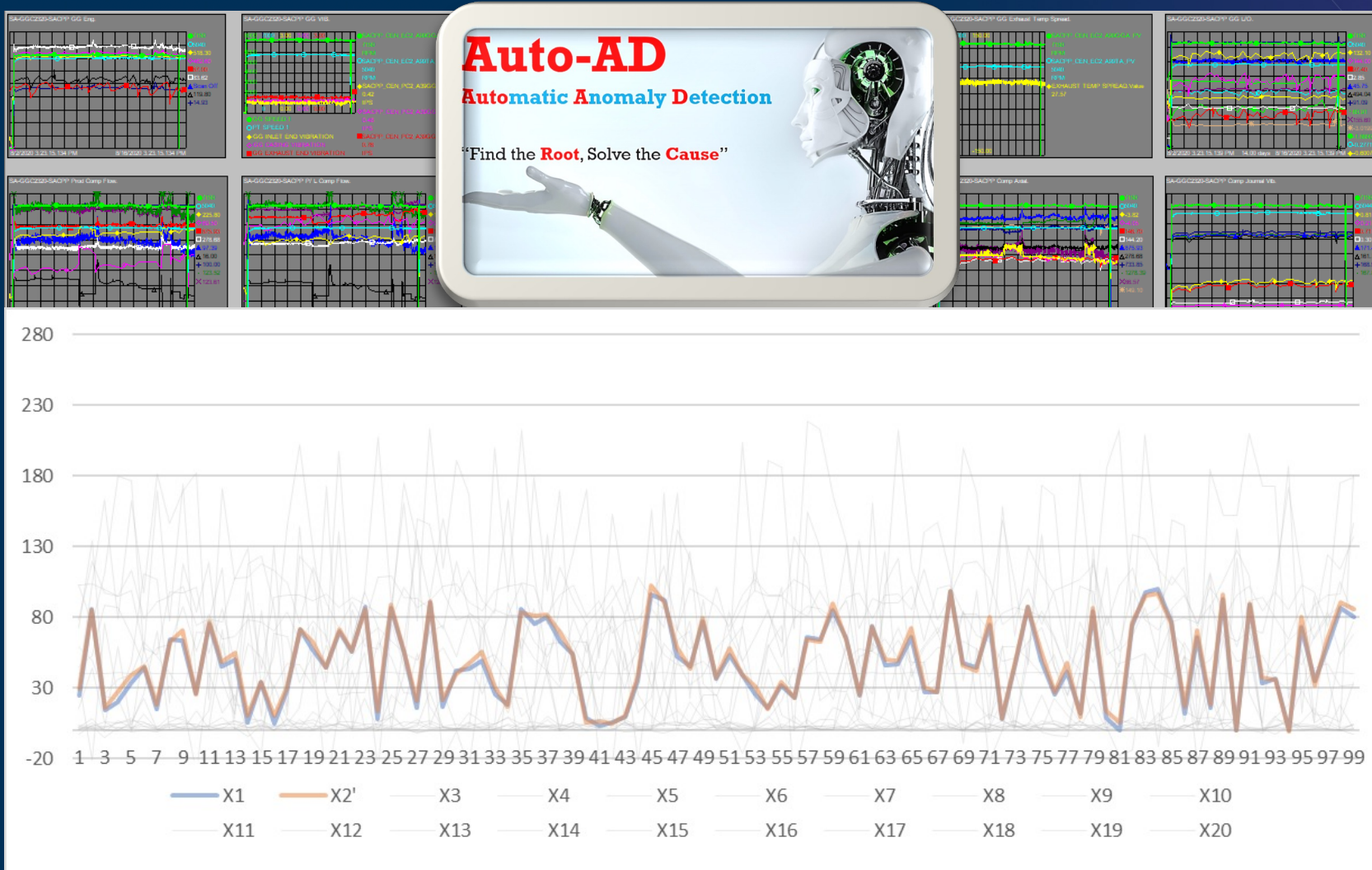


**Globally
Check**



**New
Development**

Use case 1: Anomaly detection/Root cause analysis tool



Finding and **To analyze**

Over 1,000+
faster than human
Sensors

Over 1,000,000+
Data Points

2 weeks

15 minutes



What is Auto-AD?

Auto-AD Prototype I is a **tool to detect statistical association** of reading from sensors by automatically streaming data from Aveva PI server, completing clustering algorithm and statistical tests, and reporting out.

Automatic Anomaly Detection

“Find the **Root**, Solve the **Cause**”[”]

START DATE
07/06/16 06:45

END DATE
07/06/16 07:00

SAMPLING FREQUENCY
15s

SELECT CPP
☒ SACPP ☐ PACPP ☐ Benchamas
☐ NPCPP

MAIN CATEGORY
☒ Gas_Processing ☐ Liquid_Processing
☐ Utility

SUB CATEGORY
☒ Separators ☐ Air System
☒ Condensate Stabilization ☐ Air coolers
☒ Heat Exchangers ☐ Filter Coalescers
☐ Filters ☐ Compressors ☐ Generators
☐ Glycol ☐ Heaters ☐ Hydrocyclones
☐ IGFs ☐ Launchers ☐ Pumps
☐ Receivers ☐ Sales Gas Meters
☐ Storage Tanks ☐ WHRU ☐ PWIP

METHOD
☐ Clustering (Indented Tree)
☒ Granger Causality Test

FIRST OUT TAG
CEN_FI2290_PV Gas Outlet Flow Rate

CLEAR

SUBMIT

RESULT

CEN_PI2250_PV Vessel Pressure A
0.000000e+00
CEN_PI2230_PV Vessel Pressure A
0.000000e+00
CEN_PI2450_PV Vessel Pressure A
1.000000e-09
CEN_PI2210_PV Vessel Pressure A
2.100000e-08
CEN_PI2430_PV Vessel Pressure A
3.090000e-07
CEN_FIC2291_MV Condensate Outlet Flow Control Valve
3.560000e-07
CEN_LIC2450_PV Liquid Level
7.260000e-07
CEN_FI2080_PV Gas Outlet Flow Rate
1.414560e-04
CEN_LIC2292_PV Water Level
3.972360e-04
CEN_LIC2430_MV Condensate Outlet Level Control Valve
4.845640e-04
CEN_FI2260_PV Gas Outlet Flow Rate
5.806820e-04
CEN_LIC2210_MV Condensate Outlet Level Control Valve
6.751800e-04
CEN_FI2070_PV Inlet Flow Rate
7.060670e-04
CEN_PI2460_PV Vessel Pressure A
8.827900e-04
CEN_FIC2292_PV Oily Water Flow Rate
8.998990e-04
CEN_LIC2061_PV Condensate Level
1.131817e-03
CEN_FIC2061_PV Condensate Outlet Flow Rate
1.451081e-03
CEN_LIC2291_PV Condensate Level
3.275370e-03
CEN_LIC2168_PV Liquid Level
6.414680e-03
CEN_PI2300_PV Inlet Pressure
1.208052e-02

Latency: 12.32s

SCREENSHOT

**the
human
energy
company®**



SOLUTION



RESULTS

[illegible]

Use case 2: Condensate production optimization



CHALLENGE

Unreliable Reid Vapor Pressure online analyzer
Fouling on exchangers
C5+ hydrocarbon is not optimized
Similar problems across other assets



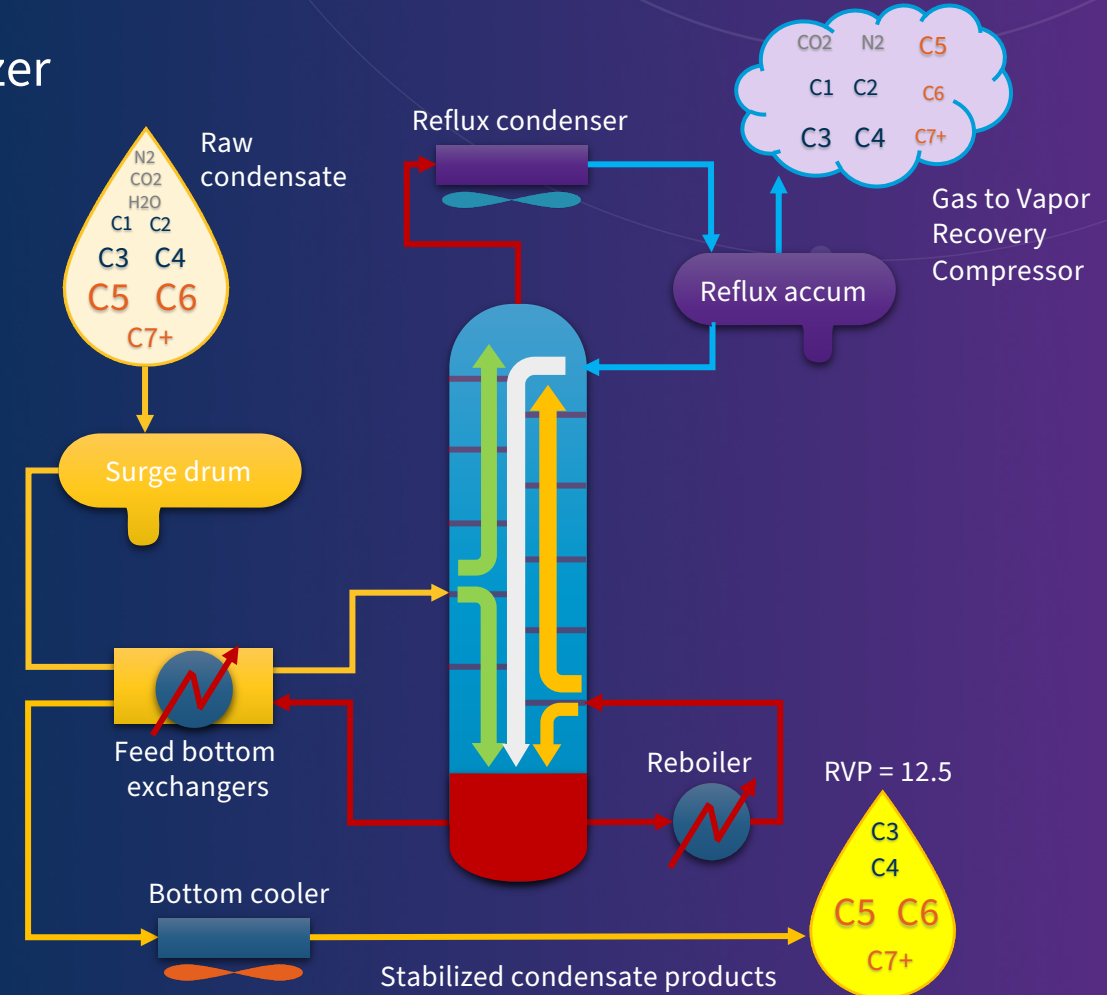
SOLUTION

Data Science Model evaluation and deployment
Calculation in DCS/PI AF
Seeq platform

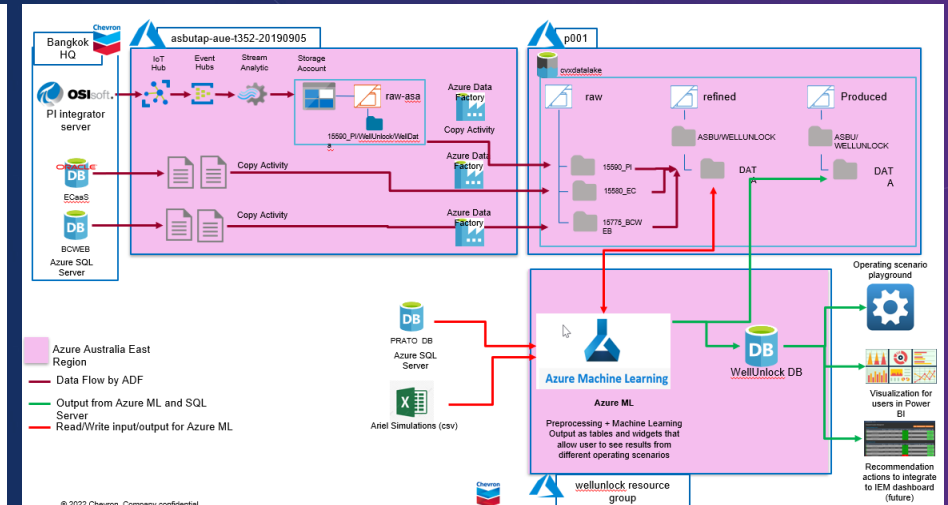
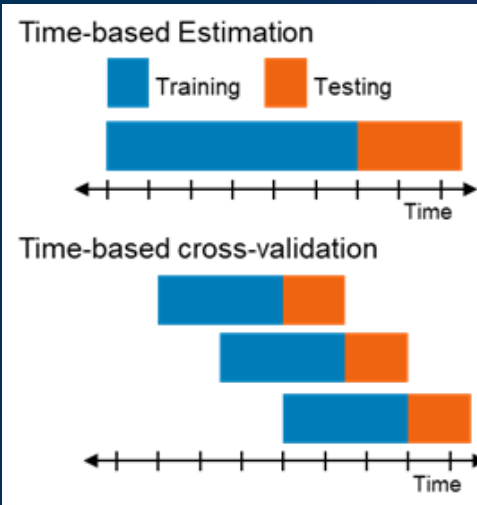
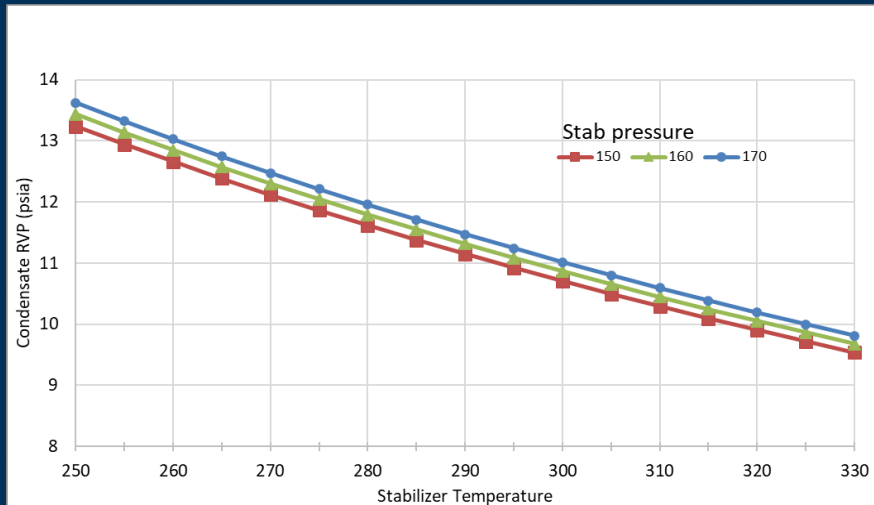


RESULTS

Improvement in RVP modelling accuracy
More accurate HEX cleaning/optimization
Values of C5+ hydrocarbon is captured
Globally optimized process



Reid Vapor Pressure (RVP) estimator model



DataRobot Use Cases AI Catalog Data Models **69** Deployments Model Registry Applications

Repository Leaderboard Insights Learning Curves Speed vs Accuracy Model Comparison

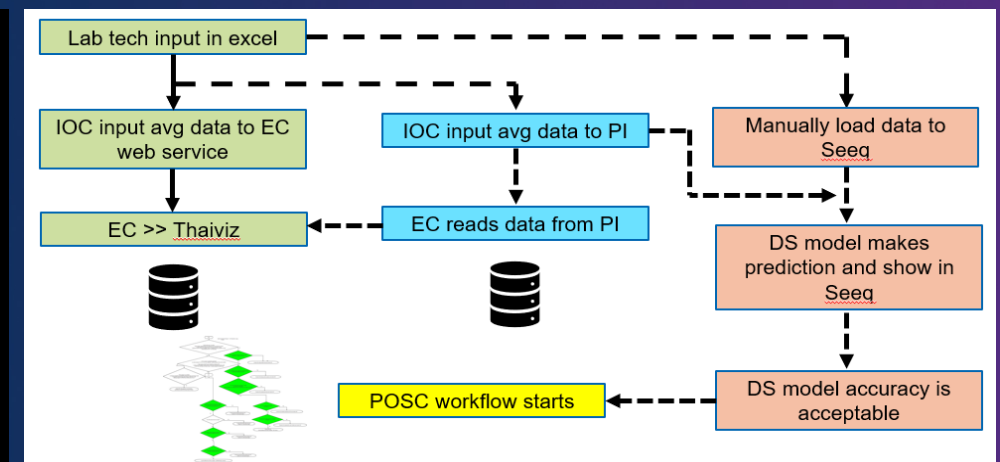
Menu Search + Add new model Filter Models Export

Model Name & Description	Feature List & Sample Size	Validation	Cross Validation	Holdout
Ridge Regressor One-Hot Encoding Numeric Data Cleansing Standardize Smooth Riddit Transform Ridge Regressor	Informative Features 100.0 %	0.5519 *	0.5049 *	0.4677 *
M83 BP71 SCORING CODE 80.09% RECOMMENDED FOR DEPLOYMENT				
ENET Blender Ridge Regressor	Multiple Feature Lists 63.8 %	0.5315	0.5046	
M87 M12+14+74+15+28+... SCORING CODE				
AVG Blender Average Blender	Informative Features 63.8 %	0.5356	0.5060	
M85 M14+29+32 SCORING CODE				

WORKERS
Using 0 of 4 total workers across all projects

STATUS
Autopilot has finished

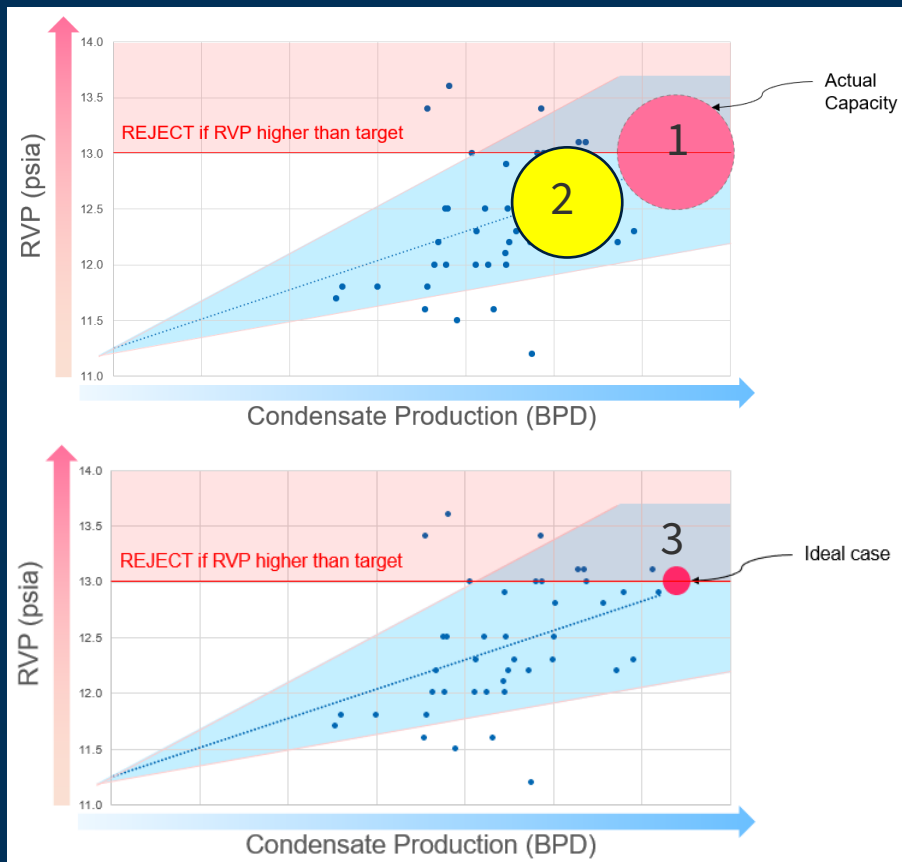
ACTIONS
Get More Accuracy
Next Modeling Mode: Comprehensive
Feature List: Informative Features
Configure modeling settings
Unlock project Holdout for all models



Condensate optimization

C5+/RVP control

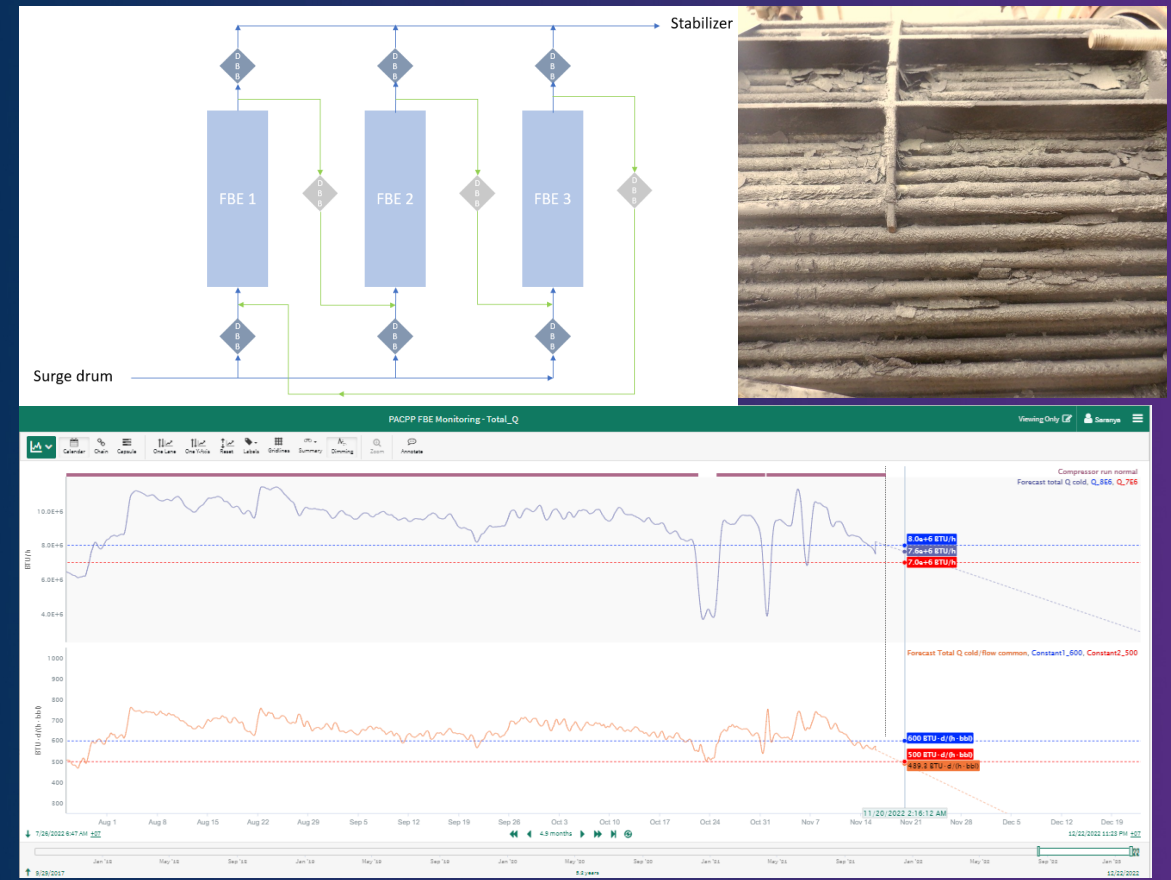
High variation due to poor control
Maximize C5+ in condensate while maintaining RVP specification



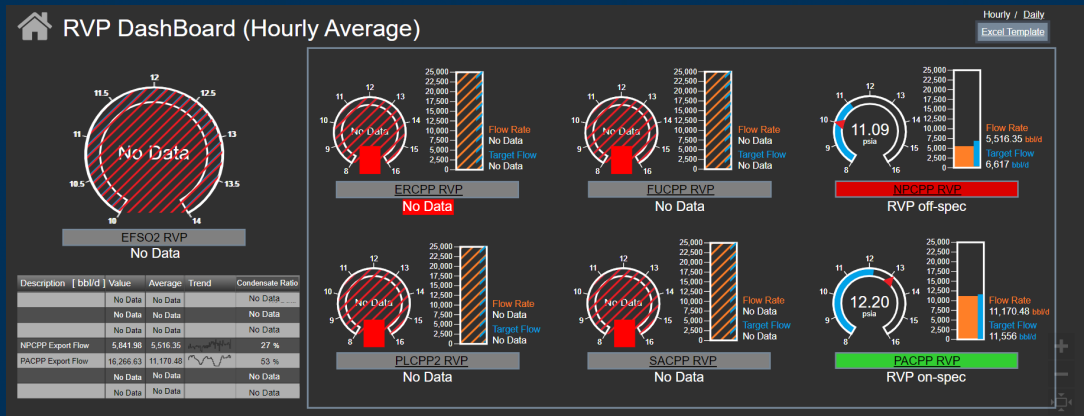
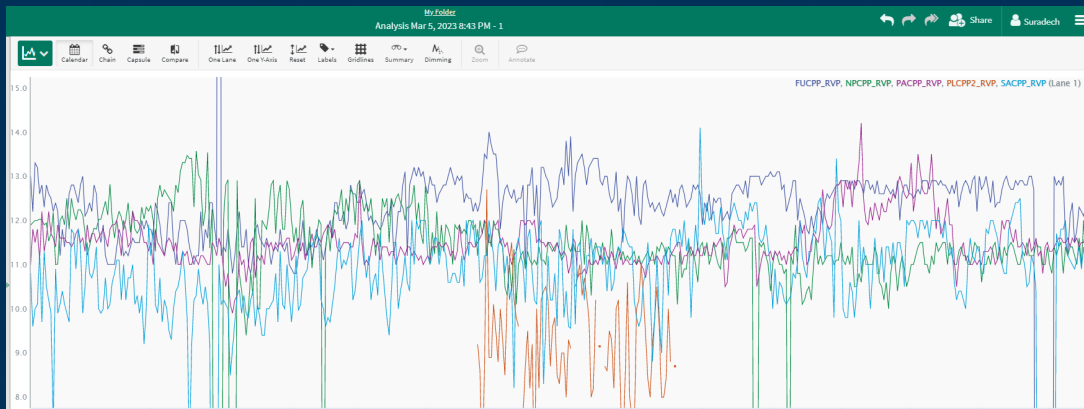
Heat exchangers

Coating/Fancy tube design

Piping modification: Parallel to Series operation



Globally optimized condensate production



POSC Process Optimization Support Center

FSO RVP Condition

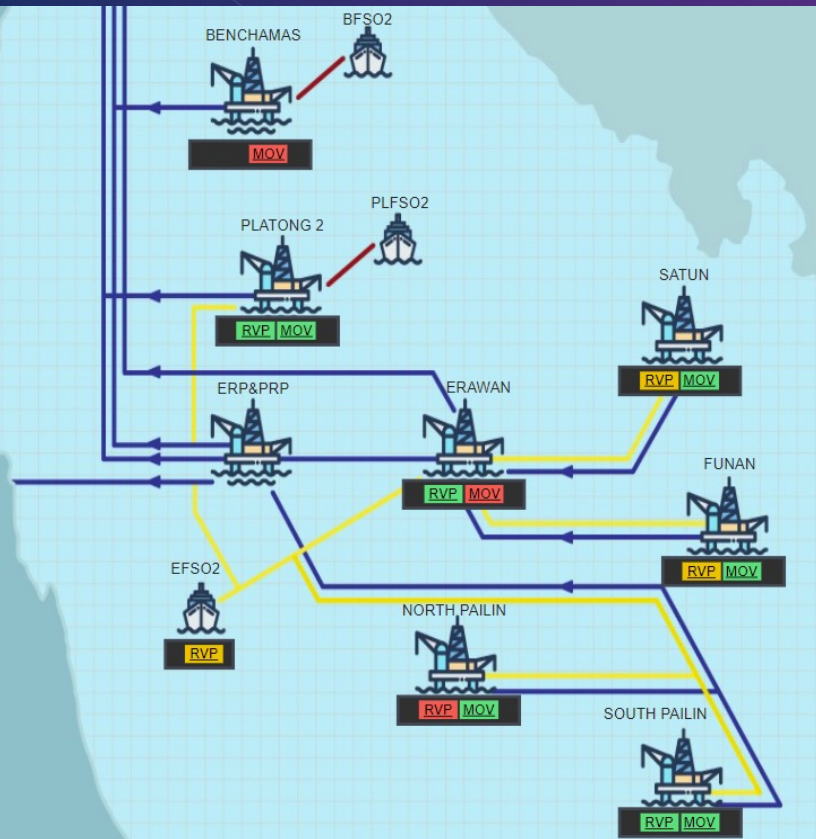
- RVP > 12.5
- 12.0 < RVP ≤ 12.5
- RVP ≤ 12.0

CPP RVP Condition

- RVP > RVP_Target
- RVP_Target - 0.5 < RVP AND RVP ≤ RVP_Target
- RVP ≤ RVP_Target - 0.5

MOV Condition

- MOV < 90% and pressure diff > 50 psi
- MOV ≥ 90% or pressure diff between 0-30 psi
- MOV < 90% and pressure diff between 30-50 psi



Use case 3: Desander Hydrocyclone Monitoring



CHALLENGE

Bad performance of desander
Repetitive damage on water injection pumps



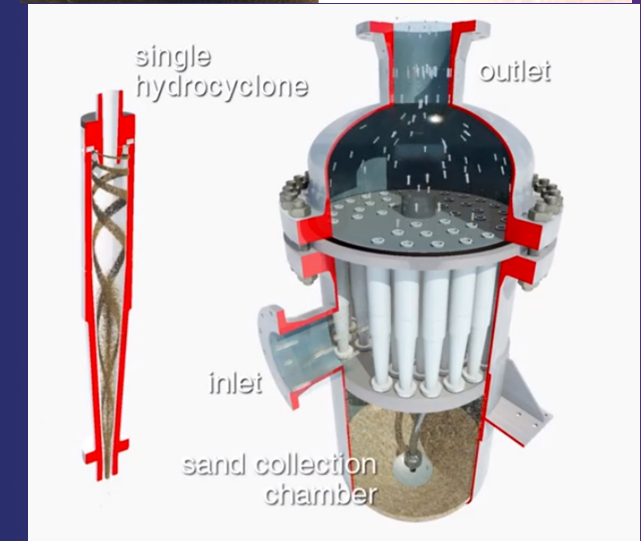
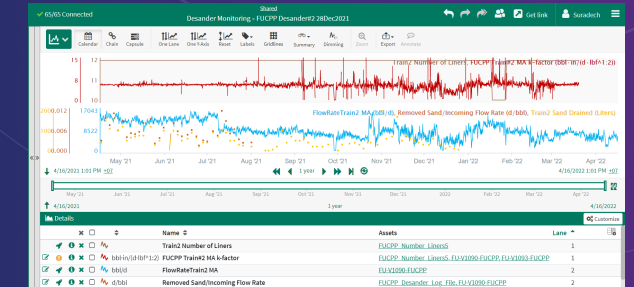
SOLUTION

Monitor the variance of k – cyclone design factor
 $\text{Capacity} = k (dP)^{0.5} \times \text{number of liners}$
Investigate events with high variance



RESULTS

Extend PM time of the pumps from 2 months to 6 – 12 months
Apply similar solution to other assets



Key takeaways

Our challenges are unique. Digital tools can be helpful.

Characteristics good digital tools are:-

- Customizable by users
- Adaptable over time
- Rely on frontline's experts
- Focus on the problems – not the technology
- What gets measured, gets done

Challenges come with opportunities – let's capture them!



Questions?