Applied Analytics for Digital Enterprises

Automation in E&P Data Management

E&P Use Cases on Automation, Analytics, AI and RPA

Agenda - Applied Automation

➢ **Applied Automation - Seismic Data**
- ✓ Seismic Sections Images to SegY

➢ **Applied Automation - Well Log**
- ✓ Well Logs Digitization
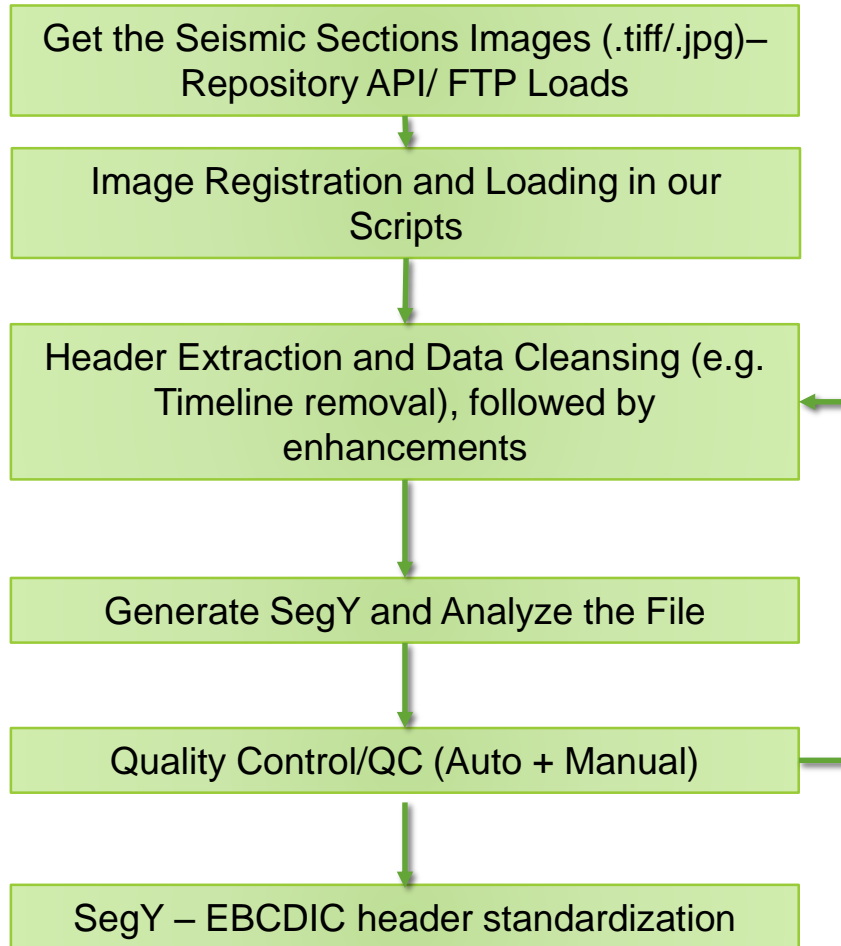- ✓ Well Logs Splicing and Merging
- ✓ Well Logs Correlation

➢ **Applied Automation - Drilling**
- ✓ Drilling Operations Monitoring
- ✓ Auto Identification of Drilling Process
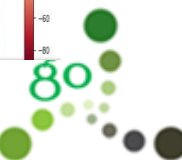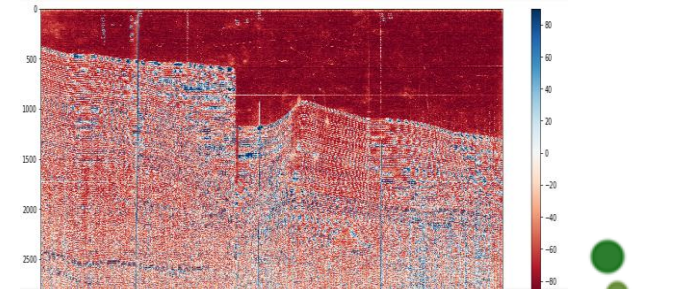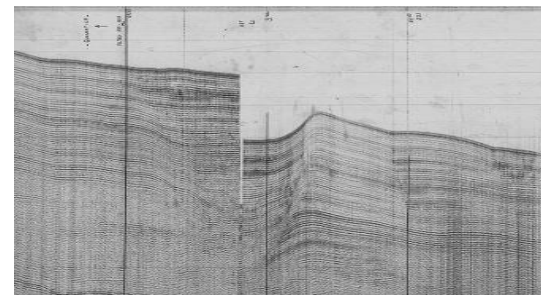- ✓ Measuring Drilling Efficiencies for NPT

Applied Automation
Seismic Sections Images to SegY

Get the Seismic Sections Images (.tiff/.jpg)– Repository API/ FTP Loads

↓

Image Registration and Loading in our Scripts

↓

Header Extraction and Data Cleansing (e.g. Timeline removal), followed by enhancements

↓

Generate SegY and Analyze the File

↓

Quality Control/QC (Auto + Manual)

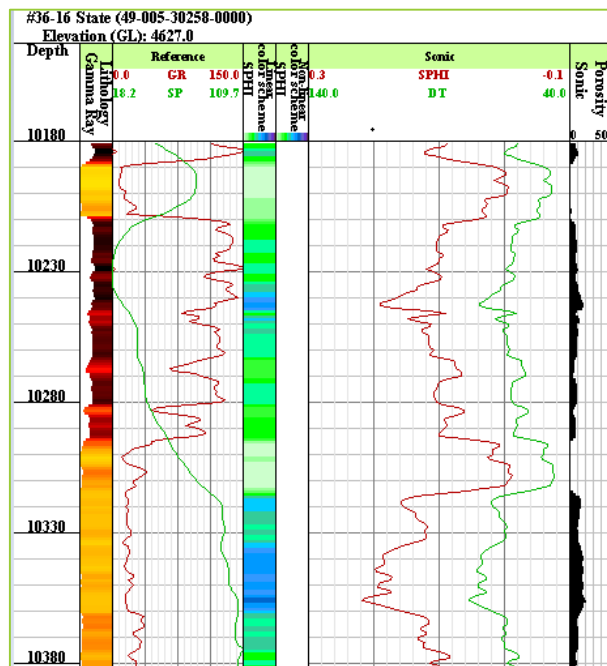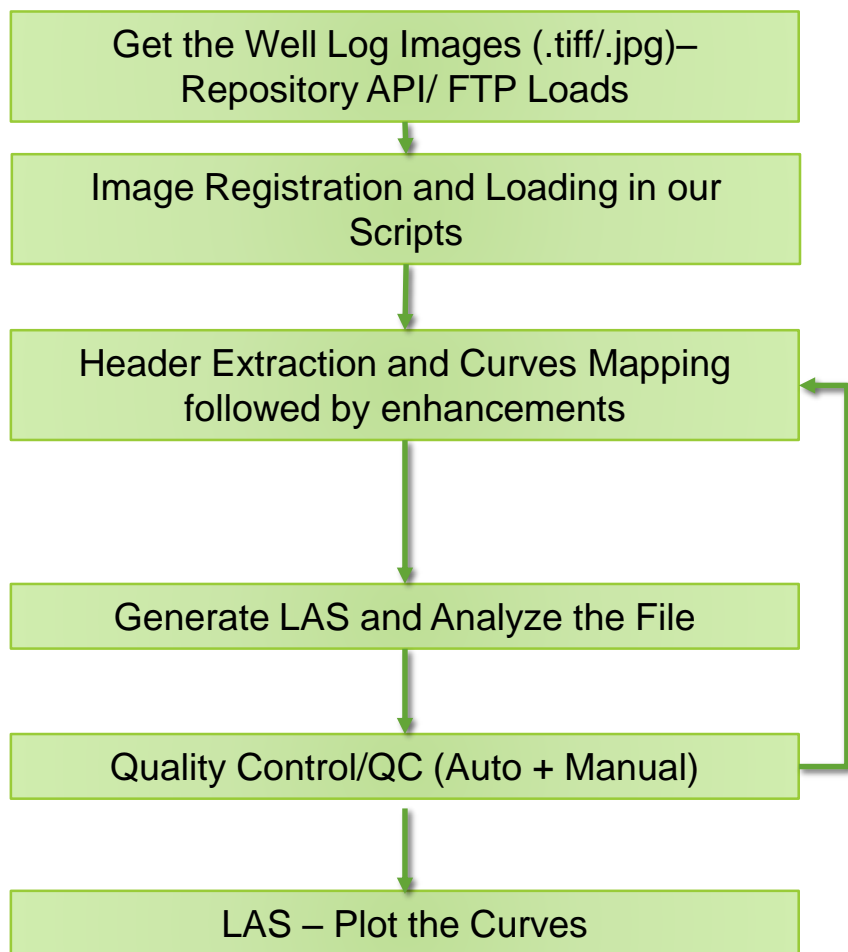↓

SegY – EBCDIC header standardization

- Typical TAT for each image file will be ~1 hr/image
  - Automated Scripts with QC (Auto+Manual) to take 0.5 hr for each image conversion process
  - Analytical Reports as well as SegY enhancements, to take additional 0.5 hr for each generated SegY file
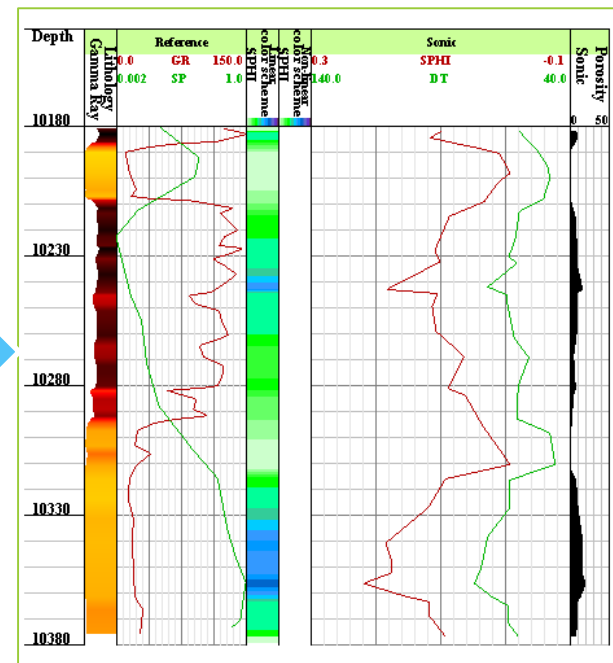- Solution can be consumed as a Service running on AWS/Azure/GCP

Applied Automation
Well Log Digitization - Images to LAS

greenojo
smart n sustainable solutions

Get the Well Log Images (.tiff/.jpg)– Repository API/ FTP Loads

Image Registration and Loading in our Scripts

Header Extraction and Curves Mapping followed by enhancements

Generate LAS and Analyze the File

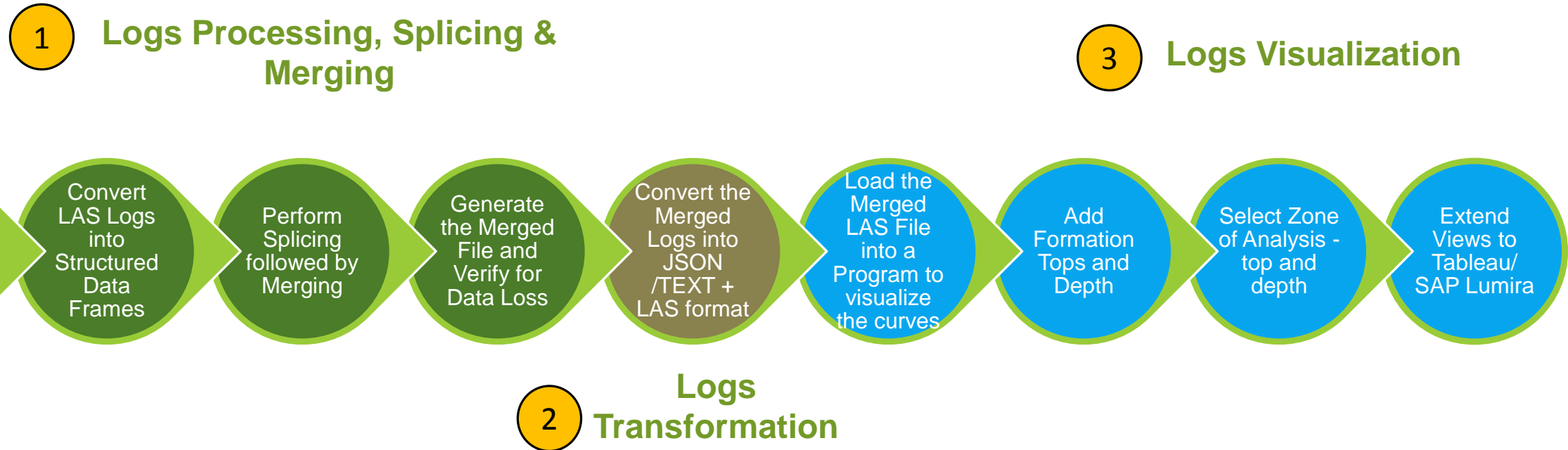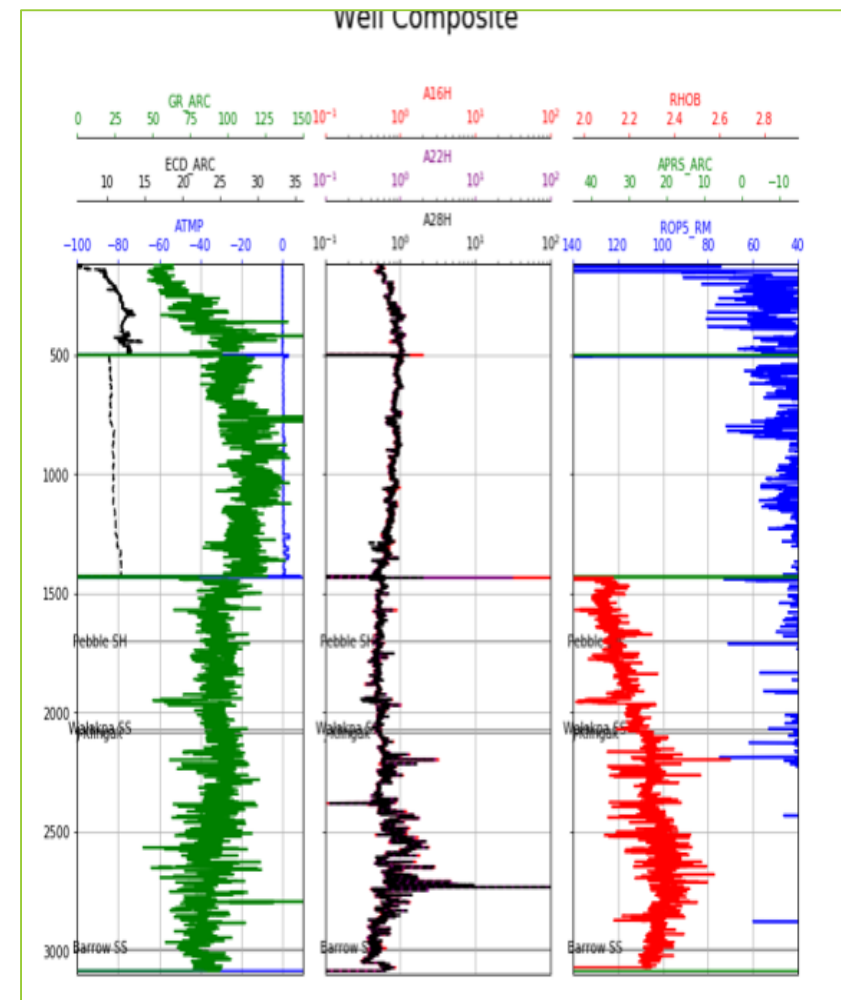Quality Control/QC (Auto + Manual)

LAS – Plot the Curves

Image

LAS

go

Applied Automation
Well Logs Splicing and Merging

1 **Logs Processing, Splicing & Merging**

3 **Logs Visualization**

Load multiple LAS files from the same Well Header – Bulk Load

Convert LAS Logs into Structured Data Frames

Perform Splicing followed by Merging

Generate the Merged File and Verify for Data Loss

Convert the Merged Logs into JSON /TEXT + LAS format

Load the Merged LAS File into a Program to visualize the curves

Add Formation Tops and Depth

Select Zone of Analysis - top and depth

Extend Views to Tableau/ SAP Lumira

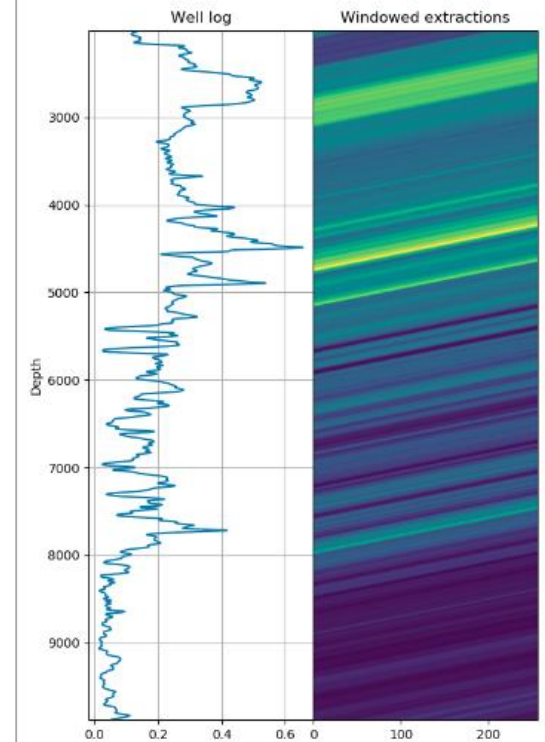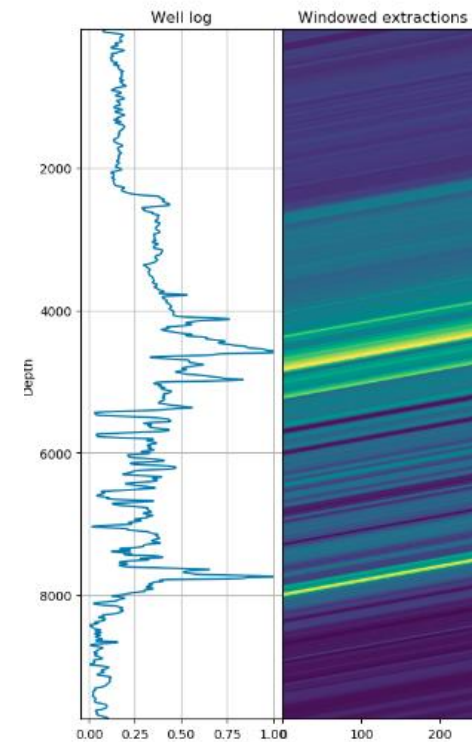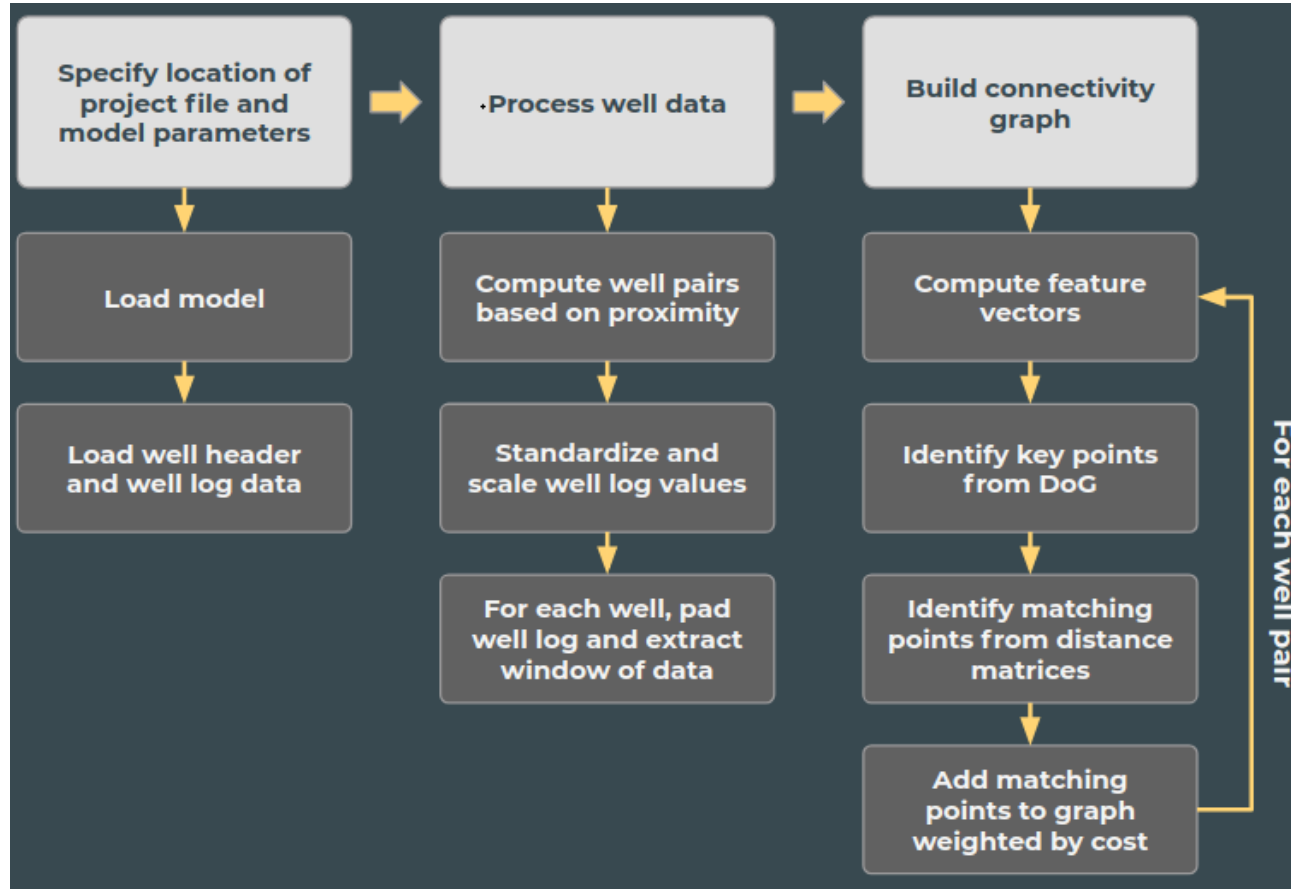**2** **Logs Transformation**

go

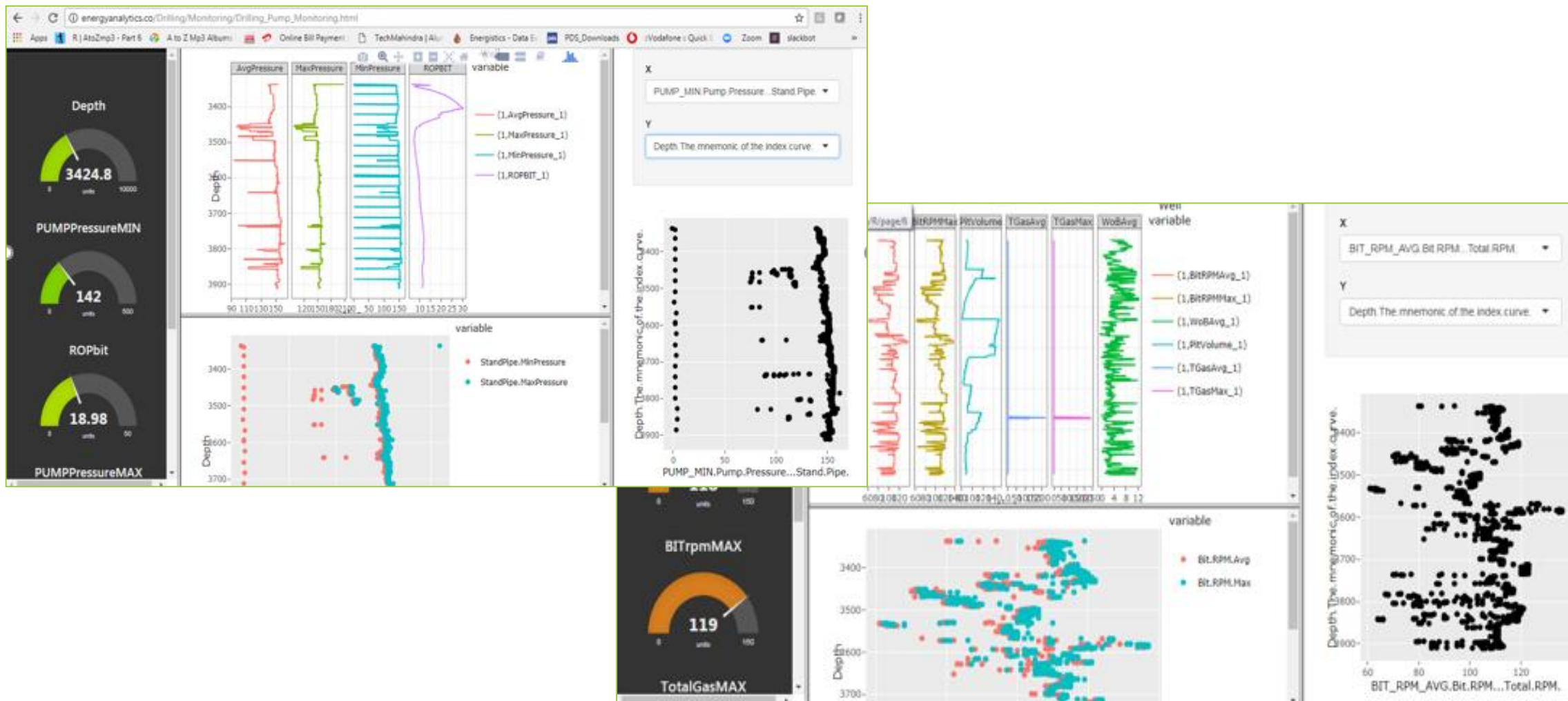# Applied Automation
Merged LAS Views
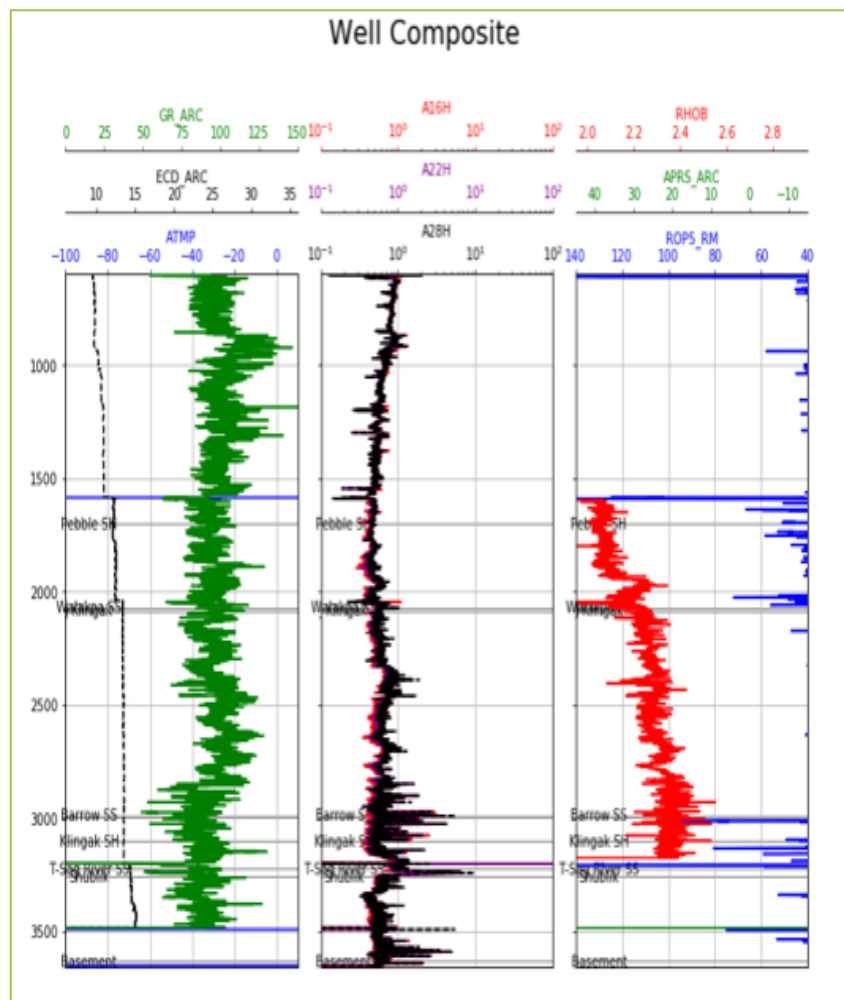
Applied Automation
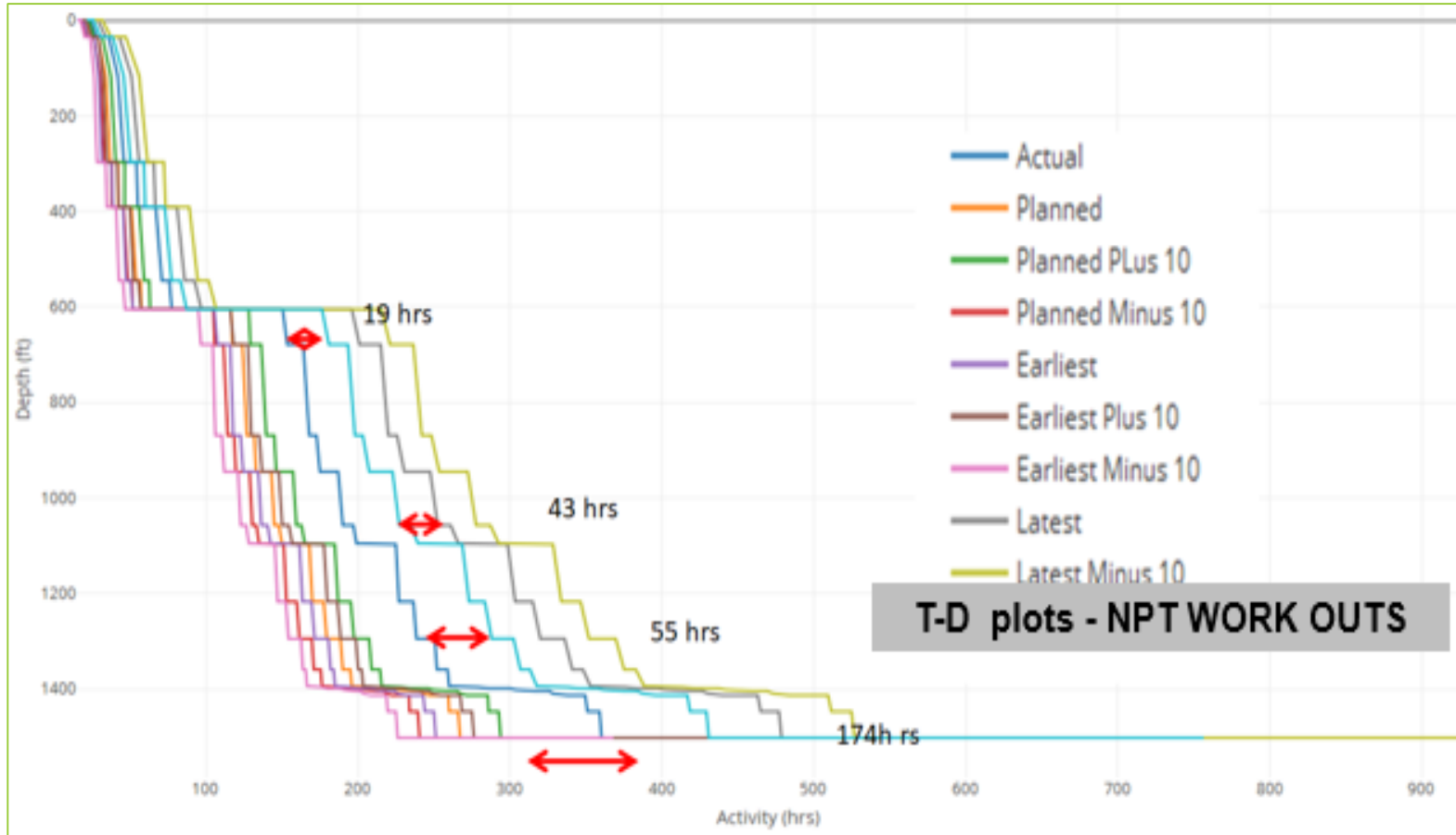## Automated Well Log Correlation

Applied Automation
Real-Time Drilling Operations Monitoring

Applied Automation
Auto Identification of Drilling Process

Applied Automation
Measuring Drilling Efficiencies (T-D Plots)

- ➢ Prediction of section wise Drilling parameters such as ROP, Weight on bit, mud weight etc.,

- ➢ Plotting TD plots without Tripping and casing information help plan ROP

To produce drilling parameters road map to be drilled, comparison with real time and providing alerts and information on necessary actions

Agenda - Applied Analytics

➢ **Applied Analytics - Seismic Data**
  ✓ Salt Prediction, Seismic Inversion

➢ **Applied Analytics - Well Log**
  ✓ Lithology Prediction
  ✓ Rules Based Monitoring of Fracture Index

➢ **Applied Analytics - Drilling & Production**
  ✓ Well Integrity
 ✓ Production Analysis, Decline Curve Analysis (DCA)

Applied Analytics
Salt Prediction, Seismic Inversion

➤ **Salt Prediction -** One of the challenges of seismic imaging is to identify the part of subsurface which is salt. Salt density is usually 2.14 g/cc which is lower than most surrounding rocks. The seismic velocity of salt is 4.5 km/sec, which is usually faster than its surrounding rocks. This difference creates a sharp reflection at the salt-sediment interface. *The unusually high seismic velocity of salt can create problems with seismic imaging.*
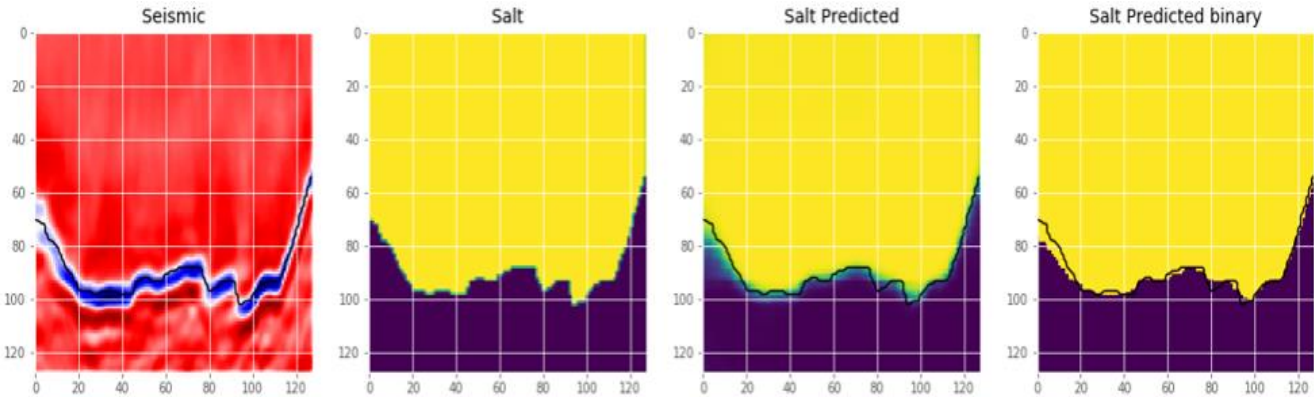

➤ **Seismic Inversion -** Transforming seismic reflection data into a quantitative rock-property description of a reservoir. Seismic data may be inspected and interpreted on its own without inversion, but this does not provide the most detailed view of the subsurface and can be misleading under certain conditions. *Because of its efficiency and quality, most oil and gas companies now use seismic inversion to increase the resolution and reliability of the data and to improve estimation of rock properties.*
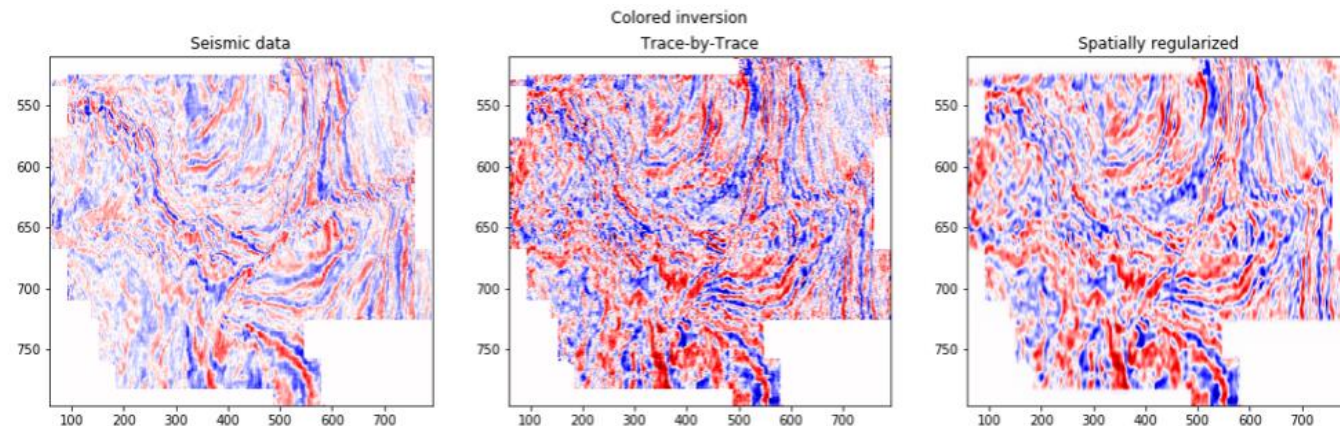
Applied Analytics
Lithology Prediction
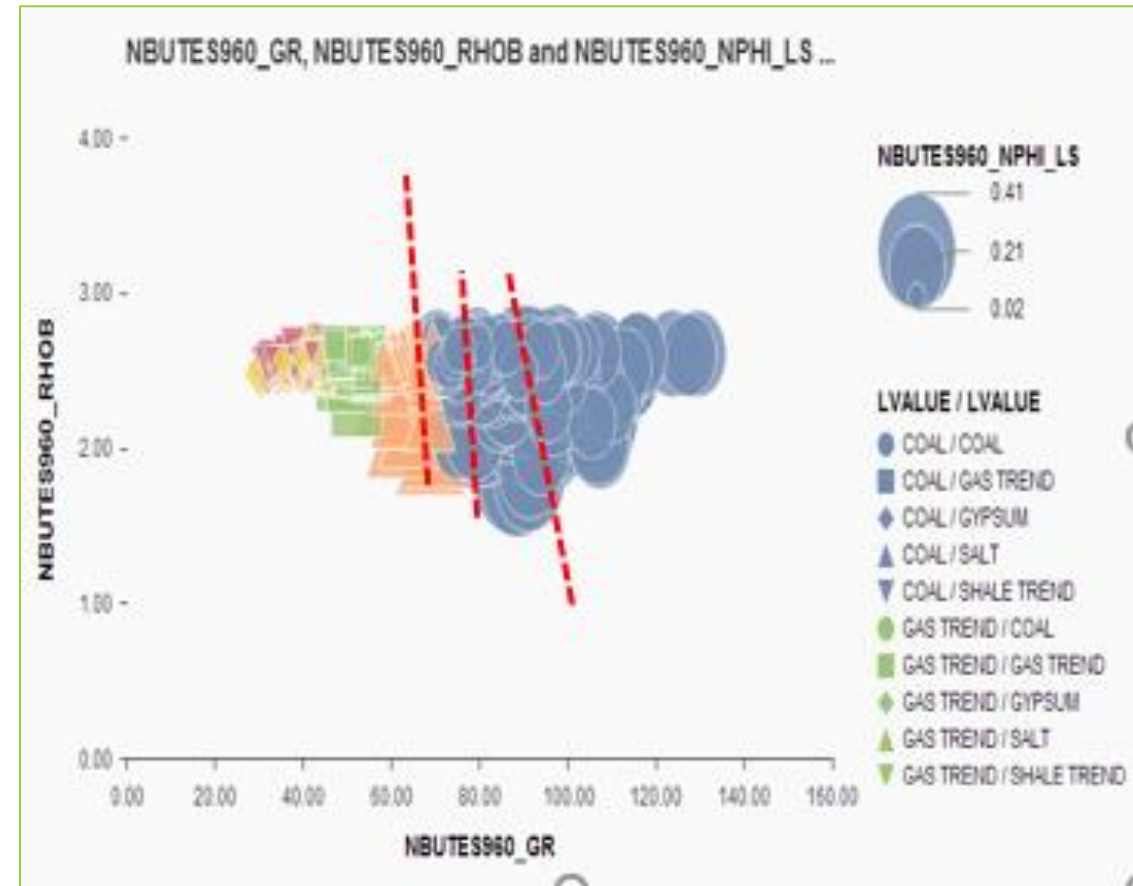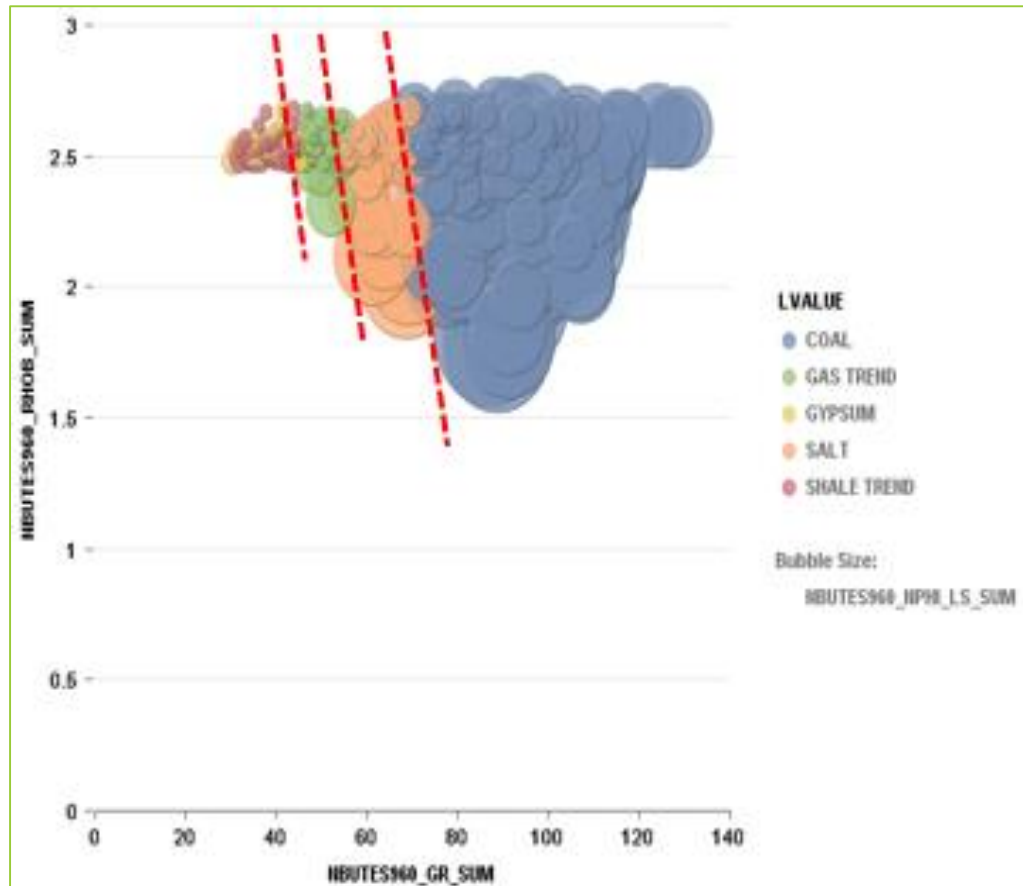
Applied Analytics
Rule Based Monitoring for Fracture Index (FI)

Set of Rules used in the different cases for the FIS

CASE 1
IF SFL and AT10/AT90 is high THEN FI is high
IF DRHO PEF is high THEN FI is high

CASE 2
IF DT , DRHO and CAL is high THEN FI is high
IF GR ,SP is high and SFL is high THEN FI is high
IF DRHO is high and CAL is medium THEN FI is high

CASE 3
IF DT SFL is high THEN FI is high
IF PEF and DRHO is high THEN FI is high
IF AT10/AT90 and ILD/ILM is high THEN FI is high

CASE 4
IF GR and PEF is high THEN FI is high
IF PORDIF and DRHO is high THEN FI is high

CASE 5
IF CAL , GR and SP is high THEN FI is high
IF DT and GR is high THEN FI is high
IF DT SP is high THEN FI is high

CASE 6
IF CAL ,GR is high and SP is high THEN FI is high
IF DT ,SFL is high and PEF is high THEN FI is high
IF DT i and SP is high THEN FI is high
IF SFL ,GR ,SP is high THEN FI is high
IF SFL and AT10/AT90 is high THEN FI is high

CASE 7
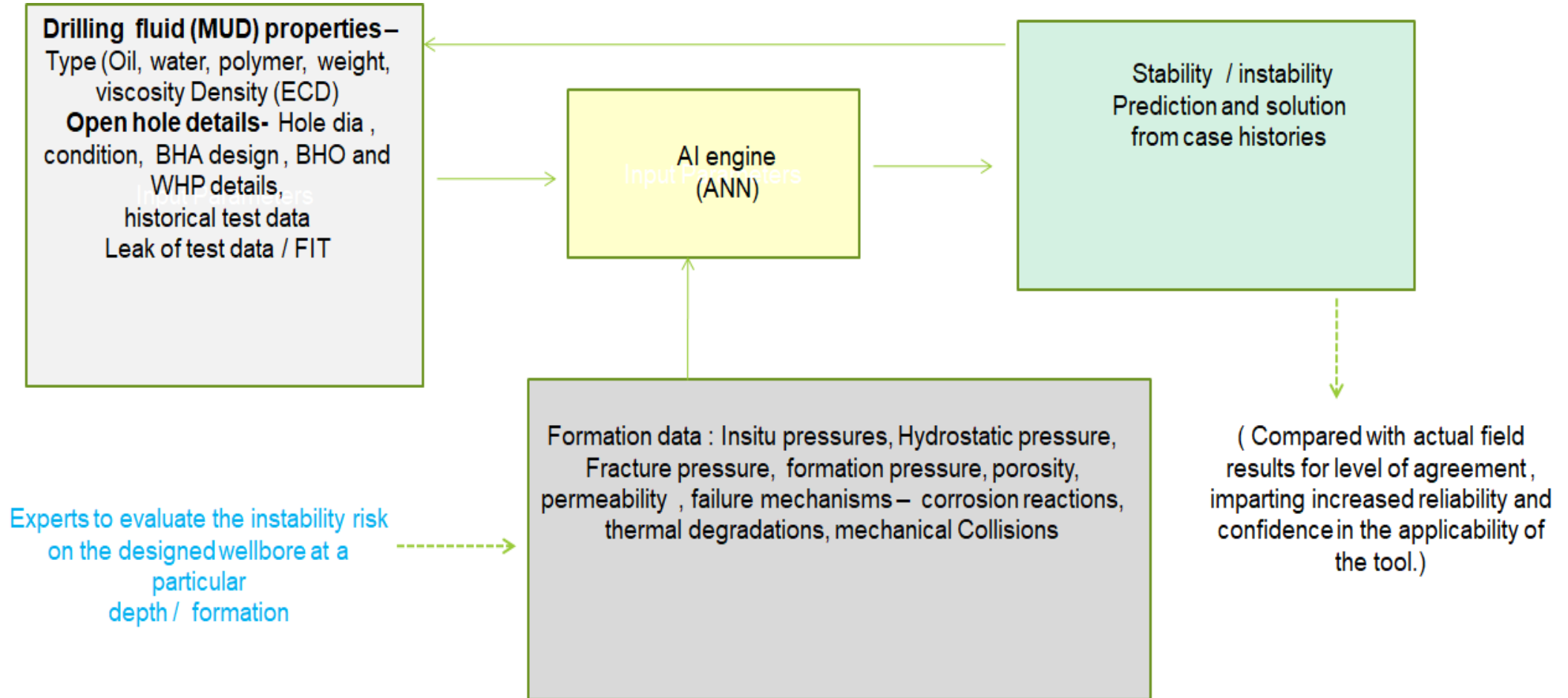IF CAL ,GR and SP is high THEN FI is high
IF DT GR is high THEN FI is high
IF NPOR-DPHI and DRHO is high THEN FI is high
IF SFL ,AT10/AT90 and ILD/ILM is high THEN FI is high
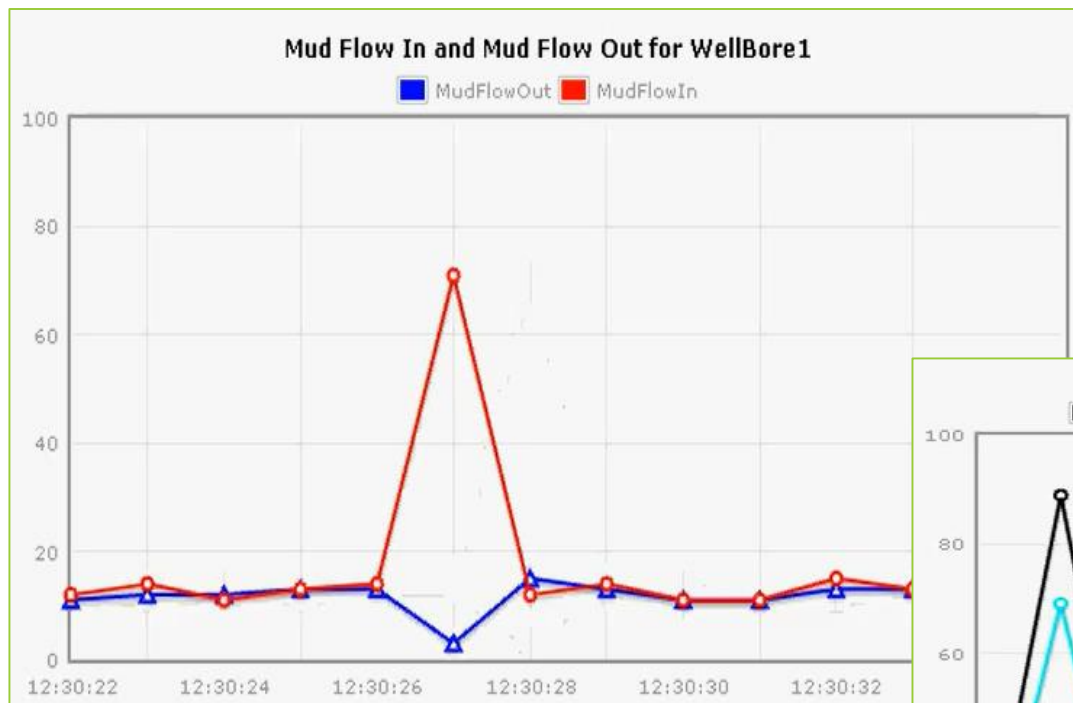
Applied Analytics
Example - Wellbore Stability

Drilling fluid (MUD) properties –
Type (Oil, water, polymer, weight, viscosity Density (ECD)
Open hole details- Hole dia, condition, BHA design, BHO and WHP details, historical test data
Leak of test data / FIT

AI engine (ANN)

Stability / instability Prediction and solution from case histories

Formation data : Insitu pressures, Hydrostatic pressure, Fracture pressure, formation pressure, porosity, permeability, failure mechanisms – corrosion reactions, thermal degradations, mechanical Collisions

Experts to evaluate the instability risk on the designed wellbore at a particular
depth / formation

(Compared with actual field results for level of agreement, imparting increased reliability and confidence in the applicability of the tool.)

Wellbore issues - Lost circulation, downhole kicks, wellbore leakages , stuck-pipe situations.

Applied Analytics
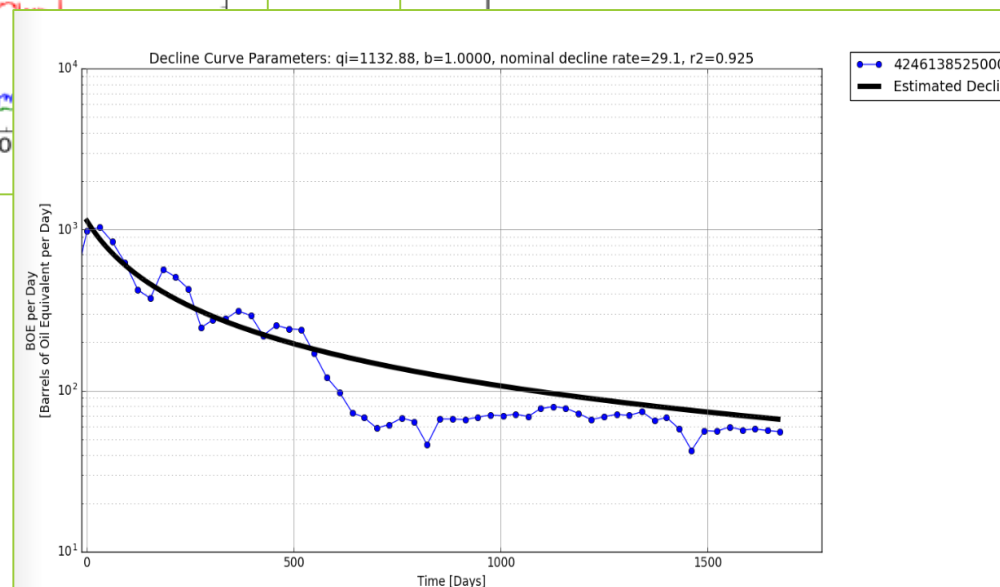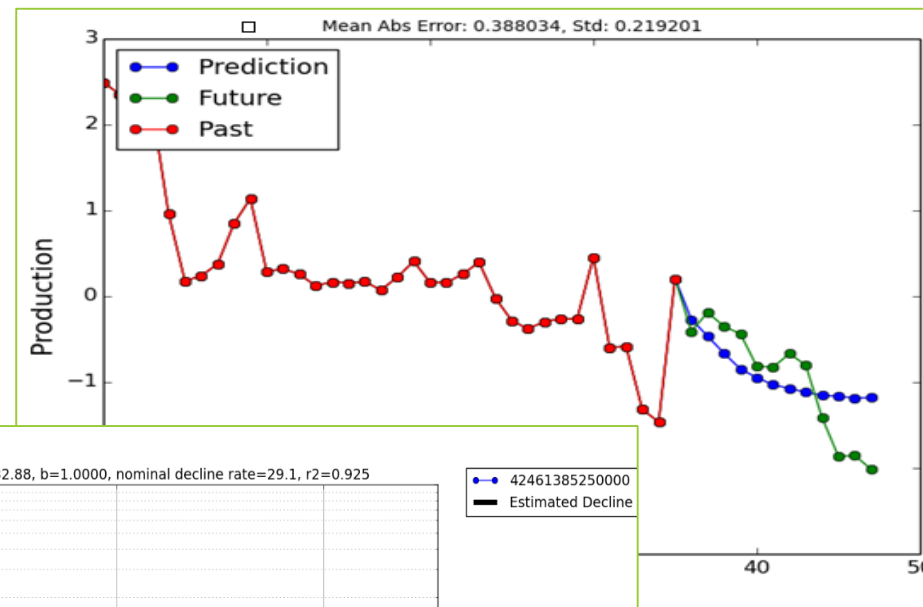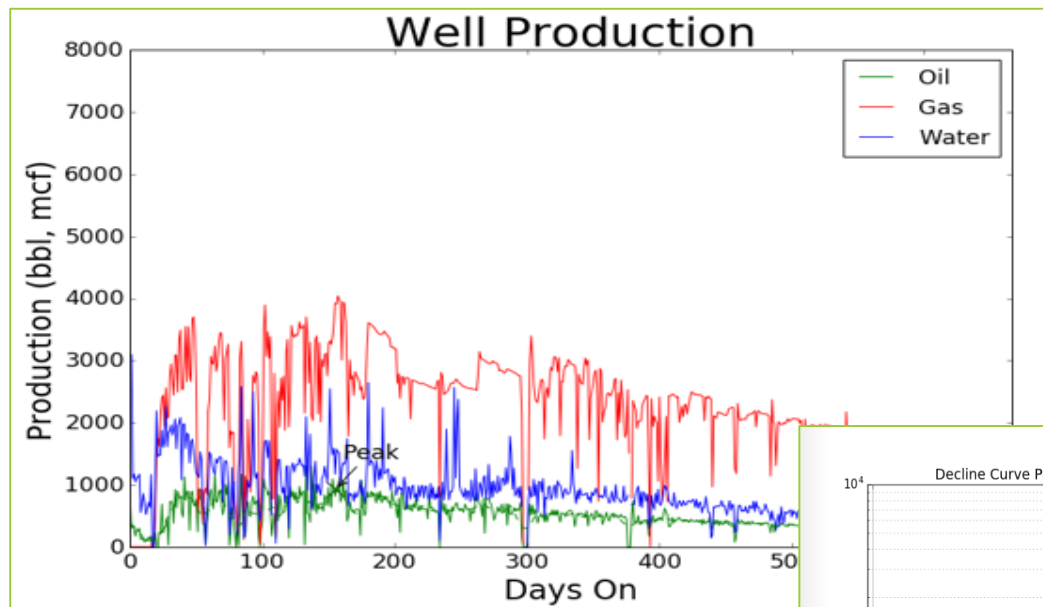## Real-time Analysis for Well Integrity

Applied Analytics
Production Analysis

Applied Analytics
DCA (Decline Curve Analysis)
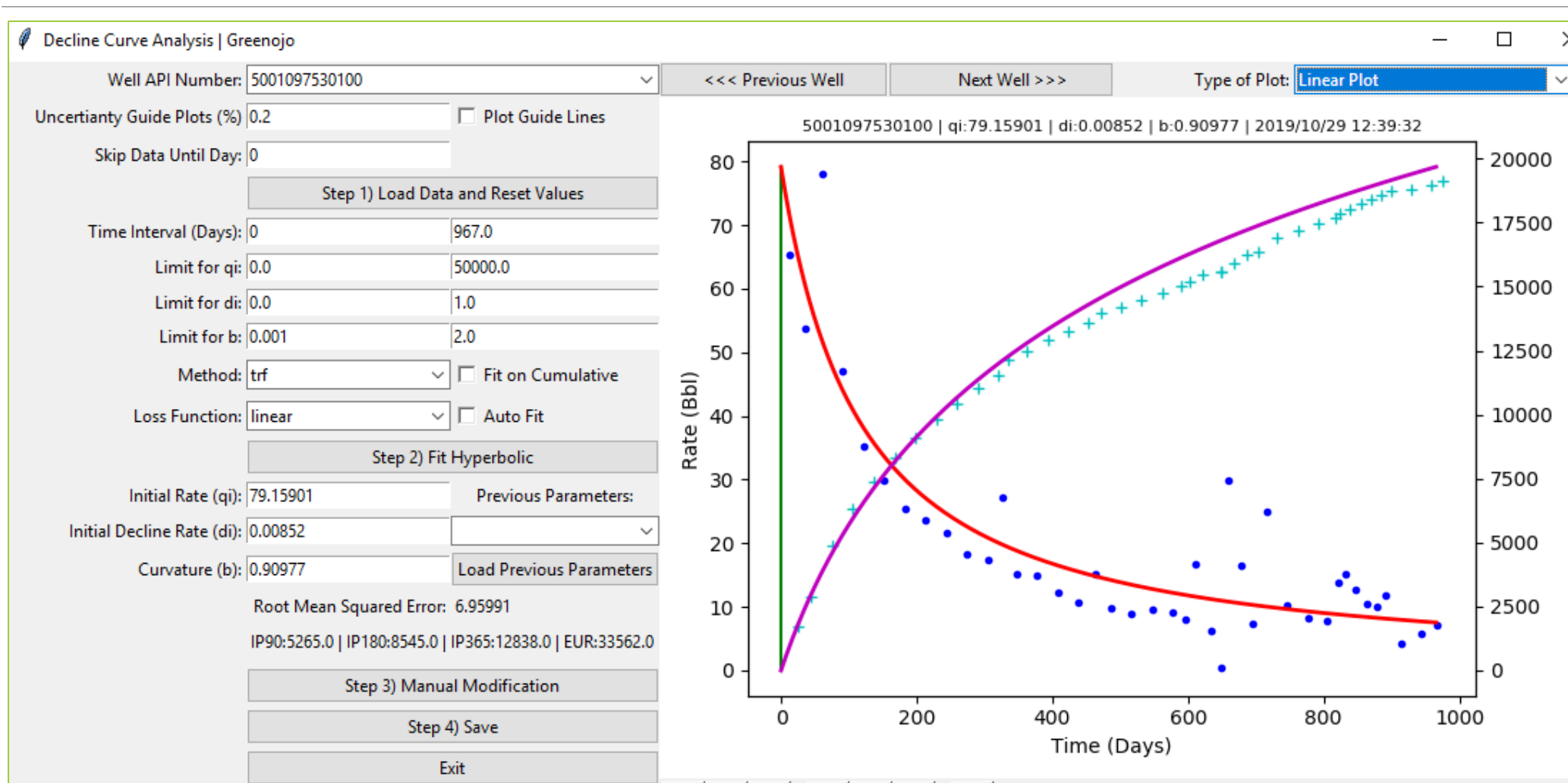
Applied Analytics
DCA (Decline Curve Analysis)
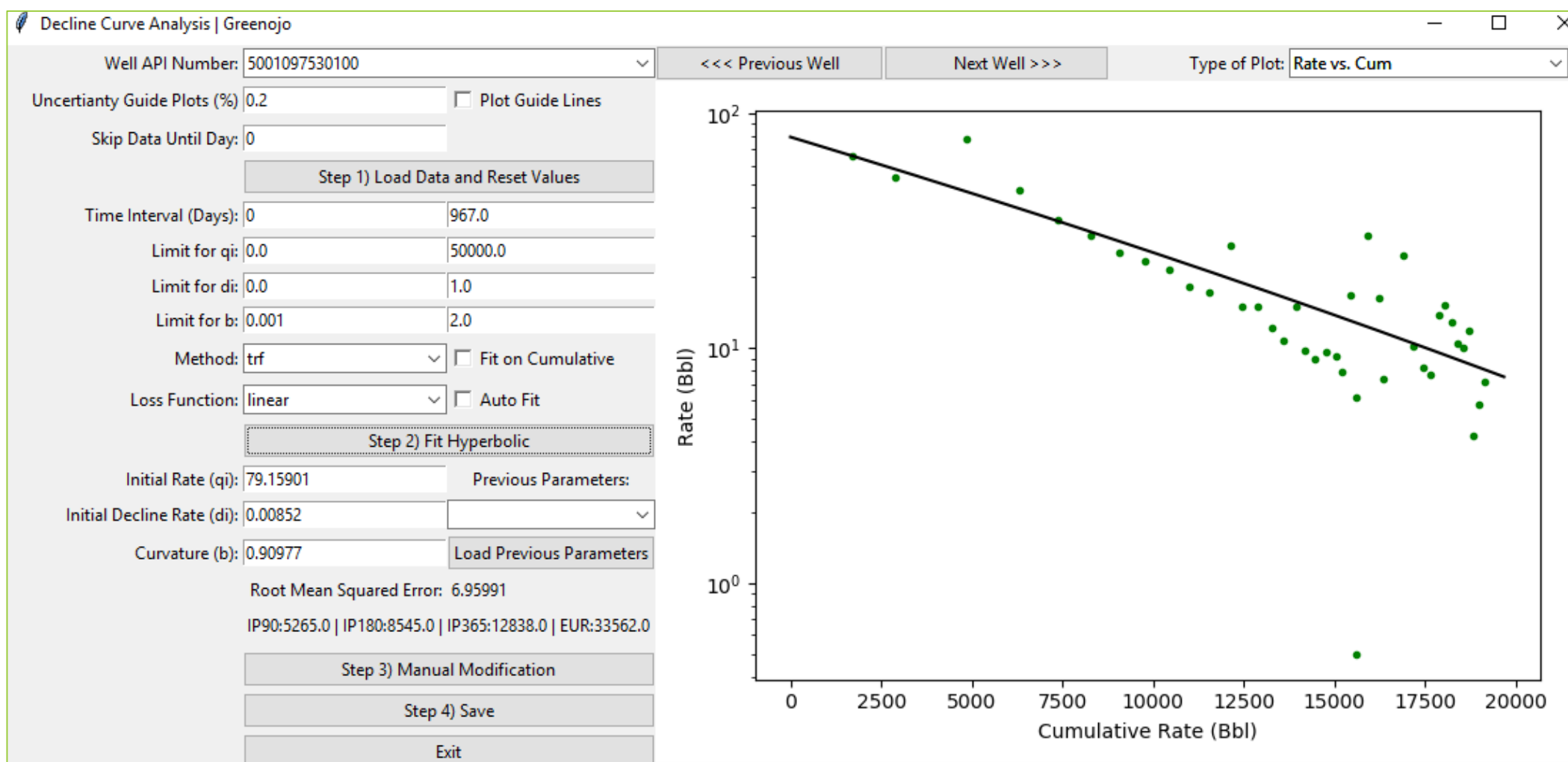
Agenda - Applied AI

➢ **Applied AI - Well Logs**
  - ✓ Facies Classification

➢ **Applied AI - Drilling**
  - ✓ Stuck Pipe, Drill Bit Selection

➢ **Applied AI - Production**
  - ✓ Production Optimization (Flow Rate Forecasting)
  - ✓ Gas Lift Optimization (Artificial Lift Selection)
  - ✓ Reservoir Production & Recovery Factor Analysis

Applied AI
Facies Classification from Well Logs
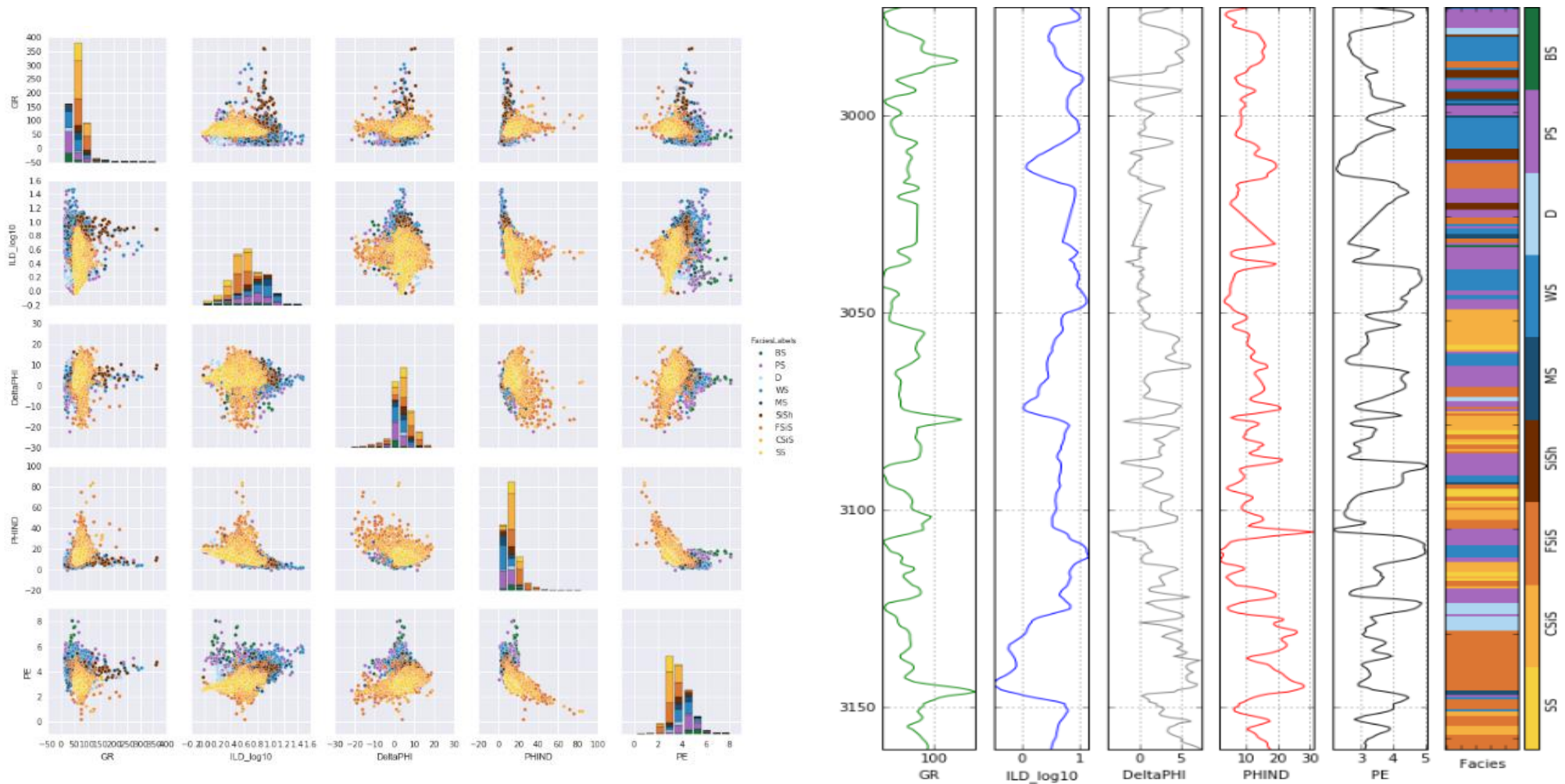
Applied AI
Hole Condition Avoidance of Stuck pipe

Real Time drilling data → **AI engine** → **Hole Condition**

**Offset well data
End user inputs**

Knowledge and Wisdom

Input Parameters
Wellbore Size & geometry
Drilling RPMs
Annular velocity
Wellbore eccentricity
Temperature (in %) i
Bottom Hole Pressure well bore
Cutting Size
ROP (average & Max.)
Mud density & viscosity and
Pit volumes
Pump rate

Output   Parameter
% Cutting Concentration

Applied AI
Drill Bit Selection

Real Time drilling data

AI engine (ANN)

Drill Bit identification and reliability details

Offset well data
End user inputs for trained ANN

Input Data

Geological Information
Carbonate, shale, sandstone sections
Petro-physical parameters
Grain size
Formation name, Thickness, age, depth
Drilling Data
ROP, mud weight and type and other details,
Bit information - Bit history and Specifications

Output Data
Bit type, operating guidelines and its performance

Production Optimization

Applied AI
Flow Rate Forecasting
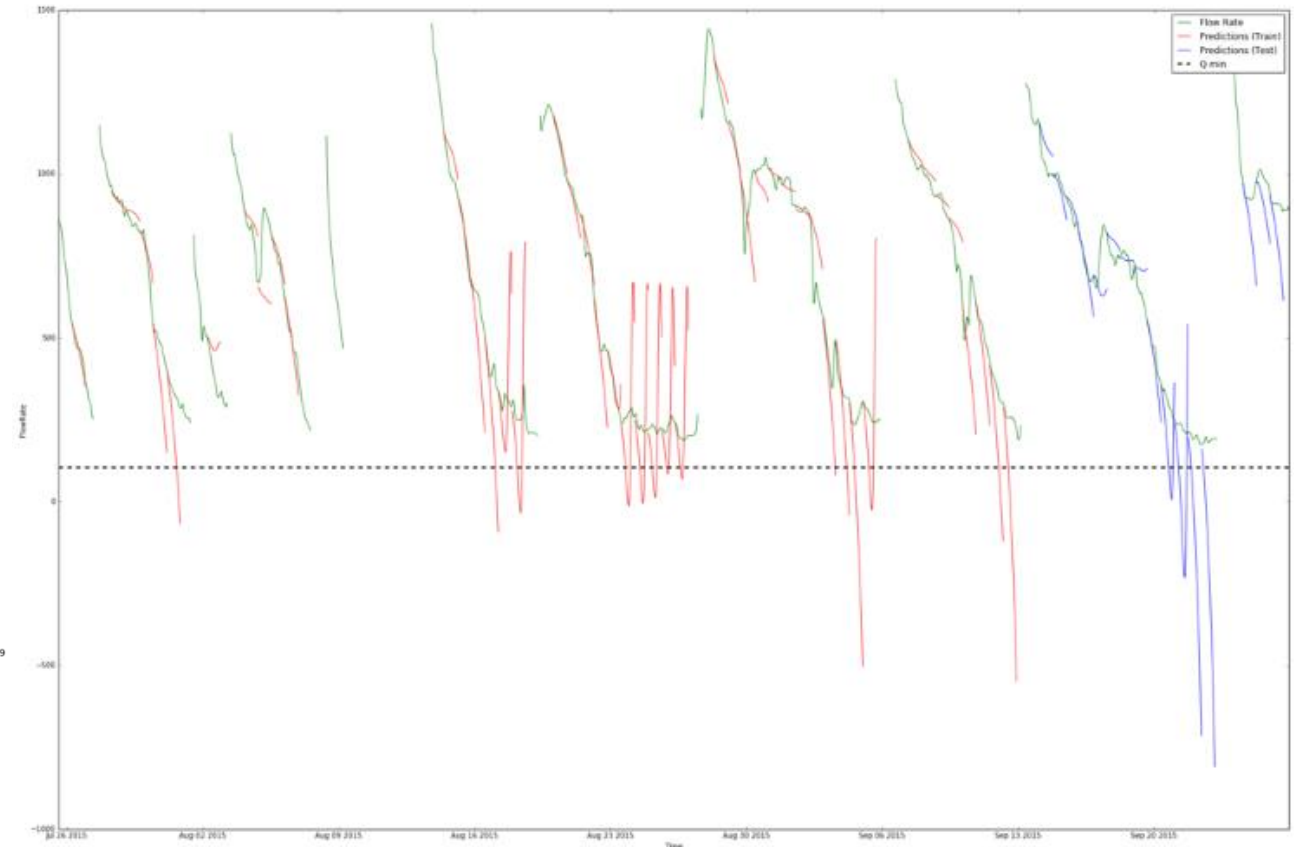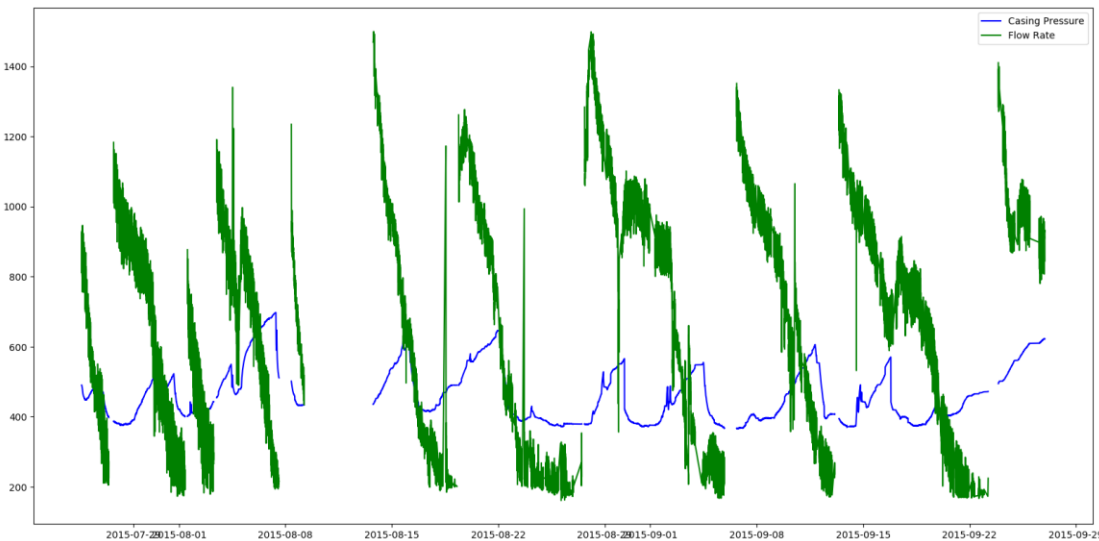
Time Series Forecasting of Flow Rate in Gas Wells in order to prevent liquid loading

Applied AI
Gas Lift Optimization
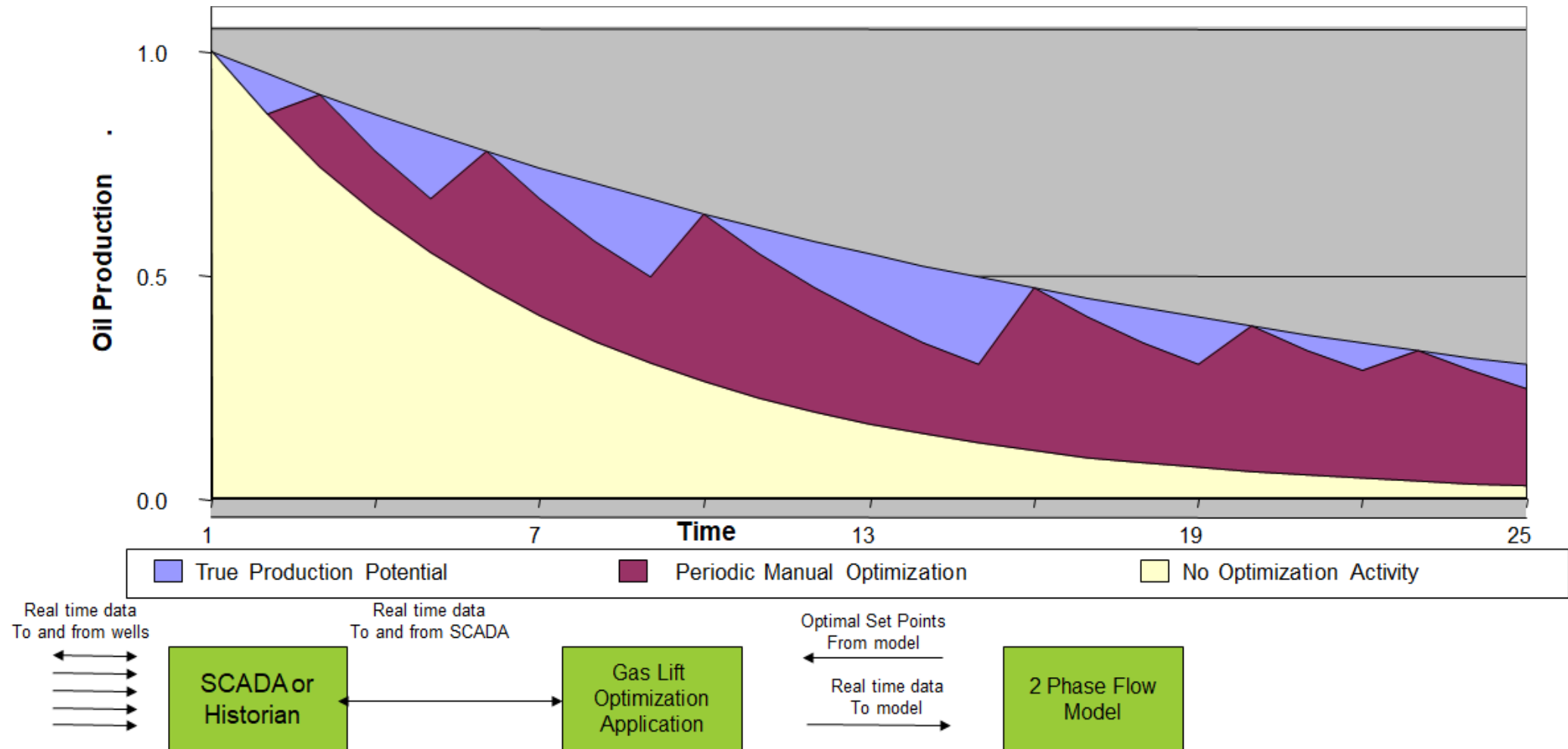
Applied AI
Artificial Lift Selection
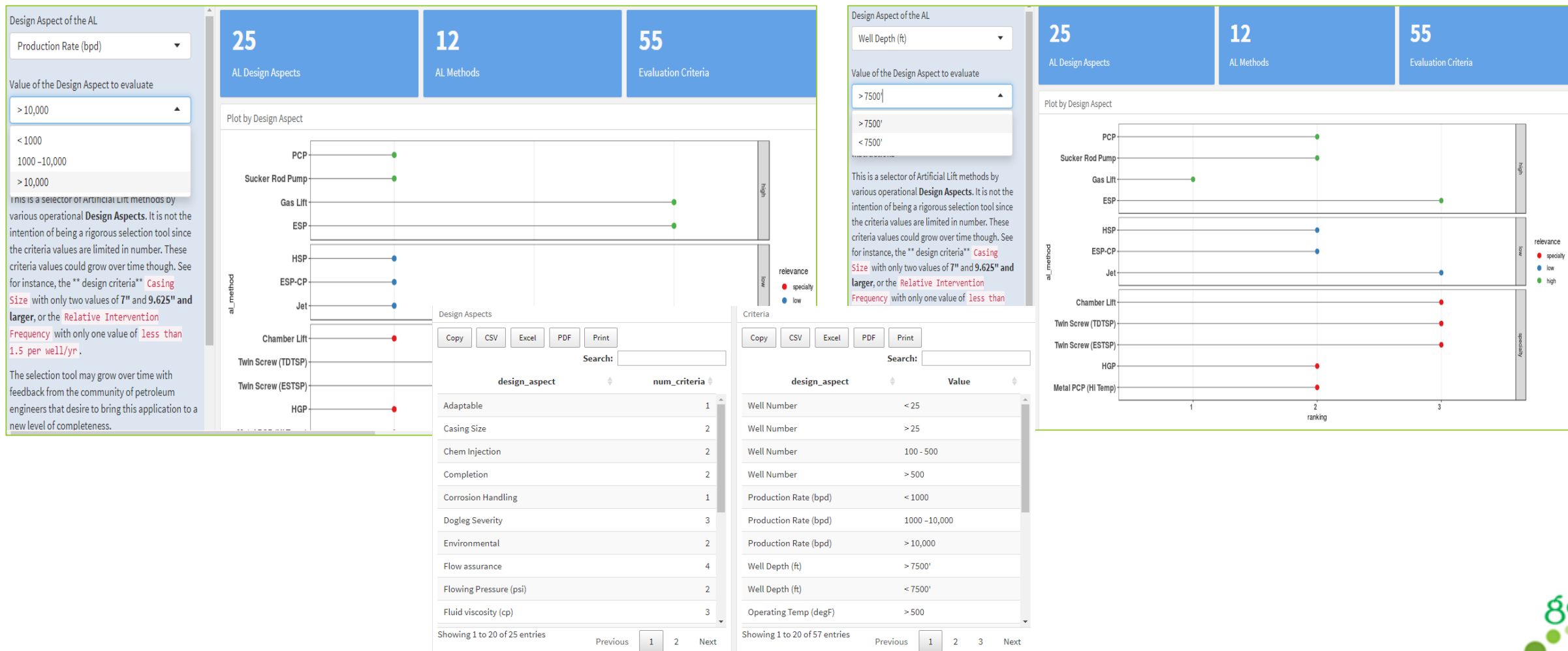
Applied AI
Reservoir Production Analysis
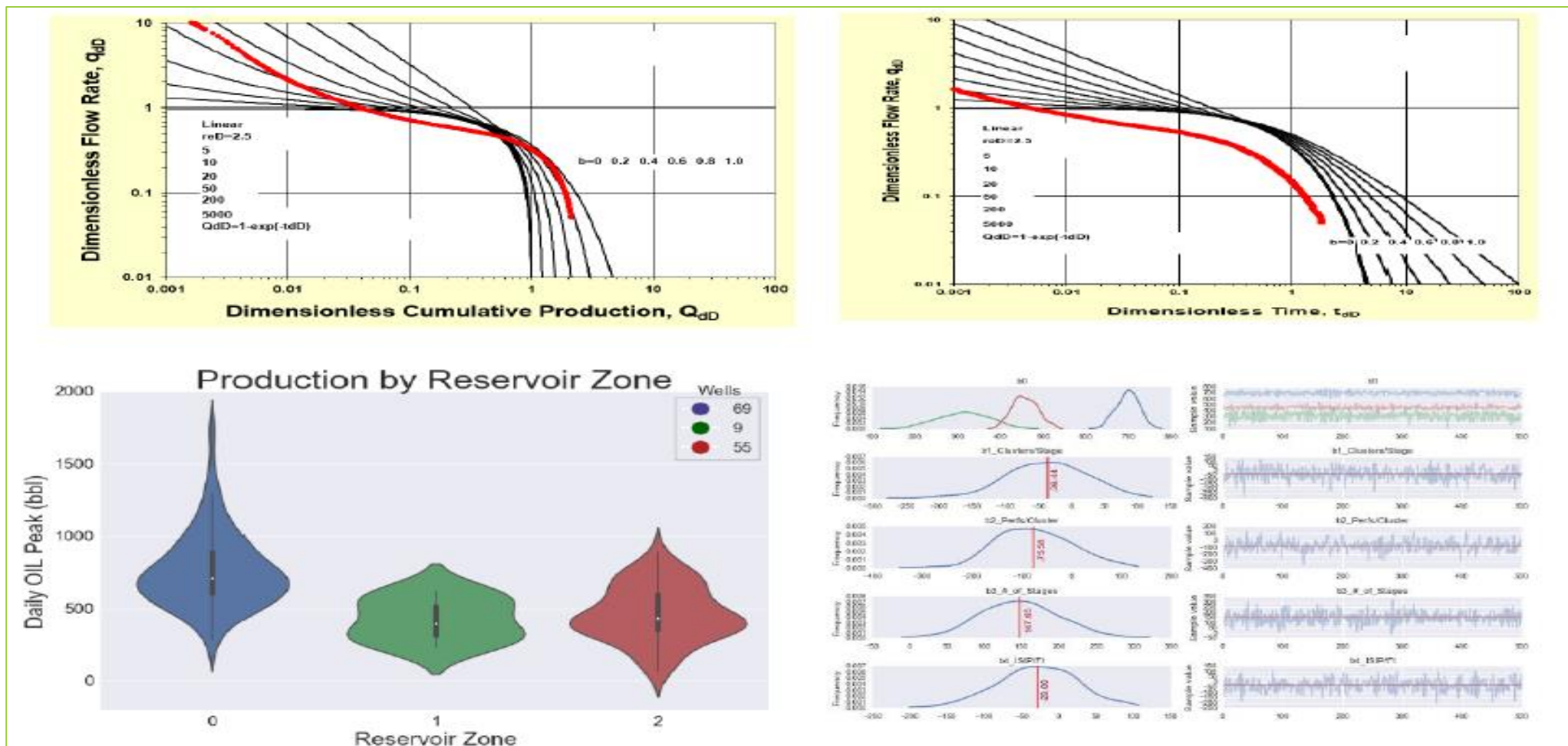
Applied AI
Recovery Factor Analysis
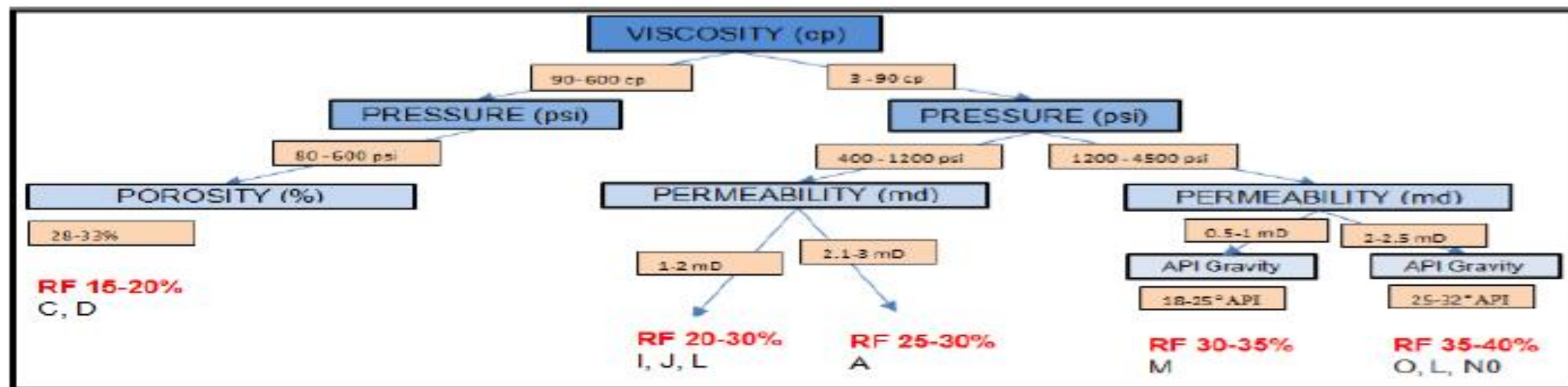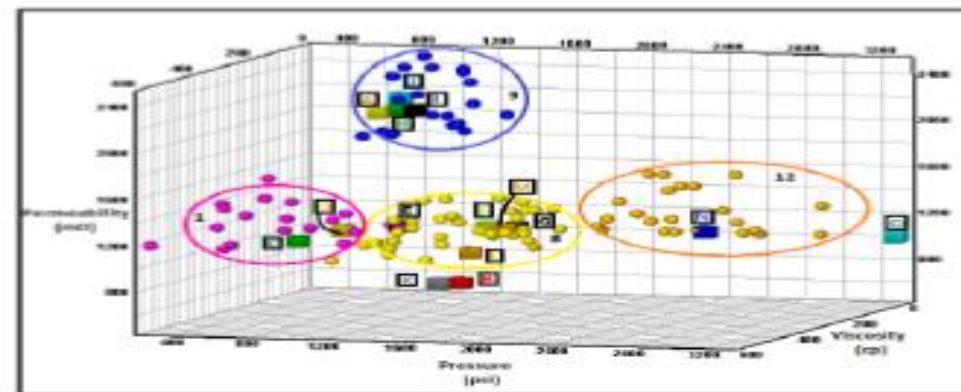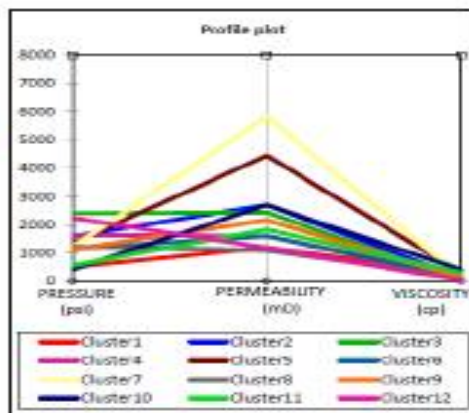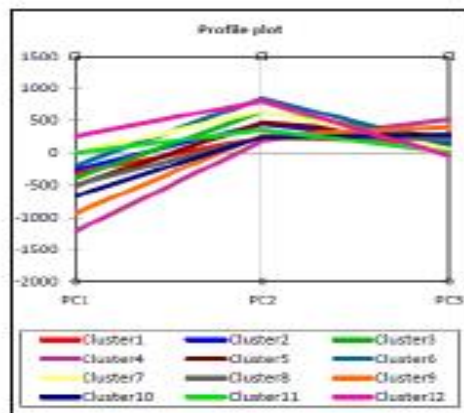
Agenda - Applied RPA

➢ **Applied RPA – E&P Data Management**
- ✓ Automate Data Gathering
- ✓ Automate Lease Payment and Reporting
- ✓ Safety/HSE Incidents Auto Reporting,
- ✓ Plant's Non-Compliance Auto Reporting

Applied RPA
Safety/HSE Incidents Auto Reporting by RPA bots

- Automated notifications – the bots can alert managers and employees to a variety of issues
- Notify employees of upcoming training courses
- Send reminders for refresher courses. This may be required after an incident, or compliance changes, to ensure employees are fully aware of safety procedures
- Alert managers to any accidents or incidents to allow an investigation or disciplinary action
- Identify new high-level risks on the risk register

HSE Incidents

Classifications → Ticket Templates ← People (HSE) → Person Groups
Create Incident (HSE) → Service Groups
Review Incidents (HSE) → People
Service Address → Operating Procedures (HSE)
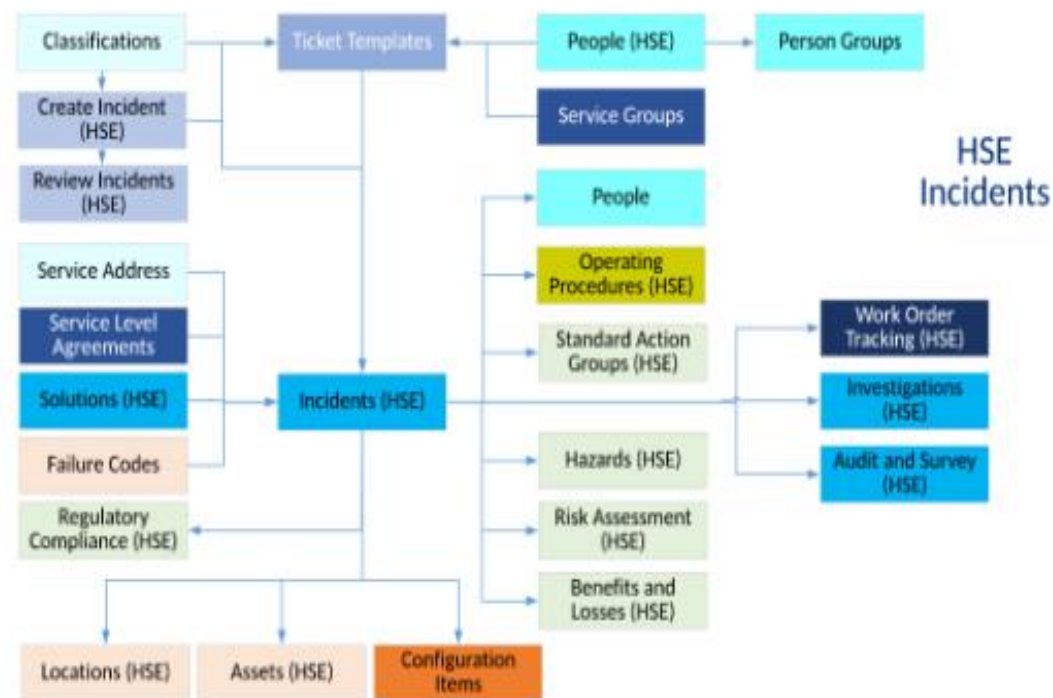Service Level Agreements → Standard Action Groups (HSE) → Work Order Tracking (HSE)
Solutions (HSE) → Incidents (HSE) → Investigations (HSE)
Failure Codes → Hazards (HSE) → Audit and Survey (HSE)
Regulatory Compliance (HSE) → Risk Assessment (HSE)
Benefits and Losses (HSE)
Locations (HSE) Assets (HSE) Configuration Items

- An Incident is a class of Ticket, the application would be used for events with a HSE impact. Some Incident records will later be marked as being a Defect.
- An Incident can be an injury/illness, a safety, environmental or security incident, a near miss, a spillage, a safety observation or a failure in a safety process.
- A Ticket Template can be applied to the Incident. It can have a classification, owner or owner group, a Service Group and a set of activities which are copied to the Incident. The applied classification creates a Specification, a set of attributes specific to the class of incident.
- Self-service applications are provided for any user to Create Incident or Review Incidents that they previously created.
- The incident can be related to one or more Locations, Assets or Configuration Items (CI). A regulatory clause may be associated with the incident.
- One or more people who were witnesses to the incident or impacted by it can be recorded. Follow-up actions can be associated with each person and an applicable Operating Procedure referenced.
- The Hazard or Risk Assessment associated with the Incident and its impact can be recorded. The impact record is created in the Benefits and Losses application.
- A Solution can be used to indicate how the incident was resolved. In addition a failure report can be recorded if it is known prior to the Investigation.

Applied RPA
Plant's Non-Compliance Auto Reporting by RPA bots
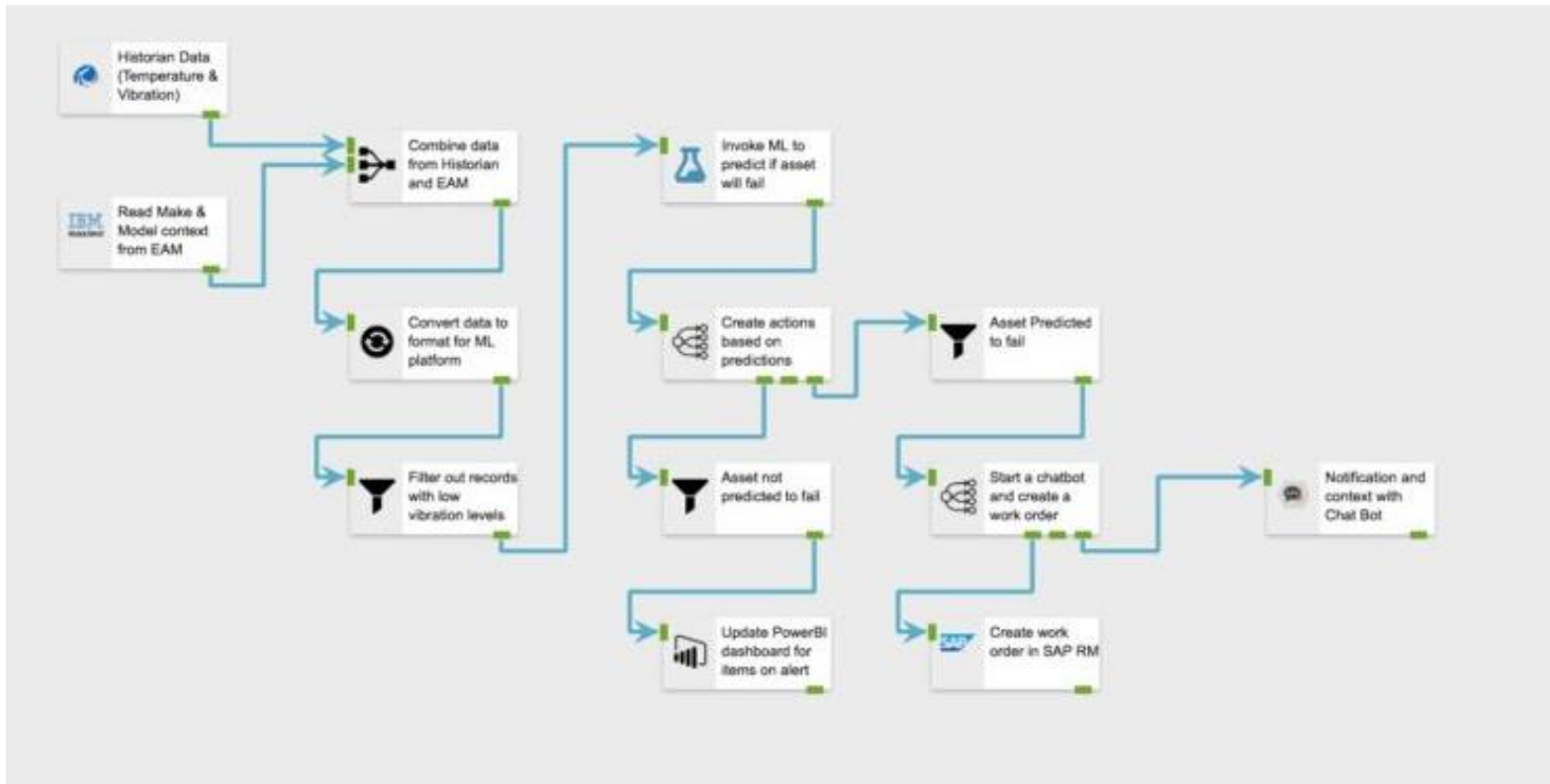
- ➢ RPA bots will measure, predict and benchmark datasets from real time data feeds from the LNG plant/each associated train

- ➢ From past A&E datasets and benchmarks laid out by OEM vendors, RPA bots can generate alerts for any abnormality based on predicted datasets

- ➢ RPA bots will create variance reporting on actuals, predicted and planned against the operational datasets at an asset level

Applied RPA
E&P Data Management Support

Use Case# 1, *Drilling + Completions* - Automate data gathering from multiple Drilling & Completion sites

RPA bots can provide valuable support for operational reporting and drilling performance by automatically pulling data from systems, to help in the drilling analysis process.

Bot Activity	Features	Benefits
Pulls data from multiple E&P systems and perform well lifecycle management tasks.	Well related data, PO data, costs, AFE, and forecast data can be automatically pulled from multiple systems that can be used for 360-degree analysis. Bots can help to create a workflow/jobs queue-based data processing work for drilling teams.	Drilling Engineers can leverage RPA tasks to identify differences between processing across rigs. This creates substantial time savings and streamlining, that results in significant financial improvements over the year.

Use Case# 2, *Subsurface Data Management* - Automate data gathering from multiple E&P apps

RPA bots can automate data request processing, data capture from legacy systems, data cleanup, data storage, conducting QA/QC steps to flag potential problems, etc. RPA bots can easily run 24x7 automated backend scripts for routine tasks like splicing, merging, data transformations.

Bot Activity	Features	Benefits
Sifts through multiple subsurface repositories and run data processing daily jobs.	Bots can automate data request processing, data capture from legacy systems, data clean up, data storage tasks from these multiple systems.	Capacity of the existing data management teams can expand, and they can be engaged in the data analytics tasks.

Applied RPA
Land/Lease Records Management

Inputs	Process	Output
• Lease, Fee and Contract Terms • Scanned Documents • Property Description, Acreage & ownership information • Names & Addresses	• Lease and Title Analysis • Acquisitions & Dispositions • Payment recommendations • Expiration Recommendation • Regulatory reporting • Mapping	• Data Sheets • Alerts & Electronic notifications • Acreage, Exhibit and Obligation reports • Checks and invoices • Integrations with other enterprise systems like Revenue Accounting • GIS Integration

The information needs to be managed can be listed as;
- Obligations & Provisions
- Developed and Non-developed Acreage
- Payments & Receivables
- Ownership by area and depth
- Chain of title
- Related agreements
- Related wells
- Financial Transaction history
- Audit History

Use Case# 3, *Lease Records Management* - Automate Lease Payment and Reporting

Oil & Gas companies spend many human hours on legacy systems reviewing and manually entering the various clauses and dates associated with land leasing necessary to not "lose" a lease.

Bot Activity	Features	Benefits
Bots can automate the payment process for the leases as well as generate reports on different leases across geos, metrics around profitability.	Bots can automate lease payments and reporting, lease master data updates, lease exceptions monitoring and notifications to stakeholders.	RPA can automate this process and reduce costs while improving data quality and reducing errors.

Applied Analytics for Digital Enterprises

Thank You

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