Integrated Real-Time Analytical Workflows for EOR Surveillance, Management & Optimization

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Integrated Real-Time Analytical Workflows for EOR Surveillance, Management & Optimization

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• Business Drivers
• A Need of Decision Support System
• Solution Groups
• Solution Architecture
• Solution Components
• EOR and WF Business Processes
• Value Creation
Business Drivers

1. Oil Rim Management:
   a) Maximize Reserves
   b) Balance Production Offtake and Injection

2. Injection Sweep Efficiency:
   a) Understand Reservoir Connectivity and Injector/Production Vertical Conformance
   b) Maximize Utilization Efficiency of Available Gas for Injection

3. Water Injection Quality and Monitoring
   a) Water quality (PC, Diss. O2, Fe, Cl)
   b) Facilities reliability and uptime

4. Sufficient Gas Supply:
   a) Integrated Production System Modelling
   b) Gas Supply
# A Need of Decision Support System

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
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</thead>
<tbody>
<tr>
<td>Is the current recovery factor as per plan?</td>
<td></td>
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<tr>
<td>How is the reservoir pressure developing?</td>
<td></td>
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<tr>
<td>Do we have enough quality water &amp; gas for injection?</td>
<td></td>
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<tr>
<td>How are the gas compressors performing?</td>
<td></td>
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<tr>
<td>Is my injection pressure less than fracture pressure?</td>
<td></td>
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<tr>
<td>How is injection flood fronts developing?</td>
<td></td>
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<tr>
<td>How much oil has been displaced from swept zones?</td>
<td></td>
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<tr>
<td>Water and Gas Injection uptime and injected volume per WAG cycle.</td>
<td></td>
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<tr>
<td>What are areal and vertical sweep efficiency?</td>
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</table>
EOR IO Business Process

Structured, integrated & multidisciplinary approach to optimize the Asset value.

Control systems (AAR)

Physical Asset

Acquire data

Data: Realtime Monitoring, EBS, IO, FPC & etc.

Decision makers & action takers

Acquire data, data processing & management

Analysis tools, interpretation & integration

Execution: Optimization & Remedial

Performance Diagnostics

Plans & Optimization Decision

Analysis & Visualisation

Generate & evaluate options

Activity & decision management

Smart wells & facilities

Acquire data

Structured, integrated & multidisciplinary approach to optimize the Asset value.
## Solution Groups

### EOR SURVEILLANCE

<table>
<thead>
<tr>
<th>Facility Integrity Monitoring</th>
<th>EOR Well Surveillance</th>
<th>WAG Surveillance Activity Tracking</th>
<th>Production Well Management</th>
<th>Injection Well Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Monitor injection fluid quality</td>
<td>- Zone Production/Injection Status</td>
<td>- Track planned WAG surveillance activities and compliance KPIs (e.g. PLT, RST, Tracer, Well Tests)</td>
<td>- Detect Productivity (Pseudo PI, etc.), - Diagnostics – Well operating envelope, Chan water &amp; gas diagnostics, sanding</td>
<td>- Detect Injectivity, pseudo-injectivity index - Diagnose Hall plot, Well operating envelope</td>
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<tr>
<td>- Injection fluid circuit pipeline monitoring</td>
<td>- Zone Rate/Pressure Estimation (ICV, PLT, ILT, IO, non-IO)</td>
<td>- Compliance summary report (incl RMP)</td>
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<tr>
<td>- Injection fluid circuit pumps and compressors monitoring</td>
<td>- Intelligent well ICV sensor health</td>
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<tr>
<td>- Well Integrity Analysis</td>
<td>- Artificial lifting</td>
<td></td>
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<tr>
<td>- Uptime</td>
<td>- (Also links to existing Well WFs)</td>
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</tbody>
</table>

### EOR MANAGEMENT & OPTIMIZATION

<table>
<thead>
<tr>
<th>Fluid Contact Management</th>
<th>Displacement Management</th>
<th>Pressure Management</th>
<th>Intelligent Well Optimization</th>
<th>Optimize EOR Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Fluid movement monitoring and quantification</td>
<td>- RST analysis; SWT, NMR, pulsed neutron capture logs,</td>
<td>- FGS, SGS analysis, VRR monitoring &amp; balancing</td>
<td>- Optimize injection distribution from each zone</td>
<td>- Quarterly to annual review of EOR performance; update strategy</td>
</tr>
<tr>
<td>- Changes in GOR, WCUT; PLT, Gas fingerprinting, Water</td>
<td>- Observation wells</td>
<td>- Zonal PEOR estimation</td>
<td></td>
<td>- Align strategy with current facility constraints</td>
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<tr>
<td>Chemistry &amp; tracer</td>
<td></td>
<td></td>
<td></td>
<td>- Evaluate sensitivities/uncertainties</td>
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<tr>
<td>- EOR agent utilization efficiency</td>
<td></td>
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<td>- Update model-based forecast and long-term planning</td>
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</tbody>
</table>
EOR Processes & Architecture

EOR Performance Summary

Facilities
- Injection Quality Monitoring
- Injection Facility Monitoring
- Existing Technical Workflows

Producers/Injectors
- WAG Well Surveillance
- Production Well Management
- Injection Well Management

Reservoir Performance
- Sweep Management
- Displacement Efficiency
- Pressure Management

Reservoir Prediction/Optimization
- EOR Strategy Optimization
- Intelligent Well Optimization

Visualization

Workflow & Integration

Technology Application

Data Management

LIMS  PI Server  PGPS  IO_DB  ODMS
Solution Components

- Injection Facility Performance Summary
- EOR Performance Summary
- Producer Performance Diagnostics
- Reservoir Prediction and Strategy Optimization
- Reservoir Performance Summary
- Injector Performance Diagnostics

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EOR IO Business Process

Structured, integrated & multidisciplinary approach to optimize the Asset value.

Physical Asset

Execution: Optimization & Remedial

Data: Realtime Monitoring, EBS, IO, FPC & etc.

Decision makers & action takers

Plans & Optimization Decision

Performance Diagnostics
Business Process: WAG Strategy Under-Performance

**EOR Surveillance**
- Get current P, Q data
- Detect field under-performance
- Well Status
- Well Rate Estimation

**EOR Management**
- Review history
- Evaluate P support
- Evaluate injection, facilities
- Evaluate Displacement
- Verify new settings are stable
- STP and new forecast

**EOR Optimization**
- Review performance
- Sensitivity, Uncertainty
- Update simulator model
- Re-optimize inj / prod
- Model-based forecast, LTP

- Activity Tracking
- Record WAG activity (surveillance, log scheduling, planning)
- Pressure Management
- Injection Well Management
- Integrity Monitoring
- Displacement Efficiency
- Validate PE Initiative
- Short-Term Planning
- WAG Performance
Value Creation

• **Increase the production & recovery factor** through prudent monitoring & total asset optimization.

• Intelligent alarms & alerts to **reduce the unplanned deferment & downtime** for continuous asset awareness.

• **Increase the operational efficiency** through streamlined & automated workflow processes, allows **faster informed decisions** by highlighting possible related measurable or calculable KPIs as key information for issue analysis from one source supported with required visualization.

• Validated data acquisition & dissemination across the organization to create a **collaborative work environment** among multiple disciplines & locations, where opportunities for improvement can be analyzed & corrective actions can be undertaken.

• **Remote monitoring of the offshore facilities** from the Regional & Central Head Quarter which are thousands of kilometers apart.
Acknowledgements/Thank You/Question

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Thank you