Asset Optimization
Workflow Implementation Examples

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Asset Optimization – Challenges and Solutions

Well Performance
- Monitor & Diagnose, Allocation, Losses, Rate Estimation, Transient Analysis

Integrity & Safety
- Corrosion, Erosion, Leak Detection, Vibration, Wear/Tear, Sand Avoidance, Maintenance

Field Operations
- Equipment Surveillance, Field Operations, Pigging, Ramp Up, Virtual Flow Metering

Lifting & Pumping
- Monitor & Optimize ESP, Gas Lift, PCP, SRP, Subsea Booster Pumps

Reservoir Optimization
- Pressure Support, Reservoir Sweep, Injection, Flooding, Water, Gas, Steam, SAGD, WAG Cycling, Zonal Control

Flow Assurance
- Hydrates, Wax, Scale, Asphaltenes, Cool Down, Inhibitors

Asset Management
- Delivery Assurance, Forecasting, Scheduling, Blending, Nominations, Well Routing, Choke Optimization, System Management

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Operation Solutions

Specific business focused solutions:

- Standard solution, minimum customization
- Quick and high quality implementation
- Standard documentation
- Post-delivery support/services
ESP Surveillance

ESP Surveillance provides real-time monitoring, operational surveillance and engineering analysis for multiple ESP installations.
Challenges and Solutions

Challenges

- Deferred production
- Lost oil due to ESP downtime
- Underperforming ESP
- Inefficient pump operation
- Faster equipment deterioration due to misoperation

Solution: ESP Surveillance will increase the average run-life of an ESP and decrease downtime.

- Optimize pump flow rate
- Minimize operational risk (e.g. operation under low flow conditions)
- Reduce number of stops and starts
- Optimize pump replacement
ESP Surveillance

“I have many ESP pumps installed but no way to monitor all centrally.”

“I need to know how my pump is performing.”

“How is the ESP Surveillance solution different?”

- ESP Surveillance package to monitor pump status and performance
- Current pump status
  - ESP operating KPIs
  - Pump performance factors
- Pre-configured solution
- Easy deployment
- Measurements to models
ESP surveillance solution

ESP surveillance features

- Field Overview with Well Production data
- GIS map view
- Surface and down-hole data trending
- Sort and Rank Wells
- Candidate selection by Range and % Change

- Events and Report Generation
- Alarms and Notifications
- Operating point within recommended operating region to minimize operational risk
- Pump performance and efficiency trends
- Run-life and uptime

- Wellbore schematic
- Pump specifications
- Pump and completion inventory tracking
ESP surveillance solution

ESP surveillance features

- Run models with real-time data
- Calculate ESP properties under operating conditions
- Virtual flow rate estimation
ESP surveillance solution

ESP surveillance value

- Minimize deferred production
- Improve run life
- Efficiency through automation
  - Surveillance
  - Candidate ranking
- Reduce capex investment
- Effective workover planning
- Increase engineer productivity of scenario evaluation
PRODcast Vx

Provides reliable online production measurements for surveillance and integration with well tests for accurate allocation.
Traditional Practice

- A long and inefficient testing cycle (2-month average)

Be more efficient

- Field Data Acquisition
- Reporting

Improve the data flow

- Well Test Validation
- Filing
- Production Allocation

Separator

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Extracting the Value of your Data

- Traditional well test practice
  - Large number of well tests from multiple wells
  - Limited visibility on equipment conditions
  - Dependency on field operators

- Multiphase Flow Meters
  - Large amounts of high-frequency data (200+ raw tags)
    - Flow rates and ratios: volume, mass, metering conditions, standard conditions
    - Operating conditions: pressure, temperature, differential pressure
    - Significant information on equipment conditions
PRODcast Vx* Production Testing Monitoring Software

“Right Data to the Right Person” – Maximize the value of data

- Production data overview and analysis
- Automated meter and measurement verification
- Well test management
- Link from acquisition to analysis

Improve Production Data Flow
Avocet Operations Solutions: PRODcast Vx

1. Vx Measurement
2. Vx Measurement Surveillance
3. Well Test
4. Production Allocation
5. Model Workflows
6. Production Optimization
PRODcast Vx

“I need to have accurate flow rate and back allocation”

“I need to be able view the measurements and make decisions quickly”

“How is the Vx Surveillance solution different?”

- Vx measures oil, gas and water rates and calculates P, T
- Streamlined input to surveillance
- Vx relays measurements to Avocet for analysis and validation

- Drives allocations from well tests
- Pre-configured solution
- Measurements to models
Well Performance

Display key production data to monitor well behavior, flag well anomalies and support corrective actions.
Well Performance

“I need to know when my well is not performing”

- Well performance package contains standard production workflows

“I need to get ready for my operational morning meeting”

- Daily production summaries
- KPIs
- Loss evaluation & well ranking
Transient Gas-Condensate Solution
OLGA for Operations

Standardized solution for single gas-condensate pipelines with workflows focused on primary challenges such as liquid management and hydrates.
Gas Condensate Pipelines

Pipelines in green or brown fields

Transient multiphase behaviour
Production Challenges for Gas Condensate Flowlines

Challenges covered by the Gas Condensate Solution

- Slugging
- Hydrate Formation
- Corrosion
- Start-up Surges
- Rate changes (Ramp-up Surges)
- Hydrate Inhibitor Consumption
- Erosion/Sand Production
- Pigging Operations
- Joule-Thompson Cooling
- Scale / Wax / Asphaltenes
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**Monitor & Diagnose**

**Allocation**

**Losses**

**Rate Estimation**

**Transient Analysis**

**Equipment Surveillance**

**Field Operations**

**Pigging**

**Ramp Up**

**Virtual Flow Metering**

**Monitor & Optimize**

**ESP**

**Gas Lift**

**PCP**

**SRP**

**Subsea Booster Pumps**

**Pressure Support**

**Reservoir Sweep**

**Injection**

**Flooding**

**Water**

**Gas**

**Steam SAGD**

**WAG Cycling**

**Zonal Control**

**Corrosion**

**Erosion**

**Leak Detection**

**Vibration**

**Wear/Tear**

**Sand Avoidance**

**Maintenance**

**Equipment Surveillance**

**Field Operations**

**Pigging**

**Ramp Up**

**Virtual Flow Metering**

**Delivery Assurance**

**Forecasting**

**Scheduling**

**Blending**

**Nominations**

**Well Routing**

**Choke Optimization**

**System Management**

**Monitor & Optimize (Cont.)**

**ESP (Cont.)**

**Gas Lift (Cont.)**

**PCP (Cont.)**

**SRP (Cont.)**

**Subsea Booster Pumps (Cont.)**

**Pressure Support (Cont.)**

**Reservoir Sweep (Cont.)**

**Injection (Cont.)**

**Flooding (Cont.)**

**Water (Cont.)**

**Gas (Cont.)**

**Steam SAGD (Cont.)**

**WAG Cycling (Cont.)**

**Zonal Control (Cont.)**

**Corrosion (Cont.)**

**Erosion (Cont.)**

**Leak Detection (Cont.)**

**Vibration (Cont.)**

**Wear/Tear (Cont.)**

**Sand Avoidance (Cont.)**

**Maintenance (Cont.)**

**Equipment Surveillance (Cont.)**

**Field Operations (Cont.)**

**Pigging (Cont.)**

**Ramp Up (Cont.)**

**Virtual Flow Metering (Cont.)**

**Delivery Assurance (Cont.)**

**Forecasting (Cont.)**

**Scheduling (Cont.)**

**Blending (Cont.)**

**Nominations (Cont.)**

**Well Routing (Cont.)**

**Choke Optimization (Cont.)**

**System Management (Cont.)**
Pigging Operations

- Monitors and visualizes the pig location

- Output
  - Pig travel distance
  - Pig velocity
  - Pig estimated arrival time

Examples of very accurate prediction of arrival time; higher production during pigging operations.
Hydrate Monitoring and Inhibitor Tracking

- Monitors temperature margin to hydrate formation region
  - Including effect of chemicals

- Monitors distribution of chemical inhibitor and calculates total inventory (MEG, MeOH, KHI/LDHI)

- For LDHI/KHI: Includes the aging effect

Optimized use of inhibitors. Examples of 50% reduction in MEG and reduced volumes of expensive LDHI.
Cooldown / No-touch Time

- The available cooldown time is used by operations to determine whether special intervention needs to be initiated, e.g. pigging and/or dead-oil circulation.

- Calculates the time until critical temperature is reached in production system, in case of a shutdown
  - With wax or hydrate risk

- Simulates shutdown of the production system in a predefined sequence while monitoring hydrate/wax margins
Deepwater Oilfield Flow Assurance AO Solution

Client/Operator: Eni Norway
Site: Goliat, Barents Sea
Implementation: 2012-2013
Reference:

Challenge:
- Remote operation performed with small team
- FA challenges slugging, hydrates, wax, etc

Solution:
- Real time production monitoring solution interfaced to advanced control applications
- Operator Training Simulator
- Virtual Flow Metering

Benefits:
- Flawless Start-up
- Optimized Production
Gassco Pipeline Monitoring Solution

- Kvitebjørn/Visund to Kollsnes
- 147 km, 30"
- Liquid handling
- Hydrates
- Component tracking
Online Transient Simulation to Support Production Operations

Client/Operator: PEMEX
Site: Dos Bocas, Mexico
Implementation: 2011-2013
Reference: SPE 169363-MS

Challenge:
- Inability to predict crude quality from field entering onshore terminal resulting in heavy delivery contract penalties because of limited water handling capacity

Solution:
- Online transient model of critical lines for volume and quality management
- Look ahead forecasting and what-if scenario planning of quality and fluid volumes arriving at terminal

Benefits:
- Reduced penalties for non-compliance by ~90%
- Greatly reduced uncertainties in volume allocations and added transparency to hydrocarbon balance
- Improved planning and operational decision making