Large Scale Subsurface and Surface Integrated Capacity Modeling - Implementation & Lessons Learned

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Agenda

Responding faster and more efficiently to support decision making…

• Motivation
• Solution Highlights
• Challenges
• Solution Description
• Leading Technical Features
• Typical User Interfaces
• ICM Business Value
• Conclusions and Lessons Learned
Motivation

Responding faster and more efficiently to support decision making…

- Compensation of production shortfalls (e.g. 10% of base)
- Quick response to market conditions
- Ranking actions for production increase
- Improving synergy among assets (e.g. gas use, resources, etc.)
- Delivering optimized products (e.g. C2, API..) to downstream
- CAPEX optimization
- Increasing and optimizing field operations and activities over next decades

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<thead>
<tr>
<th></th>
<th>Before ICM</th>
<th>After ICM</th>
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<tbody>
<tr>
<td>Production shortfall identification and management</td>
<td>1-2 weeks</td>
<td>1-2 hours</td>
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<tr>
<td>High value products (i.e. C2, API) optimization</td>
<td>NA</td>
<td>1-2 days</td>
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<td>Production ramp-up validation &amp; optimization</td>
<td>1-2 Months</td>
<td>1-2 days</td>
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<tr>
<td>Respond to downstream demand changes</td>
<td>1-2 weeks</td>
<td>1-2 days</td>
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<tr>
<td>5-years Business plan validation</td>
<td>NA</td>
<td>2-5 days</td>
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<tr>
<td>Integration with long term portfolio planning</td>
<td>NA</td>
<td>2-5 days</td>
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<tr>
<td>Future capacity planning optimization</td>
<td>NA</td>
<td>2-5 days</td>
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<tr>
<td>Future unplanned shutdown and well availability</td>
<td>NA</td>
<td>2-5 days</td>
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<tr>
<td>Production Allocation</td>
<td>1 Month</td>
<td>1 day</td>
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Solution Highlights

Responding faster and more efficiently to support decision making…

Capacity model from Rock to Stock
- >12 Assets >20 Fields
- >100 Reservoirs > 4000 Oil & Gas Strings
- >8,000 surface nodes (Pipelines, pumps)

Technical Features
- 6 Daily production scenarios
- Integrated forecasting scenarios for production maximization
- Opportunities identification including Capacity and Cost
- Unplanned Availability prediction
- Production Allocation
- Compositional tracking from well to delivery point

Knowledge Sharing
- SPE paper presented in ADIPEC 2018
- ADNOC Digital Twin component (ADIPEC 2018)

Patent filed in July 2018
- First Integrated Country-wide Capacity Model in Upstream World Wide of this scale

Support compensation opportunities > 1 M$/day
Implementation Challenges

*Responding faster and more efficiently to support decision making…*

- Integration of different available models and data
  - Different technologies and providers
  - Different type of models (Reservoir, Wells, Network, Economics, etc.)
  - Gaps in consistency between models and data
- Integrated Business Planning
  - Plan and Economics @ different time horizons
  - Different Fields / Assets
  - Production / Facilities expansion / New wells
  - Operations vs Maintenance plans
  - Scenario Analysis
Solution Description

An integrated hydraulic model with economics from well to point of delivery…

Complections PVT Well tests

Future Conditions

Well Performance (t)

Model and Simulation Parameters

>4,000 oil strings

>8,000 pipelines

>12 Assets

>20 Fields

Integrated Capacities

Results

Scenarios

User Interfaces

Daily performance calc
6 Hydraulic Scenarios

OUTPUTS:
- Integrated Capacity Assessment
- Production Compensation
- Production Ramp Up
- Production Plan Review/Update

>100 reservoirs

>4,000 oil strings

>8,000 pipelines

>12 Assets

>20 Fields
Solution Description - Downstream-Upstream Integration

An integrated hydraulic model with economics from well to point of delivery…

Reserves and Portfolio Management System

Integrated Capacity Model (ICM)

Integrated Production Planning (Downstream)
Solution Description - Functional Architecture

An integrated hydraulic model with economics from well to point of delivery…

Presentation Layer

Application Layer

Integration Platform (DSIS®)

Data Layer
Solution Description - Additional Functionality

An integrated hydraulic model with economics from well to point of delivery…

Outputs:
- Integrated Capacity Assessment
- Production Compensation
- Production Ramp Up
- Production Plan Review/Update
- Reservoir Simulation
- Lookup table
- Future Conditions
- Well Performance (R)
- Integrated Capacities
- Model and Simulation Parameters
- Surrogate Models
- Facilities Model
- Reservoir Simulation Lookup table
- Well Surface IPR Lookup table
- Completions PVT Well tests
- Upstream Data Hub
- User Interfaces
- Business Plan DB
- Alternate Scenario
- Surrogate Models
- Reservoir Sectors
- Additional Assets
- Artificial Lift
- Injection
Leading Technical Features

An integrated hydraulic model with economics from well to point of delivery…

- Leading Technical Features
  - Assets Potential and Technical rate calculation
  - Automatic Reservoir Guidelines Compliance at sector level
  - Country-wide production maximization
  - Forecast analysis
  - Unplanned Availability prediction
  - Production Allocation
  - Mobile ICM access

- Integration features
  - Oil and Gas Assets integration
  - Production Compensation
  - Business plan validation
  - Shutdown Plan integration
  - Data Quality/Integration Indicator
  - Business Process Management
Typical User Interfaces
Production Allocation
Typical User Interfaces
Quota Validation
Typical User Interfaces
Waterfall Capacity Analysis
Typical User Interfaces
Delivery Nodes – Rates and Composition
ICM Business Value

An integrated hydraulic model with economics from well to point of delivery…

Production Assurance
- Shortfall & Opportunities tracking
- 6 daily scenarios
- Ensure 100% Business Plan
  Adjust Quota to meet targets

Ensure Guidelines Compliance
- Automatic Calculation of Well Technical Rate
- Opportunity by well
- Proactive Opportunity identification within guidelines

Unlock Production Potential Effectively
- Limiting factors identified
- Opportunities without Additional CAPEX
  Optimized Business Plan

Integrated Value Chain
- Downstream Integration
- Full oil & gas composition
- Maximize UAE value
  Adapt to market changes
Conclusions and Lessons Learned

An integrated hydraulic model with economics from well to point of delivery…

- Sustainable platform to generate self-updated models combining:
  - First principle models
  - Available data
- Effective Business Plan Validation and Quota Generation Honoring Guidelines
- Short Term Opportunity Identification and Validation
- Efficient way to model the production value chain:
  - From reservoir to Point of Sales
  - Leverage existing modeling infrastructure and available data
  - Integrating information from different sources
- Effective Solution to Improve Data Quality
- Viable platform to collaborate Upstream and Downstream to optimize capacity utilization
Acknowledgements / Thank You / Questions

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Your feedback is very important to us. Please open the LIFE2019 app to answer a few short questions on this presentation.
ICM Solution description

- Patented and self updated Model, which includes:
  - Over 4000 oil & gas wells, 100 reservoirs
  - Over 8000 surface nodes (flow lines, pumps)
  - Main Oil lines from Assets to Terminal Network

- Integrates to Downstream through fully compositional model

- Integrates to OPCO’s Models:
  - Reservoir Model through proxy well models
  - Integrated Asset Models (IAM)

- System functionality includes:
  - Model calibration and data quality diagnostics
  - Potential, shortfall and opportunity identification
  - Stakeholder call-for-action issue and tracking
OPCO Process
Work Process Alignment
User Validation
Quality Assurance
Integration with IAMs and Business Process Management
BP Assurance, planning and production optimization
Panorama Integration
Downstream Integration
Assuring model predictive quality with latest real-time status
Optimize the value chain for supply and demand variations
Now
RPPM Integration
Predicting and prescribing actions by leveraging big data
Artificial Intelligence
Data Analytics
Computing power
Surrogate Models
Fast scenarios for development projects ranking and prioritization
Short Term
Mid Term
Sustainable Value Creation
Solution Description

An integrated hydraulic model with economics from well to point of delivery…